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Geomorphology of the Ashton Coal Project site in relation to archaeology.

Camberwell, Hunter Valley NSW.

Final Report: 3 June 2002.

Dr P.B. Mitchell prepared this report for White Mining Pty Ltd. It covers additional work conducted under the National Parks and Wildlife Service (NPWS) Preliminary Research Permit (PRP) No 1328 issued on 23 April 2002. The work was undertaken to address issues listed in a letter from NPWS (ref 01/00608) to White Industries, dated 14/3/02 and matters discussed at a meeting held at NPWS Head Office on 21/3/02 between Ms M Koettig (NPWS), Mr A. Wells (HLA-Envirosciences), Mr I Callow (White Mining), Dr P.B. Mitchell (Groundtruth Consulting) and Dr D. Witter (Archaeologist).

The geomorphic investigation was intended to further elucidate valley fill stratigraphy in those parts of the lease that will be subject to disturbance by mining, including areas of land subsidence. The principle focus was to confirm the extent of previously identified geomorphic features (Mitchell 2002) that may contain buried land surfaces and to test for the presence or absence of buried surfaces by excavation of a number of backhoe pits along four approved cross valley transects.

The report elaborates on the contents of an earlier report by Groundtruth Consulting (Mitchell 2002) and can be read as a stand-alone document. Copies of the draft report were circulated to all Aboriginal groups involved in the consultation process for comment before completion of this final document.

Background to the survey.

As part of the environmental impact assessment process White Mining Pty Ltd undertook Aboriginal site survey and a brief geomorphic investigation of the Ashton coal lease in the Hunter Valley. Archaeological site survey initially located 24 open sites within the valleys of Bowmans and Glennies Creeks (White Mining Pty Ltd 2001 EIS Appendix L). Additional sites have been found during re-survey by Dr Witter (Witter pers. com.).

The original brief for the geomorphic investigation (Mitchell 2002) sought to identify any areas of the lease that might contain palaeo-landscapes, which in turn might contain older Aboriginal sites. That report did identify one buried soil profile in an open pit on Glennies Creek (here referred to as Pit 15) and two small areas of high terrace on Bowmans Creek that were considered to be older than Holocene. No soil exposure was visible on the Bowmans Creek terrace and a recommendation was made for monitoring of the excavation of the proposed creek diversion channel that will cut through it.

NPWS (NPWS Reference 01/00608) criticised the report of Mitchell (2002) on several matters that were also discussed in the meeting referred to above. Consequently an application for a PRP for further work including excavation for geomorphic purposes was made to NPWS. Subsequent to that meeting consultation concerning the PRP was undertaken with Aboriginal groups in the Hunter Valley by Dr Witter with additional telephone calls and exchange of information by e-mail, fax and mail from Dr Mitchell.

All Aboriginal groups were advised of the date of the excavations and invited to attend the site during the period of the fieldwork. Two groups were represented in the field observing the backhoe excavations. The groups and people consulted and to whom the draft report was circulated were:

> Wonnarua Tribal Council. Mr Victor Perry, Ms Rhoda Perry and Mr Laurence Perry.
>
> Wanaruah Local Aboriginal Land Council. Mr Noel Downs (Co-ordinator), Ms Bev Van Vliet, Ms Christine Mathews and Mr Rodney Mathews.
>
> Lower Wonnarua Tribal Council, Mr Barry Anderson.
>
> Wanarua Nation, Mr Robert Lester also represented by Wonnarua Tribal Council.

Fieldwork was conducted between 29 April and 1 May. Fifteen backhoe pits were excavated on 30 May in the presence of Mr Barry Anderson of the Lower Wonnarua Tribal Council, Ms Christine Mathews and Mr Rodney Mathews of the Wanaruah Local Aboriginal Land Council.

Geomorphic aspects of central lowlands archaeology.

In a review of Hunter Valley archaeological site potential Dean-Jones and Mitchell (1993) concluded that most of the soil mantles in the central lowlands were relatively young (Holocene) and that they were constantly being reworked. They suggested that only four geomorphic circumstances seemed likely to provide conditions where older land surfaces might be preserved. These were:

1. Burial of a surface by advancing sand dunes.
2. Sequential burial by alluvial sediments on a floodplain, or in overlapped terrace surfaces.
3. Burial in alluvial sediment by channel switching on distal alluvial fans.
4. Burial at stream junctions where one stream had greater sediment supply rate than the other.

Since that review, further search by those authors and others has confirmed that buried soils do occur in some of these circumstances, but finding a palaeo-land surface and then finding evidence of Aboriginal occupation on that surface are two very different things. Chance plays a major role because exposures are almost always limited.

On the Ashton lease, land surface type 1 does not occur, as there are no sand dunes present. Type 2 was considered generally unlikely by Dean-Jones and Mitchell as most east-Australian terraces appear to be inset rather than overlapped and this has been confirmed on the lease during this investigation. Land surface types 3 and 4 have been identified elsewhere in the central lowlands of the Hunter Valley and these provided a focus for field inspection of the lease and the targets for backhoe excavation.

Within the central part of the Hunter Valley, alluvial and colluvial sequences have been found to contain buried land surfaces of probable Pleistocene age (Hughes 1999) and in at least one example at Nowlands Creek (Erskine 1991), these have contained Aboriginal archaeological material. Few of these buried landscape features are exposed in natural cuts. One was recently recognised in an excavated trench between Swamp Creek and Bowmans Creek on the adjacent Glendell Coal Lease and was the subject of investigation under PRP No 1325 by Umwelt Pty Ltd. The report on this work is not yet available but it can be stated that the buried soil materials identified in that trench had minimal profile development and no evidence of any Aboriginal material was found associated with them. This section of terrace alluvium lies on a third terrace and it is possible that it is a geological deposit of early to mid-Pleistocene age and thus too old to contain any evidence of human occupation.

A similar buried soil interpreted as having formed in a swampy meadow environment was investigated on Ravensworth East mine site during 2001 (Mitchell 2000, 2001). Such a site would not be particularly attractive as camp location and the soil it did not contain any archaeological material. However identification and subsequent archaeological testing of any such site is important and the research reported here set out to determine if any buried land surfaces could be found on the Ashton lease.

The Ashton lease covers a ridge of Permian sandstones and conglomerates separating the lower floodplains and terraces of Bowmans (Foy Brook) and Glennies (Fal Brook) Creeks near their junctions with the Hunter River. The highest point on the ridge is just northwest of Camberwell village at 116m and maximum relief is 56m. Both main streams are linked to short first and second order drainage lines that rise on the lease. Many of these are gullied and expose soils and sediments across the floodplains and the three terraces of the main creeks. Floodplains are up to 600m wide but high terrace remnants are much smaller. The lower reaches of both Bowmans Creek and Glennies Creek merge with the Hunter River floodplain on the lease and both valleys contain at least two terrace levels and remnants of a third. The lower reaches of the streams lie within the 1:100 flood level of the Hunter River and have accumulated post-European sediments. Little is known of the valley floor and stream channel morphology prior to the large floods of the 1950s but it is known that the upper section of Bowmans Creek on the Ashton lease and parts of Glennies Creek have been highly modified by river management works about 30-40 years ago. Neither creek bank exposures previously examined, nor any geotechnical test pits excavated (White Mining EIS) have revealed any buried land surfaces or preserved soils and the only example known on the lease is that exposed in Pit15.

The original archaeological site survey of the lease (EIS Appendix L) used a morphometric classification of landform units to stratify the search. Seven landform units were identified and this classification was an effective non-genetic description of the lease. Soils on the lease are solodic texture contrast (duplex) profiles on the hill slopes and uniform or gradation loams to clays on the alluvial landforms. General descriptions of these soil types and details of geotechnical test pits and bore logs are provided in the EIS in Appendices H, I and N.

Appendix L of the EIS described 24 open sites recognised by the presence of stone flakes at the surface. Several sites were ranked as having high significance. The most important sites occurred in Landform Units 2 and 3, these being major creek lines and first and second order streams. No other archaeological remains were identified and the stone materials and patterns of distribution seemed typical of much of the central lowlands of the Hunter Valley. As noted above, additional survey has located new sites with apparently different assemblages of artefacts including a very large open site (vicinity of GR 319099E 6403738N) adjacent to grinding grooves on sandstone on the right bank of Glennies Creek just outside the expected area of mining impact in the vicinity of Pit 15 (Witter pers. comm.).

Objectives of the investigation.

The purpose of this additional investigation was to extend knowledge of the geomorphology of the Ashton Coal Project Site by amplifying the work reported by Mitchell (2002). There were four key objectives:

1. To more fully document the extent of post-European landscape disturbance of geomorphic features on the lease.
2. To further define valley floor landscapes that may contain buried land surfaces.
3. To test the identified landscapes by trial excavation using a backhoe to improve understanding of the stratigraphy of the valley fills and to confirm the presence or absence of buried surfaces.
4. To assess the significance of any sites where buried land surfaces were located and to make recommendations for further archaeological work as appropriate.

These objectives are addressed below.

Objective 1. To more fully document the extent of post-European landscape disturbance of geomorphic features on the lease.

Nineteenth century Portion Plans covering the Lease, and air photos taken in 1958, 1967, and 1974 were obtained from NSW Land and Property Information. An enlarged colour air photo taken in July 2001 was made available by White Mining Pty. Ltd. Earlier air photos taken in the 1930s are not available in Sydney.

Using the 2001 photo as a base map, all the data sources were compared and a composite image produced depicting gross soil disturbance on the lease (Figure 1).

Three categories of disturbance were recognised:

1. Ground that had been cultivated at some time for crop production. This category does not include land that has been sown to improved pasture.

Virtually all of the floodplains of the main streams and the Hunter River have been cultivated. Soil in these areas can be expected to be homogenized by ploughing to a depth of 25 to 30cm. It should be noted that the same areas were also subject to extensive sedimentation and possibly local sheet erosion during the 1955 flood (see below and Figure 2).

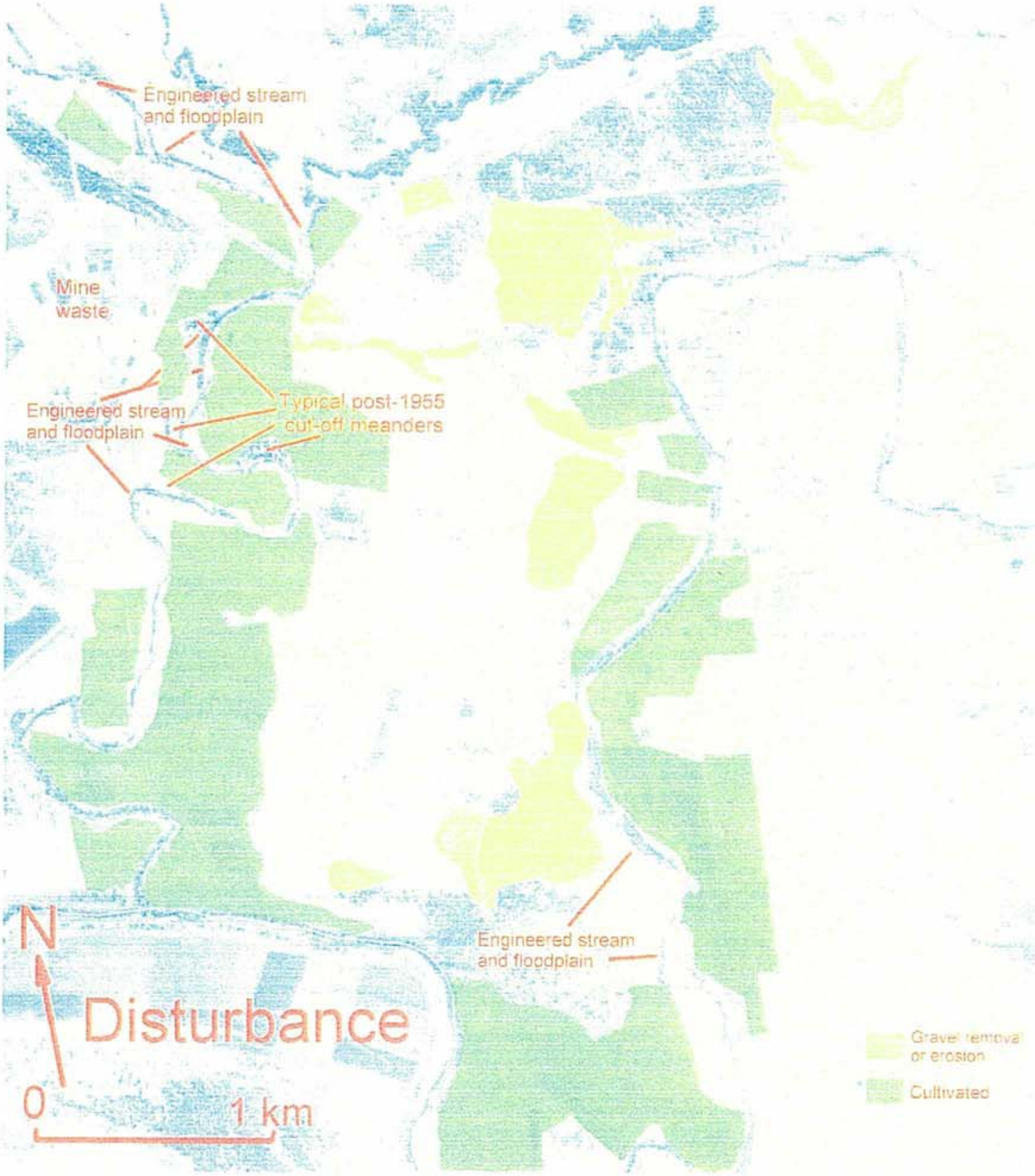

Figure 1. Composite image of areas of gross soil disturbance on the Ashton lease as interpreted from air photos dating back to 1958.

2. Ground from which soil had been removed by gravel stripping, or which has been subject to moderate to severe sheet or gully erosion.

The 1958 air photos show that hill slopes on the lease had very limited tree cover and that both sheet and gully erosion were widespread. The extent of the area mapped in Figure 1 is minimal as smaller gully features and more diffuse sheet erosion now covered by vegetation has not all been included. Eroded areas and gravel scrapes are known to contain Aboriginal sites, but any archaeological work conducted on these areas will need to consider the degree of disturbance.

3. Stream channels and floodplains that have changed course since 1955, or which are known to have been subject to engineering river 'improvement' works.

This category includes areas covered by sediments that were mainly deposited during the 1955 flood (Figure 2). The flood of that year was the largest recorded event in the Hunter River and its tributaries and its limits coincide approximately with the 1:100 flood event. Flood modelling for this event is reported in the EIS (Appendix N) and the calculated limits of a flood of this magnitude have been compared with topography in the field to produce the flood inundation map of Figure 2. This map should not be relied on for flood planning as it is only intended to define the floodplains and terraces, to provide an indication of the extent of inundation and post-European (PE) sediments for the purposes of this report.

Given the large vertical range of floodwater depth that can occur in the valleys, some standardisation is needed in defining terraces and floodplains. The low floodplain is here defined as the relatively bare gravel banks and steps within the channel and up to the limit of the 1:5 flood event. Its upper boundary is usually clear in the field as it marks a break between weed covered gravels and sands, and better pastures on soil. Above the low floodplain two terraces are evident, the lowest of which (first terrace) is apparently flooded by 1:20 events and the second terrace is flooded by 1:100 events. These terraces can be identified in the field because they both carry a mantle of PE sediments but in any one cross section both terraces are not always present. In very limited areas small remnants of a third (highest and oldest) terrace are found. These do not carry PE sediments and are beyond the reach of normal flooding.

Effectively the 1:100 floodplain extends beyond the active channels and low benches, across two poorly defined terraces, each 1 to 2m high and laps the edge of the third terrace where that terrace is preserved against the bedrock hill slopes. The entire area of the 1:100 floodplain carries 10-30cm of PE sediments burying the pre-1955 land surface. No Aboriginal archaeological materials will be visible on this surface unless they have been exposed by erosion or turned up by cultivation. Aboriginal sites however may be preserved beneath this recent mantle but would be extremely difficult to locate without large area stripping.

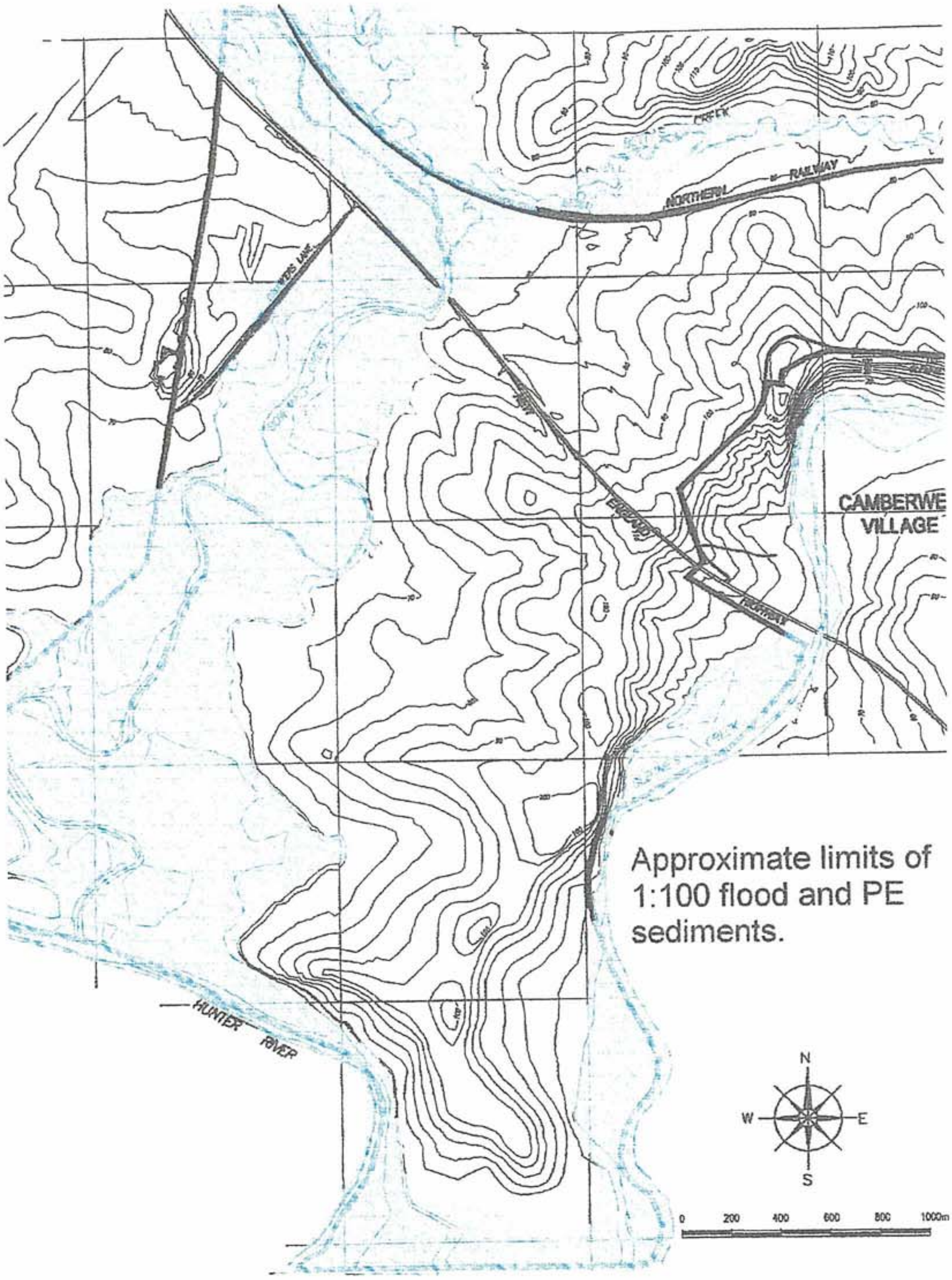

Figure 2. Approximate limits of the 1:100 flood, which covers the low floodplain, first and second terraces and which carries a blanket of PE sediments up to 50cm thick. The map is derived from Figures 3.4 and 3.5 (EIS), air photo interpretation and field observation.

In seeking evidence of change in the location of stream channels both the Portion Plans and air photos were used. Unfortunately geographic data on the Portion Plans were not sufficiently accurate to reliably measure the extent of channel relocation since the nineteenth century. However changes are visible in the sequential air photos.

The entire width (up to 200m) of the low floodplains of Bowmans and Glennies Creek were stripped bare in the 1955 flood and at least nine sections of the pre-1955 channel on both creeks were cut off as the main channel straightened and incised. All these cut off features are evident on the 2001 air photo as abandoned meanders. Examples are marked on Figure 1.

River 'improvement' works were confirmed on the ground and appear to have been constructed in the late 1970s at about the time that the New England Highway was relocated and new bridges constructed. They consist of channels and low floodplains that were reshaped by earthmoving equipment and stabilised with willow planting at fixed intervals. Cut bank sections were protected from erosion by the installation of heavy wire mesh supported on steel cables strung from driven railway line (Figure 3).

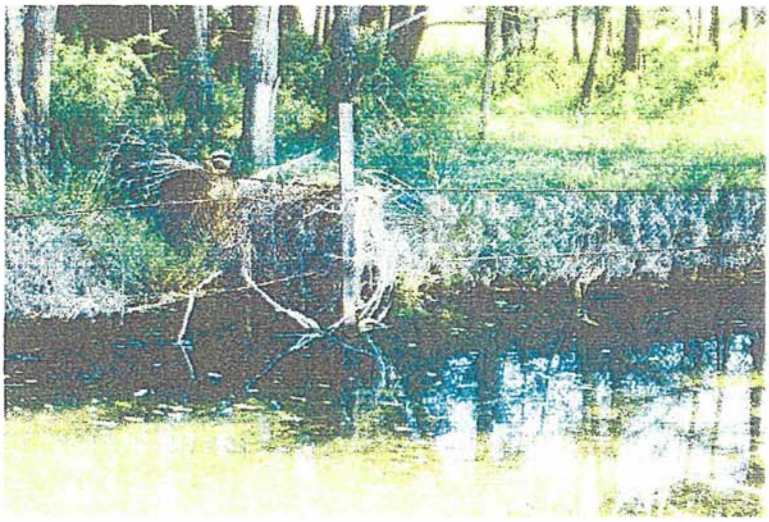

Figure 3. An intact section of engineered channel in Bowmans Creek showing the railway line piles, cables and mesh holding a constructed gravel bank. GR 317858E 6406286N

In later air photos it is evident that the low floodplain slowly stabilised and tree density (willows and river oak) increased but the main channels today are only quasi-stable. Upstream of the highway bridge on Bowmans Creek mid-channel gravel bars (Figure 4) are advancing, the 1970s stabilisation works are failing (Figure 5), and the gravel bed is subject to scour (Figure 6). In this section of Bowmans Creek a large wave of gravels is moving through the system and now reaches almost to the DLWC gauging station.

Similar fluvial activity is evident in Glennies Creek where a large gravel bar is lodged within dense river oak at the downstream end of a rock pool where grinding grooves on sandstone were found below water level (in the creek below GR 319099E 6403738N). The water level in this pool has been raised by the gravel bar in recent years and as the bar moves downstream in future floods the level can be expected to fall.

Figure 4. Large gravel bar advancing downstream in Bowmans Creek near the northwest edge of the lease. The bar is burying recent tree falls in its passage. The lobes at the front of the bar are 50cm high. GR 317997E 6407204N

Figure 5. A section of engineering works that has failed where the face of the second terrace is being eroded. Bowmans Creek upstream of the highway bridge. The surface of the terrace has nearly 60cm of PE sediment over silty clay alluvium. GR 6406883N 318433E

Figure 6. Bed and part of the low floodplain of Bowmans Creek upstream of the highway bridge showing the effects of recent scour. Even small floods are moving pebbles up to 25cm in diameter as bed load. GR 318455E 6406473N

The archaeological significance of all these fluvial changes are that any Aboriginal sites other than fixed features such as grinding grooves are unlikely to be visible anywhere on the low floodplains, and many have probably been destroyed by major changes in channel positions, bed scour or earthmoving. As noted above sites on the first and second terraces will be buried by PE sediment.

Objective 2. To further define valley floor landscapes that may contain buried land surfaces.

Having defined the extent of recent disturbance (Figure 1) and the extent of the 1:100 flood events and the PE sediment mantle (Figure 2) it was then possible to identify the small areas of third terrace located between the sandstone hill slopes and the flood limits (Figure 7). The previous survey had noted that these were of very limited extent and had identified three areas (Areas A, B and C on Figure 7) where this terrace level was present. Further inspection of the lease confirmed Areas B and C but Area A, opposite Brunkers Lane, was found to be a low angle sandstone hill slope.

All creek bank and road cut exposures of soils and sediments were inspected and another review of the geotechnical test pit logs (EIS Appendix N) was undertaken to focus further work but none of these sources gave any indication of the presence of buried land surfaces.

To test the possibility of the existence of buried surfaces four section lines were selected crossing the creek valleys from sandstone hill slopes to include the highest terrace (Lines 1, 2 and 4) and/or a steep interface between hill slopes and valley floor (Line 3). Sections were selected to take advantage of existing exposures and to avoid known Aboriginal sites. In the case of Line 4 the newly recorded Aboriginal site was found to extend onto this alignment and the three pits excavated there were limited to a smaller area than originally intended.

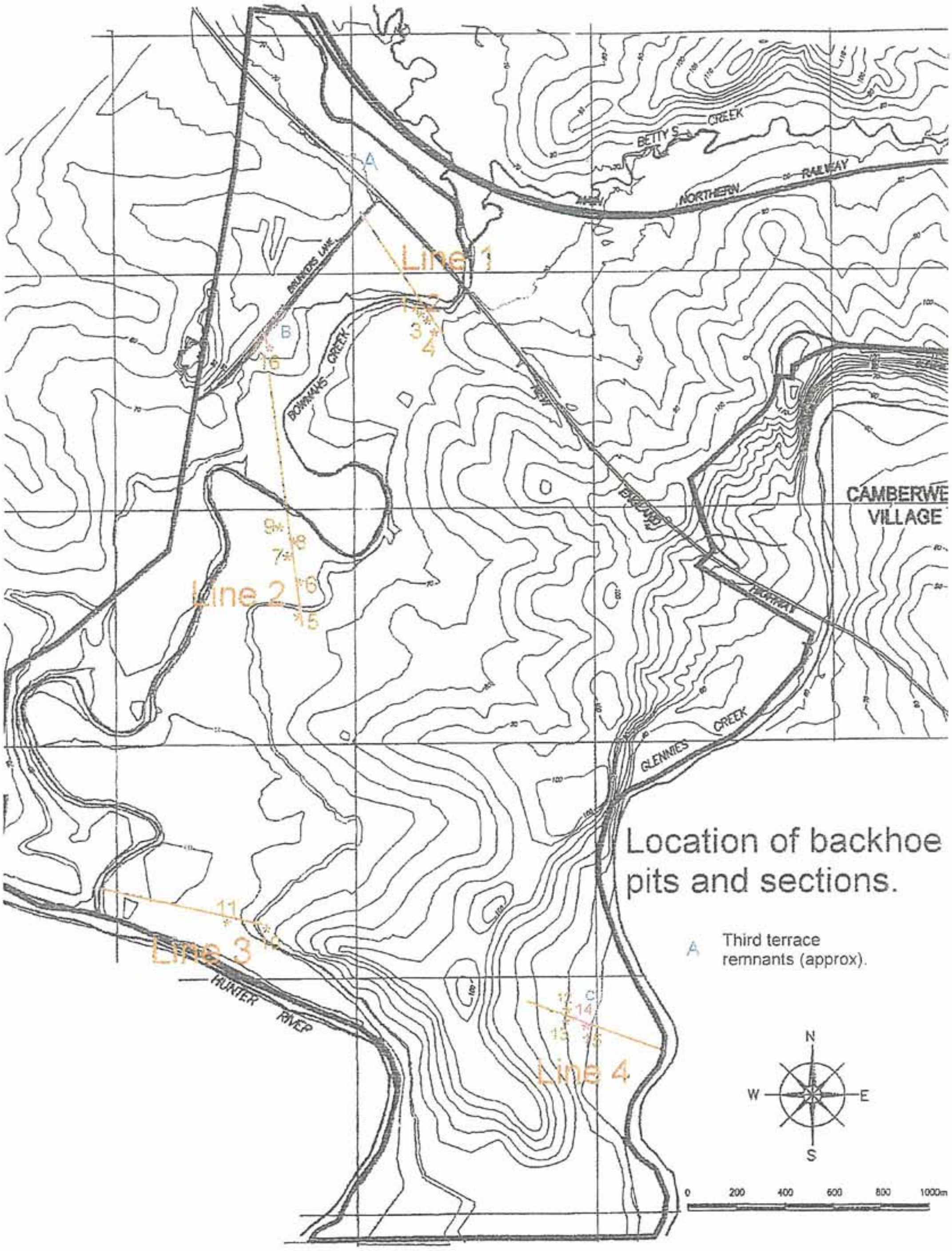

Figure 7. Location of third terrace remnants, backhoe pits and transect lines on the Ashton Lease. Note that Area A was subsequently found to be a bedrock slope not a terrace.

Objective 3. To test the identified landscapes by trial excavation to improve understanding of the stratigraphy of the valley fills and to confirm the presence or absence of buried surfaces.

In total 15 backhoe pits were excavated and backfilled on 30 May. This work was conducted in the presence of three Aboriginal observers (see above) and no Aboriginal artifacts were revealed in any test pit other than Pit 15 where they had previously been noted on the spoil heap (Mitchell 2002). No samples were taken. GPS locations and descriptions of the backhoe pits are presented in Appendix 1. Pit locations are shown on Figure 7 and summaries of the cross-valley stratigraphy are presented in Figures 8 to 11.

All the stratigraphic sections are similar and reveal a simple valley fill stratigraphy dominated by coarse creek sediments in the northern half of the lease grading to finer sediments that interface with Hunter River sands and loams in the southern half of the lease. The overall vertical and downstream sequence of sediments are fining cycles and there appears to be a consistent basal layer of coarse gravels above bedrock beneath most of the valley fill. No material was found that could be used for age dating but it is expected that third terrace sediments and basal gravels will be at least of Pleistocene age and all other sediments are expected to be Holocene or contemporary. Each section line is discussed below.

Line 1 - Pits 1 to 4.
Line 1 extended from a texture contrast soil developed on sandstone exposed in a road cutting in Brunkers Lane, across a second terrace and Bowmans Creek, through four backhoe pits and another second terrace to a sandstone hill slope (Figure 8).

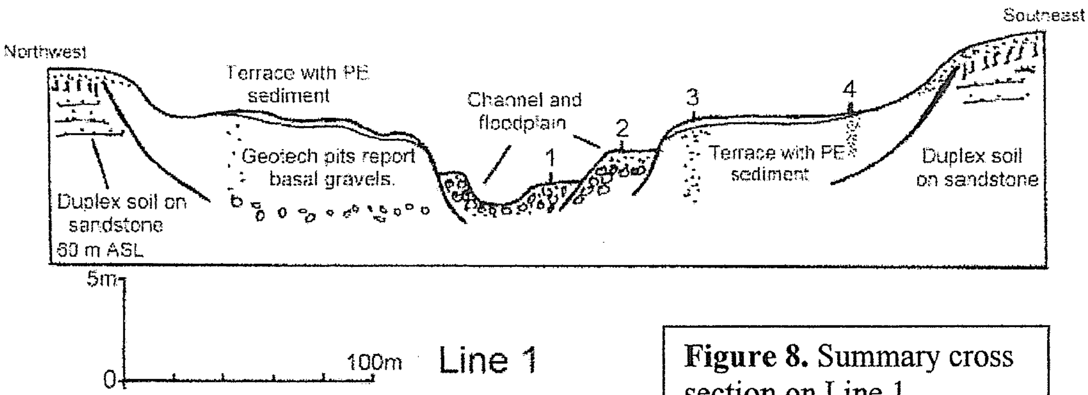

Figure 8. Summary cross section on Line 1, Bowmans Creek.

The low floodplain consisted of incoherent open gravels and sands that are subject to movement during floods. Geotechnical pits in the vicinity of this line report basal gravels beneath the second terraces at depths of 4 to5m. Both terraces had a mantle of PE sediments up to 45cm thick covering pre-1955 topsoils and the relationship between the terraces and the low flood benches appeared to be that the younger (lower) units were inset into the second terrace.

Line 2 - Pits 5 to 9 and Pit 16.
This long section was located some 900m downstream of Line 1 and was sited to sample the small remnant of third terrace near Brunkers Lane (Area B, Figure 7). This area had been identified by Mitchell (2002) as having some potential for the preservation of an old land surface and because it was on the alignment of the proposed Bowmans Creek diversion channel it was recommended that excavation of this channel should be monitored.

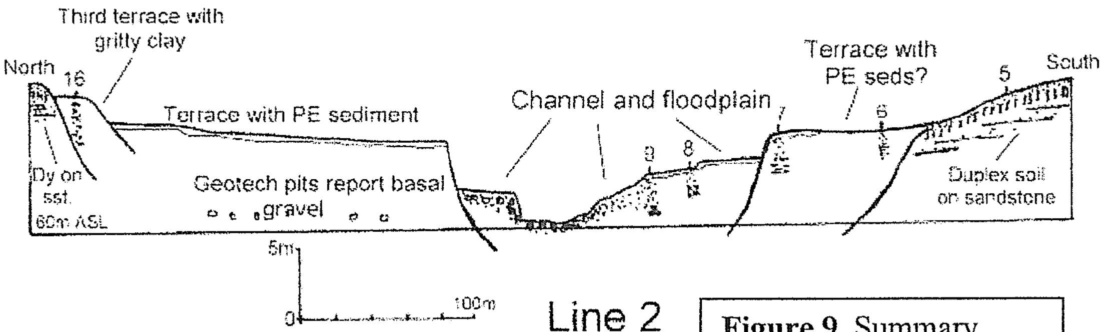

Figure 9. Summary cross section on Line 2 Bowmans Creek.

The geomorphology and stratigraphy of Line 2 (Figure 9) is similar to Line 1. The modern channel and low floodplain is wider and its bedload gravels are finer. PE sediments blanket the higher benches of the low floodplain and the second terrace to a maximum observed thickness of 15cm and the bedrock hill slopes on either side of the valley carry a texture contrast soil profile. Pit 16 was excavated to 2.3m and contained a dark brown texture contrast profile at the surface with sparse soil carbonate nodules at 90-100cm depth. This soil profile lay over a brownish black gritty clay layer 90cm thick with a slight concentration of fine charcoal. Although the colour was suggestive of a buried soil no other pedological structures were present and the clear sedimentary relationship between this unit and material above indicated that it was simply finer, slightly organic sediment.

Both the second and third terraces were interpreted to have an inset relationship with one another and with the low floodplain units. Interpretation of this section was confirmed in a long excavated drain across the second terrace on the right bank of Bowmans Creek.

Line 3 - Pits 10 and 11.
Line 3 was located 1700m south of Line 2 on the junction between a steep sandstone hill slope and the Hunter River flats and was intended to test the possibility that a colluvial mantle may have accumulated at the hill slope junction and whether any buried surfaces were present in the valley floor sediments. It was expected that the Hunter River would have deposited most of the sediment in the valley but it was also possible that some Bowmans Creek sediment may have constructed landforms in the same sequence.

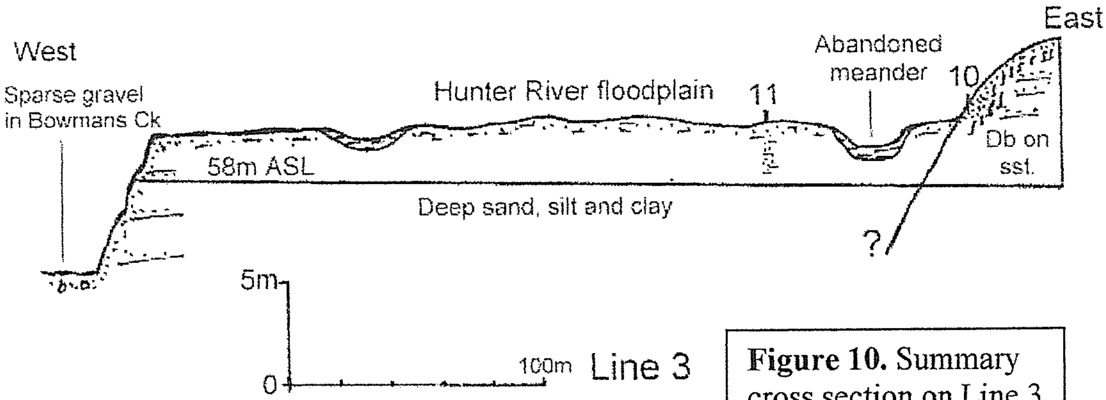

Figure 10. Summary cross section on Line 3 Bowmans Creek.

The stratigraphy of Line 3 was simple (Figure 10). The hill slope mantle carried a brown texture contrast soil and although the A-horizon at the base of the slope was thicker than average no significant thickness of colluvial accumulation was found. Pit 11 contained similar bedded sediments to those exposed in the deep banks of Bowmans Creek at its junction with the Hunter (brownish black, fine sandy, sticky clay loams). Within Bowmans Creek very little gravel was found as bedload material but basal gravels and sandstone bedrock are exposed in the valley fill upstream of this point confirming that the depth of sediment across the lower valley flats is only 8 to 10m.

<u>Line 4 - Pits 12 to 15.</u>

Line 4 sampled a section across Glennies Creek about 1.6km upstream from its junction with the Hunter River. The line included the third terrace remnant in which a pit had previously been described containing a buried soil and from which artefacts had been recorded on the dump (Mitchell 2002).

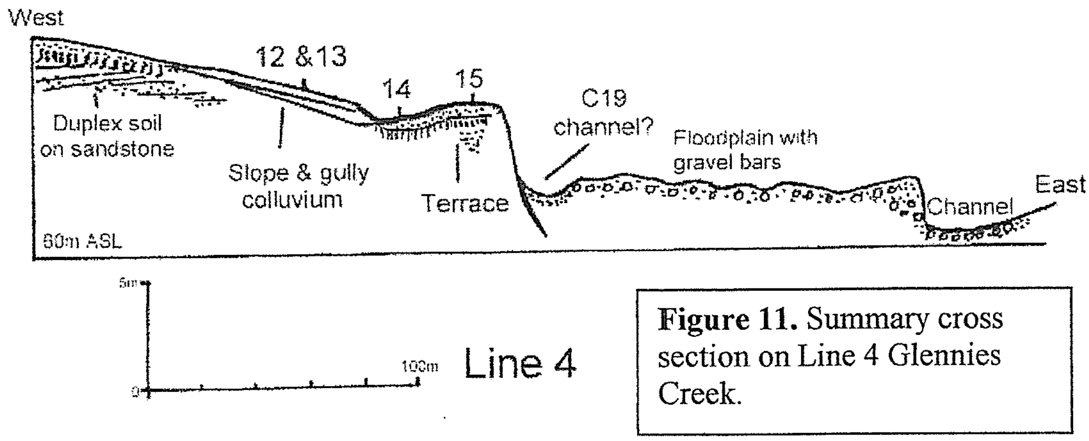

Figure 11. Summary cross section on Line 4 Glennies Creek.

The section (Figure 11) crossed a very wide floodplain with active gravel bars inset within second and third terraces with steep eroded faces. On the right hand margin of the gravel floodplain a shallow abandoned channel is bordered by large river oak and this is believed to be the nineteenth century course of Glennies Creek. If this is correct the modern creek has incised about 2m into the valley floor.

Above the third terrace remnant the lower parts of the hill slope have a shallow alluvial fan below a first order streamline extending up the hill. Pits 12 to 14 were placed here to explore the relationships between the hill slopes and the third terrace. This hill slope area is now known to be part of an extensive open site therefore the pits were kept small and only covered a limited area. The stratigraphy of this section is more complex than the other sections in that Pit 15 does contain a buried soil (Figure 12) that was also located in Pit 14. The gully fan has deposited layers of sticky, gritty clay on the margin of the terrace. The nature of these fan sediments is quite different from the upper soil in Pits 14 and 15 and the suggested explanation (Mitchell 2002) that this soil was developed in sediments deposited on an alluvial fan is shown to be erroneous. The colluvial sediments of the fan and the two profiles in Pits 14 and 15 are separate entities.

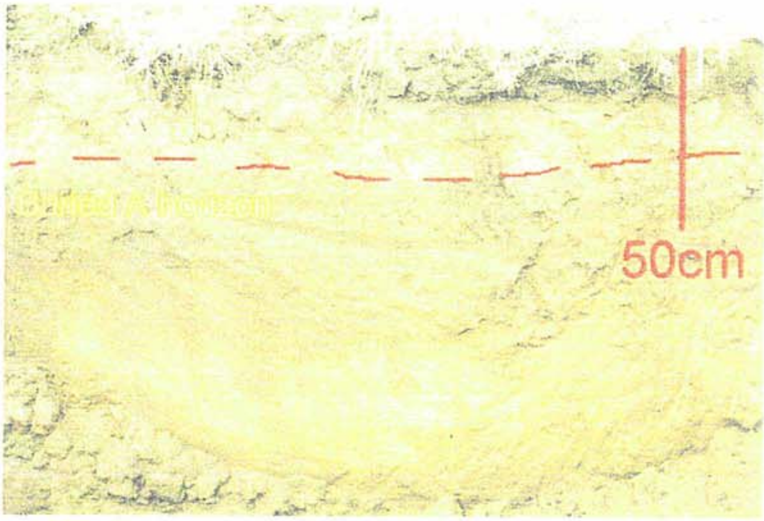

Figure 12. Buried soil profile exposed in Pit 15 on the third terrace of Glennies Creek.

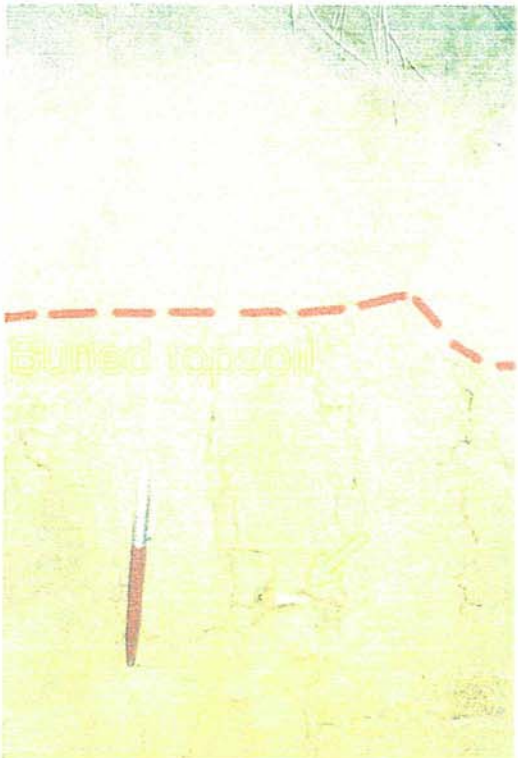

Figure 13. A single stone flake protruding from the exposed and slightly eroded face of Pit 15. The flake located some 15cm into the layer interpreted as a buried topsoil. The pen is 13cm long.

No artefacts were exposed in Pits 12 to 14 and the soil in this area was damp from seepage and stained by manganese oxides. In Pit 15 however where artefacts had previously been recorded on the dump, three flakes were found in the eroded walls. Two were located in the A_2-horizon of the upper topsoil and the third was found at a depth of 55cm, some 15cm into the layer interpreted as a buried topsoil (Figure 13).

Objective 4. To assess the significance of any sites where buried land surfaces are located and to make recommendations for further archaeological work as appropriate.

The investigations reported here mainly confirm and extend the conclusions drawn by Mitchell (2002). These are:

- The geomorphology and valley fill stratigraphy of the lower reaches of Bowmans Creek, Glennies Creek, and this part of the Hunter River comprises a maximum of three fluvial terraces each with an inset relationship to one another with the fragments of the highest (third) terrace being the only one of probable Pleistocene age and the only one in which any evidence of a buried land surface has been located.
- The 1955 flood has modified most sections of the Bowmans and Glennies Creek channels and engineering works intended to stabilise them.
- All areas of the low floodplains and first and second terraces have been extensively disturbed by cultivation, erosion and the deposition of a blanket of PE sediments during the 1955 flood. There is no visibility of Aboriginal sites in these areas and any sites that exist beneath the PE sediments are likely to be disturbed.
- Hill slope areas of the lease have been subject to extensive sheet erosion and some gully erosion in addition to direct disturbance by roads and building construction etc. Where sheet erosion is the main agent of disturbance this can increase Aboriginal site visibility but must also affect site patterning to an unknown extent.
- Three third terrace sites were previously noted (Areas A, B and C on Figure 7) as having some potential for further investigation. Of these, Area A turned out to be of no significance as it is a bedrock hill slope.
- Pit 16 tested area B on Bowmans Creek, but this pit did not reveal any important stratigraphy that would encourage further excavation. However a note of caution is necessary as a single pit may miss an important feature that could be revealed in a larger excavation. Such a large excavation is planned for the creek diversion channel and it is again recommended that excavation of that channel should be monitored for any evidence of a buried land surface or archaeological material.
- Area C on Glennies Creek was previously known to contain a buried soil and stone flakes had been found in the dump of Pit 15. These flakes can now be provenanced as this pit is located close to or within the bounds of a large surface site that was not previously known. The two flakes in the A_2-horizon are not unexpected but the deeper flake (Figure 13) is potentially more important. If the interpretation of the dark layer as a buried A-horizon is correct, then this flake could be older than flakes on the surface. Without further exploration there is no way of determining how old this soil and any associated archaeology is other than by making an estimate based on the comparative morphology of the soil profiles involved. This criterion is

notoriously inaccurate but it does suggest that an early Holocene or possibly, a late Pleistocene age for the buried profile is possible.

- Further investigation of Area C and the associated Aboriginal site may be justified in the future, but given that the site is outside the area of mining impact, including predicted land subsidence it is recommended that this area should be considered as a potential archaeological and geomorphological conservation zone. Its future management should be subject to discussion with local Aboriginal groups.

Conclusions and recommendations.

After review of the EIS, examination of the air photos and Portion Plans, pit excavations and field inspection, it is concluded that no further work is immediately justified in searching for palaeo-land surfaces on the Ashton Coal lease.

Three recommendations are made:

1. **That the new open site and the associated geomorphic features, especially the third terrace remnant at Area C on Glennies Creek (Figure 7) should be considered for reservation as an archaeological and geomorphological conservation zone. Its future management should be subject to discussion with local Aboriginal groups. No further geomorphic work is recommended on this site at this time.**

2. **That the excavation of the Bowmans Creek diversion channel, particularly where it crosses the third terrace remnant across Area B (Figure 7) should be monitored during construction for any evidence of a buried land surface and for any archaeological material.**

3. **That this final version of the report be circulated to all parties involved with the lease development.**

References.

Dean-Jones P. and Mitchell P.B. 1993. Environmental modelling for archaeological site potential in the central lowlands of the Hunter Valley. Report to NPWS. 84p.

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Mitchell P.B. 2002. Report on the geomorphology of the Ashton Coal Project site at Camberwell, Hunter Valley NSW. Report by Groundtruth Consulting to HLA-Envirosciences and White Mining Pty Ltd dated 13/2/02.

White Mining Ltd. 2001. Ashton Coal Project. Environmental Impact Statement. HLA-Envirosciences Pty. Ltd.

Appendix H. Groundwater hydrology and impact assessment.

Appendix I. Soil and land capability assessment report.

Appendix L. Archaeological survey – Ashton Mine, near Camberwell Hunter Valley, NSW.

Appendix N. Bowmans Creek diversion report.

Air photos used:

Camberwell 1958. Run 4C NSW215 5026

Camberwell 1967. Run 5C NSW 1481 5197, 5198

Run 6C NSW 1481 5151

Camberwell 1974. Run 4C NSW2259 121

Geospectrum Aust P/L Orthophotomap Ashton Coal Project. 1: 8,000 flown July 2001.

Portion Plans used:

Parish of Vane County of Durham Portions 67, 68, 69 and 70.

Appendix 1.

Location and summary descriptions of backhoe pits excavated to explore the valley stratigraphy.

GPS positions are based on AGD1984. Positions potted on Figure 7 are not as precise as the GPS locations and these should be used if relocation is necessary.

Pit 1. See Figures 7 and 8.
318185E 6406435N Left hand side of Bowmans Creek immediately above creek bed estimated 2.5m above water level. Contemporary bed load gravels.

Pit 1.2m deep in loose, bedded gravels up to 20cm diameter showing three fining upward cycles. Clasts are well rounded and fresh and interpreted as active bed load.

Pit 2. See Figures 7 and 8.
318193E 6406413N Low grassed bench 1m above Pit 1. Modern bed load gravels with a thin veneer of PE sand over weakly developed pre-1955 topsoil.

0-70cm. Brown 7.5YR4/3m, sands showing slight traces of bedding but penetrated by grass roots. Slightly darker sand at the base of the unit may be pre-1955 soil. Sharp boundary to:

70-120cm+. Open fresh gravels identical to those in Pit 1.

Pit 3. See Figures 7 and 8.
318201E 6406397N Edge of second terrace 1.0m above Pit 2. PE sand and gravel over pre-1955 weakly developed topsoil.

0-10cm. Dense grass root mat in brown, porous fine sands. PE sediment, clear to:

10-45cm. Mixed brown sands and fresh gravel with clasts to 5cm. PE sediment, sharp to:

45-70cm. Dark brown 7.5YR3/3m, buried A-horizon of loamy sand with moderate bioturbation and charcoal fragments throughout. Interpreted as pre-1955 topsoil. Clear to:

70-180cm+. Open porous slightly stained rounded gravels to 10cm diameter.

Pit 4. See Figures 7 and 8.
318280E 6406334N On the second terrace immediately below the sandstone hill slope. Patchy PE fine sand and silt over slightly developed pre-1955 soil profile that is unlikely to be older than mid-Holocene.

0-15/20cm. Brown 7.5YR4/3m, fine sand and silt with abundant grass roots. PE sediment. This sediment layer has a patchy distribution across the higher parts of the terrace, clear to:

15/20-50cm. Brownish black 7.5YR3/2m, compact, moderately bioturbated sandy loam with a lighter colour of dull yellow brown 10YR5/3m toward the base. Interpreted as the pre-1955 topsoil, profile development is minimal, gradual to:

50-240cm+. Alternating fine brown sands and thin, discontinuous gravel layers with rounded clasts to 5cm diameter.

Pit 5. See Figures 7 and 9.

318022E 6405082N A texture contrast profile on the sandstone hill slope.

0-15cm Dense grass root mat in greyish yellow brown 10YR4/2m, clay loam with good crumb structure. Clear to:

15-55cm+. Dark reddish brown 5YR3/6m, tough gritty clay B-horizon with moderate blocky pedality. Developed in situ from underlying sandstone exposed in trench.

Pit 6. See Figures 7 and 9.

317938E 6405186N On the higher part of the second terrace. PE sediment is absent from this hole but present in Pit 7 slightly lower on the same terrace. The soil profile is a reasonably developed texture contrast profile with drab colours in the B-horizon on alluvial clay. The A_1-horizon appears to have been stripped by sheet erosion. On morphological grounds it could be mid-Holocene in age.

0-15cm. Light brownish grey 7.5YR7/1d, bleached A_2-horizon of silty loam. Grass roots moderately developed but no evidence of any darker organic topsoil. Clear to:

15-34cm. Brown 7.5YR4/4m, stiff pedal clay, gradual to:

34-80/120cm. Brown 7.5YR4/6, tough alluvial clay with coarse prismatic structure.

Pit 7. See Figures 7 and 9.

317896E 6405300N On the lower edge of the second terrace. A thin and patchy drape of PE silt is present over a texture contrast/gradational profile comparable to Pit 6.

0-5cm. Light grey 10YR7/1d, very fine sand and silt with grass roots throughout. Clear to:

5-35cm. Brownish grey 10YR4/1m, pedal, tough clay loam, interpreted as the pre-1955 topsoil, gradual to:

35-140cm+. Dull brownish black 10YR2/3m, with olive patches indicative of occasional waterlogging, coarsely pedal tough medium clay. Subsoil grading to alluvial clay.

Pit 8. See Figures 7 and 9.

317878E 6405354N On the edge of a 1m high step in the middle of the first terrace. PE fine sands over a weakly developed pre-1955 uniform profile in alluvial sediments with fresh gravels at 1.5m.

0-15cm. Fine sandy silt in grass roots, PE sediment with clear boundary to:

15-25cm Brownish black 10YR2/2m, blocky clay loam, gradual to:

25-80cm Brownish black 10YR3/2m, massive and compact medium clay B-horizon with slight accumulation of soil carbonate at depth. Gradual to:

80-150cm. Dark brown alluvial clay, sharp to:

150-160cm+. Unweathered river gravels.

Pit 9. See Figures 7 and 9.

317870E 6405373N On lower edge of the first terrace. PE fine sands over a weakly developed pre-1955 uniform profile in alluvial sediments with fresh gravels at 2.0m. Comparable to Pit 8.

0-20cm. Brown, medium to fine sands with some silt PE sediment with abundant grass roots. Clear to:

20-55cm. Dark brown 10YR3/3m, pre-1955 topsoil of crumb structured sandy loam, no evidence of bleach, gradual to:
55-200cm. Brown, medium grained sandy loam, clearly bedded at depth with alternating incoherent beds and slightly compacted beds, clear to:
200cm+. Stained river gravels, open structure that would carry shallow groundwater at times.

Pit 10. See Figures 7 and 10.
317605E 6403790N Just above the foot of a steep sandstone hill slope abutting Hunter River floodplain. Sited to test for possible accumulation of colluvial debris at the break in slope. Texture contrast profile with thicker than average A-horizon (45cm) but no evidence of any buried surface.
0-15cm. Brownish black 10YR3/2m, crumb structured clay loam with dense grass roots and faecal pellets, gradual to:
15-45cm As above with fabric changing to 1cm polyhedral. Clear to:
45-65cm. Brownish black 10YR3/1m, pedal blocky clay merging gradually to:
65-85cm Brown 10YR4/4m, sandy clay with relic sandstone structure and clasts of completely weathered bedrock.

Pit 11. See Figures 7 and 10.
317492E 6403833N On a slight rise on the Hunter River floodplain. Site is frequently cropped and the expected PE sediments are not evident because they have been homogenized by cultivation. A deep pit with no evidence of buried surfaces. The soil profile development is unlikely to be more than of Holocene age.
0-75cm. Very dark brown 7/5YR2/3m, fine sandy clay loam with moderate to well developed pedality, deep root penetration and bioturbation, gradual to:
75-250cm+. Brown 7/5YR4/3m, sandy loam alluvium, with faint bedding.

Pit 12. See Figures 7 and 11.
319032E 6403398N On the right hand side of Glennies Creek at the margin of a large open archaeological site. Pit is on the sandstone hill slope immediately above a first order stream and contains a shallow texture contrast profile. Upslope from the pit artefacts are evident on the surface where about 5 to10cm of the A-horizon has been eroded.
0-18cm. Greyish yellow brown 10YR4/2m, porous sandy loam with patches of bleach toward the base. Moderate grass root development and a stone layer at the base. Clear to:
18-30cm. Dark brown 10YR3/3m, sticky clay with blocky peds to 2cm, gradual to:
30-70cm Dark reddish brown 5YR3/6m, sticky clay and in situ weathered sandstone.

Pit 13. See Figures 7 and 11.
319029E 6403376N. In the centre of the first order drainage line below Pit 12 at the head of a small alluvial fan that spreads onto the third terrace where Pit 15 is located. Undifferentiated colluvial/alluvial layers from the catchment. The sediments carry occasional or seasonal shallow groundwater flow and deeper units are heavily stained with manganese oxides. No buried surfaces are evident and almost no profile development.

0-10cm. Sandy loam continuous with the surface layer of Pit 12, bleach moderately developed at the base of the layer, clear to:
10-60cm. Bedded gritty loam, and sticky clays of hill slope wash and gully floor alluvium. High degree of bioturbation in moist soil with dense grass cover. Clear to:
60-80cm. Quartzose sandstone pebbles to 1cm and coarse sand in greyish brown 10YR4/2m, tough clay matrix, clear to:
80-170cm+ Brownish black 10YR2/1m, gritty clay with coarse blocky structure and shiny black manganese cutans on ped surfaces. This is not a buried soil and the dark colour is attributed to the manganese staining precipitated from shallow groundwater.

Pit 14. See Figures 7 and 11.
319065E 6403360N. Sited in a shallow depression on the surface of the third terrace between the alluvial fan and Pit 15. The soil in the Pit is comparable to that exposed in Pit 15 but no stratigraphic connection can be seen between the fan and the terrace soils. Interpretation of the 40-80cm layer is that it is the same buried A-horizon as described in Pit 15.

0-20cm. Dark brown 10YR3/3m, loamy sand with abundant grass roots, gradual to:
20-40cm. Light grey 10YR8/2d, fine loamy sand, bleached A_2-horizon, clear to:
40-80cm. Dark brown 7.5YR3/3m, clay with weak pedality, gradual to:
80-170cm+ Brown slightly sandy, clay loam and tough clay comparable to deeper units in Pit 15.

Pit 15. See Figures 7, 11, 12 and 13.
319140E 6403334N This is an open pit located on the third (oldest) terrace. Two stone flakes had previously been found on the spoil heaps and a buried soil profile was exposed in the pit walls (Figure 12). Both soil profiles are of fairly minimal development as uniform or gradational profiles with less pedogenic organisation than the soil found on the second terrace. During this investigation three stone flakes were found exposed by rainwash in the face of the pit and one of these was located in the buried profile (Figure 13). The soil layers in this pit are comparable to those described above in Pit 14.

Pit 16. See Figures 7 and 9.
317567E 6406127N. On the third terrace on the right hand side of Bowmans Creek approximately 500m upstream of the DLWC gauging station. Interpretation of this pit was aided by a long section exposed in a drain on the second terrace 150m to the northeast. The pit contains a well developed texture contrast profile over multiple alluvial units, one of which (100-190cm) was darker in colour and contained fragmentary charcoal. No confirmatory evidence was found to demonstrate that this was a buried soil.

0-30cm. Greyish brown 7.5YR5/2m, grading to brownish grey 7.5Y/R6/1d, sandy loam with a clear boundary to:
30-90cm. Dark brown 7.5YR3/3m, heavy clay with coarse blocky pedality. Roots penetrate along ped surfaces only. Clear to:
90-100cm. Brown 7.5YR4/3m, dense gritty clay with occasional pebbles to 2cm and sparse pieces of soil carbonate. Clear to:

100-190cm. Brownish black 7.5YR3/2m, medium to heavy clay with fine charcoal fragments. Clear to:
190-230cm+. Brown 7.5YR4/4m, sandy clay with moderate porosity, clearly bedded alluvium.

Final

ASHTON COAL MINING PROJECT

ENVIRONMENTAL IMPACT STATEMENT:

ABORIGINAL ARCHAEOLOGY

by

Dan C Witter

June 2002

Projection flake tool – a drill-like implement frequent in the Ashton study area

a report to:
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Ashton EIS Contents

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1. Summary

1.1. Background

The proposed Ashton Coal Project is a combined open cut and underground mine 14 km west of Singleton on the New England Highway. It is within a 9 km by 10 km area and is bounded by Bowmans, Glennies and Bettys Creeks and the Hunter River.

An EIS survey to assess impacts to Aboriginal archaeology has already been undertaken (Hardy 2002). However, according to the advice from the National Parks and Wildlife Service, further detail in coverage and archaeological data was required to be consistent with the NPWS standards and guidelines. In addition, the Ashton area is surrounded by existing coal mines, and because of cumulative impact in the locality, more complete information was needed.

In the course of the field work considerably more archaeology was revealed than was anticipated, and it was clear that this study needed to be a stand-alone report rather than a supplement. Extensive consultation on the results of the study was carried out with the Upper Wonnarua Tribal Council, the Lower Wonnarua Tribal Council and the Wonaruah Local Aboriginal Land Council.

1.2 Results

The field work consisted of revisiting already located sites and recording them in more detail. Areal photography was used to locate additional exposed areas of ground and these were visited on foot. A total of 285 exposures were recorded according to landscape type and ground surface conditions. Of these, there were 102 exposures with artefacts (EWAs). Places where the EWAs were clustered, or where there were numerous artefacts, were identified as sites, total 18. The remaining 31 EWAs were considered as isolated finds. In addition, all sandstone outcrops encountered were examined for grinding grooves or engraved art. In 14 outcrops recorded, six sets of grinding grooves were found.

These sites and isolated finds were distributed in geographical divisions which consisted of Bowmans Creek Valley, Glennies Creek Valley, Bettys Creek Valley, Hunter River Valley and Ashton Ridge. Sites with sufficient numbers of artefacts were graphed as assemblages. These graphs showed materials, cortex, artefact type, and size.

Three sites (Waterhole, Oxbow and Glennies Creek Sites) were of outstanding size. There were over 200 artefacts recorded for each of these sites, and the debitage (flakes) were analysed in extra detail. Although these sites are in very different landscape settings, the analysis shows that the stone technology is remarkably similar. The only common landscape elements were a high ground location next to a deep section of a permanent creek. Two of the sites have associated grinding grooves. Unlike most large sites in the Hunter Valley, all three sites had a low component of the microblade technology. In addition there were other flake characteristics which indicate an artefact assemblage type not identified elsewhere in the Hunter Valley region. It is speculated that these sites may have been drought retreats at long-term water or perhaps at fish traps. The Ashton ridge area also produced exceptionally abundant and varied archaeology.

1.3 Recommendations

The study area was divided into four management areas depending on the development proposed and the topography. The recommendations were structured as:

- Phase 1 – Post Consent (directly following development approval),
- Phase 2 – Construction (the period prior to mining).
- Phase 3 – Mining (during the life of the mine).

The specific management methods for the management areas and sites are outlined below (see Section 15 Recommendations for how these are synthesised with the developmental phases).

1. Monitoring for stripping during earth works:
   - Management Area A (Eastern Emplacement)
   - Management Area B: Bridge Site to Bettys Creek-Bowmans Creek confluence area
   - Management Area C: Construction of deviation channel for Bowmans Creek, especially in the area near the Waterhole Site.
   - Management Area D in the Western Emplacement area
   - Management Area D new access road to farms in the southern part of the area.

2. Monitoring for subsidence with markers.
   - Management area C
   - Management area D

3. NPWS Sec 90 for salvage:
   - Ridge Top Site EWA 1.
   - Tributary Site EWA 14.
   - Bridge Site EWA33
   - High Ridge Site
   - EWA 87 of Oxbow site

4. NPWS Sec 90 for collection:
   - Management Area A, all.
   - Management Area B, where development is planned
   - Management Area D, for the Western Emplacement
   - Management Area D, for the Hunter River Slope Site

5. Protective fencing:
   - Waterhole Site grinding grooves
   - Waterhole Site deposit
   - Waterhole Site lag surface site.
   - Main deposit of Oxbow site
   - All of Glennies Creek Site

6. Conservation area:
    - Waterhole and grinding grooves of the Waterhole Site
    - Main artefact concentration area of the Oxbow Site
    - Glennies Creek Site

7. Aboriginal access:
    - Waterhole and grinding grooves of the Waterhole Site
    - Glennies Creek Site

The above actions and programs need to be incorporated into an Aboriginal Site Management Plan. This needs to contain more specific details as to how the recommendations are carried out, and include the procedures specified in the NPWS Consent applications. It also needs to be developed as a negotiation process with the Aboriginal communities to maximise their involvement in all mitigation and conservation work.

2. Introduction

2.1 Background

This report follows a previous archaeological impact report which was prepared by Hardy (2002) for HLA Envirosciences. Parts of this report will utilise some of the information provided by that report. This report however is intended to be a self-contained EIS and not supplemental material for the Hardy 2002 report

2.2 Proposed Development

The Ashton Coal Project is combined open cut and underground coal mine proposed by White Mining Ltd. In addition to this are various surface facilities, infrastructure, overburden emplacements (dumps), and a diversion of a part of Bowmans Creek channel.

2.3 Study Area

The study area is in the Hunter Valley of NSW (Fig. 2). It is about 14 km north west of Singleton on the New England Highway and adjoins the village of Camberwell. The area is bounded by Bowmans Creek, Glennies Creek and Bettys Creek The area is about 1100 ha. within approximately 9 by 10 km.

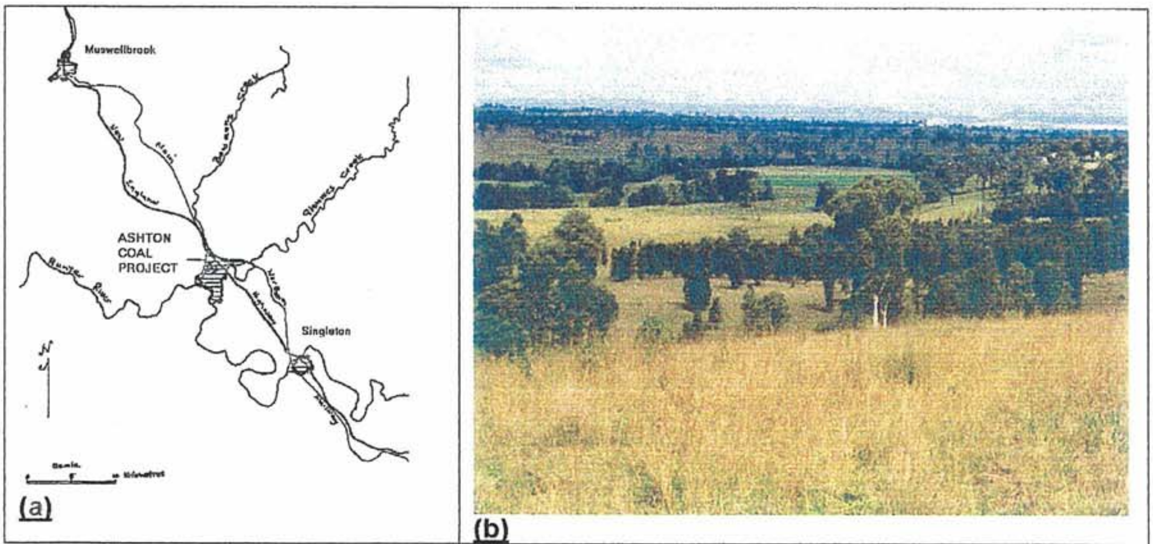


Fig. 2.1 (a) Location map of the study area between Singleton and Muswellbrook in the Hunter Valley. (b) Typical environment of the study area, looking west across Bowmans Creek valley, showing pasture grasses and woodlands on the ridge slopes and cultivated valley bottoms.

2.4 Regional Environmental Context

The study area is on the northern side of the Hunter River where it is joined by Bowmans and Glennies Creeks. Bettys Creek enters Bowmans Creek at the north west part of the study area. Thus, the locality is hilly with valleys and ridges.

The underlying geology consists of an anticline of the Permian Singleton Coal Measures and is capped with a horizon of conglomerate. The valley bottom alluvium is late Pleistocene in age. On hilly ground the soils are solodic texture contrast, and in the valley bottoms are uniform or gradation clays and loams (Mitchell 2002). Thus on the hilly ground the entire archaeological deposit will be within the 20 to 30 cm thick A horizon of the soil profile. This A horizon is heavily bioturbated (churned by plants and animals) which mixes any artefacts present and destroys any chance of stratigraphy. Bioturbation has occurred on the alluvial soils of the valley bottoms as well, but these have greater depth, and may cover older land surfaces (Mitchell 2002), resulting in stratified deposits.

The present vegetation has been greatly affected by clearing with areas of pasture grasses and areas of regeneration. Much of the regeneration is casurina but some mature trees, such as iron barks, are still present.

2.5 Pre-European Environment

In July 1824, the "Ravensworth" homestead belonging to James Bowman was visited by the surveyor Henry Dangar. This was located in the vicinity of the study area and according to Dangar "... two permanently watered creeks with important smaller tributaries with springs add to the water supply. The streams are narrow, deep and swift flowing with forest growing to the waters edge, and further down, extensive hardwood forests and large flats of good grazing land suitable for farming." (Noble nd:4). The two creeks mentioned in this statement would have been Bowmans Creek and Glennies Creek. It may be interpreted that in the study area the two creek channels were well formed, and not as a chain-of-ponds system. The valley bottom would have had open grasslands, and the ridges would have been wooded, probably as an open forest.

The two creeks were described as permanent, but in the1845 drought Glennies Creek ran dry (Noble nd:14). Dangar's 1824 description of Glennies Creek was that it was "... a narrow, deep, swift flowing stream full of fresh water fish, mussels and waterfowl" (Noble nd:74). During times in which the Hunter River was in flood, the lower parts of the two creeks were inundated by the river waters (Mitchell 2002).

It would appear that little of the ponding and swamps which occur further up the catchments were to be found on the creeks in the study area, and the supply of edible aquatic and semi-aquatic plants would have been low. However, the creek channels would have been suitable waterways for migratory fish such as eels and yellow-eyed mullet.

2.6 Personnel and Authorship

The previous archaeological survey for the mine project area was conducted by Vanessa Hardy, Victor Perry and Stanley Miller (Hardy 2002, Perry 2002). The present archaeological survey was by Dan and Alison Witter. The recording of the field data was by Dan Witter and the photography was by Alison Witter. The analysis and report writing was the responsibility of Dan Witter, and the maps, drawings and photography was by Alison Witter.

2.7 Legislation

This report is for an EIS under Part 4 of the EP&A legislation. DUAP is the determining authority except were a Section 90 Consent to destroy Aboriginal material heritage is required under the NPW Act in which the NPWS is the determining authority.

3. Aboriginal Partnership

3.1 Tribal Context and History

The study area is in the central part of Wonnarua tribal country (Horton, 1999, CMA 1987). The invasion of Europeans into the Hunter Valley was at the beginning of the 1800's, and written records on Aboriginal life are few (Brayshaw 1981). The Wonnarua tribal society was greatly disrupted, and relatively little of the traditional information has survived. In 1890, a reserve of 58 acres at St Clair were for an "Aborigines Inland Mission" was established, and 24 acres were added in 1893 (Noble nd:3). The mission was closed in 1923.

People claiming Wonnarua descent are now widely distributed out of the Hunter Valley, especially in the central coastal area of NSW. The Perry family however seems to have had the best continuity of occupation in the Hunter Valley (Victor Perry, pers. com.)

3.2 Consultation Process and Aboriginal Community Concerns

Following the information on visibility in the original field work for the Ashton Mine study area, it was initially expected that only a few additional days were needed to obtain more detailed information from the main already recorded sites and check some areas of bare ground indicated on the areal photograph which had not been covered on foot. Since Victor Perry, of the Upper Wonnarua Tribal Council, had already surveyed the area during the field work for the original report, and produced his Aboriginal Heritage Report, he suggested that the survey team of Dan and Alison Witter to proceed without him, provided he was kept informed of progress.

As work continued, it became understood that extensive changes had been made concerning Aboriginal community interests in archaeological survey participation. In December 2001 the Wonaruah Local Aboriginal Land Council announced that they wished to be involved and participate in all environmental assessment work in the Hunter Valley. In March 2002 the Lower Wonnarua Tribal Council announced that the demarcation line between them and the Upper Wonnarua Tribal Council following the land council boundary between the Wonaruah LALC and the Marindibba LALC was no longer recognised, and that they too wanted to be involved and participate in all developmental assessment work in the Hunter Valley. Also in 2002 a meeting was held for Native title claimants, including the Wonnarua Nation. At that time, according to Robert Lister, the Wonnarua Nation did not need to be involved in assessment field work, but wanted to be kept informed about all such projects, and be able to provide in-put for heritage recommendations.

Correspondence was received by HLA from the Lower Wonnarua Tribal Council dated 13 March 2002 which was a review of the Hardy (2002) report and expressing concern about not being involved in the Ashton Coal Project. The Wanaruah LALC also sent a letter to HLA dated 8 April 2002 and expressed their concern about not being involved in the Ashton study.

As part of this project therefore, it was necessary for the three Aboriginal organisations (UWTC, LWTC and WLALC) to visit the study area and discuss the known sites in terms of conservation, impact and mitigation.

(a) (b) (c) (d) (e) (f)

Plate 3.1 Aboriginal consultation.
(a) Victor Perry, Tracey Miller and Dan Witter discuss conservation options at the Bridge Site.
(b) Tracey and Dan discuss possible strategies for a sampling method for a salvage excavation at the Tributary Site.
(c) Barry Anderson, Dan and Larry Van Vliet inspect the axe grinding grooves at the Waterhole Site, discussing possible protection.
(d) Victor, Peter, Dan, Ian Callow and Tracy examine threatened implements at the Bridge Site.
(e) Glen Morris, Victor Perry and Dan discuss policy issues at the TSR Site.
(f) Barry and Bev Van Vliet discover grinding grooves at the Glennies Creek Site.

The Aboriginal consultation which took place during the field work included the following:

- A meeting on 25 March was held with Victor, Rhonda and Laurie Perry of the UWLC. As a part of the original survey a report had been prepared which outlined their recommendations (Perry 2002 pages 34-35). Victor indicated that he was satisfied with his report, and unless this survey produced hugely different results, no modification of it would be necessary. He did not want to resurvey the area, but wanted to be kept notified of progress.

- On 3 April Barry French and John Matthews were fortuitously met in the study area carrying out work for NPWS. They were showed the grinding grooves at the Waterhole Site and impacts from mining were discussed. They expressed special concern not only in the preservation of the grinding grooves but in the integrity of the waterhole itself.

- A field inspection on 10 April was conducted with Victor Perry and Tracy Miller representing the UWTC of the known sites in the study area to address concerns about preservation and mitigation for the report recommendations. This was followed on the same day by a meeting with Ian Callow of White Mining to clarify some of the potential impacts and the prospects of site conservation.

- Another field inspection on 16 April was carried out with Barry Anderson of the LWTC and Larry Van Vleit of the Wanaruah LALC in the study area. The main known sites were examined, and the proposed development and management options were discussed in detail. This was followed by a meeting with Ian Callow in which conservation and mitigation issues were extensively discussed.

- On 20 April Victor Perry again came out to the field area to inspect new sites which had been found, particularly the large Glennies Creek Site, and discuss his concerns about conservation and management issues.

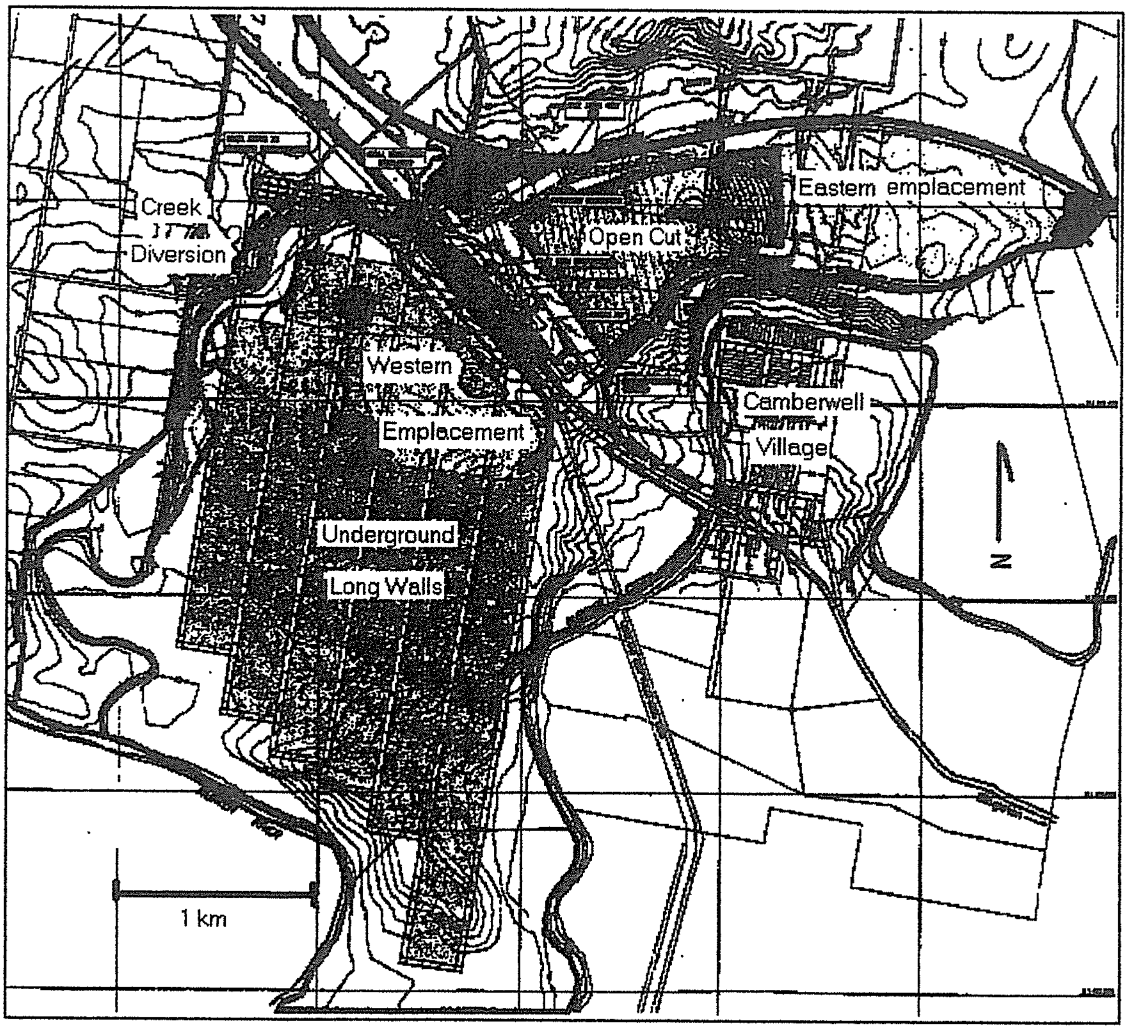
- Alison Witter met with Barry Anderson, and Larry and Bev Van Vleit on the 22nd April to examine and discuss the new sites, particularly Glennies Creek. Ian Callow also inspected the Glennies creek site at this time. Larry and Bev had independently discovered a second set of grinding grooves at the Bowmans Creek Waterhole, and these were also inspected.

The advice from the Aboriginal consultation in the field and in meetings held with White Mining management are incorporated in the recommendations section of this report. A draft of this report will to be delivered to the UWTC, LWTC, WLALC and the Wonnarua Nation for their review and comment.

4. Impacts

4.1 Description of Proposed Development.

The proposed Ashton Coal Project consists of both open cut and an underground mining operations. The various components are listed below (see Fig 4.1)



Map 4.1 Map of Ashton Coal Mining Project layout

- Open Pit. A small open pit mine is proposed in the northern part of the project area.
- Underground Mine. An underground long-wall type mine is proposed. It will use the open cut pit as access and extend across the southern part of the project area.
- Overburden Emplacements. Two main locations for over burden dumps have been identified. One is in the north eastern lobe of the project area (Eastern Emplacement), and the other is south of the New England Highway (Western Emplacement).
- Bowmans Creek Diversion. It is proposed to divert the channel of Bowmans Creek down stream of the New England Highway bridge so that it will run to

the west of the underground mine, cut through terraces of the creek valley, and rejoin the creek below the oxbow loop.

- Haul Roads. Haul roads are required for the overburden dumps and for loading coal. One of the haul roads is planned to pass under the New England Highway bridge which crosses Bowmans creek for access to the Western Emplacement Area south of the New England Highway
- Power and Telecommunication Lines. A new power line is planned to follow approximately the existing one that crosses Glennies Creek to the south east and Bettys Creek to the North. A power line and telecommunication line corridor is anticipated to run next to the southern easement boundary of the New England Highway.
- Surface Facilities. Various surface facilities such as offices and for coal handling are planned just north of the New England Highway, next to the open cut pit.
- Ponds. Ponds are proposed at the north end of the project area near Bettys Creek as well as associated with the Eastern Emplacement area and the Western Emplacement.
- Coal Stockpiles. Coal stock piles are proposed in the northern part of the project area near the railway.
- Bund Walls. Bund walls to provide a visual screen are planned for both sides of the New England Highway.
- Access roads. A new farm road to the southern end of the area is needed for access during the mining operation.

4.2 Flexibility of Design

Because the space for the mining operation is tightly confined by the location of the New England Highway and the railway, as well as by Bowmans and Glennies Creeks, there is relatively little flexibility in the design of the mining components. However, the Western Overburden Emplacement and sediment ponds have some limited potential for alteration in their location.

5. Objectives Of Study

The objective of this report is to produce an EIS for the Ashton Coal Project, and assess likely impacts on Aboriginal archaeological heritage in more detail than the previous EIS by Hardy (2002). The report is to follow the NSW NPWS standards and guidelines, as well as address issues raised by the NPWS review of the previous report. The points raised by this review, over two meetings (dated 2 February and 17 March 2002), are summarised as follows:

- A clear assessment of the heritage value of the lease area and how it would be impacted is needed.
- A synthesis of the previous work in the area (not an annotated bibliography) and existing data is needed.
- The previous work in the area needs to be used to produce archaeological models relevant to the study area, including potential Pleistocene sites. This is to be able to forecast where significant deposits may be located where ground surface conditions or buried deposits prevent surface archaeological site detection.
- Relevant models include landscape, behavioural, ethnographic, stone reduction and chronological types. The use of such models to assess the study area needs to be identified.
- The methodology used for the investigation needs to be fully explained, how it follows from previous work, and how the landscape can be related to the archaeological results.
- It is important that the study is able to assess the sites, understand the archaeology and determine the significance.
- The history of land use needs to be presented in detail, particularly if it affects the condition of archaeological deposits.
- The implications of the landscape features and their potential for sites needs to be fully developed, including potential Pleistocene deposits, and features on sandstone outcrops.
- The subsidence zone over the underground mine area needs more attention that it has had.
- The foot survey should include all places in the impact area which provide exposure. The distribution of exposures should be shown
- The interpretive framework for the results needs to be supported by data.
- The significance criteria need to be supported measurable results which identify site types as proposed by models.
- Aboriginal consultation should include a response by the Aboriginal community to the draft report.
- Management options need to be fully supported, and incorporate responses from the aboriginal community.

These comments were reviewed for the purposes of developing a new field program and report following a meeting between Margrit Koettig representing the NPWS, Alan Wells of HLA Envirosciences, Ian Callow of White Mining, Peter Mitchell, geomorphologist, and me. The priorities to complete the basic requirements for an archaeological EIS were considered to be as follows:

1. Coverage. Foot coverage of the study area needs to systematically include all areas of ground surface exposure, including the proposed area for underground mining which would be threatened by subsidence.

2. Artefact data. The artefact data needs to be more detailed in order to assess assemblage variation for different sites.

3. Relationship to surrounding studies. The study area is surrounded by large coal mines which have had archaeological EIS reports. The archaeological data in these reports requires analysis for comparison with the results from the Ashton archaeological survey.

4. Aboriginal consultation. The Aboriginal consultation must be extensive and include all interested organisations.

5. Recommendations. The recommendations must be detailed and specific and include in-put from Aboriginal consultation.

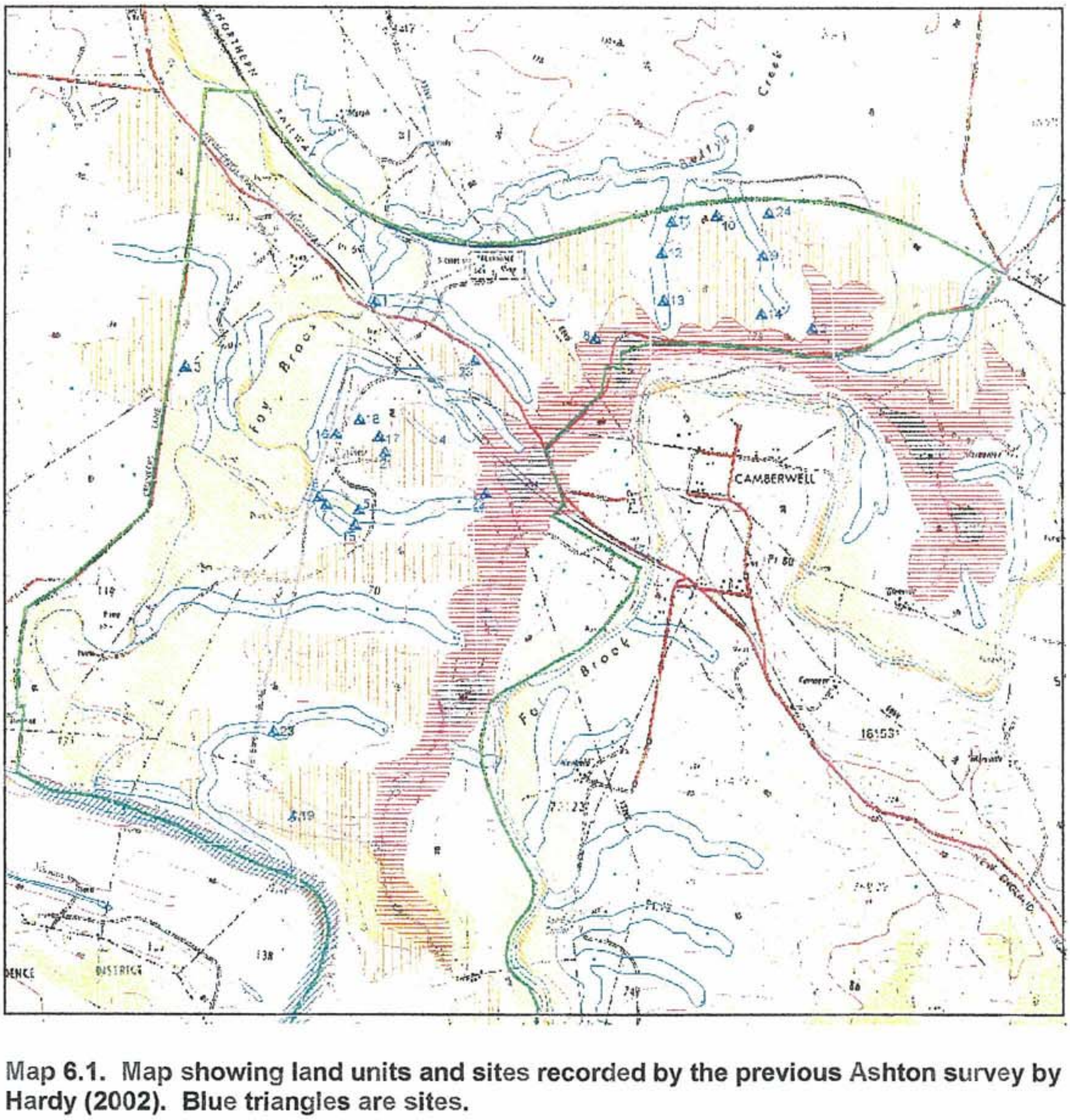
6. Pleistocene archaeology. Geomorphological testing is needed to assess the potential for buried Pleistocene surfaces which might contain artefacts.

7. Sandstone outcrops. Sandstone outcrops need to be included in the coverage data to test for the presence of grinding grooves or engraved rock art.

6. Previous Archaeological Work

6.1 Information Sources

An NPWS Register search was undertaken by the previous study (Hardy 2002, Perry 2002), and 2 sites were found recorded for the study area. These were 37-3-6 which was recorded by Hardy as Ash 4, and by this survey as EWA28 and the main part of the Waterhole Site. A second site 37-3-17 seems to have been the equivalent of Ash 5, or on this survey EWA34 and part of the Oxbow Site. The map of sites recorded during the survey by Hardy (2002) is shown in Map 6.1.



Map 6.1. Map showing land units and sites recorded by the previous Ashton survey by Hardy (2002). Blue triangles are sites.

A detailed summary by Hardy (2002) was made of previous archaeological reports in the Hunter Valley Central Lowlands. This topic is not to be covered again here.

6.2 Regional Models and Patterns

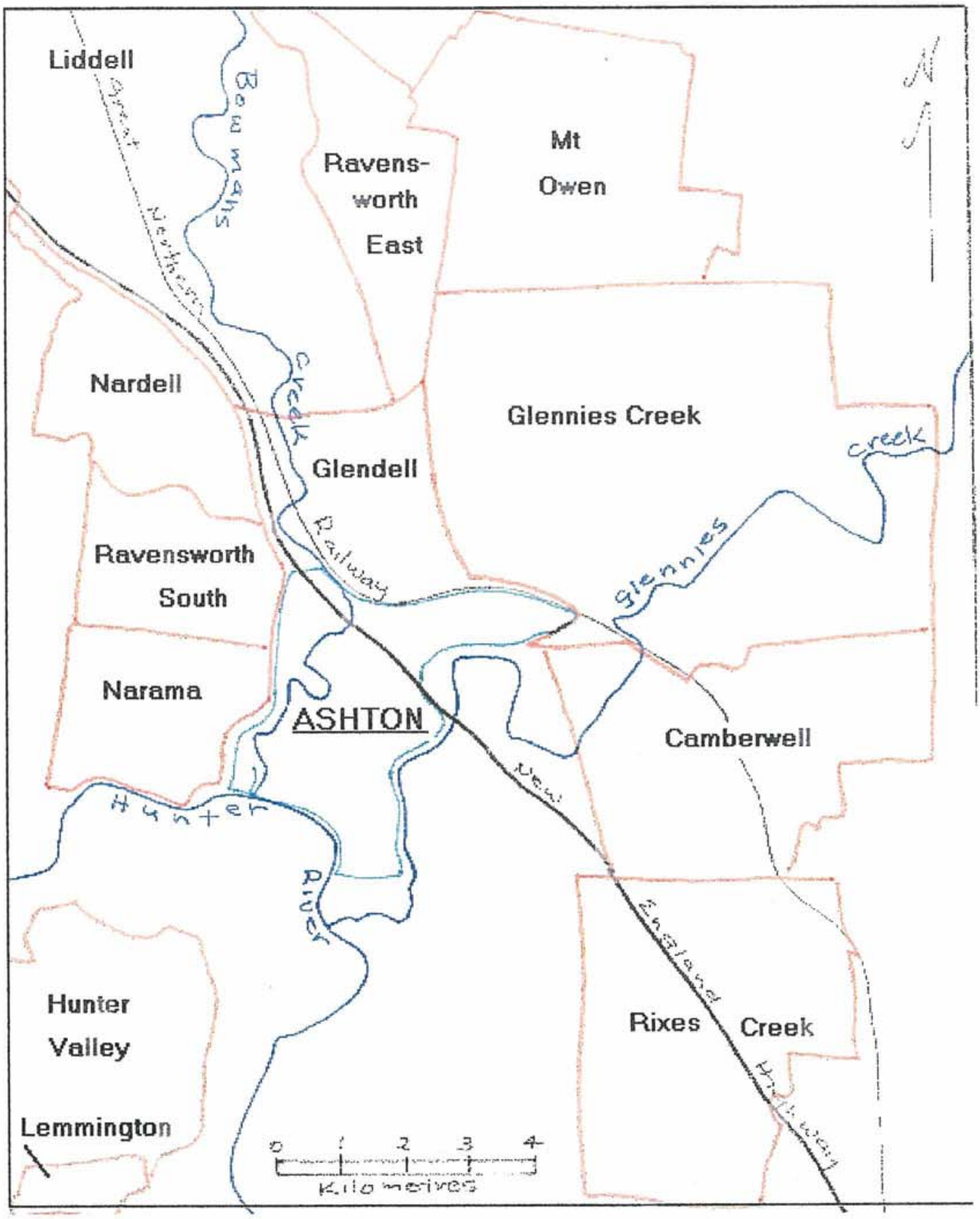
As shown by the review by Hardy (2002) there are a variety of models which have been proposed for the Hunter Valley. There has been however relatively little testing of these models using data from current studies. The models are often proposed to be predictive, and are based on the correlation of archaeological material with particular physiographic features, such as creeks. The models do little to distinguish different types of artefact assemblages with the landscape. Neither do they provide an explanatory system based on cultural strategies. As a result there is no basis for predicting artefact assemblage variation according to landscape patterns. Thus, in spite of the various models for Aboriginal settlement pattern, land use and logistics which have been offered they remain highly speculative, and are of uncertain reliability as a way of formulating speculations about a particular area.

In the case of the Ashton Coal Project area there are two problems of special concern. One is that because of cumulative impact around the study area it is of especial importance to be able to assess the remaining archaeology. The other is because the area is located where two major creek valleys join the Hunter River. The combination of stream valleys and a ridge make the area look ecologically productive and heterogeneous. The implication for hunting and gathering people is that it is likely to have been rich in food resources and a major focus for Aboriginal settlement.

Considering the difficulties in the identification of sites under difficult ground surface conditions, and the potential of buried early archaeological deposits, it would be an advantage to be able to extrapolate from nearby areas where sites might be located, their likely size and their contents. Even if such sites cannot be detected on foot, it should be possible to propose a program of subsurface testing to locate them. The use of the findings by previous reports however may be of little use for this objective, and the information recorded may in fact be "meta-data" and with little comparative meaning. In any case, the volume of reported material is vast, and not manageable except perhaps by a long term research project. In spite of this, a strategy has been undertaken in an attempt to assess some of this material.

6.3 Comparative Study

A comparative study was undertaken of the artefact assemblages in the vicinity of the study area (Map 6.2). The mine areas studies investigated were Narama, Camberwell, Ravensworth East, and Mt Owen. The reports archived in the NPWS Sites Register were examined and the data photocopied. Assemblages were selected for analysis which had large numbers of artefacts and which would indicate a variety of assemblage types.



Map 6.2. Map showing the location of existing coal mines in the Ashton area

6.4 Narama

The Narama Mine survey encompassed the lower valley of Bayswater Creek where it enters the Hunter River terraces. Artefacts from a large series of sites were collected and excavated (Rich 1992). Most of the sites were along the banks of Bayswater Creek, but some were on the valley slopes. The general trends in assemblage composition were difficult to assess from the report. Seventeen assemblages were selected as likely to reflect the range of variation. Percentages of implements and complete flakes were examined across the 17 sites and these are shown as rank order arrays in Fig 6.1. This indicates that the implements in the assemblages ranged from under 10% to over 30%. The slope of the line in the graph indicates that assemblages can be distinguished as to those with a lower or higher component of implements. The complete flakes ranged from 15% to over 35%. A jump in proportion of complete flakes seems to take place at about 20% as a distinction between high and low numbers of complete flakes.

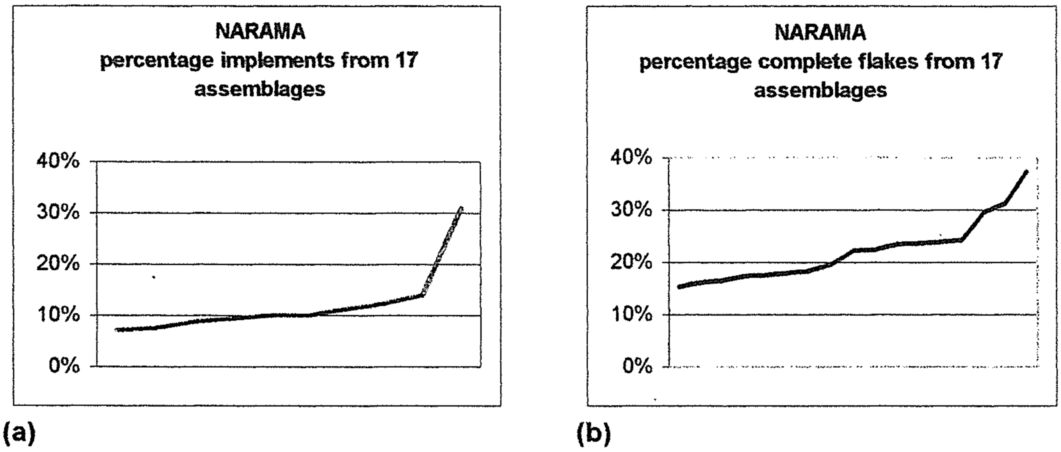


Fig 6.1 Narama archaeological assemblages for 17 sites. (a) Rank order percentages of implements of total artefacts. (b) Rank order percentages of complete flakes of total artefacts

HIGH IMPLEMENTS – LOW COMPLETE FLAKES	HIGH IMPLEMENTS – HIGH COMPLETE FLAKES
LOW IMPLEMENTS – LOW COMPLETE FLAKES	LOW IMPLEMENTS – HIGH COMPLETE FLAKES

Fig 6.2 Contingency table used to analyse the Narama assemblages

The data for the 17 assemblages were graphed and arranged according to the contingency table cells in Fig. 6.2. The results (Fig 6.3) show that nearly all of the assemblages are dominated by broken flakes. Assemblages with low proportions of implements show a gradual increase in complete flake percentages, but the numbers of angular fragments may vary. Among the assemblages with more implements, it may be seen that this was not a great proportion, except for one case which also had numerous backed blades. Cores were somewhat conspicuous where there was an increase in complete flakes.

Since the materials were shown separately from the artefact types in the original data, they could not be presented together. Seventeen assemblages were graphed as shown in Fig 6.4. The "other" category includes quartzite, petrified wood, igneous, porcelanite, etc. This graph shows that the two main materials are tuff, which is more abundant, and silcrete. Quartz is sporadically common. The other types are rarely noticeable.

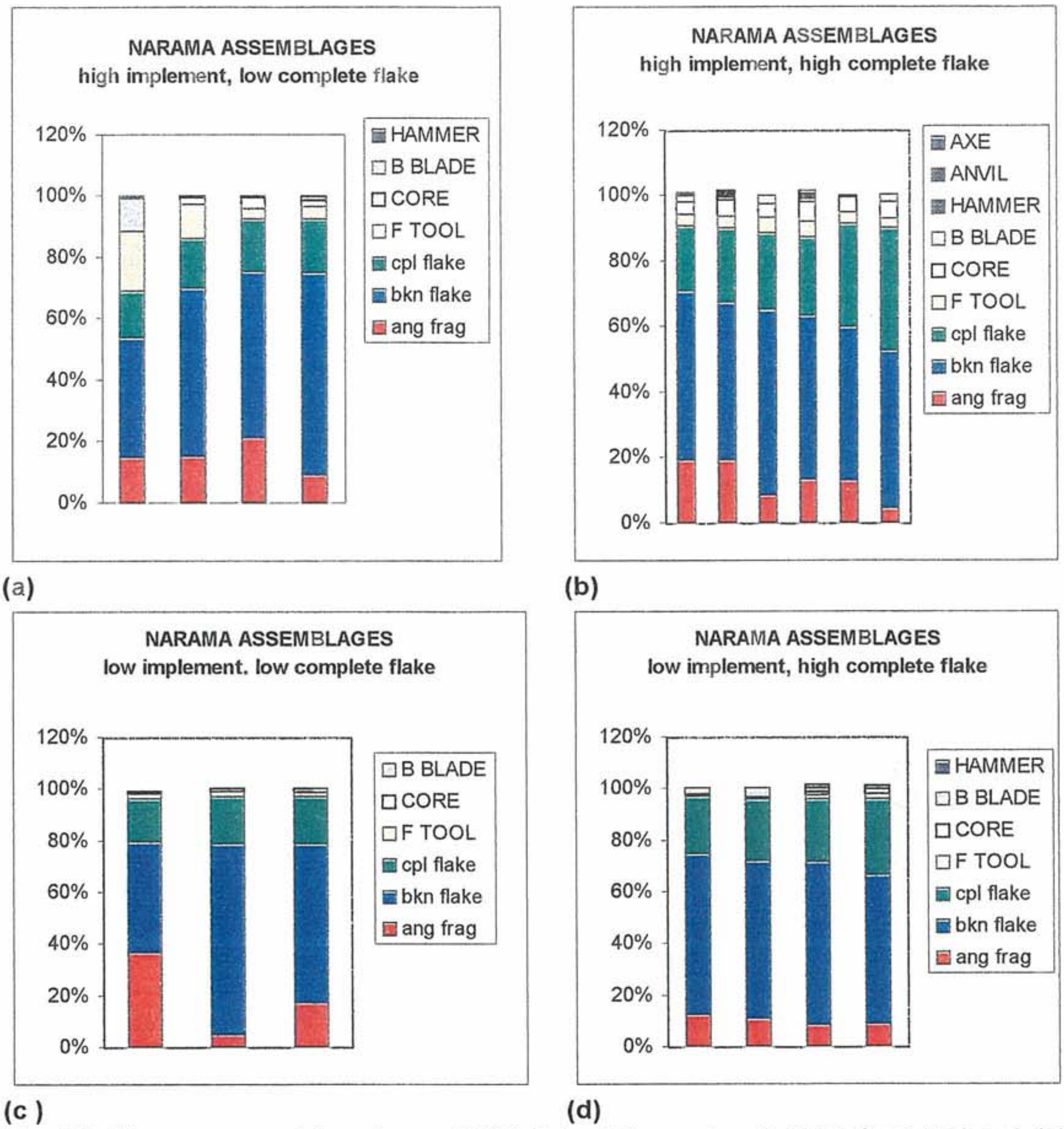


Fig. 6.3. Narama assemblage types: (a) High impl, low cpl --- (b) high impl high cpl (c) Low impl low cpl ----(d) low impl high cpl

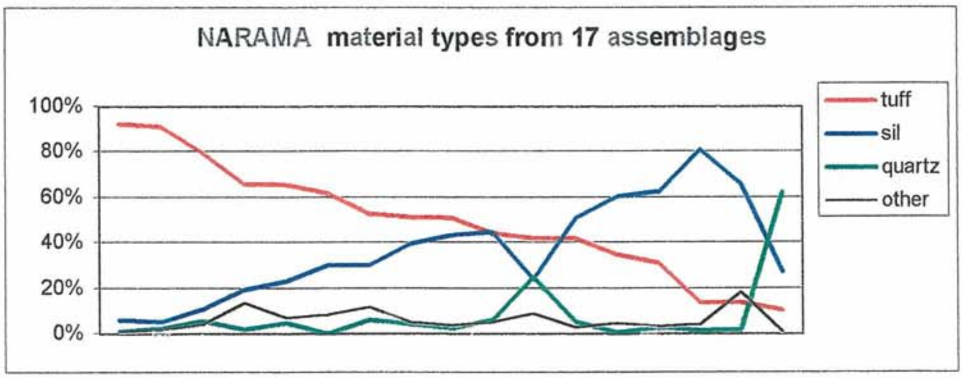


Fig 6.4 Narama material percentages for 17 sites.

These graphs reveal little about site function, although some seem to be dominated by microblade workshop debris. They do however indicate the common range of percentages for different artefact types in the lower Bayswater Creek valley. In summary, the Narama data can be used to indicate the range of variation of artefact types and materials for the lower Bayswater Creek, but little else.

6.5 Camberwell

The Camberwell study was to the east of the Aston Project area. It provides a series of excavations from Station Creek, which flows into Glennies Creek (Koettig 1992). A series of assemblages have been selected to indicate the range of variation as well as typical characteristics. The data was tabulated in the report so that the artefact types could be graphed with the material types.

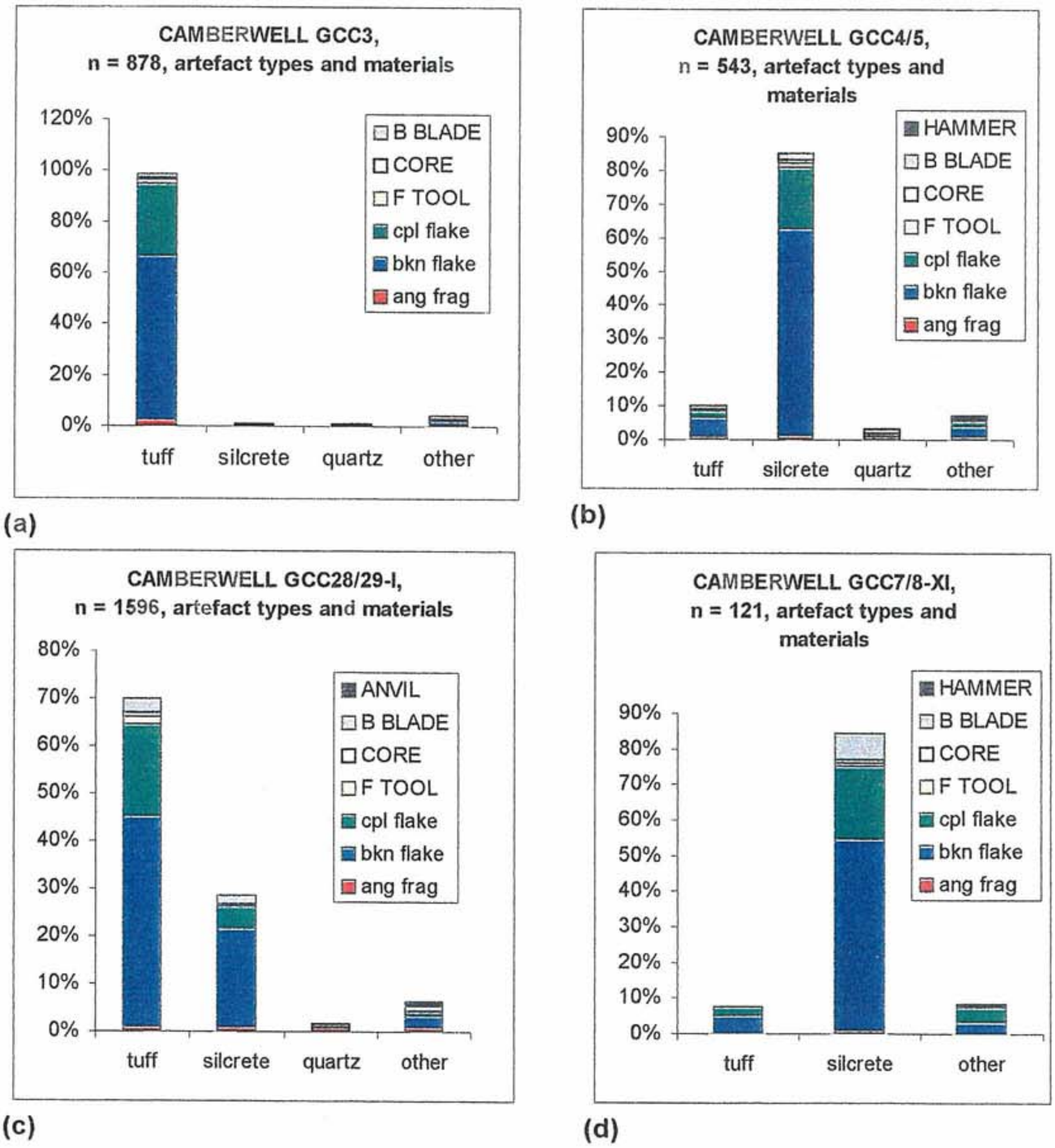


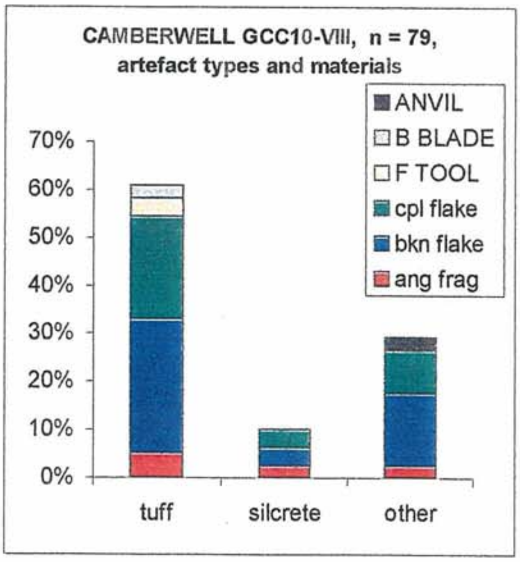
Fig 6.5. Camberwell microblade workshop assemblages. (a) tuff workshop (b) silcrete workshop (c) two core workshop (d) limited silcrete workshop

In Fig. 6.6 (a) The proportion of complete flakes is relatively greater. Backed blades are present, but there are more flake tools, and the "other" material types are relatively numerous. This small assemblage is probably representative of largely non-microblade stone flaking.

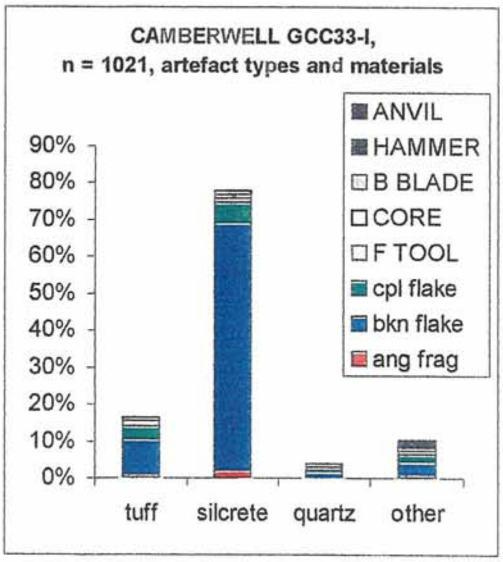
The two assemblages shown in Fig. 6.5 (a&b) are microblade workshops of tuff and silcrete. These show massive dominance of a single material with about two thirds of the artefacts being broken flakes. This high breakage is typical of microblade production since the elongate thin flakes are prone to snap at the instant of production. The low proportion of backed blades is not unusual.

In the case of Fig 6.5 (c) silcrete has been combined with tuff on the workshop indicating two different cores were being reduced. Both resulted in numerous backed blades which remained on the workshop floor. A limited silcrete microblade workshop is represented by Fig. 6.5 (d), and the backed blades remaining are relatively conspicuous. In all cases at least two thirds of the flakes are broken.
The assemblage in Fig 6.6 (b) is very large, with a variety of implement types. It is strongly dominated by broken flakes. This may in part due to the contribution of microblade workshops, or may also reflect some other process which results in a large proportion of broken flakes.

In summary, the Camberwell assemblages provide numerous examples of intensive microblade core reduction. In general, two thirds of the flakes produced from a microblade core can be expected to be broken. Flake tools and other implements other than backed blades were poorly represented in the Camberwell data. Note the choice of the assemblages to graph was not biased against other implements. This occupation along the banks of Station Creek appears to have been primarily engaged in microblade core reduction and backed blade production.



(a)



(b)

Fig 6.6. Examples of other Camberwell assemblage types. (a) high proportion of complete flakes (b) low proportion of complete flakes, but wide range of implements

6.6 Size Distribution

In some of the impact reports artefact size data is provided as well as material and type. Size is a particularly revealing factor for understanding reduction technology. The typical artefact size curve is skewed to the left,.with more small pieces than large ones. Assemblages vary therefore as to the size range and degree of skewness, as indicated in Fig. 6.7.

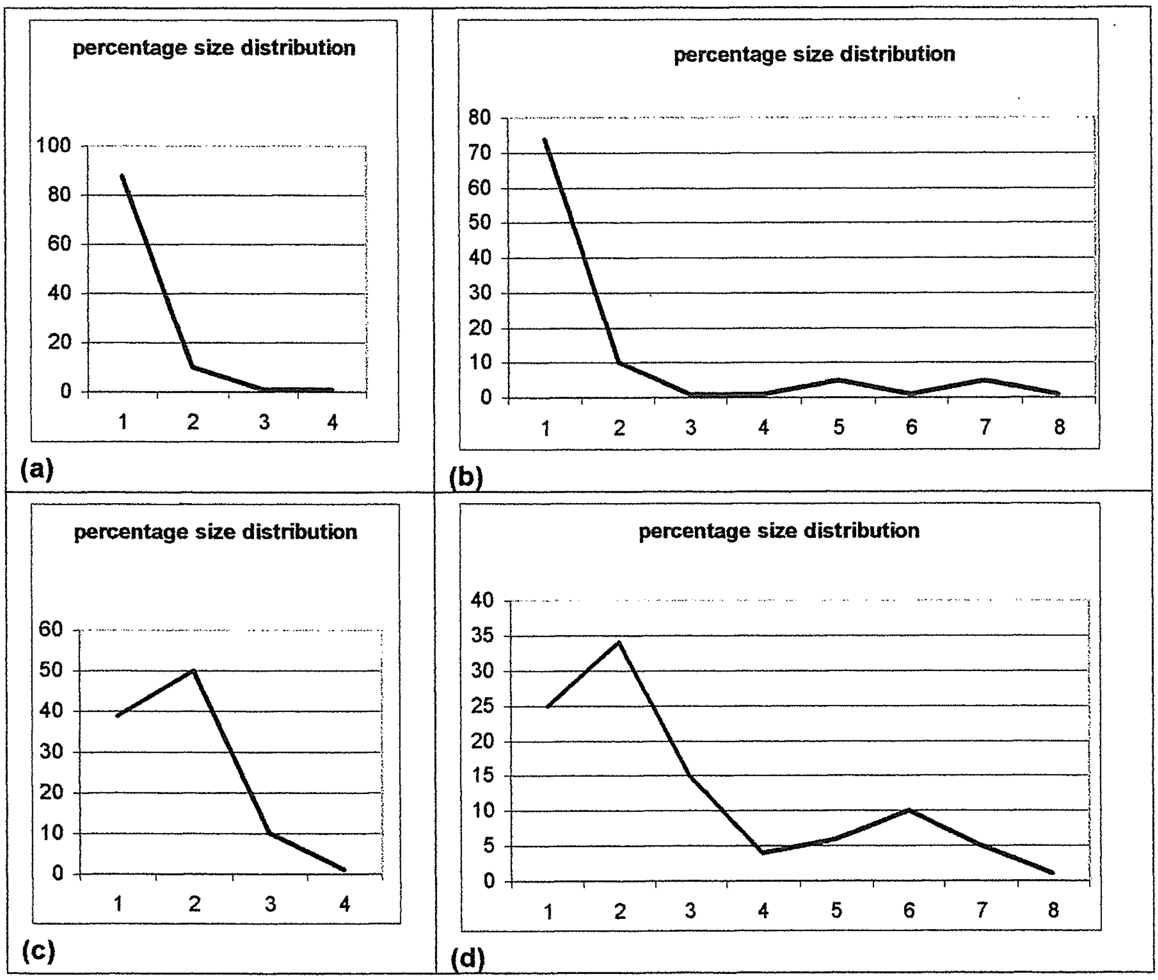


Fig. 6.7. Patterns of artefact assemblage size distribution. (a) Narrow range, heavily skewed to the small size. (b) Wide range, heavily skewed to the small size. (c) Narrow range, less skewed to the small size. (d) Wide range and bi-modal.

Size distributions were examined for some assemblages from impact reports which had length, width and thickness data. These were calculated as to the size index and artefact type system used in this report.

6.7 Ravensworth East

Ravensworth East located on Bowmans Creek upstream from the study area, and surface assemblages were recorded by Nightengale (1999). The site RE24 was recorded on Bowmans Creek about 3 km north of the study area, and RE19 was recorded as several small assemblages nearby on Swamp Creek close to where it

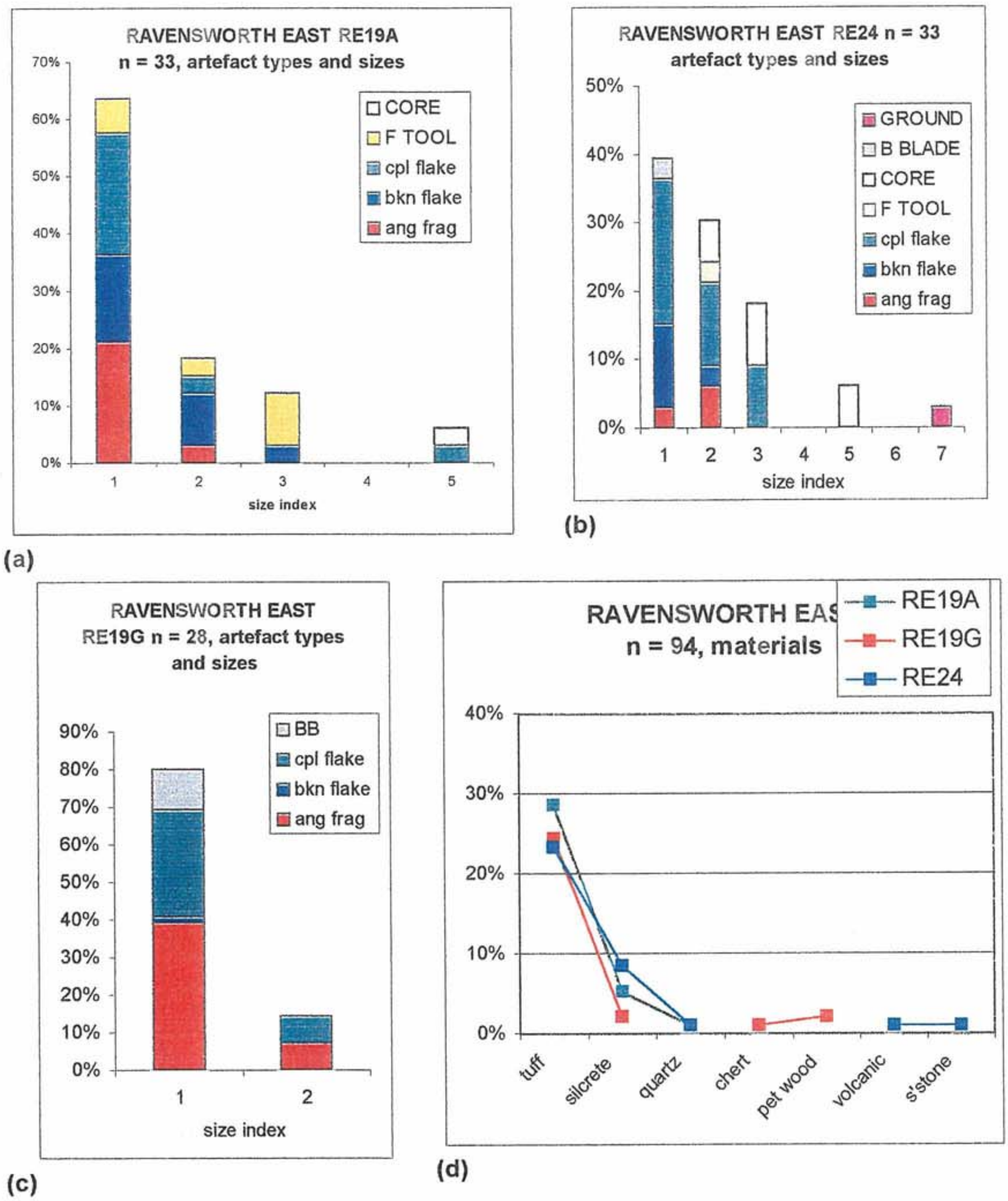


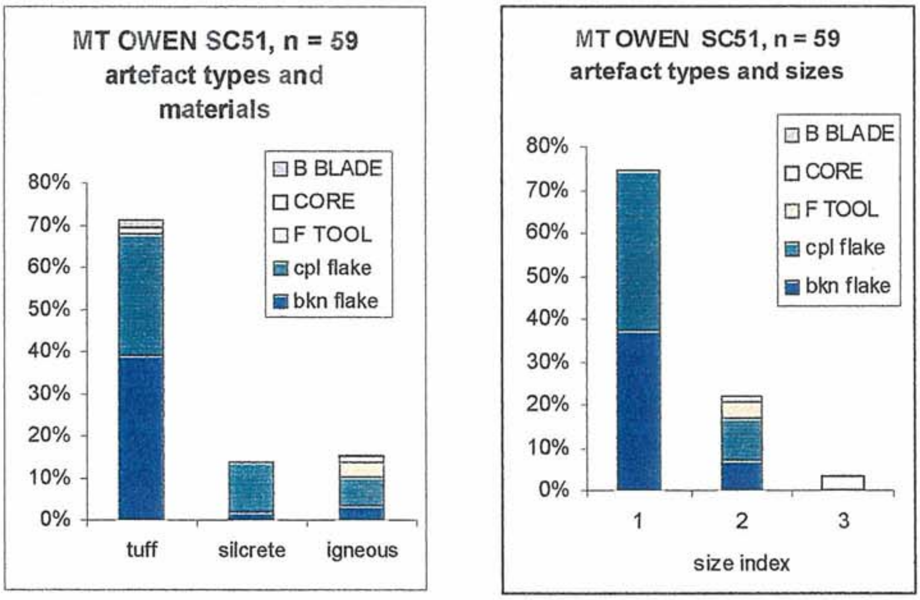
Fig 6.8. Artefact assemblages from the Ravensworth East mine area. (a) Site RE19A, (b) Site RE24, (c) Site RE19B, (d) Material distribution for sites RE19A&G, RE24.

enters Bowmans Creek. These were graphed according to artefact type and size index in Fig. 6.8(a), (b) & (c). The interpretation of typological terms in Nightengale (1999) as equivalent to those found in other reports, and the type system used in this report is uncertain. The artefacts tabulated as "flake" were translated as complete flake, the "debitage" as broken flake, and "flaked piece" as angular fragment. If "flake" actually refers to complete flakes, then there is a high proportion of complete flakes in RE24, and cores are numerous. The assemblage RE19G is very skewed to the small size and the presence of backed blades is prominent. It is consistent with a limited microblade workshop. Providing the data is interpreted correctly, flake tools are very prominent in RE19A. The materials shown in Fig 6.8 (c) show that all of the assemblages are mainly of tuff. These assemblages indicate considerable variety, and this is greatly enhanced by the size data.

6.8 Mt Owen

The Mt Owen mine area is north of the Ashton study area. A series of sites were recorded by Dean-Jones (1991) on Swamp Creek, and two assemblages were selected for analysis here. In the data, the "flaked piece" category was interpreted as both angular fragments and broken flakes, and "flake" as complete flake.

Site SC51 (Fig. 6.9a) is located high on a spur crest and dominated by a microblade workshop of tuff, but has a component of volcanic material which includes flake tools and cores. The small amount of silcrete present is almost entirely complete flakes. The overall size distribution (Fig 6.9b) however is strongly skewed to Size Index 1, in spite of being about half complete flakes.

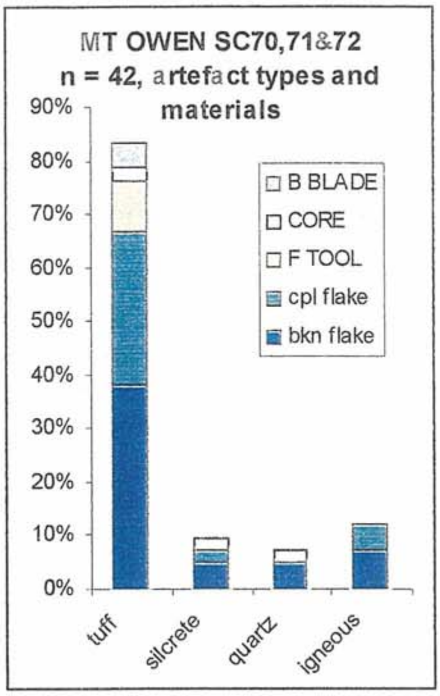


(a) **(b)**

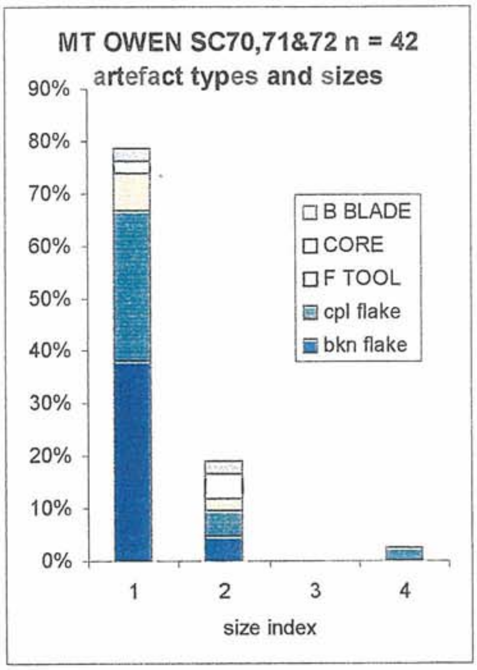
Fig 6.9 Mt Owen assemblage SC51. (a) Artefact types and materials. (b) Artefact types and sizes.

The assemblage from SC70, 71 and 72 is from the slopes of a deep tributary valley. The graph showing artefact types and materials (Fig. 6.10a) shows it to be almost entirely tuff, and that both backed blades and flake tools of this material are conspicuous. The size distribution (Fig 6.10) is again mainly Size Index 1, and about half of the debitage is complete. This appears to be a microblade workshop for the production of backed blades and in which there are numerous flake tools. Small flake tools are commonly part of a microblade workshop, but it is possible that some of the discards from the backing process were classed as retouched flakes.

Another site from Mt Owen was on Bettys Creek, about 5 km north of the study area, and located on a tributary channel on Bettys Creek valley bottom. The assemblage from this site is again dominated by tuff. The substantial presence of backed blades indicate that this is mainly a microblade workshop assemblage. Although Size Index 1 dominates (Fig 6.11b), there is a notable proportion Size Index 2 as complete flakes.

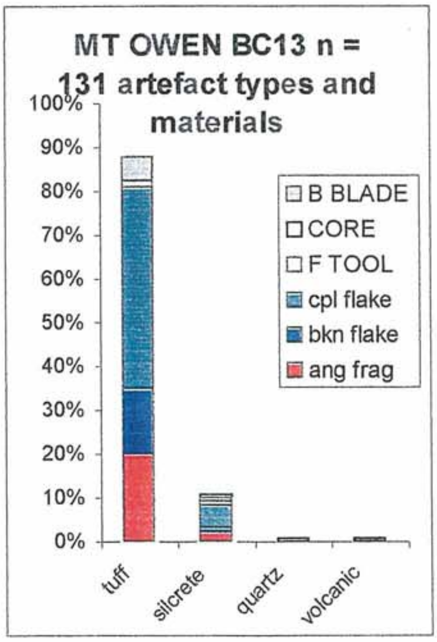


(a)

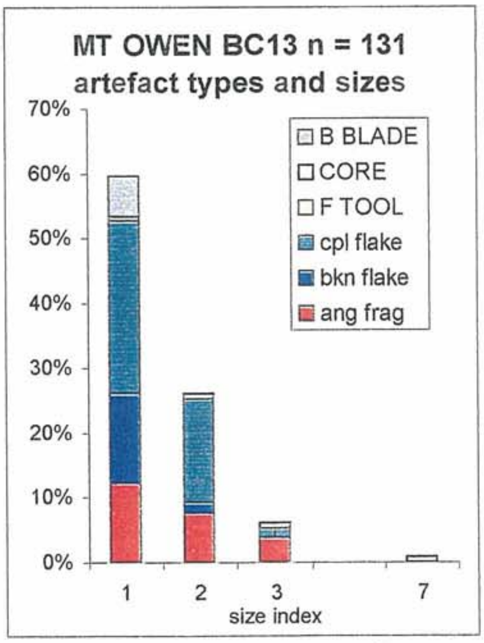


(b)

Fig 6.10. Mt Owen assemblage SC70,71&72. (a) Artefact types and materials. (b) Artefact types and sizes.



(a)



(b)

Fig 6.11. Mt Owen assemblage BC13. (a) artefact types and materials (b) artefact types and sizes.

6.9 Summary of Comparative Analysis

This comparative analysis has considered sites surrounding the Ashton Study area, from near the Hunter River to the hills flanking the mountains to the north in a roughly 10 by 15 km area. The assemblages selected for analysis were intended to reflect a variety of landscape contexts, using those with the largest number of artefacts. The comparability of the artefact types is questionable among these assemblages, but is probably sufficient to indicate trends. Most of the assemblages appear to be dominated by the microblade technology, although there are a few examples where this appears to be largely absent. Note that even a small microblade workshop generates a large amount of debitage, that can be expected to swamp the components from other technologies. The assemblages are almost always dominated by tuff and silcrete, usually one or the other. These materials have similar flaking properties and perform well for microblade reduction.

There is however considerable assemblage variability within this pattern. Different assemblage types can be discerned depending on the completeness of the debitage and the percentages of implements. The materials used are mainly silcrete and tuff. These have about the same flaking properties and perform well for the technologically demanding process of microblade core reduction. There are however assemblages that include a wider range of material types. Where size has been recorded, the distribution is strongly skewed towards the small end, although the steepness of the curve and the size range vary. Note that the examples available were from sites to the north of the comparative study area, and these may not be adequately representative for those closer to the Hunter River.

The purpose here has been to indicate the assemblage variability surrounding the Ashton study area, and to explore the prospects for identifying assemblage types from various landscapes. There is scope for further work on this topic, although this is greatly limited by the quality and comparability of the data available, and the differences in assemblages recorded from the surface or from excavations. A productive research program should be possible to examine these data using statistical tests to define assemblage types on a pattern of continuous variability.

7. Landscape Context

7.1 Geomorphology

The geomorphology of the area consists of down-cutting alluvial stream bottoms and degrading colluvial ridge systems. The stream bottoms have been examined in detail, and Mitchell (2002) has identified three terraces and a flood plain for Bowmans and Glennies Creeks. The upper terrace was suggested to be Late Pleistocene in age.

7.2 Landscape Classification

A landscape classification for hunter-gatherer land use and settlement patterns needs to consider some of the biologically determined limitations of human beings. As a large omnivorous mammal of tropical origins, there are a number of factors which determine some aspects of life, such as constraints due to size or physiology. Examples are:

- Water requirement. Human beings need to consume at least four litres of water per day, mainly to remove metabolic wastes. This requirement gives rise to the "camp sites are near water" principal. On a least-cost logistical principal, camp sites can be expected to be as close to a water source as possible. The actual proximity (distance), as well as the amount of camp activity (site size) and related behaviour (site contents) depends upon the cultural land use strategy as well as the type of water source.

- People live on flat ground. Flat ground is needed sit and socialise or conduct crafts activities, or to lie down and sleep. The amount of flat ground needed and the grade of the slope depend upon the type of cultural activities and the scale and size of humans themselves.

- People on foot have a limited foraging radius. Energetics and the scale dictated by the physical size of humans provide constraints on the feasible size of the area needed for food getting. This is affected further by the mobility, size, and food value of the food resources, combined with the cultural land use strategy and technology for acquiring the resources.

Within these parameters, various cultural strategies affect how behaviour can be expressed. For example, activities may be focussed in different places depending on the type of land use strategy. Because of this cultural factor human beings do not map on the landscape as do other animals. Archaeological settlement patterns need to be assessed in terms of the cultural strategies which were in operation. Site contents (as stone artefact assemblages) are affected by the "rocks are heavy" principal, and the way in which logistical strategies to transport stone materials for tools is integrated into the pattern of land use and settlement. In addition, there are less material factors that affect how archaeological sites are distributed over the landscape. For example there are social imperatives, such as ceremonies, which result in particular places having a more concentrated occupation.

Various approaches have been advocated for landscape classifications. Previously much attention has been given to creek lines. This "sites are near water" demonstrates that people need to drink water. The "archaeological terrain unit" approach was developed by Kuskie (2000) and is oriented towards quantifying slope on landscapes. His analysis demonstrates that artefact numbers vary according to slope, indicating that people mostly life on flat ground. The catena system (McDonald and Davidson) is a geomorphic approach which provides a systematic classification of landscapes according to topography, sediment movement, and soil formation processes, and is somewhat similar to a regolith-terrain method. These classifications are probably the most revealing on a regional basis. Their utility seems undemonstrated for the normal development impact study which is at a relatively small scale. Considering the size of a hunting and gathering foraging radius (e.g. about 7 km), most impact surveys are concerned with only part of a land use area.

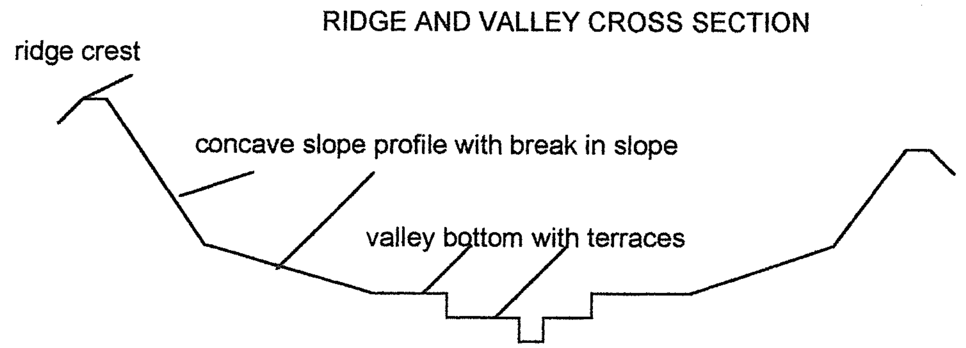


Fig. 7.1. Diagram illustrating a concave valley profile

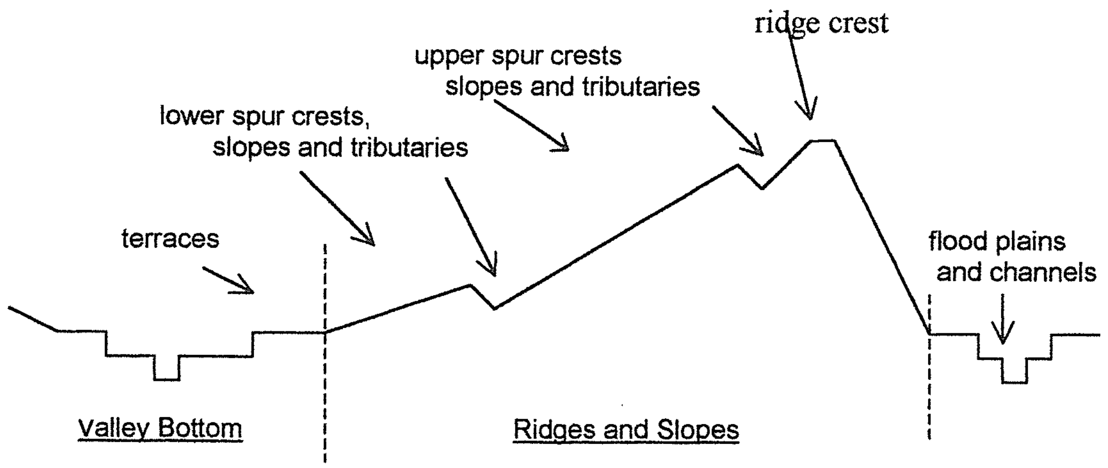


Fig. 7.2. Diagram showing the main landscape elements in the study area.

The landscape classification used here takes into account the location of water sources, flat ground, and the heterogeneity and potential productivity of the environment. The objective however is to be able to identify land units in the field which have associated archaeological evidence. For this purpose a broad assessment is made of the landscape pattern to be found in the Ashton study area, and divide it into workable units.

The Ashton landscape is in an area of stream valleys and ridges within the Central Lowlands of the Hunter Valley. The ridges in this area typically have a concave

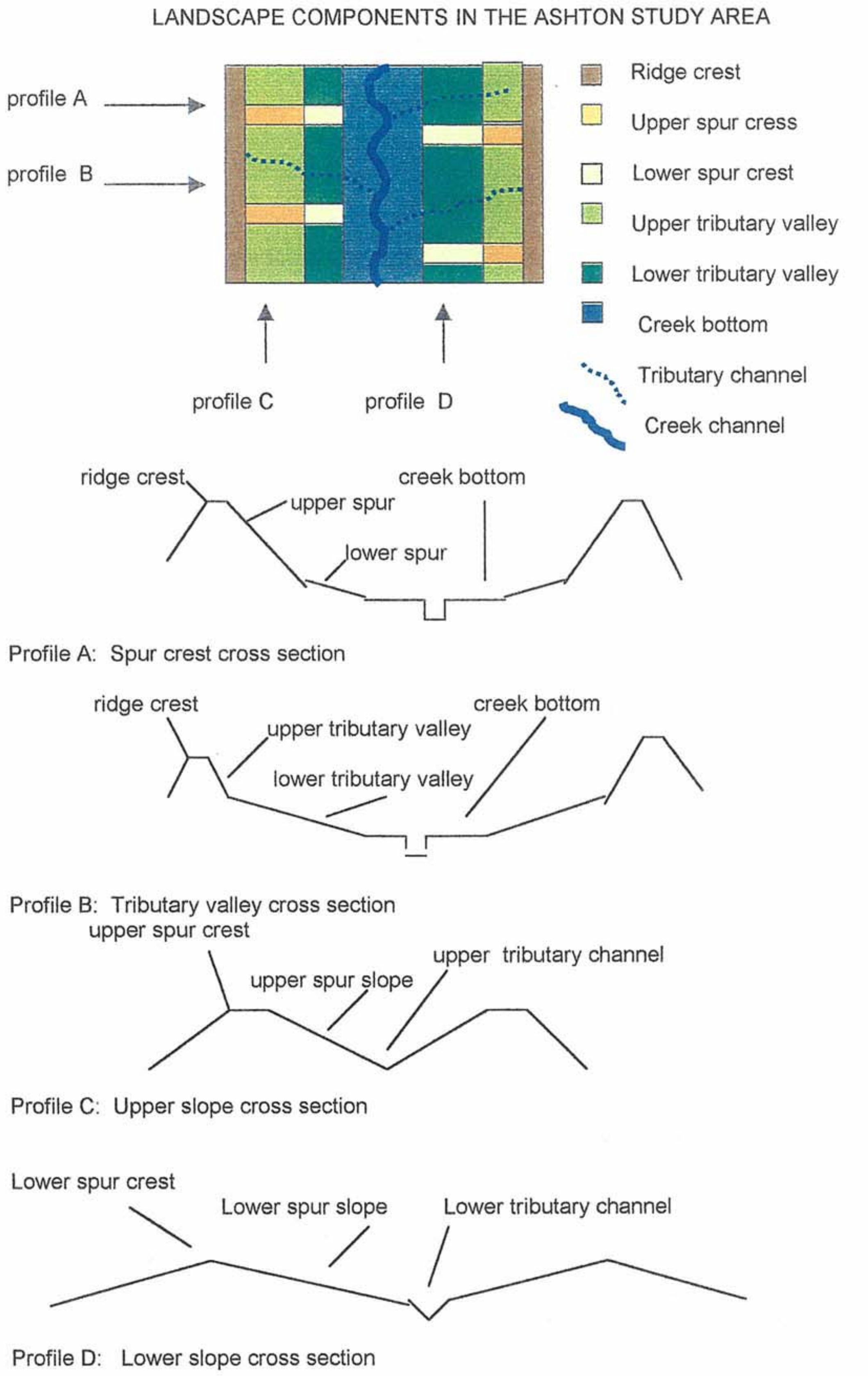


Fig. 7.3. Diagram showing the conceptual basis for the landscape classification.

profile, and the stream valleys are flat with stepped terraces. The basic cross section is shown in Fig 7.1.

The landscape classification needs to take into consideration the following principals:

- Distinguish between the valley bottoms and the ridges.
- Identify any break in slope which will distinguish steep upper slopes from gentle lower slopes.
- Identify the crests of ridges and spurs which are usually relatively flat.
- Identify the pattern of tributaries which may have flattened channel margins.

The main elements are diagrammed in Fig. 7.2. and shown in more detail in Fig 7.3. This classification was applied using a 1:25,000 map with 10 metre contour intervals, and a 1:8000 colour air photo. This information was only partly helpful for the purposed of defining the boundary between the valley bottom and the sloping land of the ridge system. Nor did it consistently indicate the location of the break in slope of the ridge system. The interpretation of these details therefore includes field observations.

The rules used for map interpretation was according to the components illustrated in the Fig. 7.3 diagram and slope cross sections. The landscape map for the study area in section 10 was based on these principles.

7. 3 Geographical Divisions

The Ashton study area belongs to a part of the Central Lowlands of the Hunter Valley which consists of the Hunter River bottom and terraces as well as a series of stream valleys and ridges to the north. The system of valleys can be diagrammed in Fig 7.4.

These geographical divisions will be used to categorise the landscape types and the archaeology resulting from the survey.

The geographical divisions are basic in the analysis used in this report and are shown diagrammatically in Fig. 7.5 (see also Map 12.1). The geographical divisions are described below:

1. Betty Creek Valley. Bettys Creek Valley in the study area consists of only the northern slopes to the railway line. Below that is the creek bottom which is outside of the study area.
2. Bowmans Creek Valley. This consists of the western slopes and valley bottom of the lower section of Bowmans Creek, downstream with its Bettys Creek junction.
3. Glennies Creek Valley. Glennies Creek valley is represented by a narrow strip of the eastern slope and creek bottom between the Hunter river and Camberwell village.
4. Hunter River Valley. This is the southern slopes and terraces of the Hunter River.
5. Ashton this is the ridge which separates Glennies Creek from Bowmans and Bettys Creek. Most of this ridge is the study area.

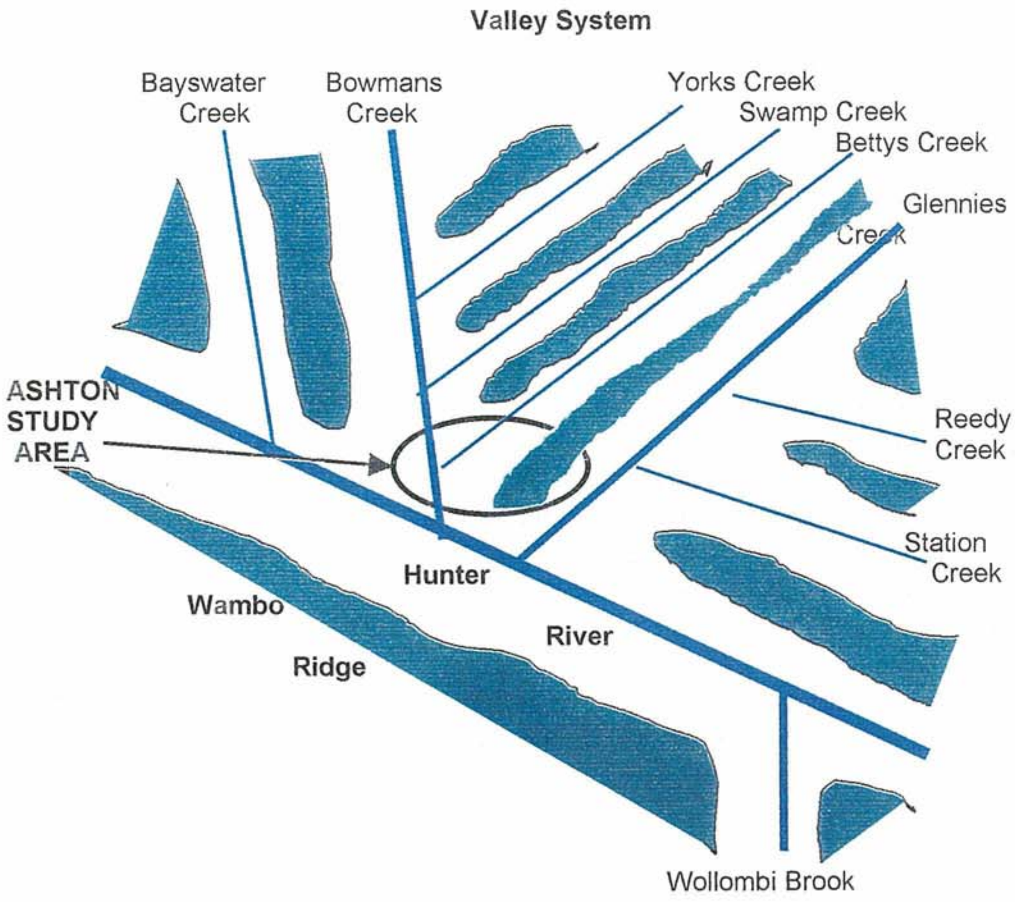


Fig. 7.4. Diagram showing the location of the Aston study area within the pattern of valley systems in the Hunter Valley Central Lowlands

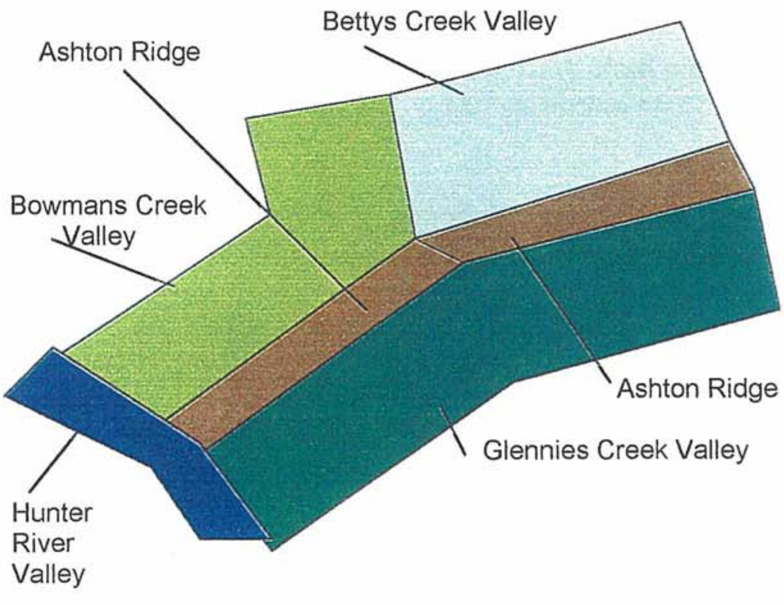


Fig. 7.5. Geographical divisions used for analysis in the Ashton study area.

7.4 European Land Use Effects

Since the 1820's there has been a history of post-European impact on the landscape in a variety of ways. The initial clearing and grazing resulted in an erosional cycle on the sloping land. Sediments were washed down on the valley bottoms where they formed a layer of PE (Post-European) laminated sands and clays on the terrace flats. Dense pasture grasses from land clearing are another major obstruction for a artefact detection. The exposure of archaeological evidence in this area requires the removal of vegetation and on the valley bottoms, the P-E deposit as well.

Continued farming resulted in the cultivation of the terraces and some of the gentle hill slopes in the valleys as well. If visited after cultivation or harvest, ploughed paddocks can permit the detection of artefacts. The spatial integrity of these sites is lost, they remain an important and potentially informative assemblage of artefacts. The addition of PE sediments however reduces the likely hood of finding Aboriginal artefacts.

Much of the area is in the process of regenerating woody plants, particularly casuarina. The result is dense litter instead of grasses. Although the regeneration helps to stabilise the ground, the loss of grasses means that erosion continues.

Because of the weathering of the Permian conglomerate rocks there are substantial gravel deposits over the area. Many of the ridge and spur crests have deposits where gravel has been commercially extracted. Usually these gravel pits are shallow scraped areas where there has been sufficient disturbance to eliminate any archaeological evidence.

Other impacts include the construction of the New England Highway through the area. This includes both an old and a new route, the latter with a deep road cut. A railway runs along the northern boundary in the Bettys and Bowmans Creek valleys. There also is an old coal mine area in the Bettys Creek valley near the railway.

The 1950's floods had a massive impact on the creek valleys and there was considerable engineering and disturbance subsequently on the Bowmans Creek bottom. This is described in further detail by Mitchell (2002).

8. Study Plan and Data Recording Procedures

8.1 Issues

Many of the issues have been discussed in the Objectives Section, and the Previous Work Section. It has been noted by the National Parks that to assess the Aboriginal archaeology of the Ashton area it is necessary to be able to associate artefact assemblage variability with landscape variability. There appear to be no successful examples of other impact reports for the Hunter Valley to follow which show how artefact assemblage types (shown visually as graphs) pattern according to landscape features.

This report needs to be able to divide the study area into landscape types and their geographical divisions. It then needs to assess coverage bias for these areas. The artefactual data recorded by the survey then needs to be identified as assemblages belonging to these areas and an analysis is needed to show the assemblage variability.

The analysis required should have the maximum potential comparability to other studies, as well as being able to examine the assemblages in greater detail. The result therefore needs to be assemblages presented as graphs which have particular landscape associations. The data recorded should satisfy these requirements and is provided in Appendix 2 and 3.

8.2 Survey Sample Strategy

The sample strategy was to document exposure types according to their landscape feature, and to record as many exposures as possible. An effort is required for this to represent the various landscape types in as balanced way as is feasible. Analysis would show how much exposure was available and what the bias was against the various landscape types.

The procedure of assigning over-all effective coverage values to individual land units was not attempted, these percentages would be almost immeasurably low (under 10%) in most cases. Considerable walking would be required, and the artefacts detected would be few, and the analytical results dubious. Instead the focus was on patches of exposure having greater than 10% effective visibility. This made the potential for larger numbers of artefacts to be recorded in close association, and improved their analytical value.

The coverage strategy was to use the 1:8,000 colour areal photography to locate all possible patches of exposure. These were then visited in the field. Walking between exposed areas also might assist in the recognition of additional exposure not evident on the areal photos.

8.3 Coverage Data

The coverage data was recorded in the following format (see Appendix 2)

survey unit	land form	dimensions	criteria	exposure %	visibility %

This included the survey unit, and the easting and northing (read from a GPS receiver). The land form term was according to the landscape classification outlined above. The length and width of the survey unit was paced and recorded as "L" and "W". The exposure criteria and type as well as the visibility are described as ground surface data below. The presence or absence of archaeological finds in an exposure was shown by an "X" or an "EWA" as defined below.

8.3.1 Survey Units

The survey units are specific locations recorded in during coverage. All exposures of about 10% visibility or more which were encountered were recorded. The types of survey units were as follows:

- X = exposure without artefacts. If no artefacts were present, the exposure was recorded with an "X" exposure number.
- EWA = exposures with artefacts. If artefacts were found, the exposure was recorded with an "EWA", number.
- SS = sandstone exposed. If a sandstone outcrop or exposure was found, and had no evidence of grinding grooves or engraved art, it was given a "SS" number.
- GG = sandstone outcrop with grinding grooves. A sandstone outcrop with grinding grooves was given a "GG" number.

8.3.2 Ground Surface Data

The ground surface data was recorded according to the following:

- Exposure criteria. The exposure criteria consisted of the means by which the exposure was identified. Examples of exposures are as follows: vehicle track, bare patch, rill bank, etc.
- Exposure type. The exposure type is the type of surface which has been exposed these include the following which are ranked on a high-medium-low scale of reliability:
    - A-lag. Exposure of the A soil horizon, low reliability
    - B-lag. Exposure in which erosion has lagged all of the soil contents on the B horizon, high reliability
    - A&B-lag Combined A and B soil horizon exposure, moderate reliability.
    - Gravel lag. Erosion down to the weathered conglomerate gravel. Medium reliability because of the visual distraction from the gravel.
    - Alluvial. Erosion into alluvial clays and loams, sometimes post-European alluvium. Variable reliability.
    - Bank talus. A lag from the soil horizon spilling down a bank and accumulating at the base. Medium reliability.
- Visibility %. The visibility was the estimated ground surface permitting artefact detection within the length by width area of the exposure. This is an effective visibility estimate expressed as a percentage.

8.4 Artefact Data

The stone artefact data for each survey unit included the material, type, dimensions and attributes. The data is contained in Appendix 3 in the following format:

survey unit	material	cortex	type	Max L	Max W	Max T	attributes

8.4.1 Stone Artefact Material Data

The stone artefact materials are defined further in the glossary. The material identified as tuff has frequently been recorded as "indurated mudstone". The material listed as hornfels is of uncertain identification. The quartz, quartzite and black chert belong to the Permian conglomerate bed rock in the study area, and other materials (e.g tuff, silcrete and acid volcanic) are from local stream gravel deposits, except perhaps for basalt, porcelanite and other cherts. The data recorded for materials was as follows:

- Material type: tuff, silcrete, quartz, quartzite, basalt, acid volcanic, porcelanite, black chert, other chert, ?hornfels
- Cortex: present, absent (Y or N),

Note that cortex present on an artefact was recorded, regardless of the location or the percentage of cortex present.

8.4.2 Artefact Measurements

The artefacts were all measured according to maximum length, width and thickness. The maximum dimension was measured as length. The width was the greatest measurement at right angles to the length. The thickness was the greatest measurement perpendicular to the length-width plane.

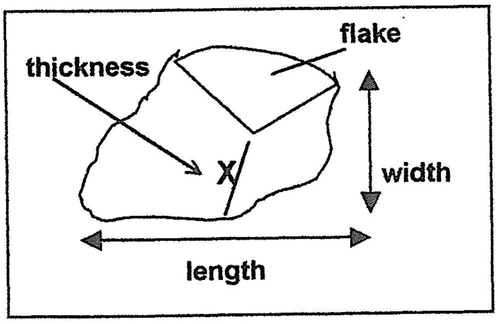


Fig. 8.1 Stone artefact measurements using an expanded flake for an example.

8.4.3 Debitage Data

The debitage types are according to the completeness or part of the flake found. The types are described in detail in the glossary and summarised below:

- Complete flake. A whole flake which is sufficiently complete to allow measurements.
- Split cone fragment. A longitudinal fracture made at the moment the flake was detached. In some cases only the proximal or distal end is present, and is noted under "comments".
- Proximal fragment. This is the platform end of a flake. No distinction is made between a step-terminated flake (technically a complete flake), a snap at the moment of removal, or a later breakage.
- Distal fragment. This is the terminal end of a flake broken as a snap at the moment of removal, or a later breakage.
- Flake fragment. This is a piece of a flake which has neither the platform or the termination. It is recognisable as a flake by either dorsal flake scars or ventral surface features.
- Angular fragment. This is a fragment of stone, which in its context, or by fracture surface features may be determined to have been part of a stone flaking process.

The debitage attributes were recorded in the following format:

flake shape	platform type	platform modification	termination

The attributes are described in the glossary (Appendix 1), and are listed below:

- Flake shape: blade, indeterminate, expanded, unidentified.
- Platform type: cortex on platform, unifacial platform, bifacial platform, Crushed platform.
- Platform modification: unmodified, modified, faceted, use-wear platform.
- Termination: feather, hinge, plunge.

8.4.4. Implement Data

The term "implement" is used here to include both tools and cores. The term "flake body" refers to a flake which has been modified as an implement. A nuclear body is a naturally weathered block or cobble which has been flaked. The implement types recorded on the survey follow Witter 1992, and are as follows:

- Flake tool. A flake used as a tool, indicated by usewear or retouch.
- Elouera. A formal type of flake tool presumed to have been hafted. The flake is relatively thick and not made on a microblade core. One side is shaped by backing on an anvil, and the edge shows wear or retouch.
- Spall tool. A flat thin nuclear body, usually broken by natural thermal processes and not a flake, which is retouched in the manner of a flake tool.
- Nuclear tool. A tool made on a nuclear body, usually indicated by an edge showing expanded flake scars.

- Producer Core. A nuclear or flake body used to produce maximum sized flakes as a stage of flake tool manufacture. Usually indicated by plunge flake scars.
- Bipolar Core. A type of producer core in which a split on an anvil has been attempted. Indicated by crushing or battering on the ends.
- Microblade Core. A nuclear or flake body used to produce bladelets in the process of backed blade manufacture. Often indicated by blade scars.
- Backed blade. A flake (not necessarily over twice as long as wide) made on a microblade core which has been backed.
- Hammerstone. A cobble showing hammerstone facets.
- Mortar. A lower grinding stone showing a circular grinding facet.
- Milling Slab. A thin piece of sandstone showing a ground surface as the bottom of a grinding stone.
- Axe Preform. A piece of stone shaped in preparation for producing a ground edge.

The implement attributes were recorded as follows:

breakage	attributes	notes

The attributes recorded varied, with some formal type names (elouera, bondi, etc) being used instead of descriptive details. The implement data, including types and attributes are listed below:

- Breakage: whole, broken.
- Attributes according to type.
    - Flake tool: use-wear edge, scalar retouch edge, step retouch edge, cuspate retouch edge, projection ("drill"), microconvex ("thumbnail scraper"), burren, elouera, burin.
    - Nuclear tool: unifacial, bifacial, multifacial.
    - Producer core: uniplatform, biplatform, multiplatform, bipolar.
    - Microblade core: trial, prismatic burin blade, bifacial.
    - Backed blade: bondi, geometric, backed piece.
    - Abraded types (hammerstone, axe preform, mortar, mill slab) number and type of wear facets.
- Notes: In some cases additional notes were provided concerning tool usage, manufacturing technique, or combined functions.

8.4.5 Artefact comments

Additional comments were sometimes included. These included descriptive notes such as when the material seemed to be "burnt", or had a fresh break. It also noted special details, such as transverse flake scars on the dorsal flake surface, or a crested dorsal ridge, or the distal end of a plunge termination had remnants of a platform.

8.5 Grinding Grooves

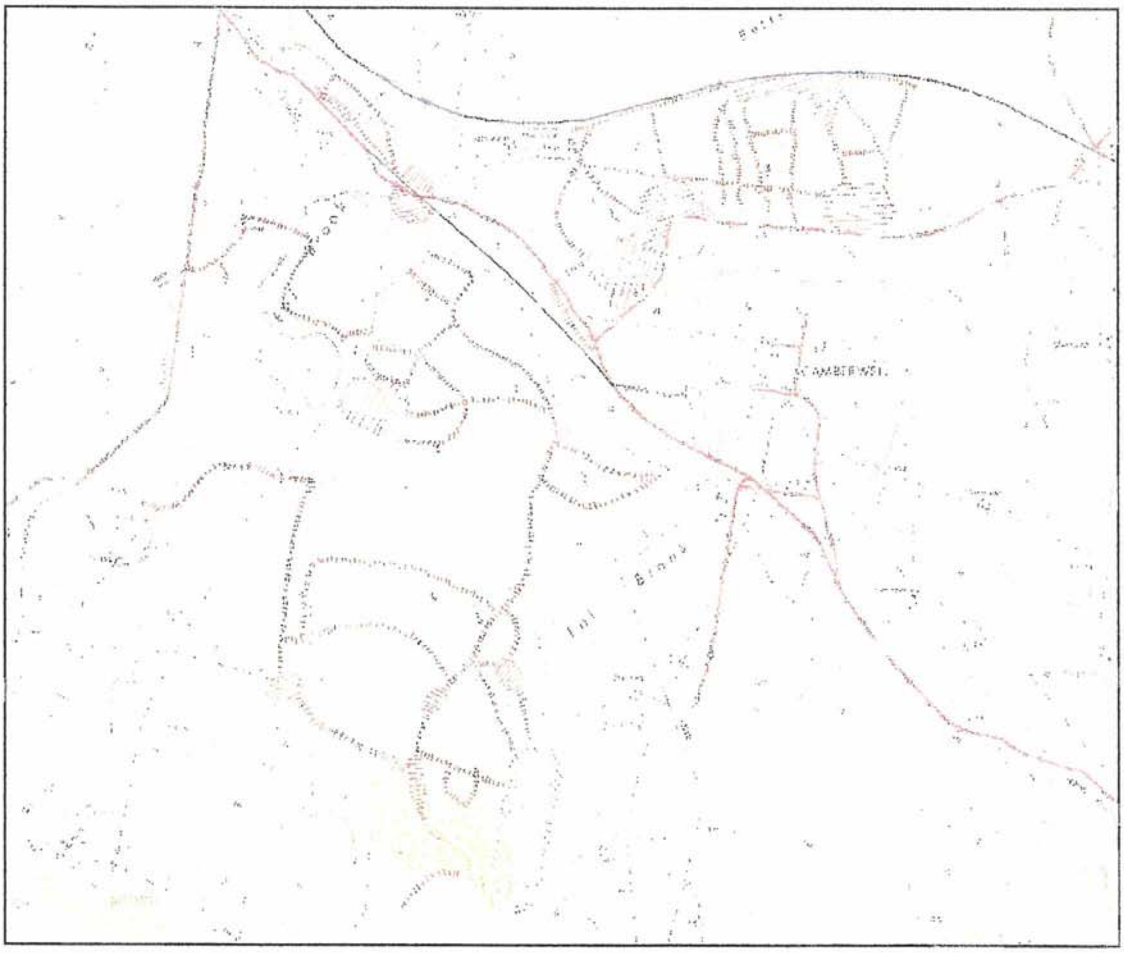
Grinding grooves were recording according to number present and the length of each. Where possible their depth was measured. The dimensions for the area each set of grooves occupied was measured as well.

9. Field Methods

9.1 Field Operation

The field area was visited on 25 March 2002 and Aboriginal consultation in the region was started. Systematic field work by Dan and Alison Witter began on 3 April and finished on 18 April, with 11 days field recording. An additional day was spent on 22 May recording additional features which had been located by members of the Aboriginal community.

It was originally expected that since the area had already been covered that little time would be required to record further detail on the 207 artefacts recorded by Hardy (2002) and the estimated additional 200 artefacts from "Ash 4". Time also was allowed to check exposures shown by the map in areas not previously covered on foot, and possibly increase the number of 24 exposures with artefacts (about half of which had under 5 artefacts) which were recorded as sites.

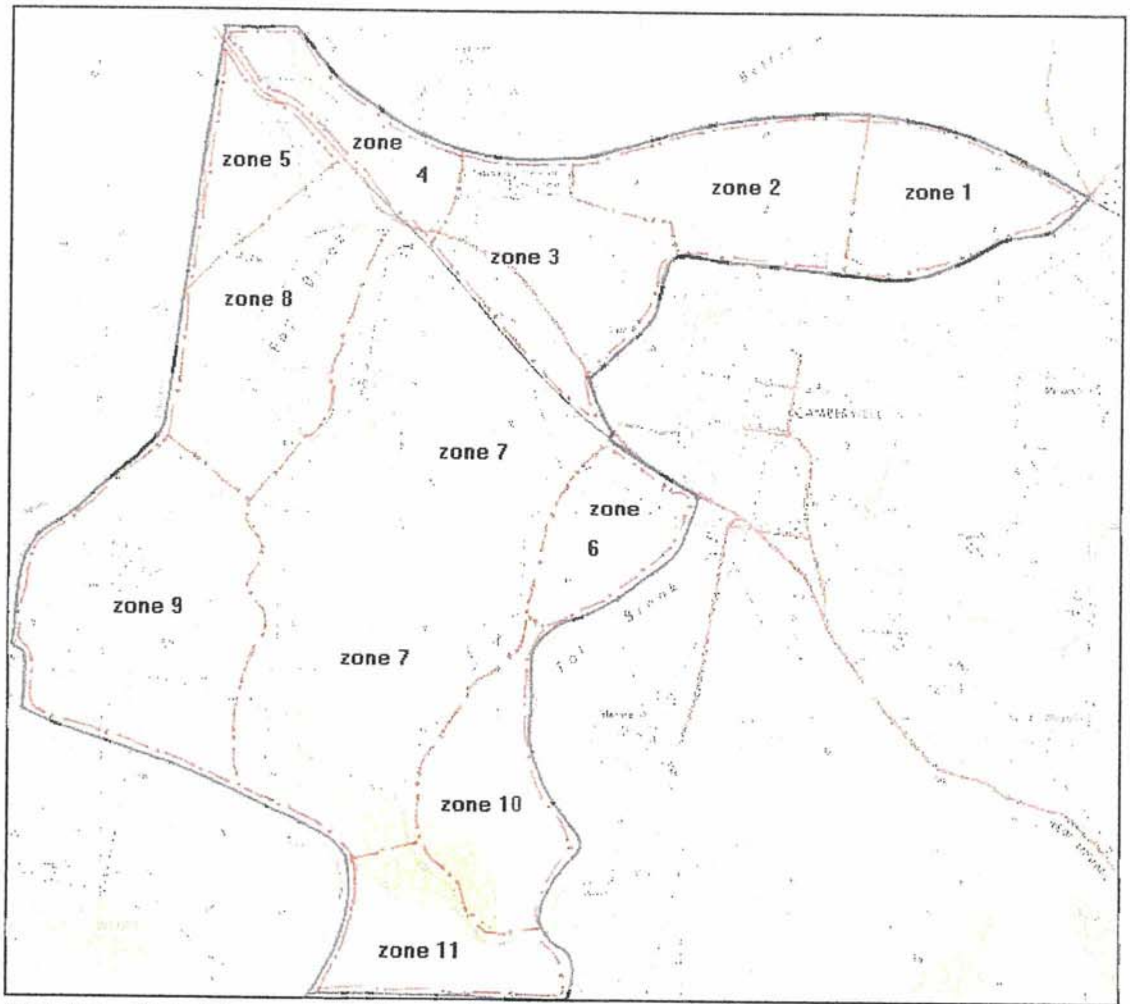


Map 9.1. Foot coverage of the study area. Hashed areas indicate main coverage by foot to examine exposures as indicated by areal photography.

As field work progressed it was found that the artefacts in the study area were relatively abundant and over 1300 were recorded. In addition it was discovered that exposures were common and nearly 200 were recorded. Over half of these had artefacts. By the conclusion of the survey it was felt that most of the worth-while exposures in locations likely to be impacted had been visited. The areas covered by foot are shown in Map 9.1

9.2 Coverage Zones

The survey work was carried out in areas which where impacts seemed likely from the project layout plan and from consultation with White Mining management. The effects of previous land use, types of ground cover, and proposed impacts are shown as coverage zones in Map 9.2.



Map 9.2. Coverage zones in the study area.

Zone 1. This is the north east end of the study area and is predominantly open pasture on the Ashton ridge crest, with wooded patches of regeneration on the slopes. There are two large gravel pits with heavy disturbance. Vehicle tracks formed transects over the ridge crest and slopes. The extreme northeastern tip not visited because of no apparent exposure. This area is in the proposed Eastern Dump Emplacement.

Zone 2. This is on the upper and lower slopes of Ashton Ridge in the Bettys Creek valley. There is dense regenerated casuarinas with heavy litter on the ground surface, and heavy grass cover in some of the lower tributaries.

Exposures occur as bare patches of A horizon in the wooded areas and occasional gully or rill banks. The vehicle track along a firebreak along a fence line was used as a transect. This was the main area of foot coverage by previous survey. It includes part of the Eastern Emplacement and part of the proposed open cut mine.

Zone 3. This is a continuation of the Ashton Ridge slopes and the Bettys Creek valley slopes, with less regeneration, and more grass cover. It includes the homestead now being used as the White Mining Office, and is cut through by the former route of the New England Highway. There is patchy exposure over much of the sloping ground. This area includes the remainder of the open cut mine and the proposed infrastructure and coal handling facilities.

Zone 4. This is the Bettys and Bowmans Creek bottom north of the New England Highway. It is a zone of very tall dense grass, with very little exposure. The creek banks indicate that much of the surface is covered by Post-European alluvium, and that ground exposures would be unlikely to be productive. There has been a previous small coal mine near the railway. There also has been extensive modification of the creek bottom after the 1950's flooding (Mitchell 2002). The exposure by a rill bank near the bridge provided the only useful exposure. The area to the northwest on Bowmans Creek, between the railway and the New England was little visited. This was because it was not within the proposed impact area, was covered with heavy grass, no exposure was indicated by the areal photograph, and much of creek bottom seems to have been modified after the 1950's floods. It was however tested for possible early buried surfaces (Mitchell 2002).

Zone 5. The area east of Brunkers Road not visited as it was a new landscape already impacted by overburden dumps and settling ponds from the neighbouring mine.

Zone 6. Ashton Ridge upper slopes and Glennies creek lower slopes south of the New England Highway. This was a cleared area which and now in pasture grasses. Exposure was in the form of vehicle tracks and rills. This area is outside the proposed direct mine impact, although a power line is proposed to pass through it

Zone 7. Ashton ridge crest and western slopes, as well as the western slopes of Bowmans Creek valley south of the New England Highway. Again, a cleared area in pasture grasses. Exposures are in gravel pits, vehicle tracks, rill and gully banks, bare patches, and the large exposure at the Waterhole site. This area further includes the Western Emplacement, settling ponds and haul road subsidence area for most of the underground mine. Although driven over by the previous survey, there had been little foot coverage. This is the subsistence area, and contains the Western Emplacement, settling ponds and a haul road.

Zone 8. This is the upper part of the Bowmans Creek valley bottom below the New England Highway bridge and west of Bowmans Creek. It was covered in dense grasses and the vehicle tracks were almost grown over this area, and most of the area had been cultivated. It was little surveyed because of the heavy ground cover and likely Post-European alluvium on the lower surfaces. There had been little foot coverage by the previous survey. It was however an area of potential buried early deposits and was tested by the geomorphic study (Mitchell 2002) with no indications of buried surfaces. It will be affected by subsidence from the proposed underground, and the Bowmans Creek diversion channel would pass through it.

Zone 9. This is the lower part of the Bowmans Creek valley. Most of this area had been cultivated and was heavily covered by grasses. Much of it was outside of the potential subsidence area, and it was not visited on foot.

Zone 10. This is the Ashton Ridge slopes and Glennies Creek valley slopes below the bluff on Glennies Creek south of Zone 7. The sloping ground was covered by regenerating casurina, and the creek bottom was heavily grassed. Exposure was in the form of a track down from the ridge crest, rill banks and bare patches in the trees. The terraces on Glennies Creek Bottom had the potential for buried surfaces. This was tested (Mitchell 2002) and a buried soil with an artefact was found.

Zone 11. This is the southern end of the study area, past the stock grid on the Ashton Ridge crest. Relatively little of this area would be affected by subsidence from underground mining, and it was little visited on foot. The area consisted of a steep bluff over looking the Hunter River and extensive terraces with cultivated pastures and limited visibility.

10. Survey Coverage Data

10.1 Coverage and Landscape Map

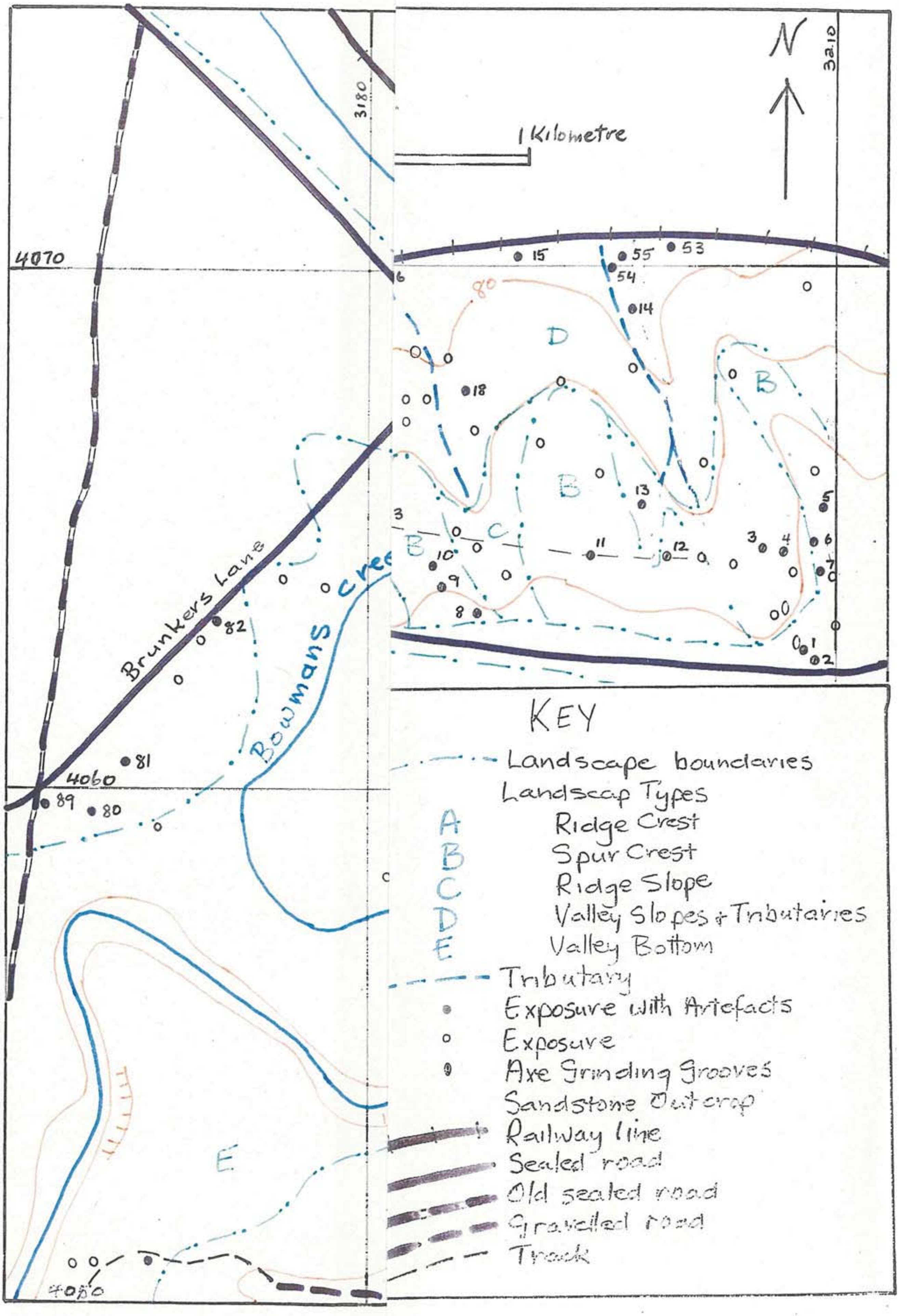
The foot coverage reported here is shown in Map 9.1. As already mentioned the foot survey was designed to identify and record specific exposures which would allow artefact detectibility as well as examine sandstone outcrops. Effective visibility over the entire area was considered to be under 10% (usually 0%) except where an exposure was recorded.

The landscape classification system described earlier for the study area is shown in Map 10.1a. for the northern and 10.1(b) for the southern parts of the survey area. The landscape units are shown are as follows:

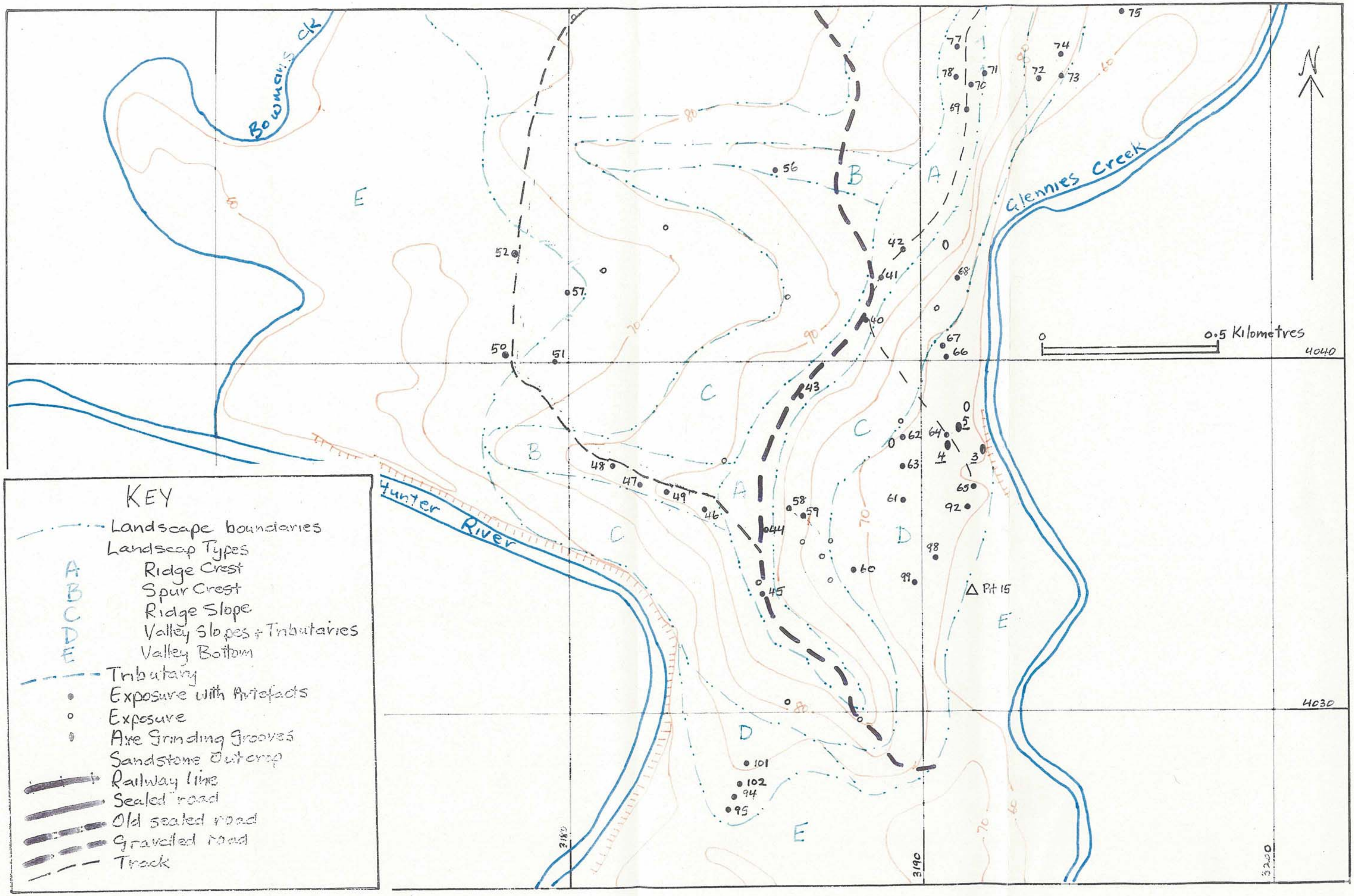
- A = Ridge crest. This is the spine of the crest of Ashton ridge which consists of a crest, parts of which are flattened, and gentle slopes dropping to steeper sides.
- B = Spur crest. These are spurs with relatively flat tops and steep slopes extending down the side of Ashton Ridge
- C = Upper ridge slopes. These are the slopes at the heads of tributaries and which drop down to narrow tributary channels.
- D = Lower slopes and tributary valleys. The valley sides consist of relatively gentle slopes, sometimes as flat toped spurs, which are in between tributaries which have flattened valleys. The boundaries between the slopes and valleys are not distinctly shown by topographic map contours, and have not been drawn separately.
- E = Valley bottoms and terraces. The valley bottoms shown is mainly the part flooded by the 1 in 100 year floods as shown in the map by Peter Mitchell (2002). This does not seem to include the high terraces, but it was difficult to determine from the topographic maps and areal photography available where the boundary between the upper terraces and the sloping land was.

The map shows the following coverage data which is detailed in Appendix 2.

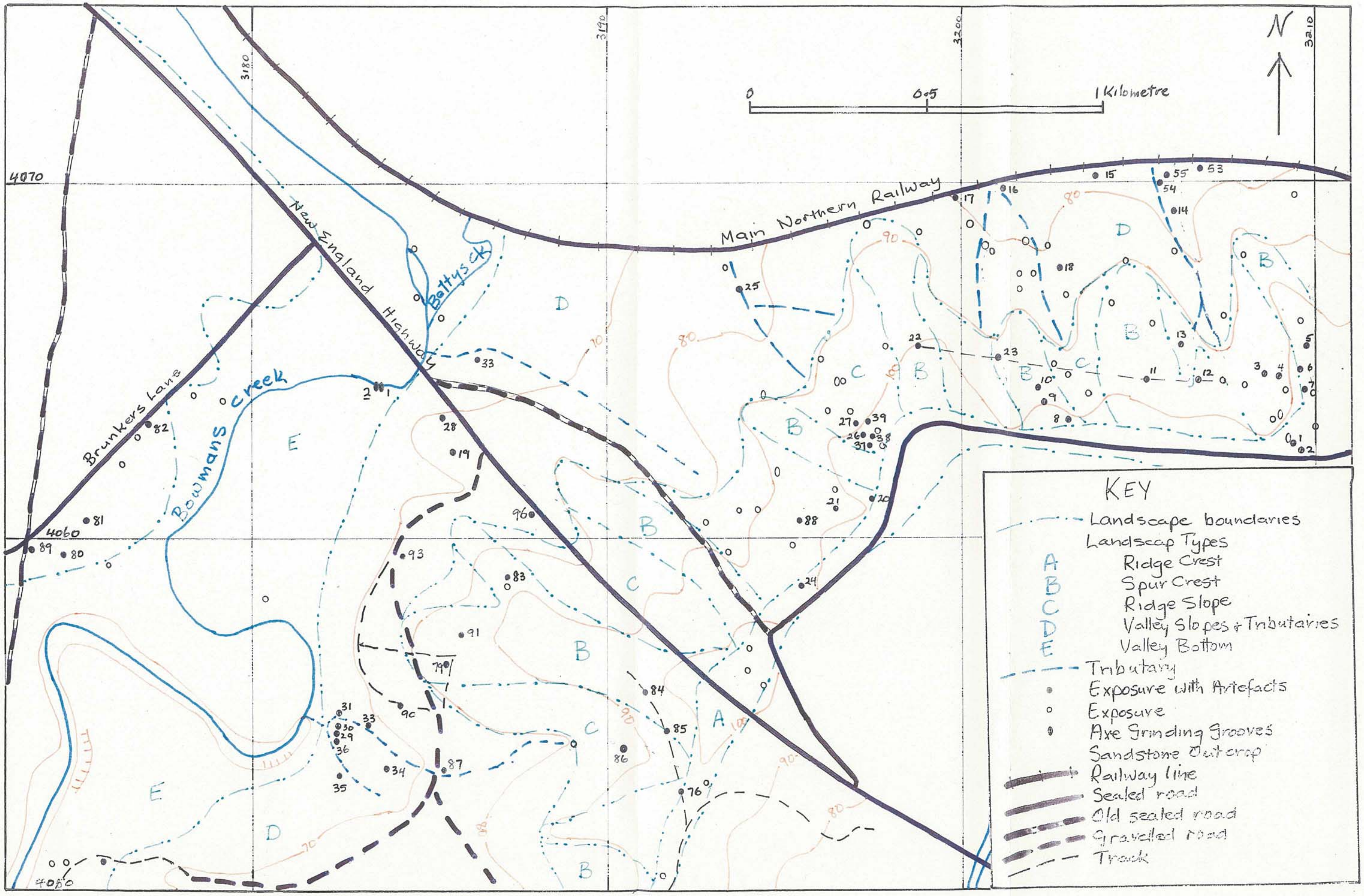
- X units: exposures recorded on which no artefacts were found.
- EWA units: exposures where artefacts were found.
- SS units: sandstone outcrops with no archaeological features
- GG units: sandstone outcrops where grinding grooves were found.
- Pit 15. This is the back hoe pit which produced an artefact from a buried early soil profile (Mitchell 2002).



Map 10.1(a). Landscape types and survey uni



Map 10.1 (b). Landscape types and survey units in the south half of the survey area.



Map 10.1(a). Landscape types and survey units in the north half of the survey area.

10.2 Effective Coverage

The exposure data shown in Appendix 2 was analysed according to landscape type and the surface type of exposure by each of the geographical divisions. The exposure types are shown in Plate 10.1. The surface types were assessed as follows:

- Alluvium. This is the valley bottom alluvium, including Post-European alluvium
- A only. This is bare ground or lag on the A horizon only, usually the bare A2.
- B, gravel (A). This is erosion through the A horizon to provide a lag surface on gravel or the B horizon. Exposure of the A horizon may be present as well.
- Talus. The talus is the creek, gully or rill bank exposures, and may have A and B exposures associated.
- Other. Other types of exposures are occur where there has been disturbance, such as a gravel pit, or a bulldozed cut.

In addition to exposures, the sandstone outcrops and grinding grooves recorded are shown. These were not calculated according to surface area, but their distribution is shown in Fig 10.1.

The analysis distinguished between exposures with artefacts (EWAs) and exposures without artefacts (X units). These were calculated for the total areas by landscape type and surface type.

The total number of artefacts for a landscape type are shown to indicate which landscapes were the most productive.

10.2.1 Bowmans Creek Valley Coverage

Bowmans Creek valley was the largest of the creek valleys with an extensive valley bottom. The effective coverage is shown in Table 10.1. Although numerous exposures were recorded, they were mostly small and on alluvium. However, artefacts appear to be common over this surface, since about half the exposed area consists of EWAs.

Landscape type	EWA survey units	GG	surface	area sq m	Eff sq m	artefacts
Valley bottom and terraces	50, 52, 57, 80, 81, 82, 89, 97	1,3,4	alluvium B, gravel (A)	790 354	148 73	Tot 23
Tributary valley	29, 30, 31, 32, 33, 34, 35, 36, 41, 51,87, 96		A only B, gravel (A) talus	400 902 6625	80 255 699	Tot 183
Valley slope	19, 28, 83, 90, 93		B, gravel (A)	11250	8476	Tot 250

(a)

Landscape type	X survey units	SS	surface	area sq m	eff sq m
Valley bottom and terraces	37, 38, 46, 47, 48, 64, 65, 66, 67, 68, 69, 80		alluvium talus	465 60	149 48
Tributary valley	35, 52, 53, 54, 71		A only talus	20 4100	4 820
Valley slope	51, 83		B, gravel (A)	1500	330

(b)

Table 10.1 Table of coverage data for the Bowmans Creek valley. (a) exposures with artefacts (EWAs) and (b) exposures not having artefacts (X units).

Plate 10.1. Exposures in the study area.
(a) Patchy A and B lag surface in a stand of casurina regrowth at the Glennies Creek Site EWA61.
(b) Bank talus at the High Spur Crest Site EWA46 where a workshop of "burnt" silcrete (flags) is spilling down a bank.
(c) Gravel lag surface showing the texture of lagged gravel on EWA28 of the Waterhole Site.
(d) Alluvial EWA65 at the Glennies Creek Site where there is a Rhyolite workshop exposed.
(e) Vehicle dirt tracks eroded down to a B lag surface were a major form of exposure, as at the Oxbow site EWA36
(f) Sandstone outcrops especially near the water were examined. This is the outcrop at the waterhole at the Waterhole Site which contained grinding grooves GG1, GG# and GG4.

The tributary valleys on the slopes of Bowmans Creek Valley is mainly represented by talus exposures in banks and dirt tracks. The vehicle tracks were usually eroded down to the gravel substrate. Overall however, the visibility is usually poor, and there was much dense tall grass at the time of the survey. Few exposures were recorded for the valley slopes although the total area was relatively large. Where exposures were found, artefacts were usually present. It is difficult to assess the occupation on the valley bottom, but artefacts appeared to be consistently found in the tributary valleys as well as on the valley slopes. No sandstone outcrops were found except on the creek bank, and this produced the Waterhole Site grinding grooves.

10.2.2 Glennies Creek Valley Coverage

Glennies Creek Valley was mostly steep slopes with small water courses that did not form well-developed tributary valleys. The coverage is summarised in Table 10.2. The creek swings in close to the ridge here and the creek bottom area is relatively small. The steep valley slopes were prone to erosion and provided numerous exposures, although with poor visibility. The majority of these exposures produced artefacts, indicating a substantial level of activity. Three sandstone outcrops were recorded at the Glennies Creek Site. One of was on the creek bank with grinding grooves. The two others were on the valley slopes and also had a set of grinding grooves each.

Landscape type	EWA survey units	GG	surface	area sq m	Eff sq m	artefacts
valley bottom	65	2,4,5	alluvium	200	100	Tot 15
tributary valley	75		talus	50	40	Tot 13
valley slopes	60, 61, 62, 63, 64, 66, 67, 72,73, 74,92, 98,99,100, pit 15		A only B, gravel (A) talus	103 12667 255	11 7296 21	Tot 227

(a)

Landscape type	X survey units	SS	surface	Sq m survey units	Sq m effective area
Valley bottom		12		0	0
Tributary valley				0	0
Valley slope	56, 57, 58, 59, 60	9	A only B, gravel (A)	4400 60	83 5

(b)

Table 10.2 Table of coverage data for the Glennies Creek valley. (a) exposures with artefacts (EWAs) and (b) exposures not having artefacts (X units).

10.2.3 Bettys Creek Valley Coverage

Bettys Creek valley was entirely the valley side, and the coverage is summarised in Table 10.3. A large portion of the exposures were bare patches revealing the A horizon only, usually in the wooded regeneration areas and covered by heavy leaf litter. Many of the exposures also had lag surfaces on the B horizon or on gravel, with about the same amount of effective visibility as with the A-lag surfaces. Relatively few of the exposures produced artefacts, particularly in the tributary valleys. Two sandstone outcrops were found on the slopes but showed no archaeological features.

10.2.4 Hunter River Valley Coverage

Since little of this geographic division was likely to be affected by mining, and few exposures were indicated by the areal photography, it was little surveyed (Table 10.4) The vehicle track on the valley slopes produced four exposures with artefacts.

Landscape type	EWA survey units	surface	area sq m	Eff sq m	artefacts
Tributary valley	14, 16, 25, 54, 55	A only B, gravel (A)	903 950	91 80	Tot 50
Valley slope	15, 17, 18, 53	A only B, gravel (A) other	400 625 160	200 250 32	Tot 45

(a)

Landscape type	X survey units	surface	SS	area sq m	eff sq m
Tributary valley	11, 12, 13, 14, 15, 16, 17, 18, 21, 23, 24, 25, 26, 28, 29, 30, 42,49,	A only B, gravel (A) other		3575 6830 100	2020 2084 20
Valley slope	3, 27, 50, 72	A only B, gravel (A)	5, 6	40 2100	20 1020

(b)

Table 10.3. Table of coverage data for the Bettys Creek valley. (a) exposures with artefacts (EWAs) and (b) exposures not having artefacts (X units).

Landscape type	EWA survey units	surface	area sq m	Eff sq m	artefacts
valley bottom			0	0	
tributary valley			0	0	
valley slopes	94, 95, 101, 102	B, gravel (A)	114	61	110

(a)

Landscape type	X survey units	SS	surface	sq m area	eff area
valley bottom				0	0
tributary valley				0	0
Valley slope				0	0

(b)

Table 10.4. Table of coverage data for the Hunter River valley. (a) exposures with artefacts (EWAs) and (b) exposures not having artefacts (X units).

10.2.5 Ashton Ridge

The dominant physiographic feature in the study area is the Ashton ridge. The coverage is summarised in Table 10.5. Numerous small tributaries head up on its slopes, and prominent spurs run down the sides. The ridge crest was mostly exposed as a lag on the B horizon or gravel as vehicle track. About three quarters of these exposures produced artefacts, indicating small concentrations and a high numerous isolated finds as part of the relatively dense back ground scatter over this landscape type. There was considerably more B-lag exposure on the spur crests, although many of these were heavily disturbed by gravel pits. Artefacts appeared for about half of the effective exposure indicting a complex pattern of activity over this landscape. The ridge slopes had considerable exposure associated with tributary erosion, much of it being B-lag, and some also as rill talus. Again, about half of this exposed area had artefacts, suggesting a similar intensity of occupation to the spur crests.

10.3 Coverage Summary and Biases

The data above indicate that artefacts occur with regularity over most of the study area, including the ridge. The valley bottoms were the most poorly assessed, and the Hunter River valley was little visited. The summary of these results is shown in Table 10.6 in which "area sqm" is the square meters of all of the exposures recorded and "effective sqm" is the area of effective visibility. The survey units include both EWAs and X units. The exposure areas are further shown by percentages in Fig. 10.1

Landscape type	EWA survey units	GG	surface	area sq m	Eff sq m	artefacts
Ridge Crest	1,2, 24, 40,41,42, 43, 44, 45, 69, 70, 76, 77, 78		A only B, gravel (A)	30 3270	17 999	Tot 57
Spur crest	5, 6, 7, 8, 9, 10, 11, 12, 22, 46, 47, 48, 49, 56, 79, 83, 84, 85, 91		A only B, gravel (A) talus other	>1 4486 300 130	>1 1766 150 70	Tot 166
Ridge slope	3,4, 13, 20, 21, 23, 26, 27, 37, 38, 39, 58, 59, 68,71, 86, 88		A only B, gravel (A) talus	1600 4455 2850	800 2280 570	Tot 39

(b)

Landscape type	X survey units	SS	surface	area sq m	eff sq m
Ridge Crest	43, 44, 61, 62, 63, 77, 78, 79, 81	1, 4, 10	A only B, gravel (A)	160 586	40 255
Spur crest	4, 5, 6, 7, 10, 22, 39, 40, 41, 45, 70	7	A only B, gravel (A)	3000 2020	1015 1006
Ridge slope	1, 2, 8, 9, 19, 20, 31, 32, 33, 34, 36, 43, 55, 73, 74, 75, 76, 82	2, 3, 9	A only B, gravel (A) Talus	12250 1630 100	2460 413 20

(a)

Table 10.5. Table of coverage data for the Ashton ridge. (a) exposures with artefacts and (b) exposures not having artefacts (X units).

	area sqm	effective sqm	survey units
Ashton Ridge	36768	11842	86
Bowmans Cr valley	26466	11082	44
Glennies Cr valley	17690	7523	18
Bettys Cr valley	15673	5817	32
Hunter R. Valley	114	61	4
total	96717	36324	182

Table 10.6. Summary of the areas surveyed by geographic division, the effective area and the total number of survey units.

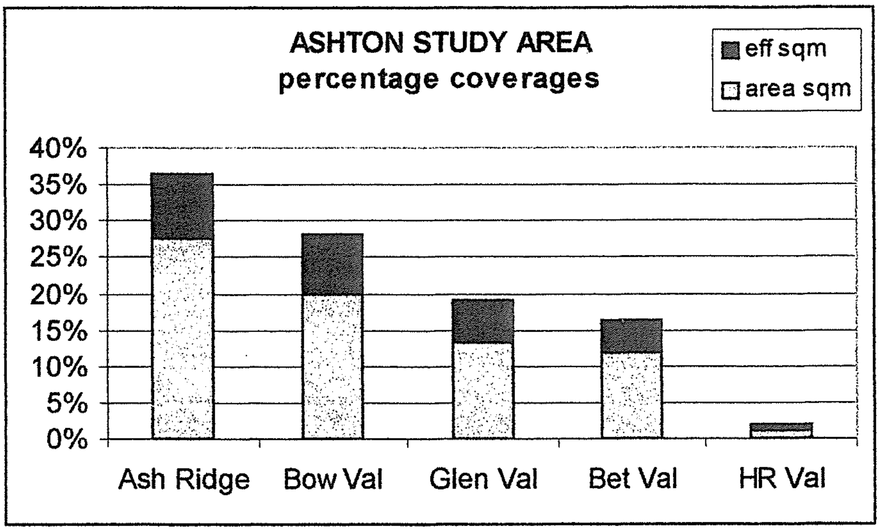


Fig 10.1. Graph showing percentage coverage by area and effective visibility.

The effective visibility, as indicated by "eff sqm" in Fig 10.1, was consistently a small portion of an area showing exposure. The basis of extrapolation from the coverage is best for Ashton Ridge ("Ash ridge"), followed by Bowmans Creek valley ("Bow Val"). Less reliable is Glennies Creek Valley ("Glen Val"), and Bettys Creek Valley ("Bet Val"). The conclusions concerning the survey coverage are as follows:

- Ashton Ridge. This has artefacts distributed over the ridge and spur crests as well as on the slope. Fig 10.1(a&b) shows that a group of exposures were found in the central part of the eastern arm of the ridge and that a cluster of EWAs is within an area of ridge slope at a tributary head. The extreme eastern section of this part of the ridge shows no recorded exposures. It is probable however that the pattern elsewhere on the ridge extends into this area. The southern arm of the ridge in Fig. 10.1(b) shows that artefacts are regularly present in exposures, especially the higher part of the ridge.
- Bowmans Creek valley. Although exposure was poor on the creek bottom and terraces, artefacts are present. The valley sides are biased by more exposures being recorded for the northern tributary valleys and slopes as seen in Map 10.1 (a&b). An extrapolation from this area however may not necessarily hold for the southern part, since the Bowmans Creek channel moves further away to the west.
- Glennies Creek valley. This geographical division was less covered than the Bowmans Creek valley, and it is smaller in area. Two main areas of recorded exposures are shown in Map 10.1(b) and EWAs are frequent. These are probably a good indication of what may be found in the area.
- Bettys Creek valley. Although the Bettys Creek tributary valley sides were the most intensively walked area (Map 9.1), exposures were difficult to find (Map 10.1a), and it is rather weakly represented in the Fig. 10.1 graph. For the area exposed, the proportion which was effective was low compared to the other geographical divisions, and extrapolations to parts of the valley sides with no recorded exposures is more doubtful, in particular the western part.
- Hunter River Valley. This geographical division is the least represented, and much of it is a steep bluff overlooking the river. More archaeology can be expected for this area, including in the vicinity of the current dairy farm buildings.

10.4 Sandstone Outcrops

Sandstone outcrops were considered to be a potentially sensitive feature for grinding grooves and perhaps rock engravings. Sandstone outcrops were present on or near creek banks in two cases (Waterhole Site and Glennies Creek Site), and grinding grooves were present in both cases. Other outcrops, such as SS12 on a high peak of Ashton ridge and on a bluff overlooking Glennies Creek were examined closely for possible engravings.

10.5 Buried Pleistocene Surfaces

The potential for buried Pleistocene surfaces or deposits was investigated by Peter Mitchell (Mitchell 2002) using backhoe pits to test four locations. The main potential was where sediments from the valley sides might be washed out over the upper terraces to cover an early soil profile. In addition, it was possible there might be buried surfaces where Bettys Creek joined Bowmans Creek.

A single example of a buried soil was found on Glennies Creek, where sediments were washed over a high terrace, and an artefact was discovered in the early deposit (see pit 15, Map 10.1b). This deposit is mostly outside of any potential impact from subsidence.

11. Site Definition

An archaeological site can be defined in a variety of ways depending upon the purpose of the user of the term, but normally refers to archaeological materials at a particular place. The definition here is oriented towards archaeological materials as a spatial unit of heritage and management assessment. In some cases, where the evidence is sufficient, this refers to as an area of a prehistoric encampment. This is usually derived from a pattern of exposed artefact concentrations on a landscape which can be interpreted as a locality with repeated occupation and an accumulation of artefacts in a domestic context.

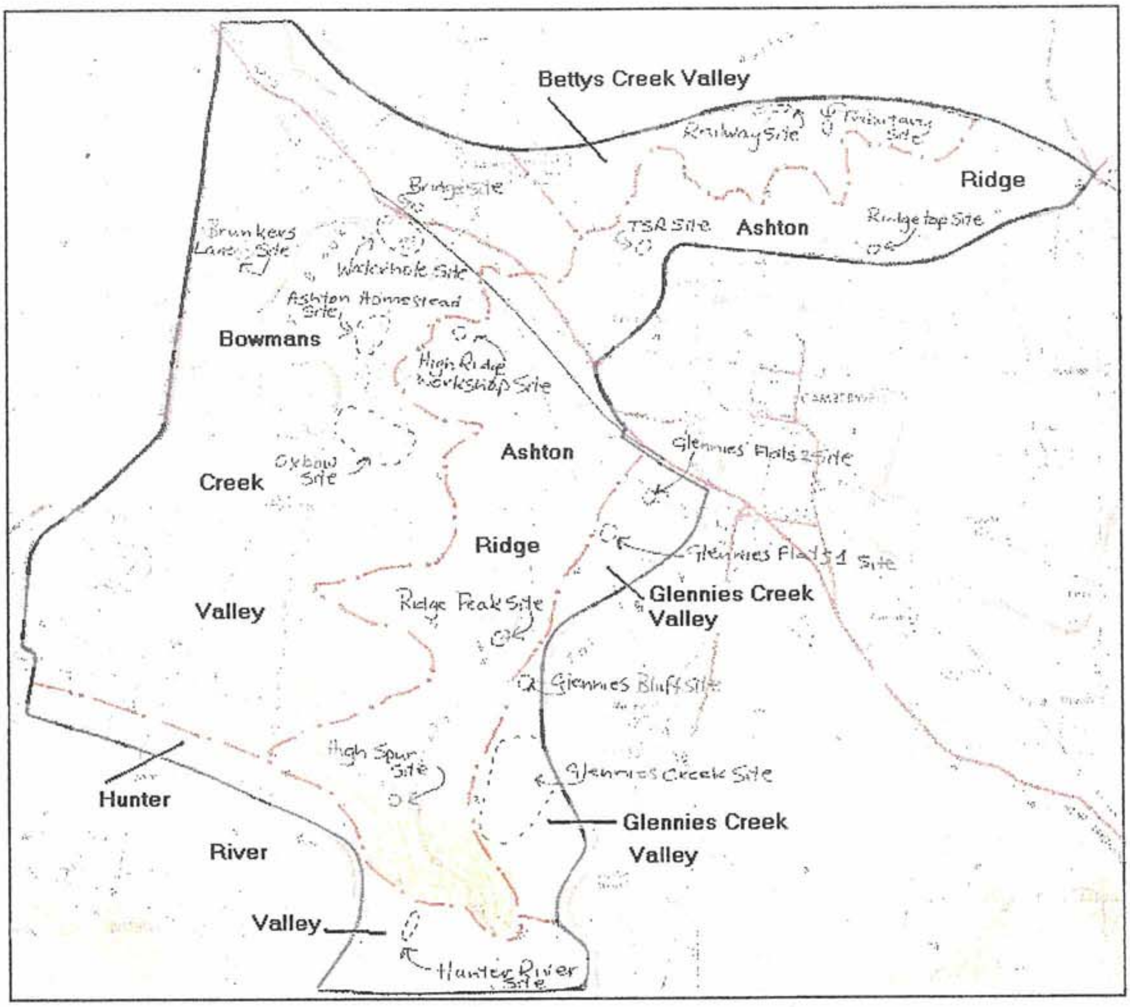
Frequently however the field information is more limited. It may only be possible to identify a land form over which there were human activities, or locations of specific activities where there are artefact concentrations. In most cases, the only evidence is as patchy exposures in which there are a few artefacts for which any interpretation is extremely limited. Although isolated finds may have cumulative value for a landscape unit, they are considered to be interpretively more limited than a "site".

The minimum unit of observation here are exposures with one or more artefacts (EWAs). These may be grouped into "sites", some of which may be several hundred metres across, or remain as isolated finds in which there are a few artefacts in a smaller area. Note that "isolated find" does not always refer to a single artefact in an exposure, but relatively few artefacts in what appears to be the background density for the land unit..

For the purpose of artefact analysis sites may be subdivided as assemblages which might indicate spatial partitioning. Assemblages also may be made up of several EWAs within a site, or an assemblage may be intended to represent a land form generally and be made up of artefacts from both sites and isolated finds.

12. Archaeological Data

The archaeological sites and isolated finds are presented in their geographical divisions. These geographical divisions and associated sites are shown in Fig 12.1.



Map 12.1. Geographical divisions and sites in the Ashton study area.

For each geographical division there is a table listing the sites and the EWAs which comprise each site. The grid reference is for about the middle of the site area. Specific grid references for EWAs are in Appendix 2. The site dimensions include all of the EWAs, and the assessment of visibility refers to this entire area.

12.1 Bowmans Creek Valley

This is the creek flats, terraces and eastern lower slopes of Bowmans Creek Valley. There are two major sites in the valley: the Waterhole Site and the Oxbow Site, as shown in Fig 12.1. The archaeology recorded is shown in Table 12.1 (a)&(b).

site name	survey unit	site type	E ·	N	landscape type
Waterhole Site	EWA 28,19, GG1, GG3	open camp site	31853	540633	valley lower slope and creek channel
Bridge Site	EWA 33	open camp site	318646	6406566	valley bottom terrace
Oxbow Site	EWA 29, 30, 31, 32, 34, 35, 36, 87, 90	open camp site	318241	6405450	lower tributary valley
Bruckers Lane Site	82	open camp site	317707	6406329	terrace
Ashton Homestead Site	93	open camp site	318420	6405517	Tributary bottom
	50	Isolated find	320772	6404021	Tributary flat
	51	Isolated find	317954	6404021	Tributary flat
	52	Isolated find	317847	6404293	Tributary flat
	57	Isolated find	318001	6404205	Tributary bottom
	80	Isolated find	317463	6405942	Low flat spur
	81	Isolated find	317534	6406017	terrace
	89	Isolated find	317378	6405955	terrace
	96	Isolated find	318772	6406066	Tributary bottom
	97	Isolated find	317583	6405075	Terrace edge

(a)

nite name	dimen.	criteria	exposure type	vis.	site contents	site condition
Waterhole Site	250 x 100 m	exposure, land form	gravel lag sheet erosion	50%	256 artefacts, 3 sets grinding grooves	Heavily eroded stripped, pos. 50 x 50 m intact
Bridge Site	170 x 120 m	exposure	Rill bank talus	10%	21 artefacts	Pos 100 x 50 m intact behind erosional front
Oxbow Site	400 x 150 m	exposure, land form	A&B lag, bank talus	10%	204 artefacts	Prob 50 x 50 m intact heavy concentration
Bruckers Lane Site	20 x 2 m	exposure	Alluvium track	20%	11 artefacts	Prob cultivated, disturbed by road
Farm Road Site	10 x 3 m	exposure	Erosion bank A&B lag, talus	80%	8 artefacts	Intact deposit
Isolated find EWA 50	1 x 2 m	exposure	A&B lag, Bare patch	50%	1 artefact	
Isolated find EWA 51	1 x 2 m	exposure	A&B lag, Bare patch	50%	1 artefact	
Isolated find EWA 52	1 x 2 m	exposure	A&B lag track	80%	1 artefact	
Isolated find EWA 57	5 x 50 m	Exposure landform	A&B lag, talus Track,. banks	20%	3 artefacts	
Isolated find EWA 80	50 x 2 m	Exposure landform	Gravel lag track	20%	2 artefacts	
Isolated find EWA 81	50 x 2 m	Exposure arbitrary	Alluvium track	10%	1 artefact	
Isolated find EWA 89	50 x 5 m	exposure	Alluvium Bare patch	20%	1 artefact	
Isolated find EWA 96	20 x 3 m	exposure	Rill bank A&B lag, talus	50%	1 artefact	
Isolated find EWA 97	700 x 2 m	exposure arbitrary	B lag track	20%	3 artefacts	

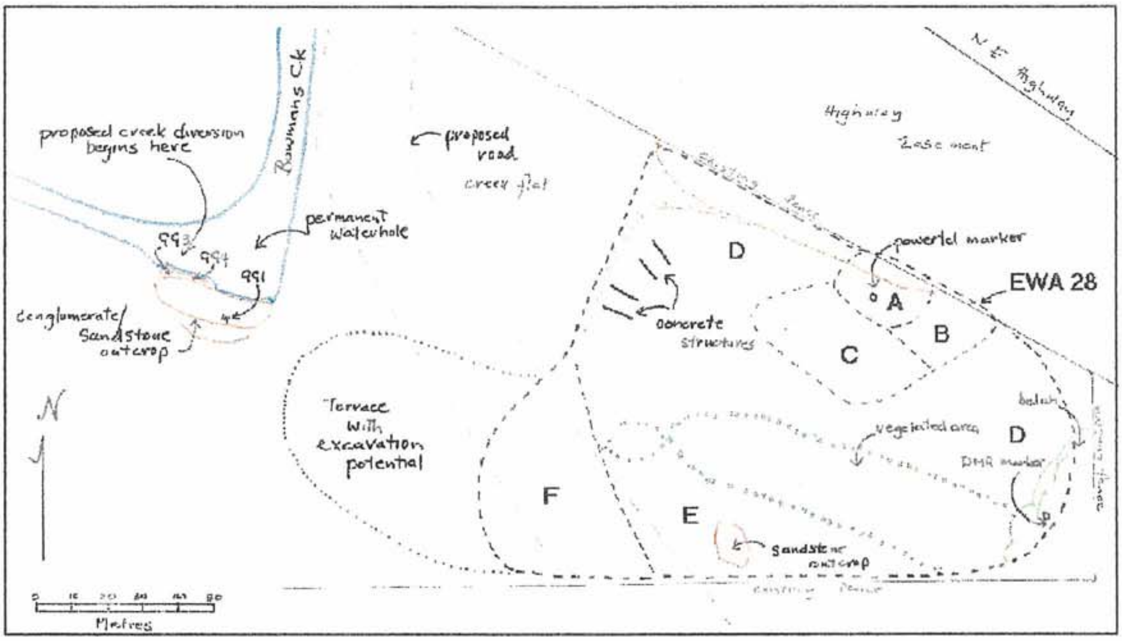
(b)

Table 12.1 Bowmans Creek valley sites and isolated finds. (a) Locational data and (b) descriptive data.

12.2 The Waterhole Site

The Waterhole Site is located next to a waterhole formed against a three metre high conglomerate/sandstone outcrop within 100 m south of the New England Highway bridge, on the east bank. This site was referred to by Hardy as "Ash 4", though it was incorrectly located on her map. The site is exposed by an area of gravel lag about 150 x 100 m, in which 256 artefacts were recorded. The entire site, including the conglomerate/sandstone outcrop which contains two sets of grinding grooves, is estimated at 250 by 100 m. (Map 12.2.)

The exposed area has been heavily disturbed with all topsoil washed away, and contains two concrete structures of unknown function. The topographic map shows two "sheds" there, but we were told by local people the area used was used by the RTA to process gravel.



Map 12.2. Sketch map showing the Waterhole Site. Areas A, B, C, D, E and F were recorded separately. Note the proposed haul road through the site.

The site sketch Fig. 12.2 shows an extensive exposure, EWA28, located about 50 metres above the waterhole on Bowmans Creek, which was divided into separate areas for recording. These areas as shown in Table 12.2.

EWA	dimen.	landform	exposure	visibility	n artefacts
28 Area A	25 x 20 m	slope	gravel lag	90%	118
28 Area B	20 x 15 m	slope	gravel lag	90%	24
28 Area C	50 x 20	slope	gravel lag	90%	35
28 Area D	100 x 50	slope	gravel lag	80%	41
28 Area E	75 x 20 m	slope	gravel lag	80%	16
28 Area F	50 x 50 m	slope	gravel lag	60%	22

Table 12.2 Description of areas in the Waterhole Site EWA28

The areas are described further below.

- Area A. This area was the main concentration of artefacts on the upper slope, next to highway easement fence.
- Area B. This area was up slope (east) of Area A with a lower density of artefacts.

- Area C. This area was next (south) to Area A, with a lower density of artefacts.
- Area D. This area surrounded the above three areas. Artefacts were at the lowest density and disturbance seemed to be greatest, including two large concrete structures.
- Area E. This area was the upper slopes in the south part of the exposed area, separated from the rest by a patch of vegetation.
- Area F. This was the lower slopes, in an area of the considerable disturbance.

12.2.1. Waterhole Site Artefacts

The artefacts from the Waterhole Site EWA28 are summarised here. The total number of implements recorded at the Waterhole site was 36 (Table 12.3). These included a wide range of types and stages, with the most conspicuous being the scalar retouched flake tools and the trial microblade cores.

implement type	implement stage	number
flake tool	Usewear	2
	scalar retouch	6
	step retouch	1
	Projection	1
	Elouera	1
nuclear tool	Unifacial	1
	Multifacial	1
producer core	Bipolar	2
	Broken	1
microblade core	Trial	8
	Prismatic	3
	Bifacial	2
	Multiplatform	1
backed blade	Bondi	1
	backed piece	2
axe	Preform	1
hammerstone	2 facet	2

Table 12.3 List of implements in the Waterhole Site

The cortex present on all artefacts from the Waterhole site is shown in Fig 12.1. This graph shows that tuff is the dominant material on the site, about half of which have cortex. Cortex is rarely present on the implements. The silcrete debitage has little cortex, and the quartz and quartzite artefacts a slightly higher proportion.

The assemblage featured an axe preform with the bit end re-flaked, and presumably ready to be re-ground on the grinding grooves near-by (Plate 12.1.b). Other unusual artefact types included an elouera (Plate 12.1.c) and two hammerstones (Plate 12.1.d). There also were some unusually large blades (Plate 12.1.a). Some of these came from the same core and were probably part of a workshop. However, the present surface is so heavily stripped by sheet wash that any such workshops have been washed away. These large blades were probably part of the blade core preparation process and the development of straight parallel vertical ridges rather than blanks for backed blades.

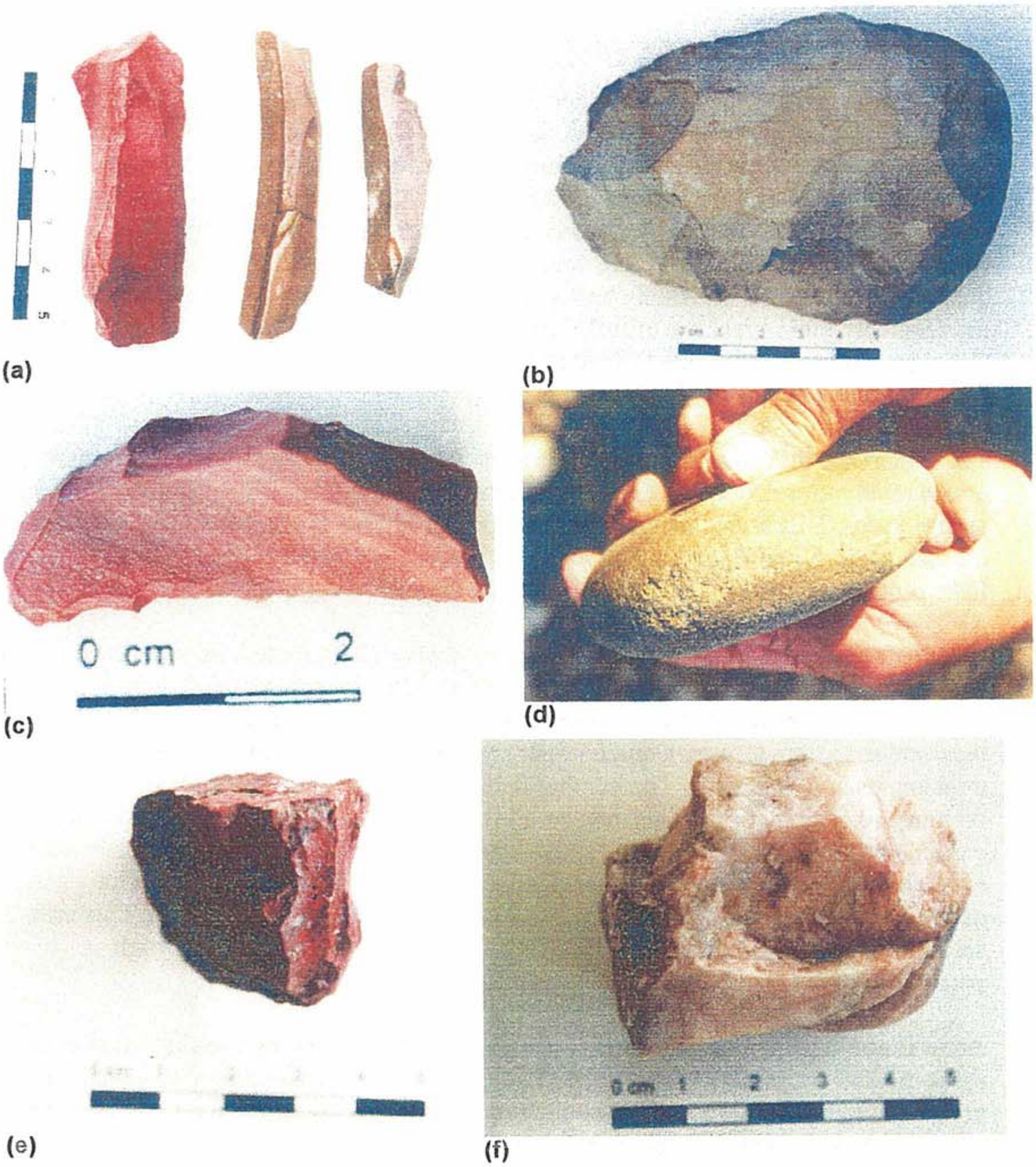


Plate 12.1. Artefacts from the Waterhole Site.

(a) Unusually large blades of tuff found lagged on the gravel surface. These probably belonged to workshops which are now mostly lost to sheet wash erosion.

(b) Axe preform. The bit has been re-flaked and ready for a new ground edge. The material is volcanic ("rhyolite") and there is hammerstone wear on the butt, and there is no ground surface on the body.

(c) A backed elouera of tuff with retouch on the edge.

(d) Hammerstone of quartzite with a well-formed wear facet.

(e) Trial microblade showing preliminary blade scars on an angular fragment of silcrete.

(f) Quartz nuclear tool with expanded resharpening flake scars.

The assemblage recorded for the waterhole site are shown as graphs (Fig 12.2 a & b). The proportion of complete to broken flakes is about equal for both the tuff and silcrete debitage. Although the microblade cores were of either tuff or silcrete, the other implement types however consist of mostly different materials. There are more artefact in Size Index 1 than Size Index 2. Considering the heavily eroded condition of the site it is surprising that there was not a greater loss of Size Class 1 artefacts lost, due to heavy run-off. The likely heavy traffic on the surface may have contributed to the relatively more breakage of tuff flakes which are probably more fragile, but if so, this seems to have contributed to relatively few angular fragments. The flake tools can be seen to have been of various sizes.

The Waterhole Site area C (Fig. 12.3) is strongly dominated by tuff, in which there are relatively more complete flakes, and implements are few. The assemblage peaks at Size Index 2. It seems unlikely that this part of the site was receiving heavier run-off than areas A and B, and it is probable that this was an area of relatively large sized flake production, especially considering the larger percentage at Size Index 3.

The artefacts from area D (Fig. 12.4) were extensively distributed up and down slope from areas A, B, and C. The debitage is dominated by complete tuff flakes, and the silcrete present shows relatively more broken flakes. The number of artefacts is about the same as in area C, over a much larger area, and there is a wider range of implements and materials. The number debitage belonging to Size Index 1 is nearly the same as Size Index 2. This may be due to run-off, and smaller artefacts being carried away by sheet wash. This seems likely considering the strong representation of microblade cores which might be expected to have produced numerous fine debitage. This may also account for some of the relatively large debitage. This area seemed to have had very heavy traffic impact, yet there is a remarkably high percentage of complete flakes.

Areas E and F (Fig. 12.5) are further peripheral to Area A, being the slope further to the south and the bottom of the slope. Although this area also seemed to have had considerable traffic impact the debitage is dominated by complete flakes. There is a relatively broad range of implements and materials. The larger proportion of debitage at Size Class 1 suggests that fewer of the small debitage has been lost in this part of the site.

12.2.2 Waterhole Site Grinding Grooves

The main set of grinding grooves (GG1) were on the top of the sandstone outcrop at the waterhole. The 9 grooves were grouped within an 80 cm x 50 cm area. This was a tight cluster within a sandy lens in the conglomerate (Map 12.3).

An additional set of six grinding grooves were found (GG3) on a ledge near the water within a 80 by 70 cm area. On the same ledge about 10 metres away was a single grinding groove (GG4). This was associated with a pecked area similar to engraved rock art, but no image could be discerned. The data on individual grooves is shown in Table 12.4.

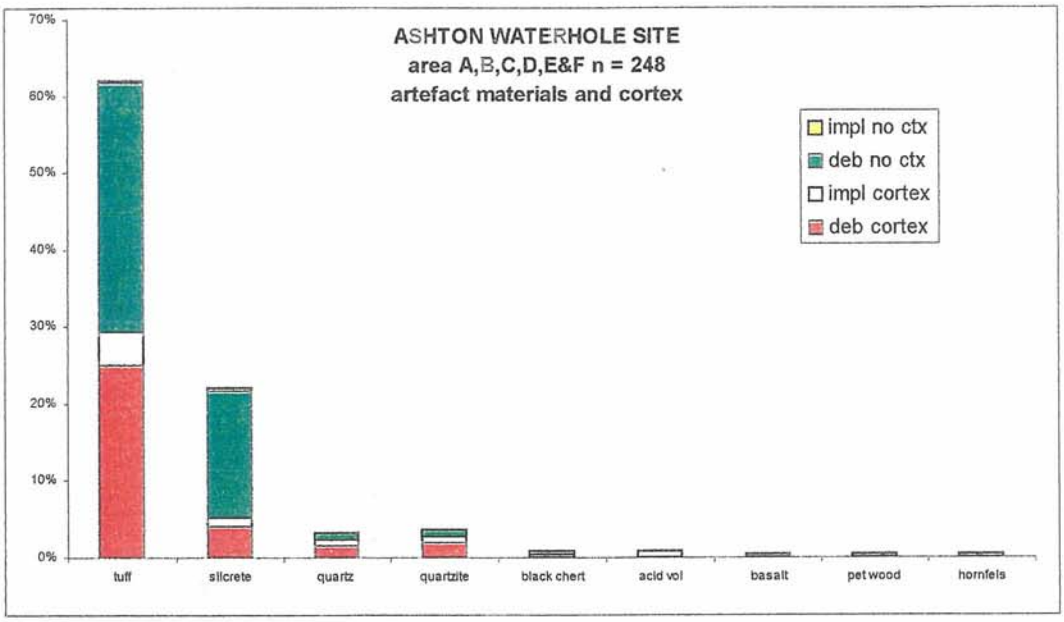
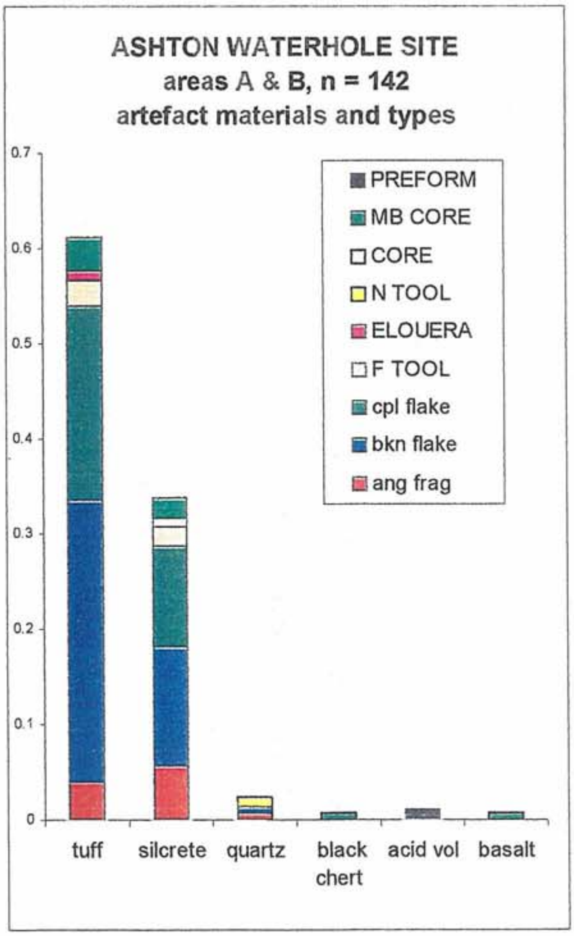
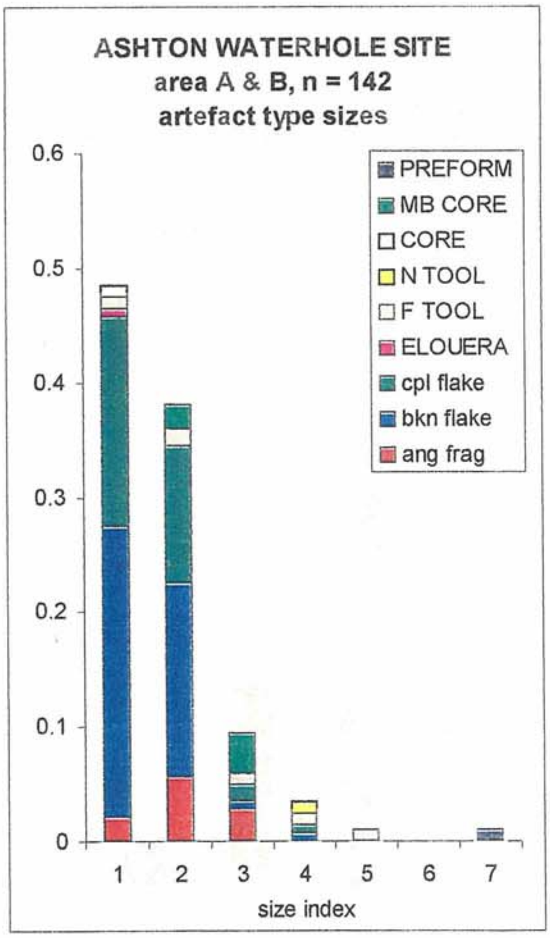


Fig. 12.1 The percentage of cortex for all material types on debitage and implements from the Waterhole site.

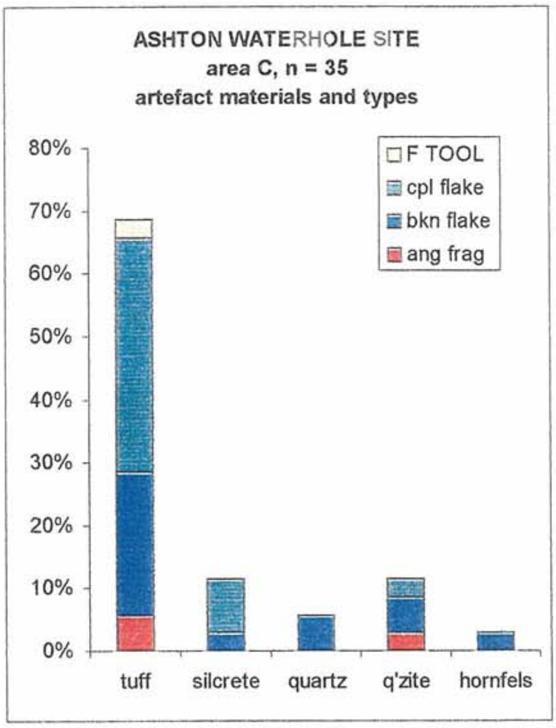


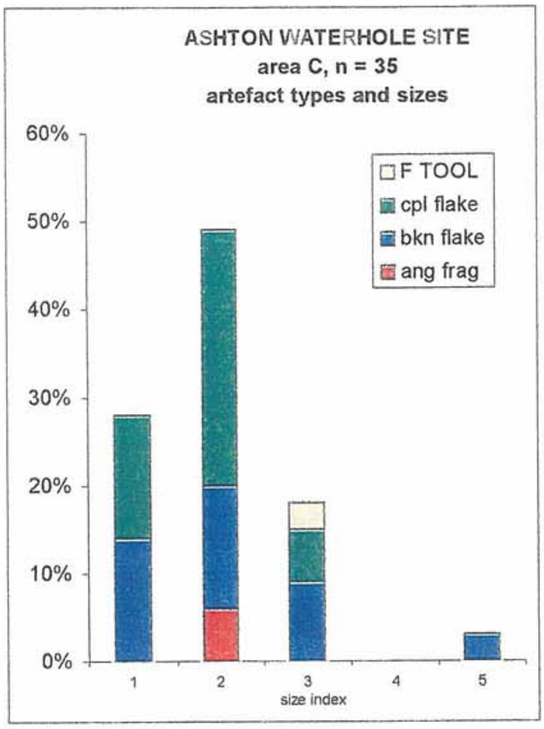
12.2 (a)



12.2 (b)

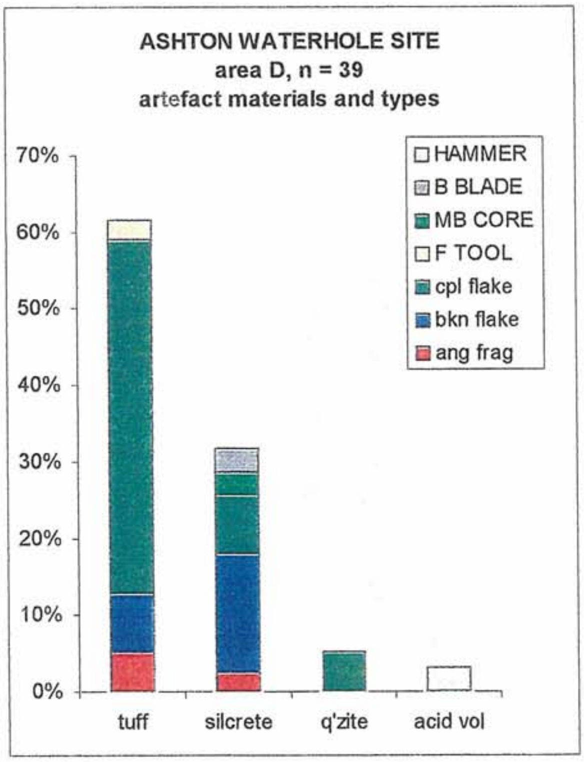
Fig. 12.2. Artefact assemblage graphs for the Waterhole Site, Areas A&B. (a) Artefact type and material and (b) artefact type and size.

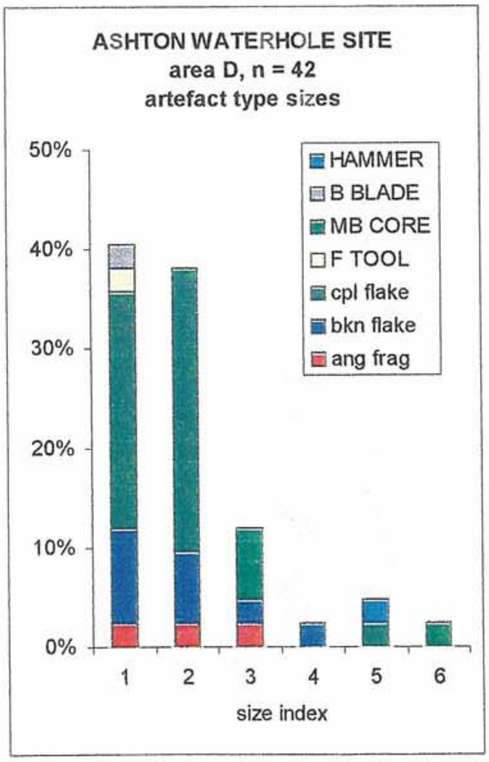




(a) (b)

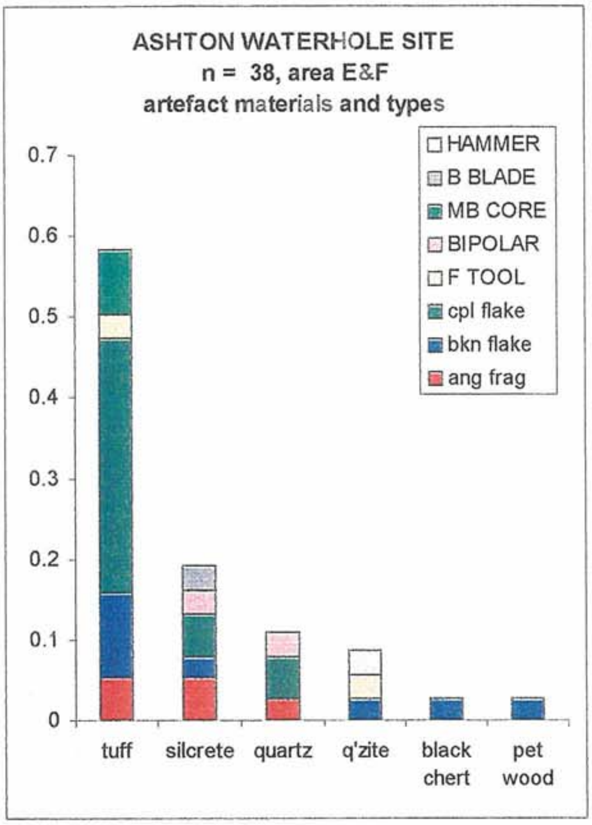
Fig. 12.3 Artefact assemblage graphs for the Waterhole Site, Area C. (a) Artefact type and material and (b) artefact type and size.



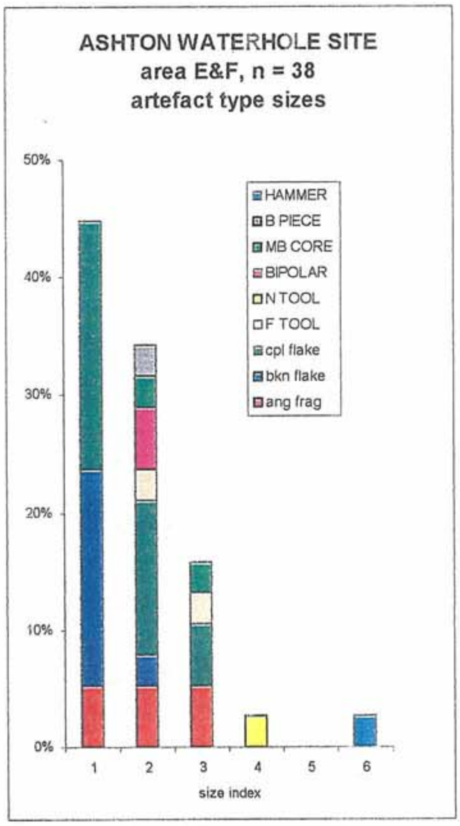


12.3 (a) **12.3 (b)**

Fig. 12.4 Artefact assemblage graphs for the Waterhole Site, Area D. (a) Artefact type and material and (b) artefact type and size.



(a)



(b)

Fig. 12.5. Artefact assemblage graphs for the Waterhole Site, Areas E&F. (a) Artefact type and material and (b) artefact type and size.

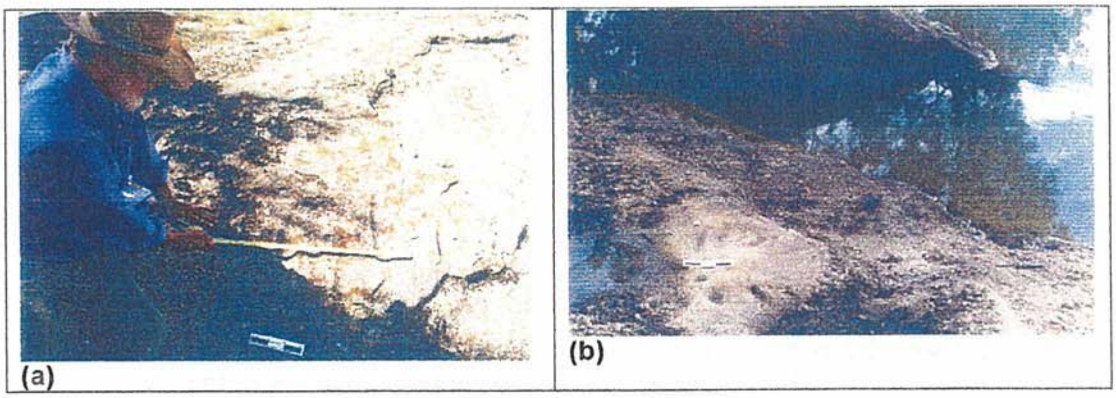


Plate 12.2. Grinding grooves at the Waterhole Site.
- **(a) The grooves GG1 on top of the conglomerate outcrop are in a sandstone lens. This sandstone is very friable and is peeling away. No foot traffic should approach these grooves.**
- **(b) The grooves GG3 on a sandstone ledge near the water.**

site	groove	Dimensions	Depth
GG1	1	29 x 6 cm	shallow
	2	41 x 7cm	2 cm deep
	3	26 x 5 cm	shallow
	4	33 x 5 cm	shallow
	5	26 x 7 cm	1 cm deep
	6	39 x 14 cm	3 cm deep
	7	14 x 4 cm	shallow
	8	7 x 16 cm	1 cm deep
	9	13 x 5 cm	shallow
GG3	1	21 x 8 nm	shallow
	2	22 x 7 cm	shallow
	3	15 x 6 cm	shallow
	4	21 x 9 cm	shallow
	5	23 x 4 cm	shallow
	6	22 x 4 cm	shallow
GG4	1	33 x 5 cm	shallow

Table 12.4. Waterhole Site grinding grooves.

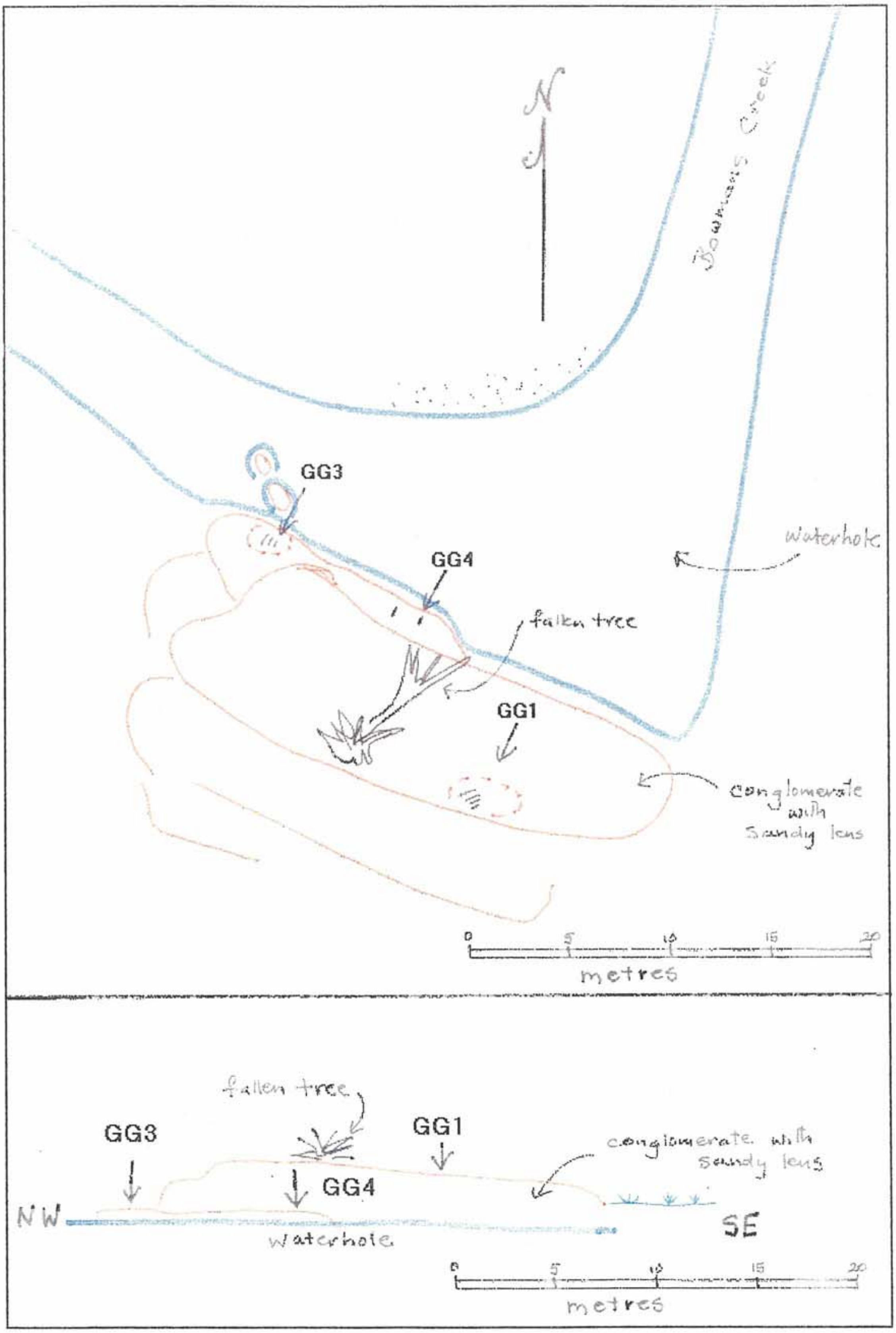
12.2.3 Waterhole Site Summary and Interpretation

The Waterhole Site covers an extensive area in which a large number of artefacts are exposed. The site area was subdivided for artefact recording. This was to assess the potential for spatial partitioning and indications of repeated internal organisation of activities by the Aboriginal occupants. While the amount of erosion and disturbance on the surface introduce some uncertainty, there are indications of assemblage differences in various parts of the site which probably reflect different activities rather than preservational factors.

The artefacts indicate a broad range of implement types and there is a wide variety of materials, some of which are present in small quantities. No microblade workshops were observed while recording, although there were a few unusually large blades seen, including at least one pair from the same core. This lack of intensive blade core workshops might seem to be inconsistent with the numerous blade cores present. However these are mostly trial blade cores, cores in which there was an attempt to set up a platform and prepare vertical ridges, then discarded before any systematic blade production took place.

Thus although a large encampment is indicated, this site does not seem to be a "microblade base camp" type of occupation. While the site is close to a broad valley bottom, the channel was probably well defined throughout, and it is unlikely that it was a chain-of-ponds with swamps and abundant semiaquatic vegetation.

One possible interpretation is that the site was a fishing camp, and the waterhole was suitable for fish traps. The fish trapping may have been for mullet or eels, both of which are known to migrate in Hunter Valley streams. The stone tool kit required for fish trap construction is highly conjectural, but heavy chopping tools may have been necessary if a weir-like structure was needed.



Map 12.3. Sketch map showing the grinding grooves at the Waterhole Site.

Another possible function of the site may have been as a drought retreat. Bowmans Creek is a long-term water source. Its head waters are in the ranges of the New England Tablelands, and when the streams which head within the Hunter Valley rain shadow area dry up, Bowmans Creek is likely to still be flowing. Even when this stream becomes dry, water would be available at the waterhole for a considerable time. Indeed, several Aboriginal people remarked that the waterhole is permanent. With the on-set of drought, Aboriginal people may have retreated to the long term streams, possibly as scattered groups, to maximise food resources. Finally they would have gathered at the most durable waterholes. Here, even if water remained, the food supply could well run out before the rains returned. Then these groups would have to temporarily migrate out of the Hunter Valley. The waterhole site may have been one of these final drought refuges on Bowmans Creek. The stone tool kit which would belong to a drought retreat type of camp is highly conjectural. Possibly there would be intensive crafts activities to produce exchange items for the likely need to move out into a different tribal territory.

The large proportion of microblade "trials" could be associated with either a fish trap or drought retreat situation. Microblade workshops would not be produced if the usual activities requiring backed blades were not being practiced. In either situation the repair of microblade equipment could have been occasional and unexpected, and prepared microblade cores may not have been available. It may have been necessary to scavenge the debris on the camp ground to find a piece of stone suitable for a blade core. These would be systematically started, and those which were not successful would be rejected.

12.2.3 Potential Deposit for the Waterhole Site

This site has been heavily disturbed. However there seems to be an area of *in situ* deposit about 50 by 50 m between the exposed area EWA 28 and the grinding grooves on the waterhole (see Map 12.1). The large exposed area indicates that the artefacts become increasingly few up slope. The Bridge Site (section 12.3) is possibly a continuation of this encampment further up the east bank of Bowmans Creek.

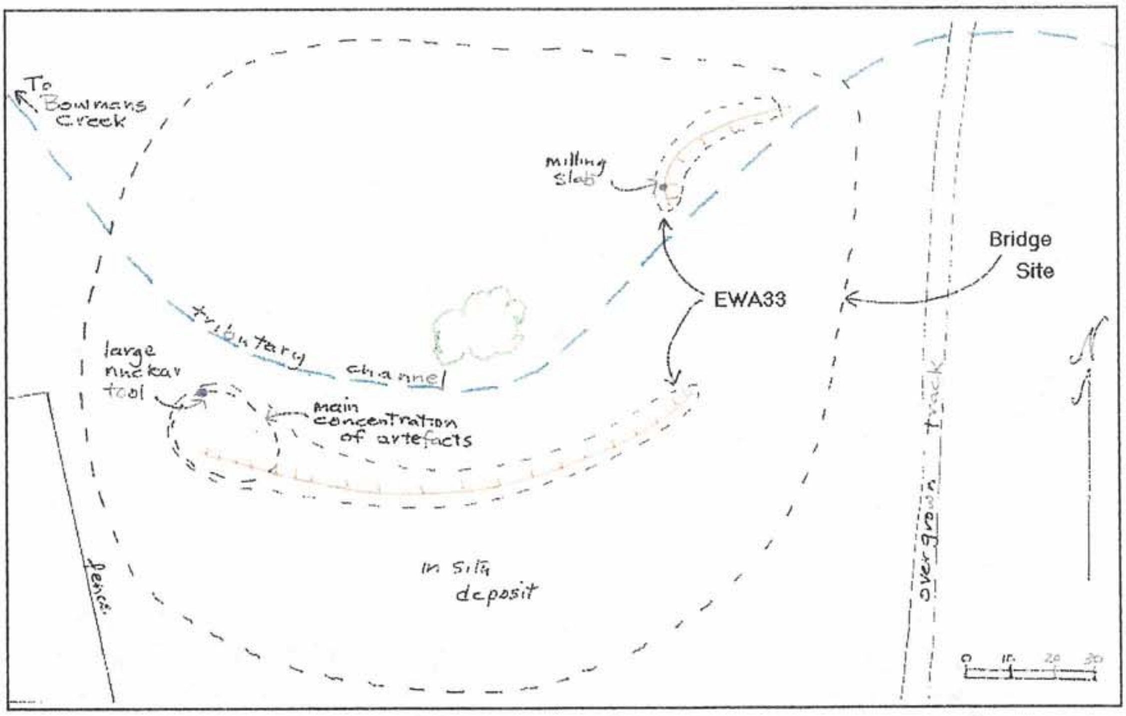
12.3. Bridge Site

This site (EWA 33) is located on a terrace which has been cut by a tributary, and the artefacts have been exposed in the bank. It is north of the New England Highway bridge over Bowmans Creek, on the east bank. It was recorded as "Ash 1" by Hardy (2002). The site is about 130 by 50 metres in size and produced 21 artefacts. This site is probably an extension of the Waterhole Site encampment on the other side of the highway. It also may extend to the confluence of Bowmans and Betty's Creek which is about 500 metres to the north.

12.3.1 Bridge Site Artefacts

The Bridge Site artefacts are summarised in Table 12.5. Since the artefact numbers are relatively low, they are not shown as percentage graphs. Seven of the twenty artefacts are implements. The graph in Fig 12.6 shows that the nuclear tool, spall tool, producer core are exceptionally large, and the milling slab also is large. It may be that this site is on the edge of a large occupation, the Waterhole Site, and these large artefacts have been cached. The milling slab and large nuclear tool are shown in Plate 12.3. Note the pecking on the milling slab that was used to keep seeds in place and improve the abrasion . The breakage was probably from cattle trampling. The large nuclear tool also shows heavy duty usewear on the working edge.

This site may represent specialised activities away from the camp core, and be a storage area. Recent survey work in the Hume Reservoir area near Albury indicates that the storage of axes, grinding gear and large implements in hollow trunks or at the base of large trees was common (Witter and Kelly 2002). The Bridge Site area was probably heavily cleared in European times. A stand of trees is now regenerating near by. Large trees may have previously grown at this location, and it been an area important for caching from the Waterhole Site.



Map. 12.4 Sketch map showing the Bridge Site.

EWA	ang frag	bkn flake	cpl flake	implements	n
33	2	5	7	flake tool	1
				spall tool	1
				nuclear tool	1
				producer core	1
				microblade core	2
				milling slab	1

Table12.5. Bridge Site artefact types.

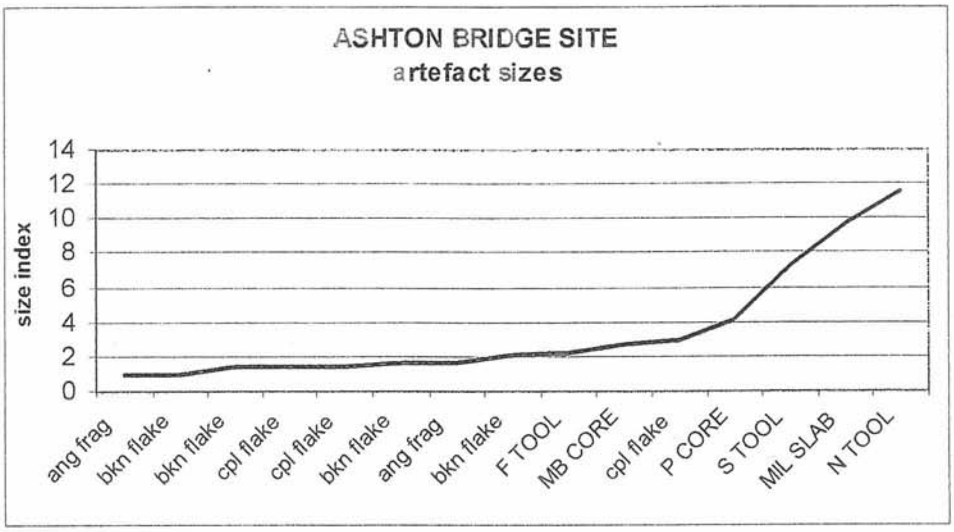


Fig 12.6. Artefact sizes by the Size Index for the Bridge Site showing the group of very large artefacts.

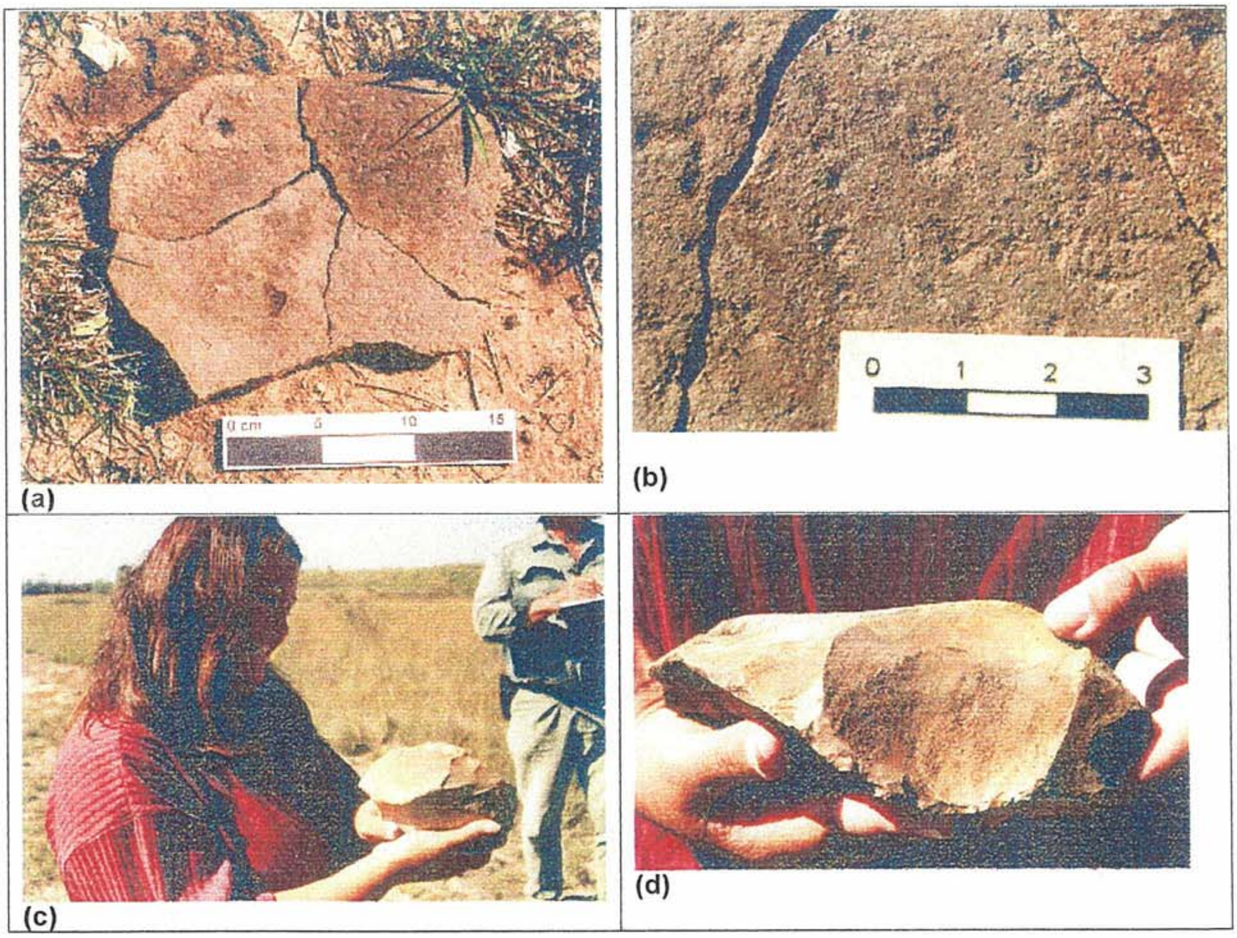


Plate 12.3. Artefacts from the Bridge Site.

(a) Milling slab, about ¾ complete in four pieces.

(b) Detail of the milling slab surface showing peckings needed to improve the ability of the milling surface to hold seeds.

(c) Tracey Miller holding an extremely large heavy duty nuclear tool from the Bridge Site.

(d) Detail of the heavy duty use-wear on the nuclear tool.

12.3.2 Bridge Site Summary and Interpretation

The Bridge Site is located north of the Waterhole Site, across the New England Highway. It is considered likely that this site is part of the same encampment, and the artefacts increase in density in the direction of the Waterhole Site. The possibility of this having been a peripheral activity area and used for the storage of equipment has been suggested.

12.3.3 Potential Deposit for the Bridge Site

There is a strong potential for an extensive undisturbed deposit to extend back to the east and south of the exposures. There also may be further deposit between this site and Bowmans and Betty's Creek, but this is likely to have been cultivated in the past.

12.4 Oxbow Site

The Oxbow Site is located on the outside margin of Bowmans Creek where the channel cuts against the valley slopes (Maps 12.5 & 6). The major concentration of exposed artefacts is located in the "V" where two tributaries join at the edge of the valley bottom. Patchy exposure indicates that smaller artefact concentrations continue about 400 metres further up the two tributary channels within the broad valley they form in combination. It is possible that artefact concentrations occur away from the tributary channels, but there is no exposure to assess this. The entire site, which is interpreted as an encampment, is about 400 x 150 m in size, and a total of 204 artefacts were recorded from the EWAs (Table 12.6). The occupation is on high ground adjacent to the oxbow loop of Bowmans Creek within a sheltered broad valley system of gentle slopes. Thus Bowmans Creek provides water without having to cross the terraces or the flood plain. It is possible that the area between the two tributaries has never been cultivated and, apart from a stock dam up stream, the site is latgely intact.

The main exposed areas with concentrations of artefacts are shown in Table 12.6 as separate EWAs within the 400 x 150 m area, mainly clustered at the tributary confluence on the Bowmans Creek oxbow.

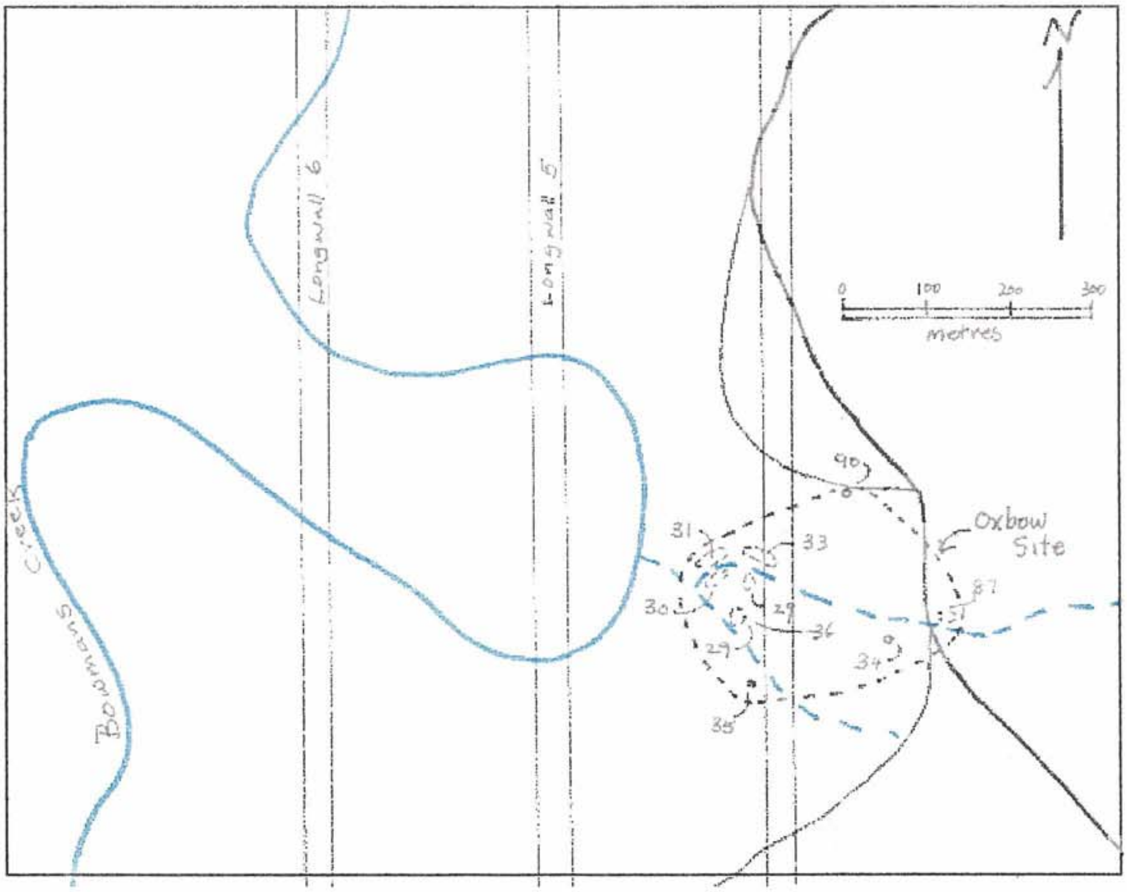
EWA	dimensions	landform	exposure	vis.	n artefacts
29	20 x 10 m	tributary margin	vehicle track, bare patches, A&B-lag	20%	68
30	20 x 2 m	tributary margin	gully bank talus	50%	4
31	30 x 1 m	tributary margin	gully bank talus	20%	29
32	35 x 1 m	tributary margin	gully bank talus	20%	13
34					3
35	40 x 1 m	tributary margin	gully bank talus, stock track A&B-lag	10%	31
36	30 x 20 m	tributary margin	vehicle track, bare patches, A&B-lag	30%	61
87	20 x 1 m	Tributary bottom	Bully bank talus, A&B-lag	80%	9
9xxx					

Table 12.6. Description of areas in the Oxbow Site

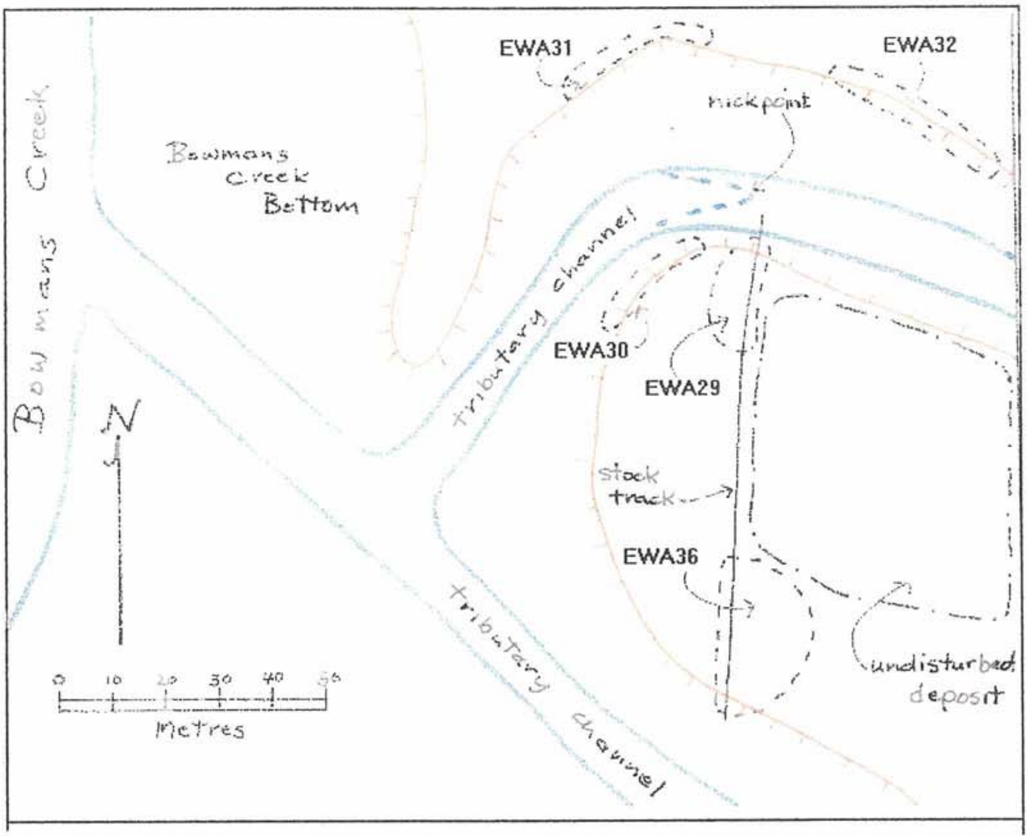
12.4.1 Oxbow Site Artefacts

The Oxbow Site implements below (Table 12.7) are from EWAS 29, 30, 31, 32, and 36 which are clustered together where the two tributaries join at the edge of the creek

bottom, as well as a microblade core from EWA 35 which is about 100 m up one of the tributary channels. The total implements are 27. The flake tools show a wide range of reduction, from usewear to cuspate, suggesting relatively intense usage compared to the Waterhole Site. Microblade cores also are prominent, with both trial and reduced types. However, with a total of 13 blade cores, only 4 backed blades were found, and there were no identifiable microblade workshops. Although some of the exposure was from a vehicle track which may have had some smaller artefacts washed away, most of the exposure would have clearly indicated a workshop if it had been present.



Map 12.5. Sketch map showing the Oxbow Site and distribution of EWAs.



Map 12.5. Sketch map of the main concentration of artefacts in the Oxbow Site.

implement type	implement stage	number
flake tool	usewear	4
	scalar	3
	step	3
	cuspate	2
	burren	1
nuclear tool	unifacial	1
	multifacial	1
microblade core	trial	4
	prismatic	6
	burin blade	1
	broken	2
backed blade	bondi	2
	geometric	1
	backed fragment	1
hammerstone	3 facets	1

Table 12.7 List of implements in the Oxbow Site

The materials in Fig 12.7 show a greater proportion of tuff, with about equal amounts of cortex present or absent, both for debitage and implements. The silcrete artefacts are fewer, and with substantially more without cortex. This would have been partly due to workshop of "burnt' silcrete in EWA 35 in which14 out of 15 flakes had no cortex. There also was probably some contribution from some similar burnt silcrete in EWA 29. A range of other materials are present in small numbers.

(a)

(b)

(c)

(d)

Plate 12.4. Artefacts from the Oxbow Site.
(a) Large heavy duty nuclear tool with expanded flake scars for edge production and resharpening.
(b) Smaller example of a nuclear tool with expanded
(c) Trial microblade core, showing initial set of blade-like scars on a flake fragment.
(d) Heavily reduced classic prismatic conical microblade core.

The central part of the cluster of high density artefact exposures was EWA 29 and 30 shown in Fig 12.8. This was dominated by tuff complete flakes. The numerous silcrete angular fragments were mainly of a "burnt" material. The large percentage of tuff microblade cores did not result in a workshop as indicated in graph 12. (b). The peak at size class 2 instead of size class 1 is not what would have been expected if there had been considerable microblade core reduction. The flake tools can be seen to be of a variety of materials and cover a broad range of sizes, with heavy duty nuclear tools in addition.

The combined assemblage provided by EWA 31 and 32 are on the north bank of the northern tributary, on the margin of the site, and exposed by the tributary bank (Fig 12.9). This assemblage contains a slight majority of tuff over silcrete, and roughly an equal number of complete flakes to broken flakes. The range of materials is wider than in the case of EWA 29&30, though the number of artefacts is less. Size Indexes 1 and 2 are about equal, indicating a bias against small flake production, and with a substantial percentage of complete flakes in Size Index 3. The tools include unusual types such as a burren and a hammerstone. One backed blade was present, no microblade cores were recorded, and there was no evidence of a microblade workshop.

Also in the main group of exposures was EWA 36 to the south of EWA 29 & 30, on the margin of the tributary bank (Fig 12.10). This assemblage is dominated by tuff, and about half complete and half broken flakes for both the tuff and silcrete. Even though there are more artefacts present than assemblage EWA 31 &32, there are fewer material types. The debitage in Size Index 1 is slightly greater than in Size Index 2, and appears to be due to more broken flakes in Size Index 1. The reason for this breakage may have been the tendency to produce snapped flakes in microblade reduction. Microblade cores and backed blades are conspicuous, and even though relatively more microblade core reduction is indicated, there were no detectible microblade workshops present. As in the case of the EWA 29 & 30 area about 10 metres away, there is a wide size range of flake tool sizes.

The EWA 35 assemblage in mainly on a stock track along a tributary bank about 100 metres back from the main group of exposures near the edge of Bowmans Creek. Fig. 12.11. clearly shows the dominance of broken silcrete flakes which are due to the presence of a workshop consisting of burnt material. Although the broken debitage is mostly small sized and in Size Index 1, there are larger pieces as well and a substantial number of complete flakes in Size Index 3. This workshop seems to be oriented towards the production of relatively large flakes, and clearly is not related to microblade core reduction (the microblade core present was not part of the same type of silcrete). The artefacts from EWA therefore seem to be a workshop event in a zone of low density artefacts.

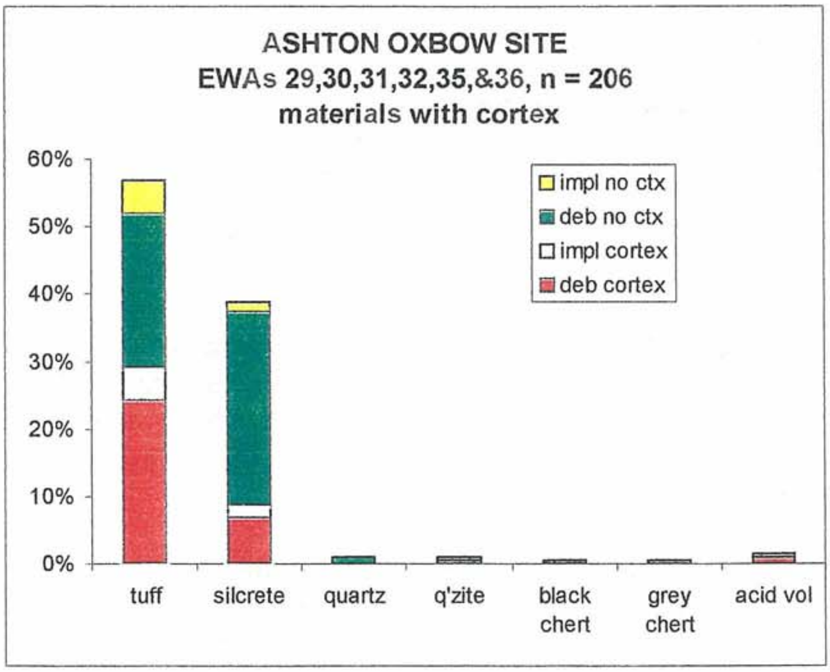


Fig. 12.7. Graph showing the proportion of cortex to materials for the Oxbow Site.

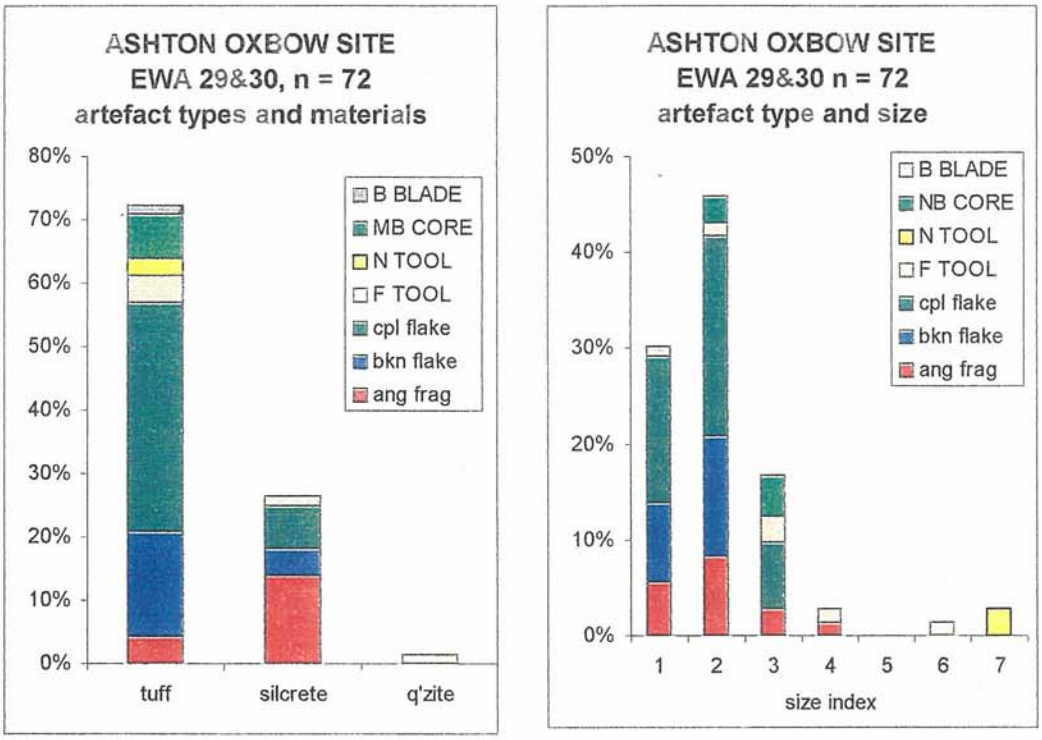


Fig. 12.8. Artefact assemblage graphs for the Oxbow site, EWA 29 & 30. (a) Artefact type and material, (b) artefact type and size.

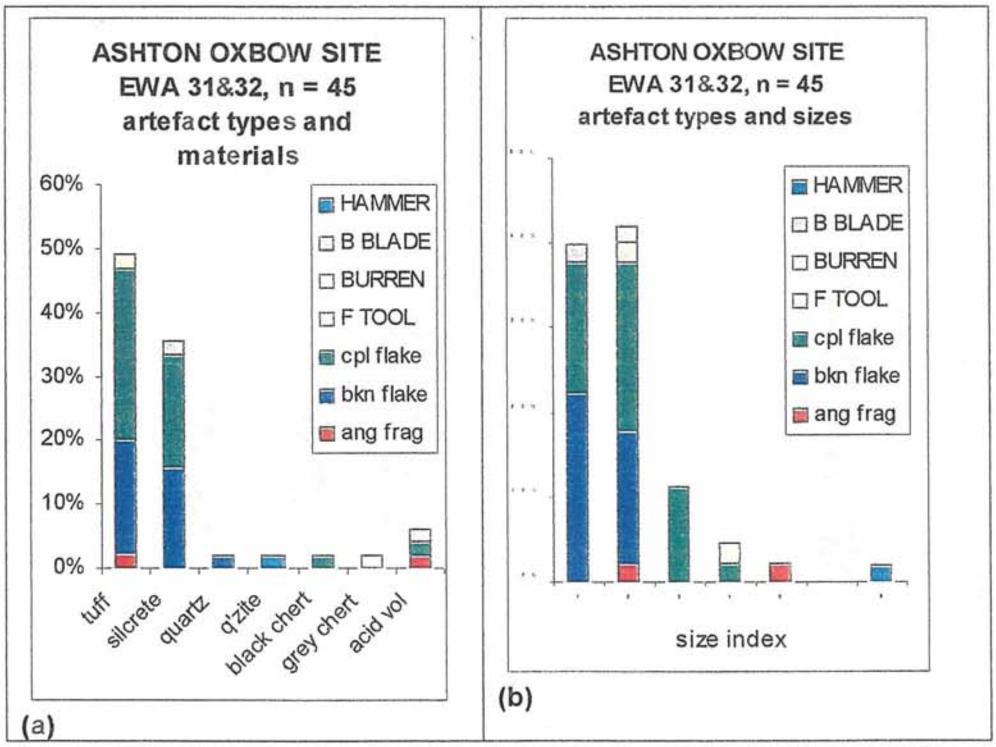


Fig. 12.9. Artefact assemblage graphs for the Oxbow site, EWA 31 & 32. (a) Artefact type and material, (b) artefact type and size.

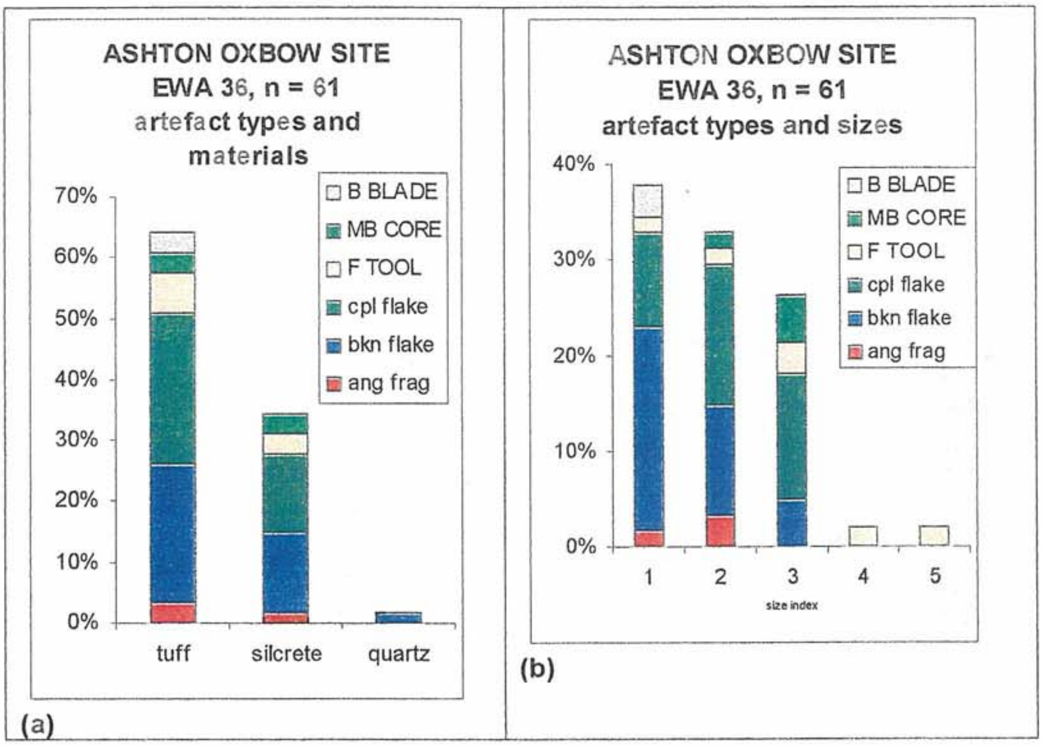


Fig. 12.10. Artefact assemblage graphs for the Oxbow site, EWA 36. (a) Artefact type and material and (b) artefact type and size.

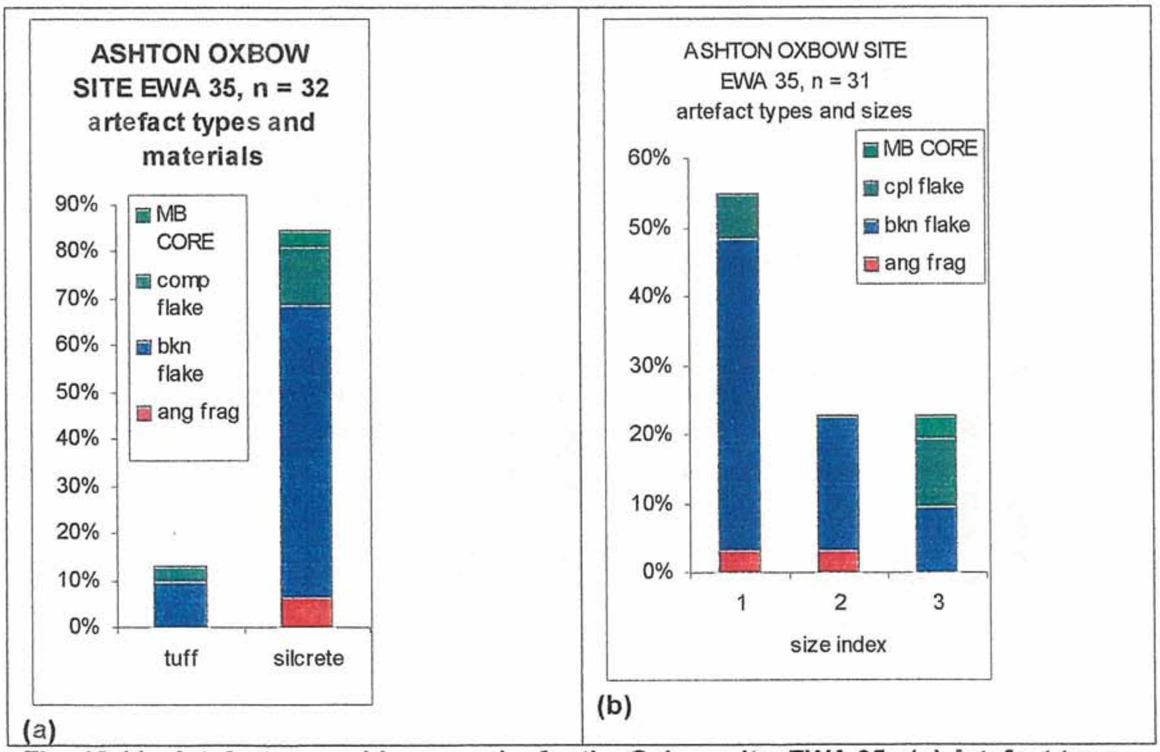
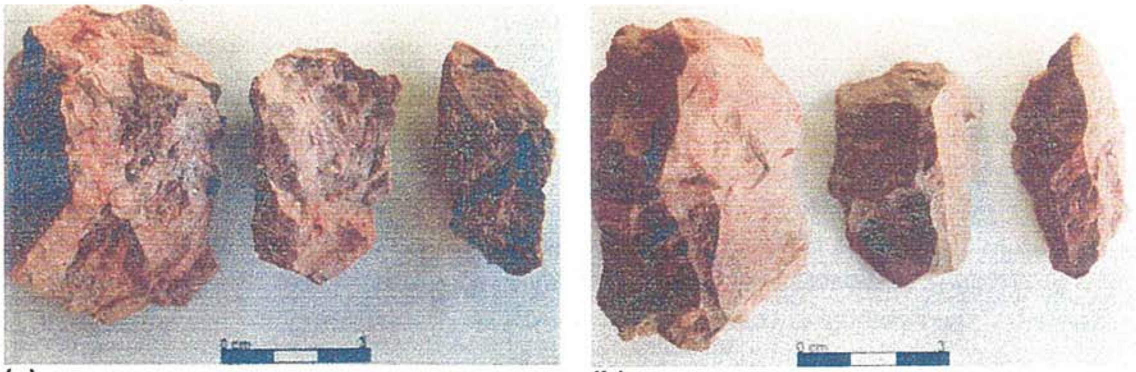


Fig. 12.11. Artefact assemblage graphs for the Oxbow site, EWA 35. (a) Artefact type and material, (b) artefact type and size.



(a) (b)

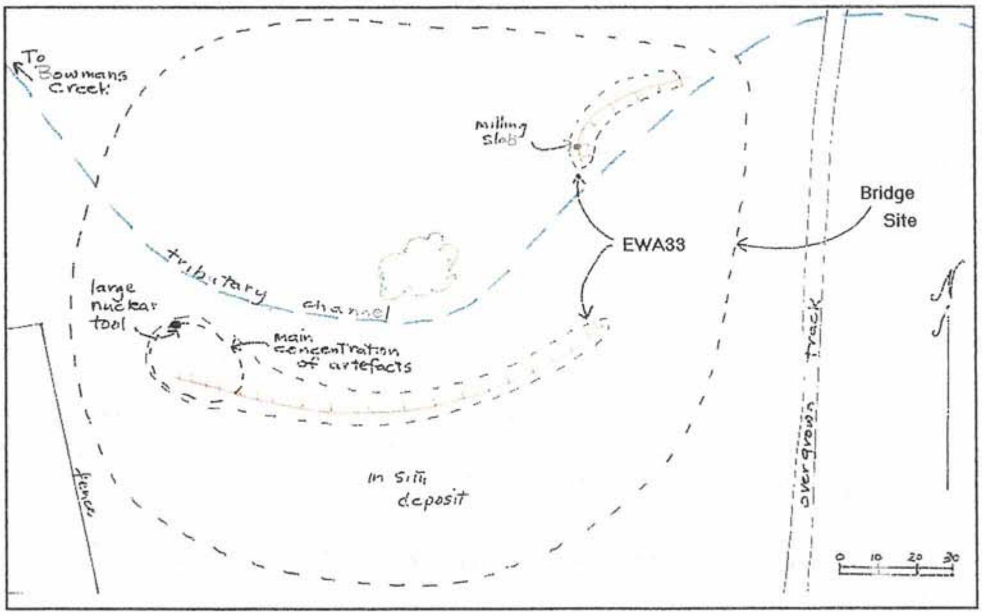
Plate 12.5 "Burnt Silcrete from EWA35. (a) Flake fragments showing the irregular fracture and crumbly texture of burnt silcrete. (b) Flake fragments showing potlidding from contact with excessive heat.

12.4.2 Oxbow Site Workshop at EWA 87

In addition to the above assemblages EWA 87 was about 400 metres south of Bowmans Creek but part of the same tributary valley system, and linked to the rest of the Oxbow Site by the artefacts in EWA34 (see Map 12.6). This exposure in the tributary banks (Table 7) includes a microblade workshop of 9 yellow tuff flakes and two microblade cores of a different tuff material. This seems similar to the EWA 35 workshop of burnt silcrete as a single event in a zone of low artefact density.

EWA	ang frag	bkn flake	cpl flake	implements	
87		4	3	Microblade core	2
Yel tuff		4	1		

Table12.7 Oxbow Site workshop EWA 87 artefact types



Map 12.7 EWA87 extension of the Oxbow site up a small tributary east of the farm road. This is a small yellow tuff microblade workshop exposed in the bank talus, and may be impacted by the Western Overburden Emplacement.

12.4.3. Oxbow Site Summary and Interpretation

By analogy with well-exposed sites in western NSW (Holdaway et al ...) the size of 400 by 150 metres is consistent with an ordinary encampment, and the Oxbow Site is probably a good example of a typical camping area. The occupation is focused on the high ground near the bank of Bowmans Creek, but extends further up the valley formed by the double tributaries where various other activities took place. Although 13 microblade cores were recorded, microblade core reduction seems to have been limited. The debitage is consistently relatively large, and a wide range of flake tools are present, both large and small. However, no cores were found for their production, although large nuclear tools were present.

The site is not explicable as a "microblade base camp". The Bowmans Creek bottom does not seem to have been swampy, providing wetland resources. The site contents are somewhat similar to the Waterhole Site, which is about 1 km up stream, There is a low density distribution of artefacts between the two (Homestead Site, including Ash 16 and 18 in Hardy 2002).

As suggested for the Waterhole Site, this site may have been related to fish traps, if the topographic map indication of a narrow channel without gravel bars obtained in the past. It also may have been part of the drought retreat system and occupied until Bowmans Creek dried up and it was necessary to shift to the Waterhole site.

12.4.4 Potential Deposit of the Oxbow Site

An area about 50 by 50 metres is located behind the main artefact concentration between the two tributaries which is likely to be a high density artefact zone and is undisturbed. There is further potential for small concentrations extending about 400 metres back from Bowmans Creek which also seem to be mostly undisturbed except for a dam on one tributary and a rubbish dump on the other. The only exposures are along the tributaries, and these seem not to have been cultivated, and this may be indicative of the entire site.

12.5 <u>Bowmans creek Valley other sites and exposures</u>

12.5.1 Brunkers Lane Site

This site is where a small tributary from the west side of the valley cuts through a terrace. The area has been heavily disturbed by earth moving and road construction. The few artefacts visible however indicate that a more extensive deposit is likely to be present, although this surface is likely to have been cultivated. This site is in the vicinity of the proposed Bowmans Creek channel diversion.

	ang frag	bkn flake	cpl flake	implements
Bruckers Lane Site	2	7	2	

Table 12.9. Brunkers Lane Site artefact types

A group of exposures were recorded by the previous survey (Hardy 2002) in the Ashton Homestead area as Ash 16, 17, 18 and 21. The contents of these exposures is shown in Table 12.9. These were mostly on gentle valley slopes over looking the Bowmans Creek valley bottom between the Waterhole Site and the Oxbow Site. An additional exposure with artefacts was found by this survey, and recorded as EWA 93. This exposure with six artefacts is in a small tributary bottom up from the Waterhole Site, and may be an extension of that encampment.

	ang frag	flake	core	tool
Ash 16	Tuff 4	Tuff 2, sil 4		
Ash 17	Tuff 3	Tuff 3	Sil 1	
Ash 18	Tuff 1	Tuff 2		
Ash 21		tuff		

Table 12.10. Ashton Homestead Site artefacts from Hardy (2002).

	ang frag	bkn flake	cpl flake	implements	n
EWA 93	3	2	1	Flake tool	2

Table 12.11. Ashton Homestead EWA 93 artefact types.

The Ashton homestead area was not further covered by this survey, but the evidence indicates the presence of artefacts in the zone between the Waterhole and Oxbow Sites, even though there has been some building disturbance.

12.5.3 Bowmans Creek Valley Isolated Finds

The survey recorded nine isolated finds elsewhere in the Bowmans Creek Valley (Table 12.10). These show proportions of artefact types consistent with the exposures of artefact concentrations. The poor reliability of exposures on the terraces and lower slopes on the east side of the valley is shown in Map 10.1(b). In particular, terrace margins where tributaries cut through to Bowmans Creek are not represented by exposures and are likely places for sites.

isolated find	ang frag	bkn flake	cpl flake	implements
EWA 50		1		
EWA 51			1	
EWA 52	1			
EWA 57		2		flake tool
EWA 80		1	1	
EWA 81		1		
EWA 89		1		
EWA 96			1	
EWA 97		1	2	

Table 12.12. Bowmans Creek valley isolated find artefact types.

12.6 Glennies Creek Valley

The Glennies Creek valley is the terraces and flood plain on the western side of Glennies Creek below the New England Highway. It also includes the lower slopes and tributaries which belong to Ashton Ridge. The exposures with artefacts are shown below in Table 12.13 in which it may be seen that a large site with abundant artefacts and several exposures is present as the Glennies Creek Site.

site name	survey unit	site type	easting	northing	landscape type
Glennies Creek Site	EWA61 ,62, 64, 65, 92, GG2	open camp site	318948	6403776	valley lower slopes and creek channel
Glennies Bluff Site	EWA 67,66	open camp site	319059	6404050	slope
Glennies flats Site 1	EWA 72, 73, 74	open camp site	319410	6404860	Gentle slope
Glennies flats Site 2	EWA 75	open camp site	319563	6404982	Tributary bottom
	EWA 60	isolated find	318798	6403400	Tributary bottom

(a)

site name	dimen.	criteria	exposure type	vis.	site contents	site condition
Glennies Creek Site	600 x 400 m	exposure, land form	bare patches, vehicle track	20%	238 + 60? artefacts, grinding grooves	most of area undisturbed & intact except for vehicle track
Glennies Bluff Site	70 x 3 m	Exposure	B lag Erosion bank	80	8 artefacts	Most of area undisturbed
Glennies flats 1	5 0 x 50 m	Exposure	A&B lag Track, bank	10%	13 artefacts	Most of area undisturbed
Glennies Flats 2	10 x 5	exposure	A&B lag, talus Gully bank	80%	13 artefacts	Prob not cultivated
EWA 60	20 x 2 m	Exposure	B lag Track	20	1 artefact	
EWA 66	70 x 3 m	Exposure	A&B lag, talus Rill banks	10	4 artefacts	

(b)

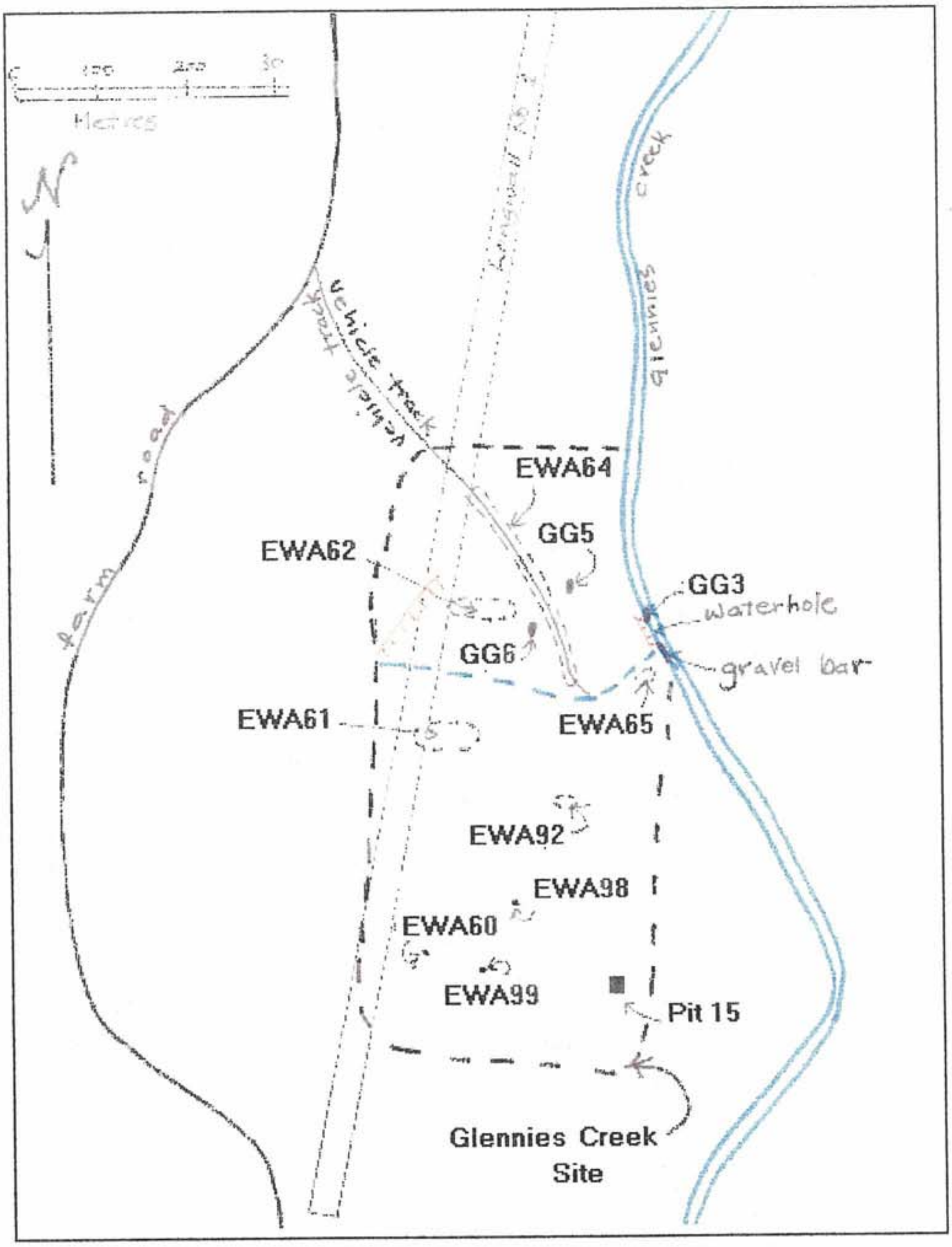
Table 12.13. Glennies Creek valley sites and isolated finds. (a) Locational data and (b) descriptive data.

12.7 Glennies Creek Site

The Glennies Creek Site is located at a large waterhole on Glennies Creek where it swings close to the valley side (Map12.18).. The site is mainly on the lower slopes and a terrace of the creek valley with a steep 30 metre high ridge slope behind. The site is about 600 by 400 metres in extent in which 236 artefacts were recorded and at least 60 more estimated to be visible.

The site is on the edge of a waterhole in Glennies Creek which is about 3 metres below a sandstone outcrop. Grinding grooves were visible on the sandstone under the water. The waterhole seems to have been formed by the creek being constricted by the sandstone and throwing up a massive gravel bar as a dam. The site contains a remarkable workshop of yellow tuff with 38 pieces in which 16 were flake tools. There also was a rhyolite workshop with 15 pieces which are mostly large.

Details for five exposures were recorded as shown in Table 12.14 EWAs, 61, 62, and 64 and 92, are on spur-like tongues that have gentle slopes and are divided from each other by narrow tributary valleys. EWA 65 which was on a high terrace on the creek bank and a tributary seemed to have a lower density of artefacts than the other higher exposures.



Map. 12.8. Sketch map showing the Glennies Creek Site.

EWA	dimen.	landform	exposure	vis.	n artefacts
Glennies Cr 1, EWA61	65 x 50 m	slope	A&B-lag	20%	48 + 20?
Glennies Cr 2, EWA62	60 x 20 m	slope	A&B-lag	20%	23 + 10
Glennies Cr 3, EWA64	150 x 50	slope	gravel lag	80%	95 + 20?
Glennies Cr 4, EWA65	20 x 10 m	terrace	alluvium	50	15 + 10?
Glennies Cr W/S, EWA92	12 x 4 m	slope	B-lag	30%	61

Table 12.14 Description of the EWAs in the Glennies Creek Site.

The EWA64 was a 150 metre vehicle track which was recorded in 10 metre sections in which there was about 80% visibility. These sections and the number of artefacts present are shown in Table 12.15. Note that the section 100 to 115 metres was blank because of grass cover. The zero starting point was up-slope where artefacts were beginning to appear. The end at 150 metres was where the vehicle track was largely covered by grass on the lower slope. The surface of the track was a hard B horizon with gravel, and it is likely that there had been some loss of artefacts down slope, particularly small sized ones. However, it may be seen there was a concentration between 10 and 30 metres as well as between 90 and 100 metres.

metres on track	0 10	10 20	20 30	30 40	40 50	50 60	60 70	70 80	80 90	90 100	100 115	115 120	120 130	130 140	140 150
n. artef.	2	21	14	6	3	6	1	1	3	14	xxx	4	5	2	6

Table 12.15. EWA64 numbers of artefacts per 10 metre intervals in vehicle track exposure.

12.7.1 Glennies Creek Site Artefacts

The 39 implements from the EWAs, except EWA92,belonging to the Glennies Creek Site are shown in Table 12.16. An additional 21 from the workshop at EWA92 are in Table 12.17, making a total of 60 implements. The implements in Table 16 show a wide range of flake tools in different resharpening stages, and include the specialised types projection ("drill") and burin. Nuclear tools are present as well as unifacial producer cores and bipolars. Of the ten microblade cores, four are trials, and no backed blades were recorded. A mortar with a 9 cm circular grinding facet and trimmed and hammer dressed to a bowl-like shape was also present.

The workshop EWA92 produced 21 flake tools including an elouera and a microconvex ("thumbnail scraper") with a working edge on both ends. In addition, there were six projection flake tools, one of which had a projection at both ends which might have been a microconvex, and one of which was made on a discoidal flake tool. Two of the projections had the tip snapped, presumably from use, and three had use-wear on the tip including one which had heavy step "twist"-like use-wear. The two with concave edges also were probably for specialised use. Among the flake tools with scalar retouch one showed very heavy use-wear, possibly from bone-sawing. This workshop was a single intensive event which belonging to a highly specialised set of activities. This seems to have included boring holes and carving.

implement type	implement stage	number
flake tool	usewear	2
	scalar retouch	4
	step retouch	7
	cuspate retouch	4
	projection	1
	burin	1
nuclear tool	usewear	1
	unifacial	3
producer core	bipolar	2
	uniplatform	3
microblade core	trial	4
	burin blade	2
	faceted	1
	rotated	1
	broken	2
mortar	1 facet	1

Table 12.16 List of implements in the Glennies Creek Site EWA 61,61,64&65.

(a) (b)

Plate 12.6. Artefacts from the Glennies Creek Site.
(a) Mortar with circular grinding facet in the centre from EWA61. The margins have been trimmed and the back shaped by hammer dressing.
(b) Small milling slab at EWA98.

implement type	implement stage	number
flake tool	usewear	4
	scalar retouch	6
	step retouch	1
	projection	6
	concave	2
	microconvex	1
	elouera	1

Table 12.17 List of implements in the Glennies Creek Site, flake tool workshop EWA92.

The cortex present is shown in Fig. 12.11. The two tuff workshops (pink and yellow) are shown separately, and are mainly without cortex. The remaining tuff and silcrete debitage however have a decidedly high proportion of cortex, as does the tuff implements. This is in contrast to both the Waterhole and the Oxbow Sites in which the proportions of cortex or no cortex for tuff was about equal and there was a lesser amount with cortex for silcrete. In all three sites the material from the local conglomerate (quartz, quartzite and black chert) are present but not common.

The assemblage data for EWA61&61 is shown in Fig.12.12. These artefacts were on two slopes divided by a narrow tributary valley and covered with regenerating casurina. The artefacts were emerging from the A2 and sometimes B horizon. A small pink tuff microblade workshop was present. Tuff was clearly the dominant material for this assemblage. There was a slightly greater amount of broken debitage compared to complete flakes for both tuff and silcrete. The Size Index distribution is very different from either the Waterhole or Oxbow sites, with a very high percentage in Size Index 1. This may have been influenced by the additional flake breakage, and conditions of exposure. However, it seems unlikely that the exposure conditions of the Oxbow Site differed greatly from EWA61&62 of the Glennies Creek Site. A wide size range of flake tools are indicated, mostly larger than the complete flakes being made. These may have been carried in from manufacturing locations elsewhere

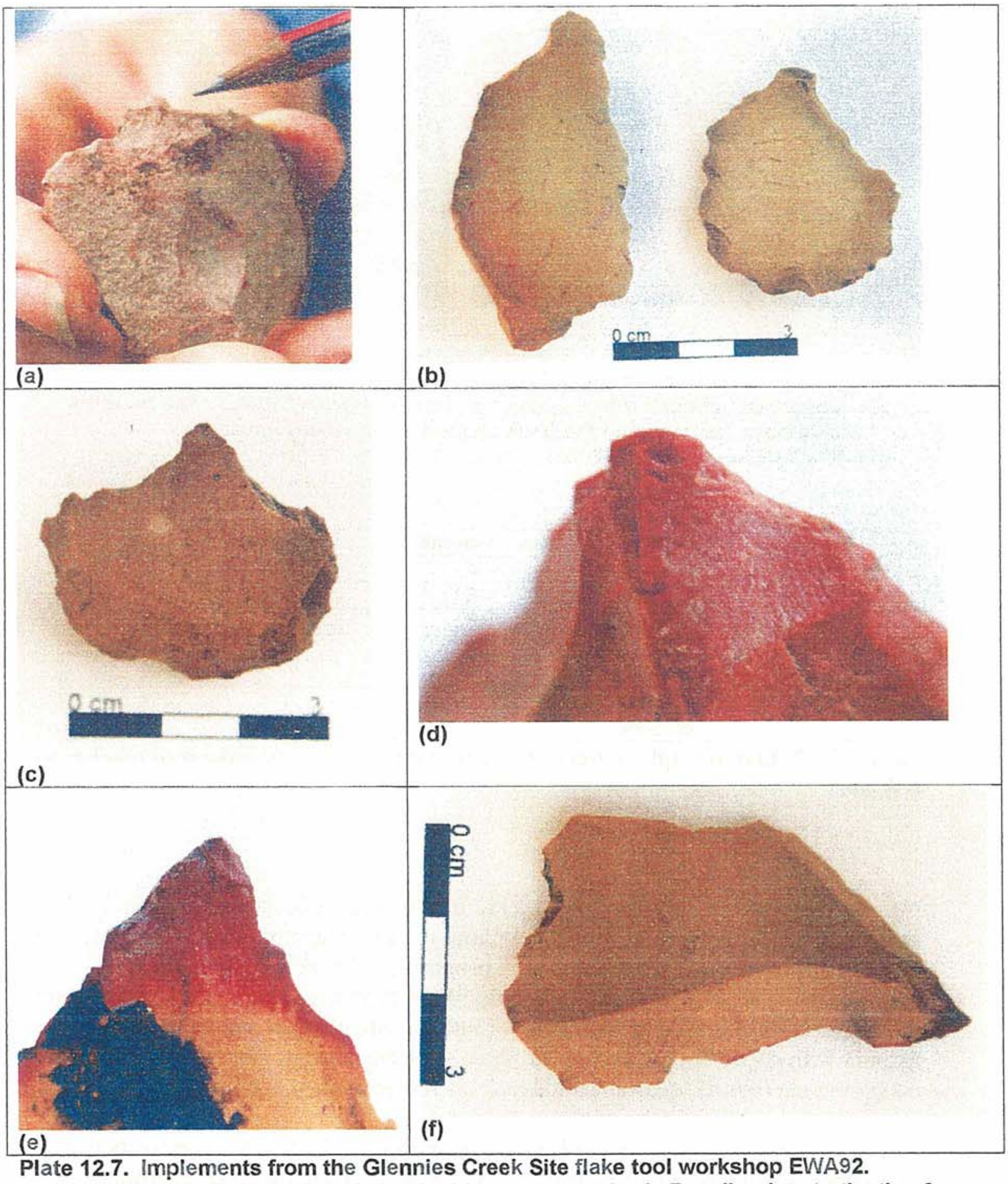


Plate 12.7. Implements from the Glennies Creek Site flake tool workshop EWA92.

a) Projection flake tool made by the bi-concave method. Pencil points to the tip of the projection.

(b) Two projection flake tools, one of which has a snapped tip. This presumably took place dring use since it is not a fresh break.

(c)Projection with a complete tip made by the bi-concave technique.

(d) Close up of step-terminated usewear flakes on the tip of a projection.

(e) Tip of a projection showing fine retouch and usewear.

(f) The full view of the tool in (e), showing that the projection was made on the end of a pointed flake.

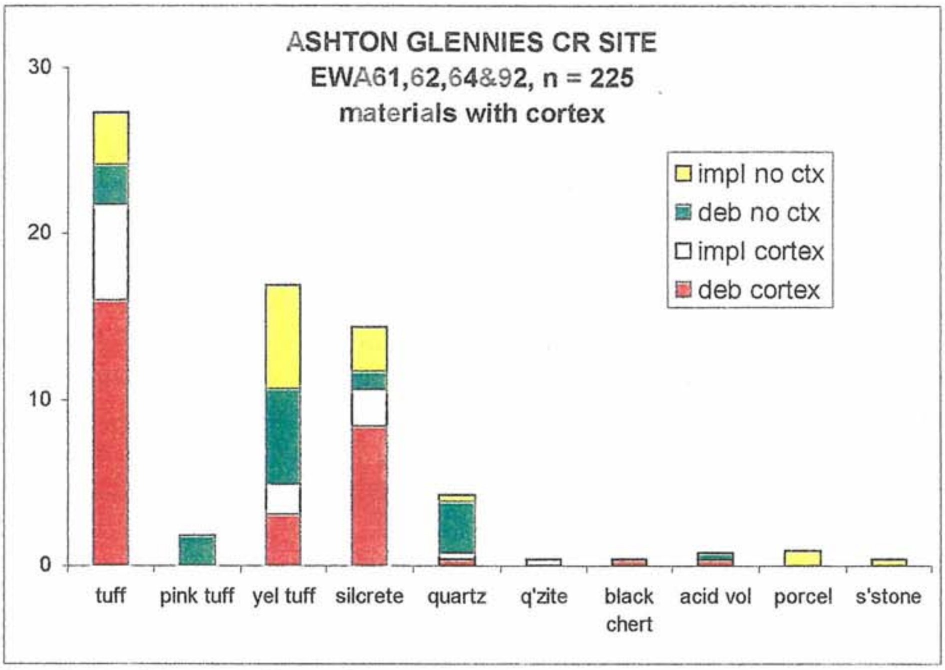
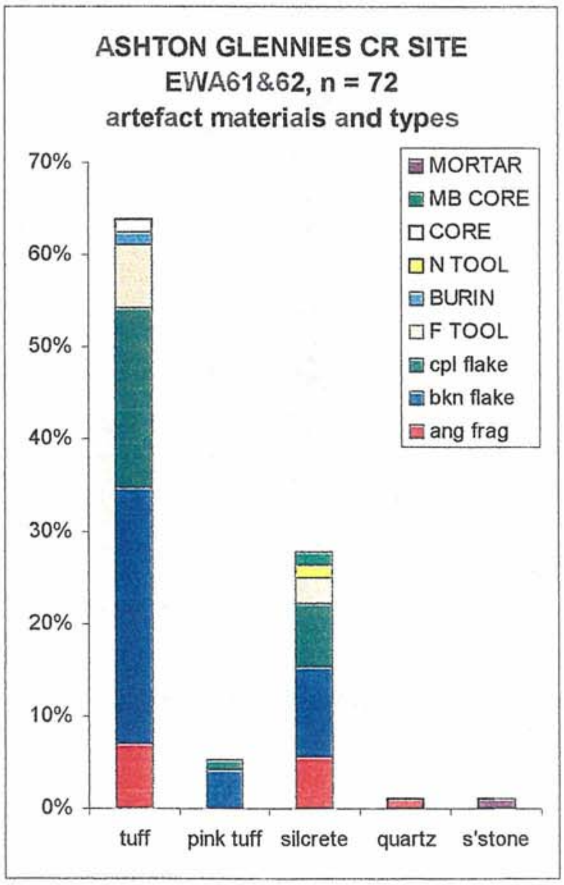
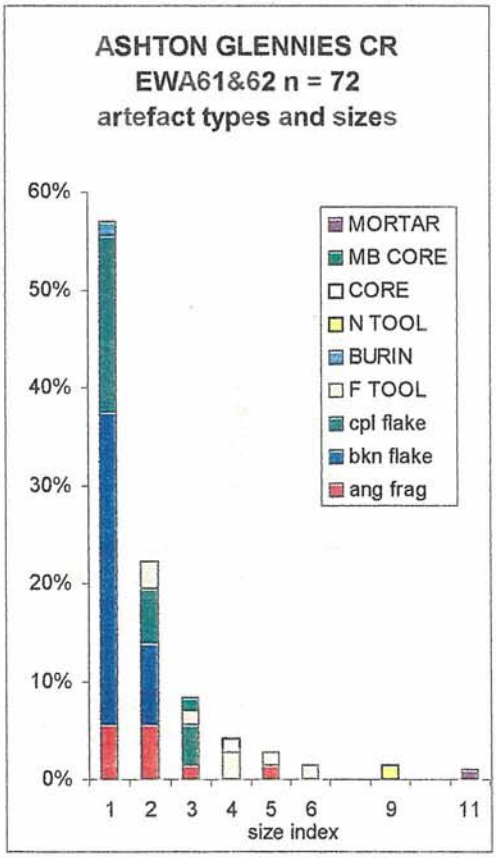


Fig 12.12. Glennies Creek Site materials and percentage cortex.





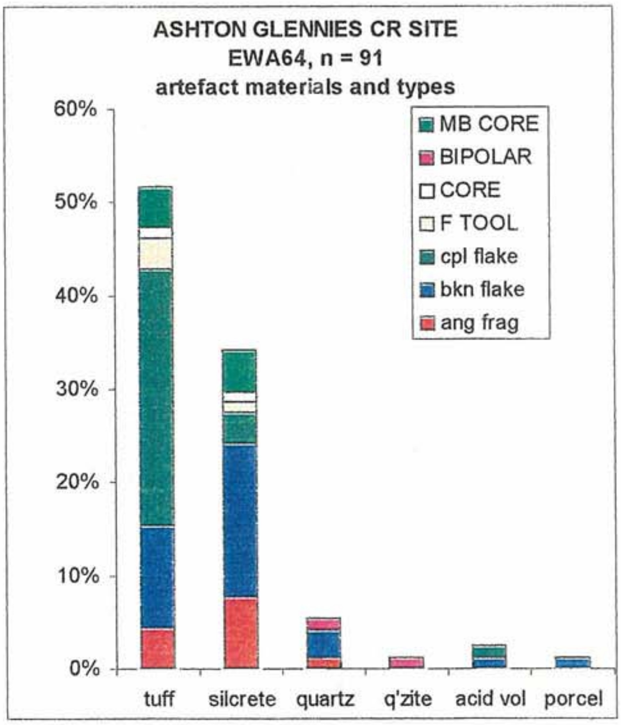
(b)

(a)

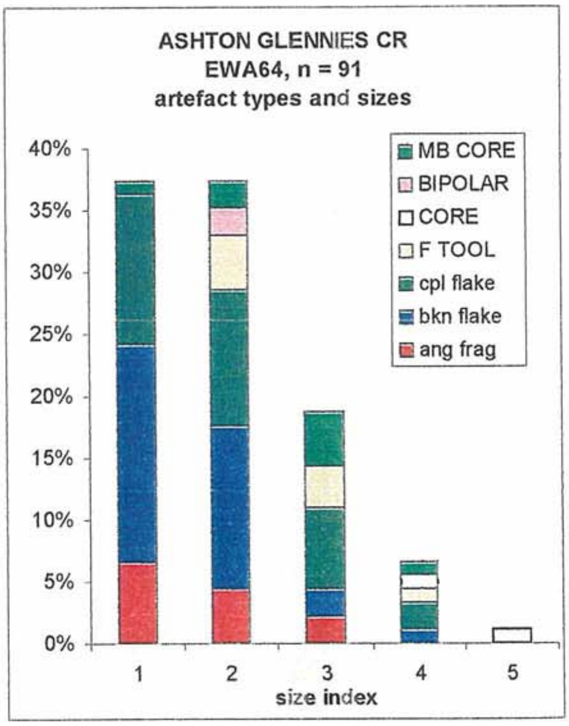
Fig. 12.13 Artefact assemblage graphs for the Glennies Creek EWA61&62. (a) Artefact type and type and (b) artefact type and size.

The EWA64 assemblage was from a 150 metre vehicle track (see Table 12.15). The effect of vehicle traffic is not clear since there are more complete tuff flakes than broken ones yet more broken flakes than complete for the silcrete. Some loss of the Size Index 1 artefacts can be anticipated due to heavy down-slope run-off on the track. This seems to be reflected in Fig. 12.14 (b) in which there is nearly as much Size Index 2 debitage as for Size Index 1. The flake tools are well represented in a variety of sizes as are microblade cores. There is however no indication of a microblade workshop, although this would have been noticeable if one had been cut by the edge of the road.

The workshop at the lower end of the slope to the south of the site was exposed as a small 12 by 3 metre patch (EWA92) in a power line vehicle access track. As described above this was a single event with the reduction of a yellow tuff core to provide a remarkable range of specialised flake tools, and a few additional specialised flake tools from different materials were present as well (Table 12.15). This is illustrated in Fig 12.15 (a). Almost all of these tools were small-sized for fine-duty work (Fig 12.15b).



(a)



(b)

Fig. 12.14. Artefact assemblage graphs for the Glennies Creek Site EWA64. (a) Artefact type and material, (b) artefact type and size.

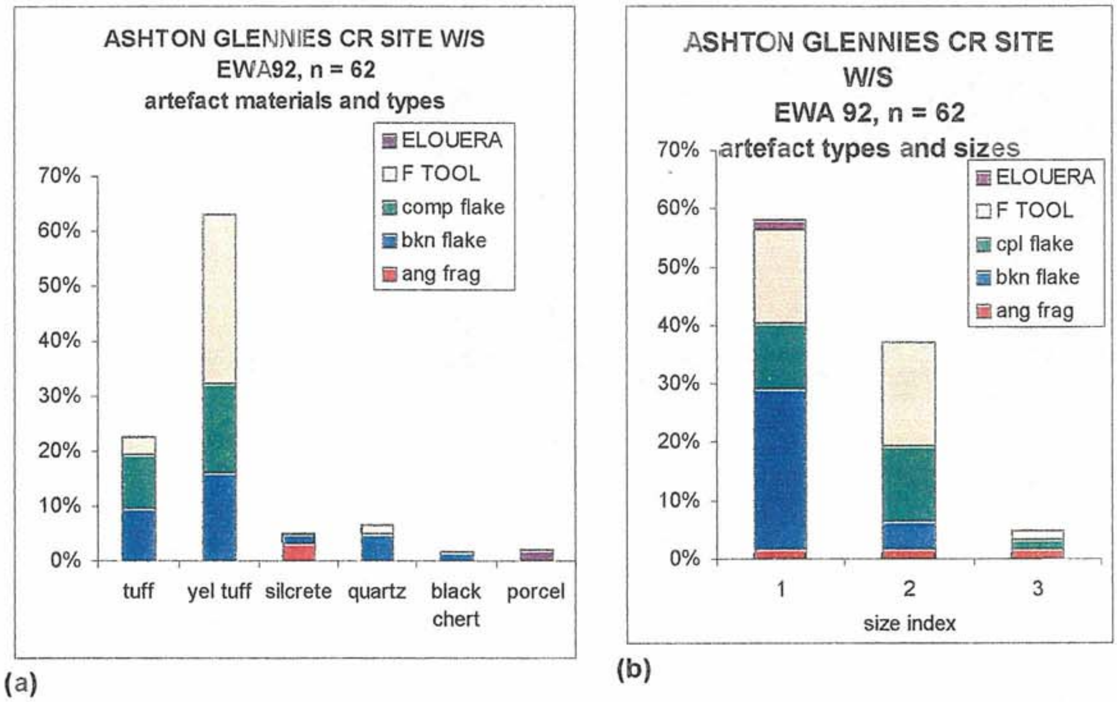


Fig. 12.15. Artefact assemblage graphs for the Glennies Creek Site tool workshop. (a) Artefact type and material, (b) artefact type and si

12.7.2 Glennies Creek Grinding Grooves

Four grinding grooves (GG2) were located on a sandstone ledge by the water hole. These were in a 1 by ½ metre area at water level. A outcrop about 2 ½ by 1 ½ metres was located on the bench about 50 metres back from the creek bank which had a single grinding groove (GG5). By the track, about 100 m from the creek bank was another sandstone outcrop about 1 metre ½ metre which had 4 grinding grooves (GG6). The details of the grooves are shown in Table 12.18.

site	groove	Dimensions	Depth
GG2	1	43 x 7 cm	8 mm
	2	25 x 7 cm	5 mm
	3	29 x 5 cm	shallow
	4	23 x 4 cm	shallow
GG5	1	24 x 5 cm	
GG6	1	49 x 7 cm	shallow
	2	29 x 6 cm	shallow
	3	21 x 5 cm	shallow
	4	28 x 6	12mm

Table 12.18. Glennies Creek grinding grooves.

12.7.3 Summary and Interpretation of Glennies Creek Site

The Glennies Creek Site is interpreted as an encampment of at least 600 by 400 metres. Patches of exposure and soil pits indicate a drop in artefact density to the southern end. The site however might extend for 100 m or more to the north, but exposures on the steep slopes imply a limit. Thus the site is distributed over a slope

Creek Site Grinding Grooves

(a)

(b)

Plate 12.7. Grinding grooves at Glennies Creek waterhole. (a) Grooves on ledge at water level (GG2). (b) Grooves on boulder away from the creek bank (GG6).

which is divided into three, possibly four, sections by small tributaries. These sections are in the order of 100 x 300 metres in size and each potentially offer sufficient room for a camp The narrow strip of terrace in front may also have provided an additional camp space. It is conceivable therefore that this site could have been occupied by several different Aboriginal groups camping together.
During the survey it was noted that although artefacts were numerous, they were not present in great abundance. In the case of the vehicle track exposure for EWA64, the two metre wide 10 to 20 metre section with 12 artefacts and 80% visibility would have had an effective density of 1.3 sqm per artefact. Even if half of the artefacts had been washed away, this is not a high density. If therefore, this place had been used by multiple groups coming together, such an event may not have been frequent or of long durations.
Tuff was the dominant material, similar to the Waterhole and Oxbow Sites. At the Glennies Creek Site there are more tuff artefacts with cortex than those without. The silcrete a higher proportion of without cortex than with. However, the Waterhole and Oxbow sites both have the cortex in about equal proportions for the tuff, and for the silcrete there is a greater proportion with cortex. These relationships suggest differences in the supply of raw material. If so, then the distance of three or four km and an intervening 30 mete high ridge had significant effects for stone material transport. It may be noted however that all three sites showed a strong selectivity for tuff and silcrete, and only occasional use of pebbles from the local conglomerate, or even the acid volcanic rhyolite-like material in the stream gravels.

There is evidence for more small debitage at the Glennies Creek Site than the Waterhole or Oxbow Sites, even considering differences in exposure. This is not attributable to substantial microblade production, and may have been from resharpening large flake and nuclear tools. Specialised tool types such as the projection, elouera and burren were present on the three large camp sites, but it is the yellow tuff workshop that gives the Glennies Creek Site the appearance of greater specialisation. All three sites also had numerous microblade cores, but with meagre evidence of workshops and few backed blades. In all three sites the "trial' type of blade core was conspicuous.

It has been suggested for the Waterhole and Oxbow Sites that drought retreats or fish-trap camps might be plausible functions, and the same seems to apply to the Glennies Creek Site. Indeed it is possible that steep narrow banks may have been both suitable for the construction of fish traps as well as provide deep waterholes. If so, there may have been a preference for the Glennies Creek Site for fish traps. It would accommodate multiple groups to join for fishing, but as a relatively infrequent event, and perhaps the varied and specialised flake tools belonging to the yellow tuff workshop were related to the manufacture of fishing gear.

12.7.4 Potential Deposit of Glennies Creek Site

The majority of the 400 by 600 area of the site is intact. The part on the terrace may have been cultivated, and there is some disturbance on the vehicle track. About two thirds of the occupation is on the slopes under the juvenile casuarina trees, and is slowly eroding because of the lack of ground cover and trampling by cattle. In general however the condition of this site is outstanding. It also is adjacent to Pit 15, the only buried Pleistocene surface found in the study area (Plate 12.8). Pit 15 is discussed in the report by Mitchell (2002) on the geomorphology which is included as Appendix 5 in this report.


(a)


(b)

Plate 12.98 Buried soil with an artefact *in situ*.
(a) Barry Anderson in Pit 15 showing the location of an *in situ* artefact in the wall section.
(b) Detail of *in situ* artefact. The white horizon belongs to a later soil.

12.8 Other sites and Exposures in Glennies Creek Valley

12.8.1 Glennies Bluff Site

The Glennies bluff site was on a relatively steep slope overlooking Glennies creek where it cuts into Ashton ridge and forms a bluff. Twelve artefacts were found in two exposures on a steep slope on the valley side (Table 12.19). Although a domestic camp seems unlikely in such a location, other kinds of activities are indicated. This may be indicated by relatively numerous flake tools (four) which were present.

EWA	ang frag	bkn flake	cpl flake	implements	n
67, 66		2	6	Flake tool	4

Table 12.19 Glennies Bluff Site artefact types.

12.8.2 Glennies Flats Sites

The lower slopes of Glennies Creek valley south of the New England Highway produced exposures indicating a light concentration of artefacts in the area, and 22 were recorded (Table 12) of which five were implements. These may be an extension of activities on the near by cultivated terrace.

EWA	ang frag	bkn flake	cpl flake	implements	n
72, 73,74.75		7	10	flake tool nuclear tool producer core microblade core	1 1 1 2

Table 12.20 Glennies Flats Sites artefact types.

12.8.3. Glennies Creek Valley Isolated Finds

The area of Glennies Creek valley south of the large Glennies Creek Site was little covered since it was mostly outside of the area of potential subsidence. However, an isolated find was present, and other exposures could be expected to also produce artefacts in this area.

EWA	ang frag	bkn flake	cpl flake	implements
EWA 60			1	

Table 12.21. Glennies Creek valley isolated finds artefact types.

12.13 Bettys Creek Valley

This is the southern slopes of Bettys Creek valley. It is bounded by the railway line, and none of the valley bottom terraces were in the study area. The sites recorded are shown in Table 12.22. Three sites were analysed for this valley: the Railway Site, Tributary Site and Slope Site.

site name	survey unit	site type	easting	northing	landscape type
Railway Site	EWA15,53,54&55	Open camp site	320384	6407026	lower slopes and tributary valley
Tributary Site	EWA14	open camp site	320603	6406916	tributary margin
Slope Site	EWA18	open camp site	320278	6406766	tributary slopes
	16	isolated find	320124	6408981	tributary bottom
	17	isolated find	319974	6406963	flat spur slopes
	25	isolated find	319418	6406709	tributary bottom

(a)

site name	dimen	criteria	exposure type	vis.	site contents	site condition
Railway Site	400 x 10 m	exposure, landform	Gravel lag track, bare patches	10%	38 artefacts	bladed, disturbed, some intact
Tributary Site	20 x 10 m	landform	A lag, talus gully bank, bare patches	20%	45 artefacts	erosional front, mostly intact
Slope Site	40 x 10m	exposure	A lag Bare patches	50%	8 artefacts	
EWA 16	15 x 10 m	exposure	A&B lag Bank, track	20%	2 artefacts	
EWA 17	50 x 2 m	exposure	B lag Track	40%	1 artefact	
EWA 25	60 x 10 m	exposure	A&B lag Gully bank	20%	1 artefact	

(b)

Table 12.22 Bettys Creek valley sites and isolated finds. (a) Locational data and (b) descriptive data.

12.10 Railway Site

The railway site is on the lower slopes of Bettys Creek valley where it is exposed by the bladed service track. This cuts through a larger site area which apparently extends out on a terrace surface on Bettys Creek valley bottom (Jan Wilson, pers. com.). Thus the Railway site is probably on a peripheral portion of the main site. The site is mostly between two tributaries which are about 500 metres apart. In addition to EWA15 which provided most of the artefacts, other exposures associated with the eastern tributary valley have been included to make up the site area, as shown in Table 12.23.

EWA	dime.	landform	exposure	vis.	n artefacts
15	75 x 7	slope	vehicle track gravel lag	40%	34
53	40 x 4	slope	vehicle track gravel lag	20%	2
54	30 x 30	slope	bare patches, A-lag	10%	1
55	3 x 1	slope	bare patches, A-lag	20%	1

Table 12.23. EWAs belonging to the Railway Site

A major part of the site area has been destroyed by the railway and disturbance in the easement. Most of the artefacts were recorded from the bladed vehicle track, or along the edge. The intact deposit which extends further up slope is probably a marginal area with a low density of artefacts.

12.10.1 Railway Site Artefacts

The implements recorded are shown in Table 12.24. These include a "spall tool" A spall tool is a natural nuclear fragment which is relatively flat and thin and has been retouched in the manner of a flake tool. The one from this site was flaked completely around the margin. A flake tool was also retouched completely around is margin, including the platform end as a second discoidal. Microblade reduction is indicated by a microblade core and a backed blade.

implement type	implement stage	number
flake tool	use-wear	1
	cuspate	1
	discoidal	1
spall tool	discoidal	1
nuclear tool	unifacial	1
microblade core	prismatic	1
backed blade	broken	1
axe	preform	1

Table 12.24 List of implements in the Railway Site

The percentages of cortex on the various materials is shown in Fig 12.16 in which tuff and silcrete are in about equal proportions. The tuff debitage is about half with cortex and half without, and none of the silcrete has cortex.

Graphs of the artefact assemblage is shown in Fig. 12.17. The somewhat higher proportion of broken debitage in Size Index 1 is probably due to breakage from blading and vehicle traffic. The tools are mostly large sized. The nuclear tool which is Size Index 7 and the axe preform are both from the tributary valley to the east, and are probably a more peripheral part of the encampment.

12.10.2 Railway Site Summary and Interpretation

The Railway Site seems to be part of the back fringe of a large encampment which is along Bettys Creek Valley. Some microblade activity is indicated, plus some resharpening of large sized tools.

12.10.3 Railway Site Potential Deposit

The deposit associated with the Railway Site is heavily disturbed by a bulldozed track. The remaining deposit up slope seems to be intact, but with likely decreasing densities of artefacts.

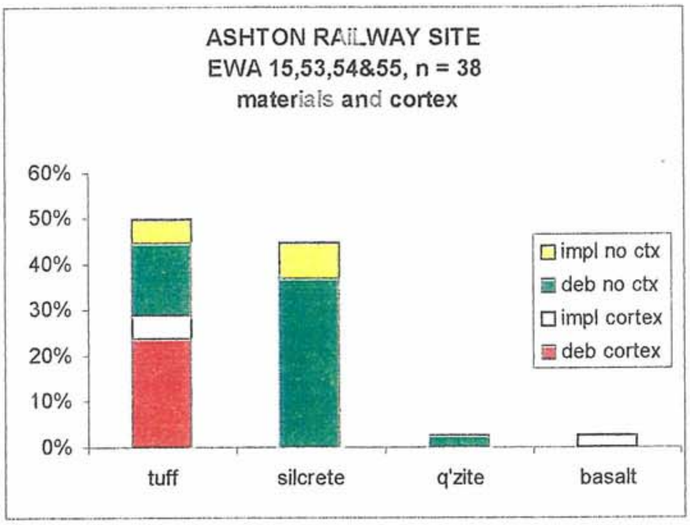


Fig. 12.16. Materials and cortex from the Railway Site.

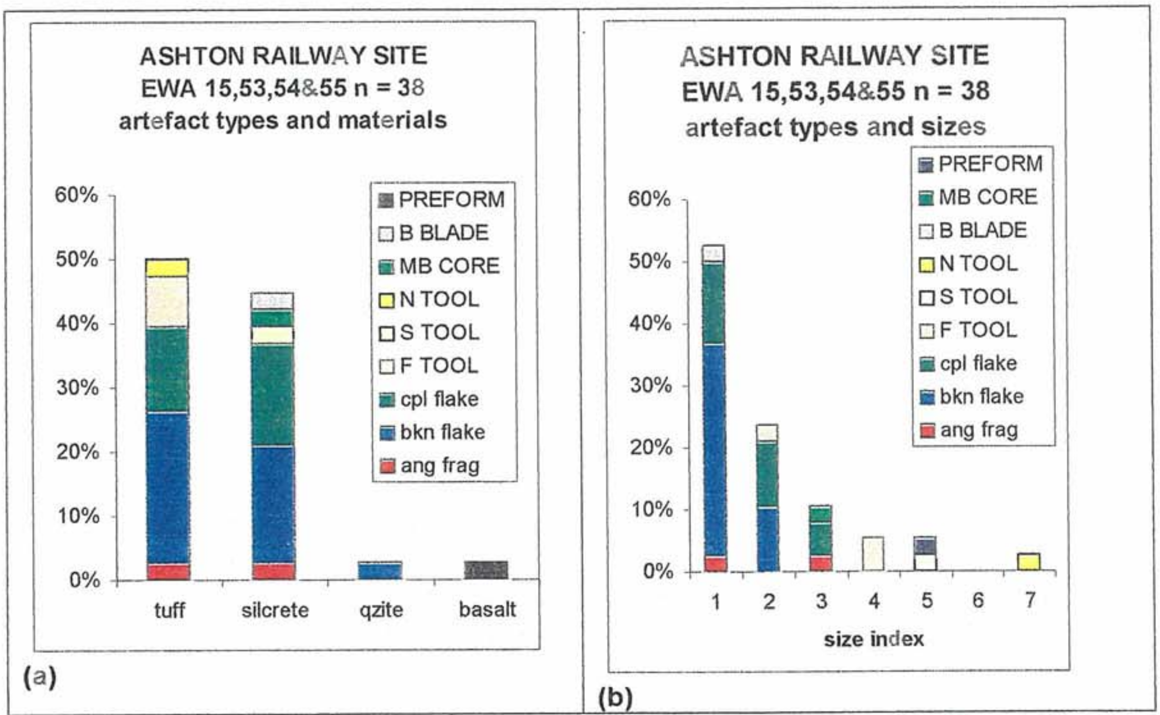
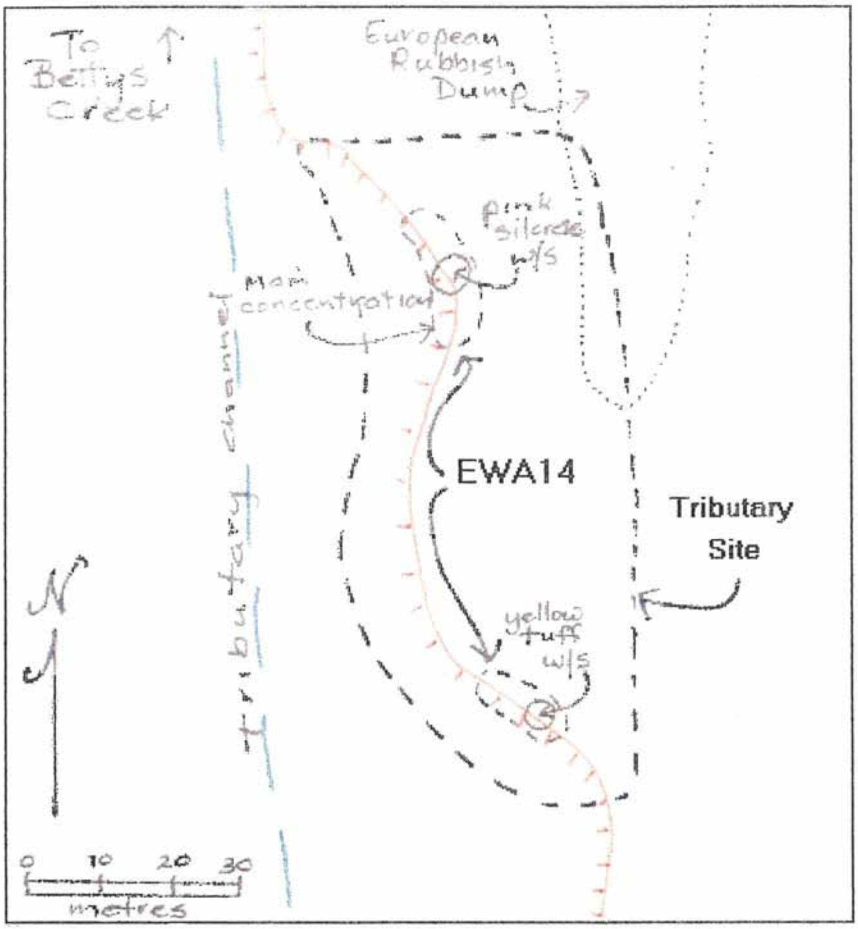


Fig. 12.17. Artefact assemblage graphs for the Railway Site. (a) Artefact type and material, and (b) artefact type and size.

12.11 Tributary Site

The tributary site is about 200 to 300 metres up the east tributary from the Railway Site on Bettys Creek valley. The exposures indicate that is a well contained artefact concentration about 20 by 10 metres in size (Table 12.26), apparently not continuous with the Railway Site.



Map 12.9. Sketch map showing the Tributary Site.

12.11.1 Tributary Site Artefacts

The implements from the Tributary Site consist of backed blades, flake tools and a nuclear tool (Table 12.25). The materials and cortex graph (Fig 12.18) indicate the presence of a workshop of pink silcrete and another of yellow tuff. Cortex is mostly lacking on the debitage, except for the non-workshop tuff which is about half and half.

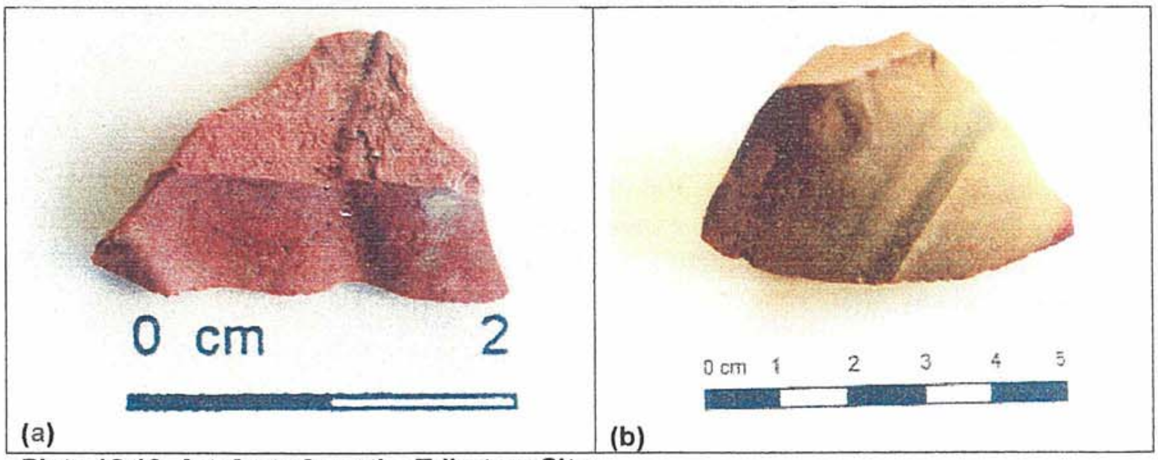


Plate 12.10 Artefacts from the Tributary Site.
(a) Geometric backed blade from the pink silcrete workshop.
(b) Flake tool of tuff on an expanded flake with fine usewear on the distal edge.

implement type	implement stage	number
flake tool	usewear	2
	cuspate	1
nuclear tool	unifacial	1
backed blade	bondi	1
	geometric	1
	broken	1

Table 12.25. List of implements in the Tributary Site

The assemblage for the Tributary Site is shown in Fig. 12.18. The proportions of complete and broken debitage vary for the different materials. The pink silcrete with the backed blades is mainly broken flakes. It is typical for the thin elongated flakes made during microblade production to break at the moment of detachment. The high percentage of debitage in Size Index 1 also reflects a substantial microblade core reduction in the assemblage. The quartz debitage and large tools indicate that other activities were present besides microblade production.

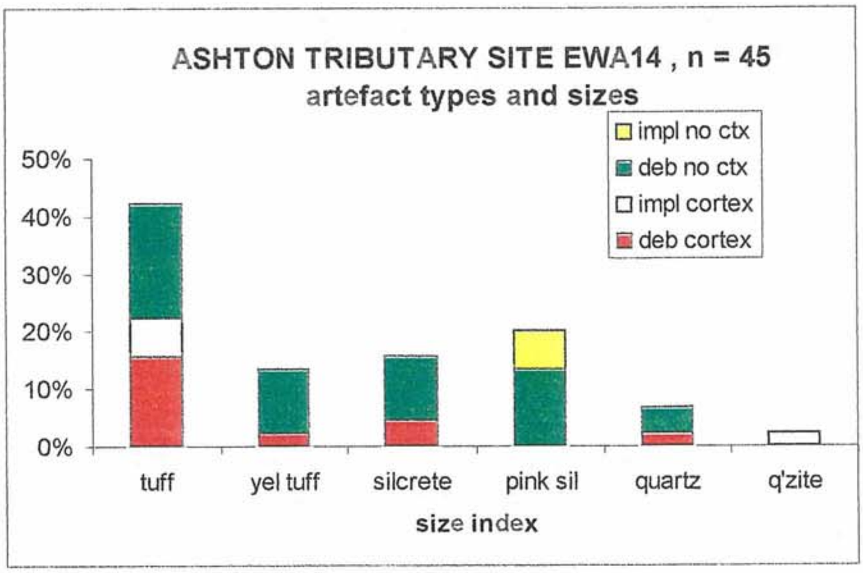
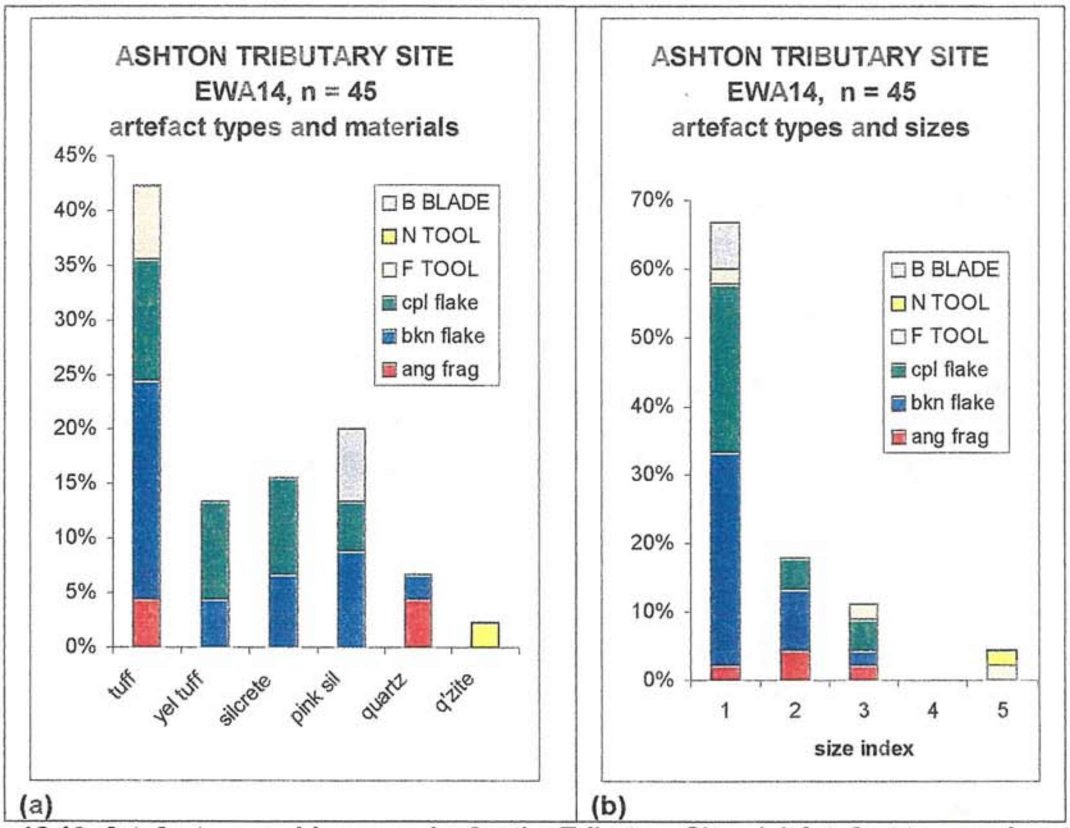


Fig. 12.18. Materials and cortex for the Tributary Site

12.11.2 Tributary Site Summary and Interpretation

This site seems to be a small isolated location up a tributary, away from the Bettys Creek bottom, and the occupation on the ridge. The pink silcrete shows a clear microblade component. And the yellow tuff workshop also seems to be from a microblade core (with a distal blade fragment Appendix 3). Observations made on-site indicate that these workshops were not of the large concentrated types common in the Hunter Valley, but of limited size. The Tributary Site therefore seems to be an example of a "satellite camp" or "maintenance camp" occupied at a time when the small tributary was able to provide water.



12.19 Artefact assemblage graphs for the Tributary Site. (a) Artefact type and material and (b) artefact type and size.

12.11.3 Tributary Site Potential Deposit

Only part of this site seems to have been lost by gully bank erosion, and most of the deposit appears to be intact. The European rubbish dump which is present at the site has probably not caused any disturbance.

12.12 Betty Creek Valley, other sites and exposures

12.12.1 Slope Site

The Slope Site is on the side of a small tributary valley. Only eight artefacts were found (Table 12.26), and these were all angular fragments and broken flakes of unusually large size (Fig 12.). No tools, or conventional workshop debris were found. An explanation for this occurrence is elusive.

EWA	ang frag	bkn flake	cpl flake	implements
18	5	3		

Table 12.26 Slope Site artefact types.

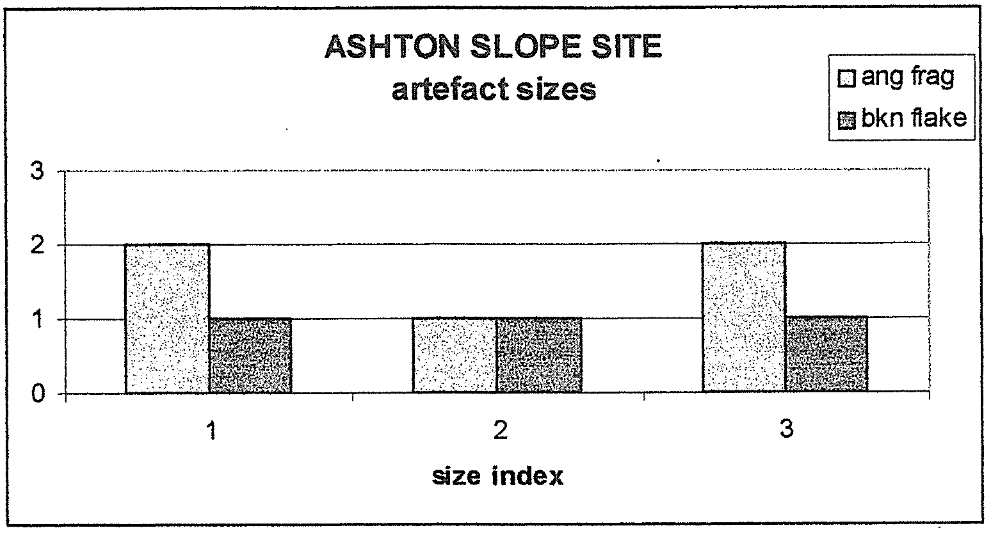


Fig. 12.19 Graph showing large sized angular fragments and broken flakes at the Slope Site.

12.12.2 Bettys Creek Valley Isolated Finds

Additional isolated finds were found in exposures in Bettys Creek Valley as show in Table 12.27.

EWA	ang frag	bkn flake	cpl flake	implements
EWA 16	1		2	
EWA 17				Flake tool
EWA 25	1			

Table 12.27. Bettys Creek Valley isolated find artefact types.

12.13 Ashton Ridge

The Ashton Ridge sites are artefact concentrations, or clusters of exposures with artefacts on the crest and upper spurs, tributaries and slopes on the Ashton Ridge. The Ashton ridge begins in the south on the edge of the Hunter River bottom and continues north between Bowmans Creek and Glennies Creek. It then turns east where Bettys Creek enters Bowmans Creek. From there it lies between Bettys and Glennies Creeks where it swings around to the south to contain the big loop of Glennies Creek that is where the village of Camberwell is located. This southern extension is not in the study area but is bounded by the Glennies Creek road. The sites recorded are shown in Table 12.28.

12.14 Ridge Top Site

The Ridge Top Site is on the broad gently sloping crest of Ashton Ridge. The main exposure is a vehicle track which cuts through it, but there are also a few bare patches with artefacts. The vehicle track provides a transect which indicates that although artefacts are present, the density is low, and with few concentrations. The EWAs which have been grouped to make up the assemblage are listed in Table 28a7b.

site name	survey unit	site type	easting	northing	landscape type
Ridge Top Site	EWA1,2,3,4,5,6&7	Open camp site	320920	6406428	Broad ridge crest
Fire Break Site	EWA8,10,12,13, 22,23	Open camp site	320518	6406443	Spur crests
TSR Site	EWA 20,21,24,26, 27,37, 38,39,88	Open camp site	319727	6406284	Upper slope tributary
High Ridge W/S Site	EWA76,79,83, 84, 85&86	Open camp site	319096	6405565	Shoulder of ridge
Ridge Peak Site	EWA41,40, 42,43, 44,45,58&59	Open camp site	318933	6404325	Peak and crest of ridge
High Spur Site	EWA46,47,48, 49	Open camp site	318390	6403574	Spur crest
	EWA 9	Isolated find	320294	6406386	Ridge slope
	EWA 11	Isolated find	320518	6406443	Spur crest
	EWA 20	Isolated find	319737	6406100	Ridge slope
	EWA 21	Isolated find	319631	6406100	Slope tributary
	EWA 24	Isolated find	319546	6405851	Spur crest
	EWA 26	Isolated find	319727	6406284	Spur crest
	EWA 27	Isolated find	319704	6406313	Spur crest
	EWA 39	Isolated find	319734	6406323	Slope
	EWA 56	Isolated find	318571	6404615	Spur crest
	EWA 68	Isolated find	319107	6404223	Ridge slope
	EWA 69	Isolated find	319117	6404707	Ridge crest
	EWA 70	Isolated find	319141	6404775	Ridge crest
	EWA 71	Isolated find	319247	6404798	Ridge slope
	EWA 77	Isolated find	319099	6404875	Ridge crest
	EWA 78	Isolated find	319111	6404804	Ridge crest
	EWA 83	Isolated find	318727	6405883	Spur crest
	EWA 88	Isolated find	319535	6406043	Spur crest
	EWA 91	Isolated find	318572	6405733	Spur crest

(a)

Table 28a Ashton Ridge sites and isolated finds, locational data.

site name	dimen.	criteria	exposure type	vis	site contents	site condition
Ridge Top Site	300 x 100 m	Exposure Land form	A&B lag Track, bare patches	10%	22 artefacts	
Fire Break Site	600 x 200 m	Exposure Land form	A,B, gravel lag Track, bare patches	20%	30 artefacts	
TSR Site	200 x 200 m	Exposure Land form	Gravel lag Bare patches	20%	19 artefacts	
High Ridge W/S Site	300 x 200 m	Exposure Land form	B, gravel lag Tracks, bare patches	10%	19 artefacts	
Ridge Peak Site	800 x 100 m	Exposure Land form	B, gravel lag Tracks, bare patches	10%	34 artefacts	
High Spur Site	400 x 50 m	Exposure Land form	B, gravel lag Tracks, bare patches	20%	142 artefacts	
EWA 9	50 x 2 m	exposure	B lag, Track	30%	2 artefacts	
EWA 11	20 x 2 m	exposure	B lag. Track	30	2 artefacts	
EWA 20	20 x 5 m	exposure	A&B lag, Bare patches	20	1 artefact	
EWA 21	80 x 10 m	exposure	A lag, bare patches	50%	1 artefact	
EWA 24	60 x 2 m	exposure	A&B lag, Track	30	2 artefacts	
EWA 26	30 x 20 m	exposure	B lag, Bare patches	80	3 artefacts	
EWA 27	80 x 20 m	exposure	B lag, Gully bank, bare patches	20%	1 artefact	
EWA 39	40 x 70 m	exposure	A&B lag, talus Rill, gully bank	20%	1 artefact	
EWA 56	5 x 1 m	exposure	A&B lag, Stock track	59%	2 artefacts	
EWA 68	10 x 5 m	exposure	B lag, Erosion front	80%	1 artefact	
EWA 69	100 x 2 m	Exposure arbitrary	A&B lag, track	10%	2 artefacts	
EWA 70	30 x 3 m	exposure	A&B lag, track	50%	1 artefact	
EWA 71	10 x 5 m	exposure	B lag, track	20	4 artefacts	
EWA 77	60 x 2 m	exposure	Gravel lag, track	20	2 artefacts	
EWA 78	50 x 2 m	exposure	Gravel lag, track	80%	2 artefacts	
EWA 83	20 x 5 m	exposure	Gravel lag, Gravel pit	20%	1 artefact	
EWA 88	50 x 20 m	exposure	B lag. Bare patches	20%	1 artefact	
EWA 91	3 x 2 m	exposure	gravel lag, bare patch	40%	2 artefacts	

(b)

Table 28b Ashton Ridge sites and isolated finds, descriptive data.

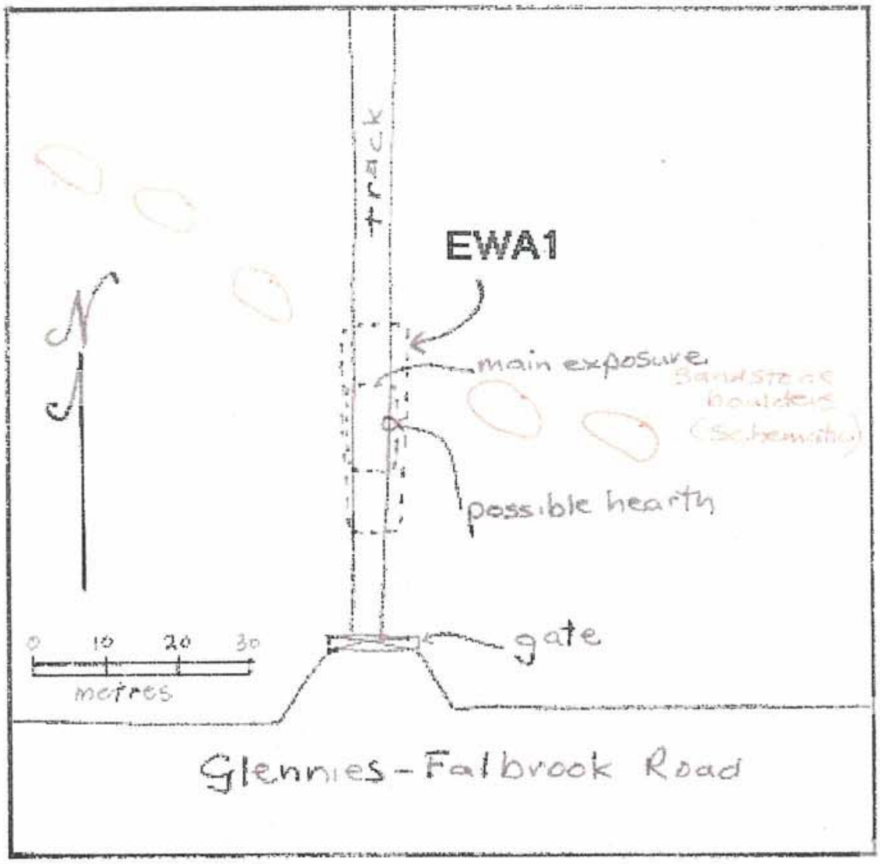
12.14.1 Ridge Top Site Artefacts

The seven implements from the Ridge Top Site are shown in Table 12.30. There are four flake tools, a bipolar core, a blade core (which was converted to a nuclear tool) and a backed blade (Plate 12.10). The cortex and materials are shown in Fig 12.21. There is more silcrete than tuff, unusual in the sites of the study area, where tuff usually dominates.

The graphs of the assemblage in Fig 12.22 show a considerable proportion of broken flakes, some of which may be due to a large part being found on the vehicle track. The debitage is dominantly Size Index 1, and Appendix 3 shows that many of them are blades. The silcrete flake tools are relatively numerous and of varied size.

EWA	dimen.	landform	exposure	vis.	n artefacts
1	20 x 5 m	Ridge crest	B lag, vehicle track	80%	11
2	2 x 5 m	Ridge crest	A lag, bare patches	10%	1
3	20 x 5 m	Ridge slope	B lag, rill banks,	50%	2
4	0.2 x 2 m	Ridge slope	A lag, stock track	50%	1
5	0.1 x 2 m	Ridge crest	B lag, track	50%	1
6	2 x 30 m	Ridge crest	B lag, track	20%	2
7	2 x 30	Ridge crest	B lag, track	20%	4

Table 12.29. EWAs belonging to the Ridge Top Site



Map 10. Sketch map showing the Ridge top Site (EWA1).

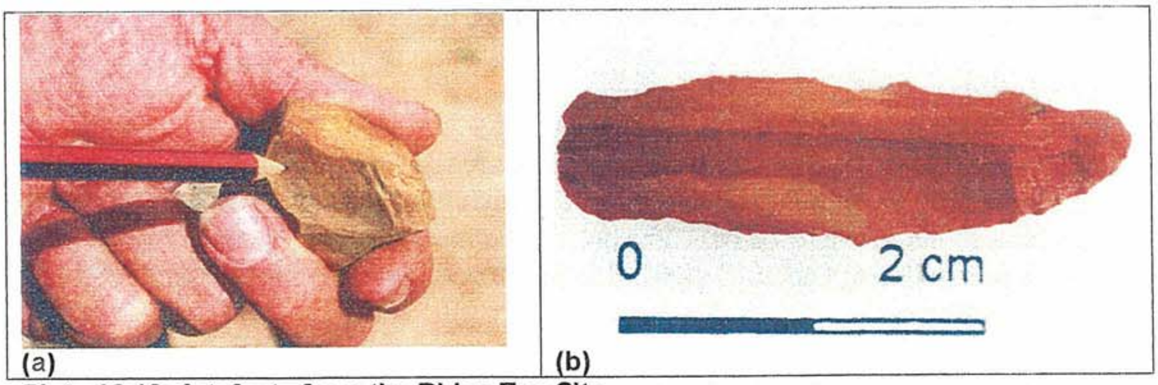


Plate 12.10 Artefacts from the Ridge Top Site.

(a) Microblade core of tuff which has been converted into a nuclear tool. The pencil shows the flake scar from an expanded flake used to form the working edge.

(b) Bondi point of tuff with heavy damage on the edge from vehicle traffic.

implement type	implement stage	number
flake tool	usewear	2
	scalar retouch	1
	concave	1
producer core	bipolar	1
microblade core	unifacial	1
backed blade	bondi	1

Table 12.30 List of implements in the Ridge Top Site.

Table 12.30 List of implements in the Ridge Top Site.

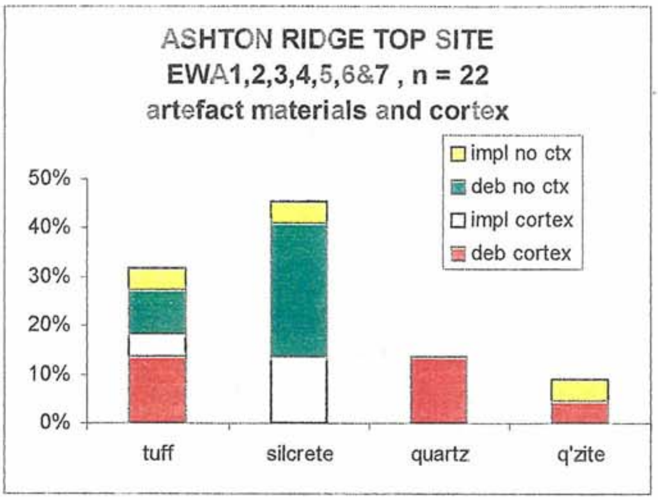


Fig. 12.21. Graph showing materials and cortex for the Ridge Top Site

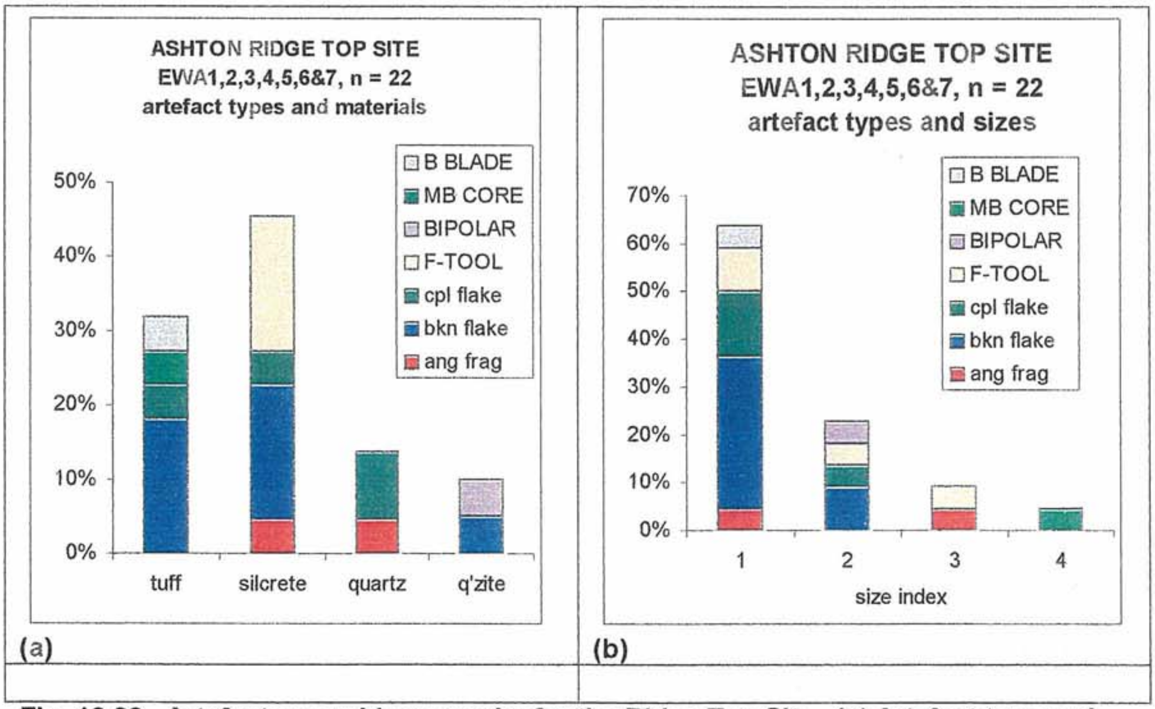


Fig. 12.22. Artefact assemblage graphs for the Ridge Top Site. (a) Artefact type and material, (b) artefact type and size.

12.14.2. Summary and Interpretation of the Ridge Top Site

Although represented by very few artefacts, the Ridge Top Site and associated EWAs were analysed. The narrow range of materials and implements may be due to the small numbers. However, if taken at face value it may be that the variety of activities on the top of this part of Ashton ridge was limited.

12.14.3 Potential Deposit for the Ridge Top Site

This ridge top has been cleared and is in grass. It probably has never been ploughed and seems to be mostly intact. It is likely that there are more clearly defined activity areas indicated by artefact concentrations across this broad high surface.

12.15. Fire Break Site

The firebreak is off the main ridge line and on a spur crest. The main concentration (EWA12) overlooks the tributary which contains the Tributary Site and which leads up to the Ridge Top Site. The track which runs along the fire break and fence line provides an effective transect across the spur crests on this part of the Ashton ridge over-looking Bettys Creek Valley. The EWAs which comprise this site are shown in Table 12.31.

12.15.1 Firebreak Site Artefacts

Few implements were present at this site (Table 12.32), and these were mainly use-wear flake tools. The producer core found had been little worked and may have been a core which was tested and then cached.

EWA	dimen.	landform	exposure	vis.	n artefacts
8	50 x 2 m	Ridge crest	B lag, track	50%	1
10	50 x 2 m	Spur crest	B lag, track	30%	1
12	50 x 5 m	Spur crest	B lag, track, disturbed	30%	14
13	50 x 5 m	Spur slope	A lag, bare patch	80%	1
22	50 x 2 m	Spur crest	B lag, track	30%	1
23	40 x 2 m	Spur slope	B lag, track	50%	2

Table 12.31. EWAs belonging to the Fire Break Site

The debitage in Fig 12.24 is dominated by tuff, with slightly less flakes with than without cortex, and like the Ridge Top Site, none of the silcrete flakes had cortex. Only thirty artefacts were recorded, but a relatively wide range of material types is indicated.

implement type	implement stage	number
flake tool	usewear	3
producer core	unifacial (test)	1
microblade core	broken	1

Table 12.32 List of implements in the Fire Break Site

12.15.2 Summary and Interpretation for the Fire Break Site

It seems that the low density artefact concentration indicated by EWA12 was the main focus of activity on these ridge crests over-looking Bettys Creek. This may have been because this place is strategically located as part of a series of sites from the Railway Site, to the Tributary Site and the Ridge Top Site. Topographically, it would be on a likely travel route from Bettys Creek Valley to Glennies Creek Valley and over a

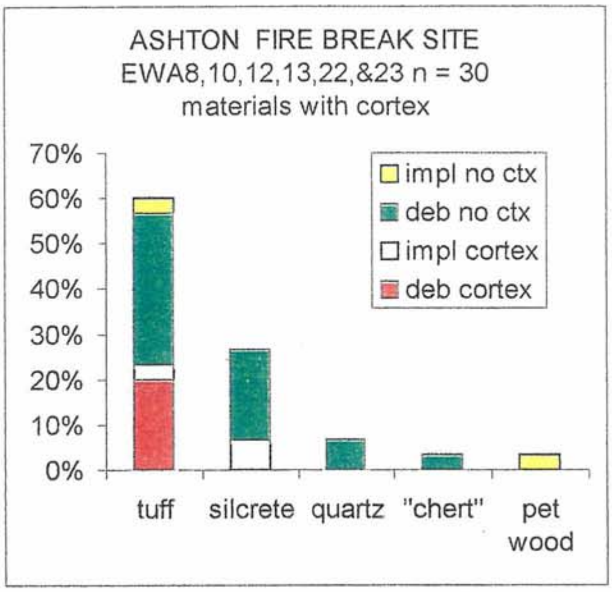


Fig. 12.23. Graph showing materials and cortex for the Fire Break Site.

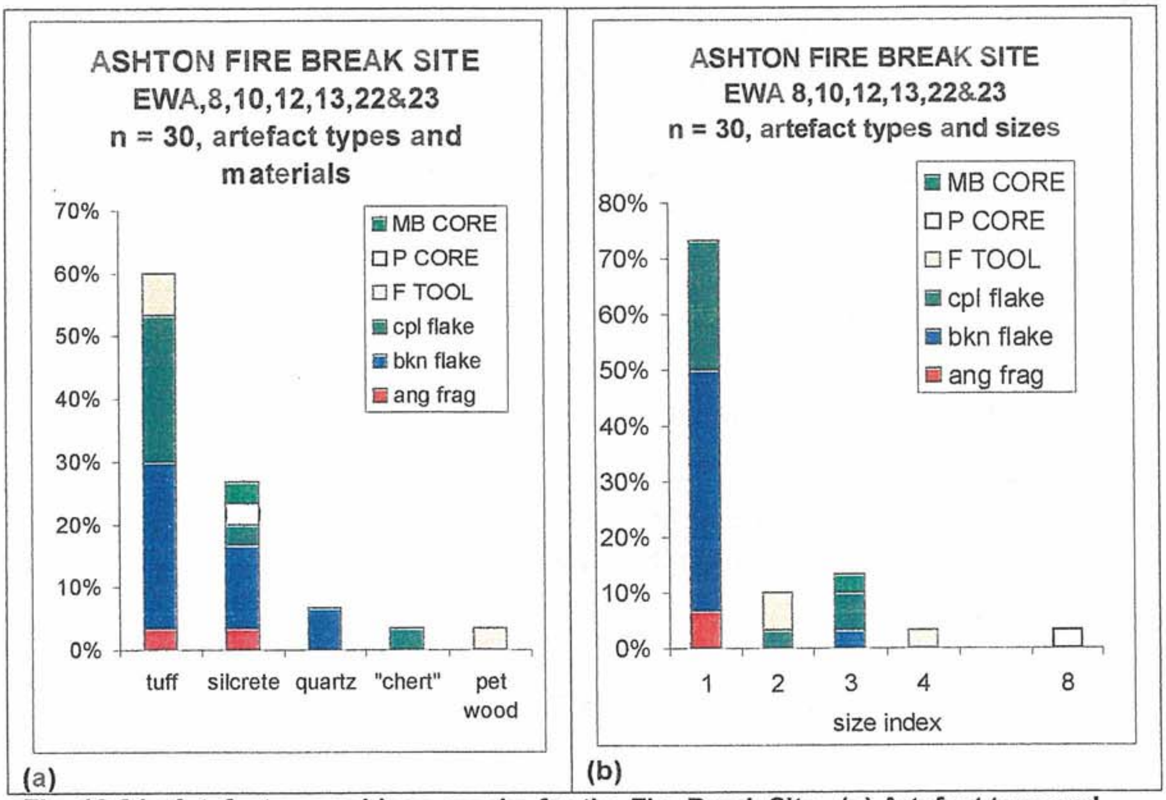


Fig. 12.24. Artefact assemblage graphs for the Fire Break Site. (a) Artefact type and material and (b) artefact type and size.

saddle in the Ashton Ridge crest. Specific activities are not indicated, and the site may have been a stopping point for a variety of reasons.

12.15.3 Firebreak Site Potential Deposit

The site is heavily disturbed by bull dozing and there is a European rubbish dump at the site. The artefact density is low, and the potential for undisturbed concentrations elsewhere on the main spur seems low.

12.16 TSR Site

The TSR site is a thinly distributed concentration of artefacts appearing in patches of exposure where a tributary heads, lying between two spurs high on Ashton ridge Table 12.33. Although only 24 artefacts were recorded, six were implements, all of which were flake tools, Table 12.34 . One of these was a pointed drill-like projection. The size distribution of these flake tools is shown in Fig 12.35. This shows that some of the flake tools were relatively large, possibly due to specialised use of that location.

EWA	dimen.	landform	exposure	vis.	n artefacts
20	20 x 5 m	Ridge slope	A&B lag, bare patches	20%	1
21	80 x 10 m	Slope tributary	A lag, bare patches	50%	1
24	60 x 2 m	Spur crest slope	A&B lag, track	30%	2
26	30 x 20 m	Spur crest slope	B lag, bare patches	80%	3
27	80 x 20 m	Tributary margin	B lag, bank, bare	20%	6
37	40 x 10 m	Ridge shoulder	A lag, Bare patches	50%	1
38	30 x 20 m	Ridge shoulder	B, gravel lag Bare	20%	9
88	50 x 20 m	Spur crest slope	B lag, bare patches	20%	1

Table 12.33. EWAs belonging to the TSR Site

EWA	ang frag	bkn flake	cpl flake	implements	n
20	1				
21				Flake tool	1
24	1	1	1	Flake tool	1
26		1	1		
27	1				
37		3	2	Flake tool	1
38		1	3	Flake tool	3
88		1			

Table 12.34. TSR Site artefact types

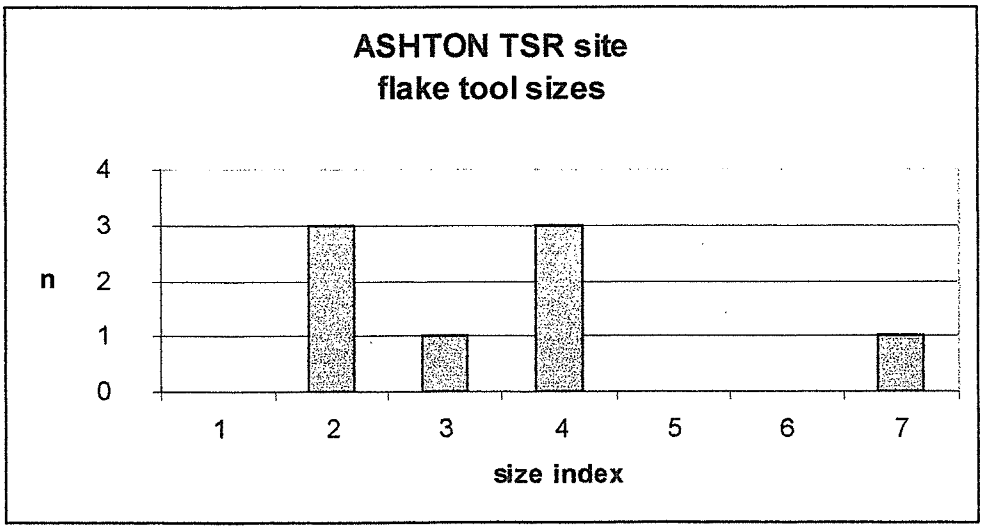


Fig. 25. Size distribution of flake tools from the TSR Site.

12.17 High Ridge Workshop Site

The high ridge workshop site is on a shoulder of Ashton Ridge, and features a microblade workshop of grey tuff. There are several exposures in the locality as are listed in Table 12.40. Although only a few flakes belonging to the grey tuff microblade workshop, they consisted of finely made blades and a perfect geometric. The microblade core present was of silcrete. This workshop occurred in a relatively high density background of conventional debitage as indicated by Table 12.28

The deposit associated with the grey tuff workshop is intact and although it has been cut through by a bladed farm track, is likely that excavation would recover more of it.

EWA	dimen.	landform	exposure	vis.	n artefacts
76	100 x 3	Ridge crest	A&B lag, track	50%	4
79	10 x 10	Ridge crest	A,B,gravel lag, track	20%	2
83	20 x 5 m	Spur crest	Gravel lag, gravel pit	20%	1
84	15 x 3 m	Spur shoulder	A&B lag, tack	80%	10
85	50 x 50 m	Spur crest	A&B lag, track, erosion	50%	1
86	50 x 1 m	Slope tributary	Talus, rill banks	20%	1

Table 12.40 EWAs belonging to the High Ridge Workshop site.

12.18 Ridge Peak Site

The Ridge Peak Site is the highest point on Ashton Ridge, between Bowmans Creek and Glennies Creek and provides an outstanding view of the Hunter Valley. It over-looks the Glennies Creek Site and may have been particularly associated with that site. The EWAs which comprise the assemblage for this site are shown in Table 12.36.

EWA	dimen.	landform	exposure	vis.	n artefacts
40	100 x 2 m	Ridge saddle	B lag, track, mitre drain	50%	3
41	100 x 2 m	Ridge crest	B lag, track	50%	2
42	20 x 2 m	Ridge peak	B lag, track	80%	11
43	20 x 40 m	Ridge peak	B lag, bare patches	20%	2
44	1 x 20 m	Ridge peak	B lag, track	10%	8
45	100 x 2 m	Ridge crest	B lag, track	10%	6
58	20 x 30 m	slope tributary	A lag, bare patch	20%	4
59	30 x 2	Ridge slope	B lag, track	50%	1

Table 12.36. EWAs belonging to the Ridge Peak Site.

12.18.1 Ridge Peak Site Artefacts

Although only six implements were recorded at this site, producer cores, normally uncommon, here outnumber the flake tools, usually the most frequent implement type. The flake tool which was present was a projection, which is a specialised type. The dominant material type is tuff with about an equal proportion of debitage with and without cortex.

implement type	implement stage	number
flake tool	projection	1
producer core	multiplatform	2
	bipolar	1
Microblade core	trial	1
	bi-directional	1

Table 12.37. List of implements in the Ridge Peak Site

The assemblage shown in Fig 12.27 is dominated by tuff in which the complete debitage is in about equal proportion to complete. The greater part of the broken flakes were in Size Index 1. An unusually large proportion of complete flakes were present in Size Index 3 and 4.

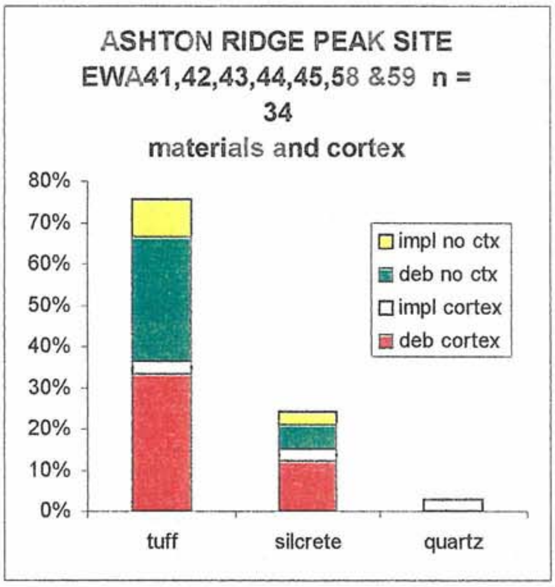


Fig. 12.27. Graph showing materials and cortex for the Ridge Peak Site

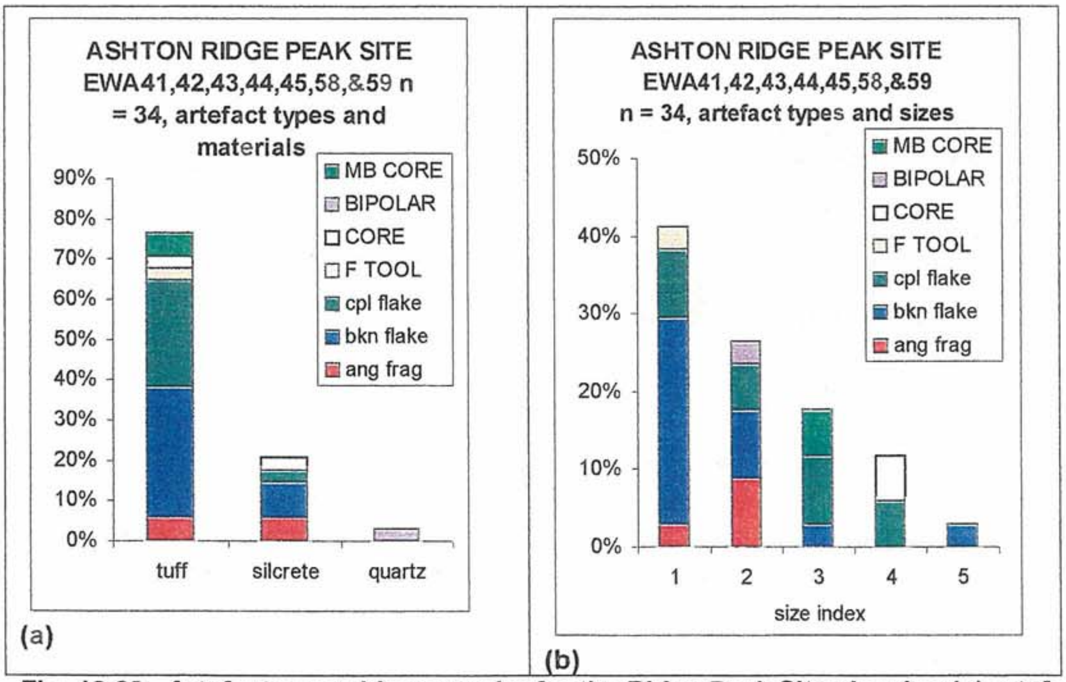


Fig. 12.28. Artefact assemblage graphs for the Ridge Peak Site showing (a) artefact type and material and (b) artefact type and size.

12.18.2 Ridge Peak Site Summary and Interpretation

The Ridge Peak Site assemblage is small, but seems to be a place of production of relatively large flake, associated with producer cores. With the limited range of materials, and the specialised projection type of flake tool, the activities at this site seem to have been quite specific.

12.18.3 Potential Deposit for the Ridge Peak Site

The main concentration of artefacts seems to be on the top of the peak itself, where there is a considerable area of undisturbed surface.

12.19 High Spur Site

The High Spur Site is on a prominent spur which overlooks the Hunter River to the south and the Bowmans Creek valley to the west. The ridge was exposed by a vehicle track and a furrow which also ran down the ridge. All of this exposure only produced debitage, much of which was broken by bladeing or traffic. The main concentration however was EWA46 which was an erosional pocket high on the side of the spur. This included a large workshop of "burnt" silcrete, as well as an area referred to as the "quartz workshop" in Appendix 3, although there were only a few quartz flakes present.

EWA	dimen.	landform	exposure	vis.	n artefacts
46	30 x 10 m	Spur crest	B lag, talus, erosion front	50%	121
47	20 x 1 m	Spur crest	Disturbed, Drainage furrow	50%	14
48	10 x 1 m	Spur crest	Disturbed, Drainage furrow	50%	14
49	10 x 2 m	Spur crest	A&B lag, track	20%	4

Table 12.38 EWAs belonging to the High Spur Site

12.19.1 High Spur Site Artefacts

The implements from EWA 46 are shown in Table 12.36, and those from the silcrete workshop are in Table 12.37. The total of six implements is rather small, and the only notable implement was a hammerstone. The cortex present (Fig. 12.29) excludes the burnt silcrete workshop. Even so, silcrete is the dominant material, mostly without cortex.

implement type	implement stage	number
flake tool	scalar retouch	2
microblade core	trial	1
hammerstone	2 facets	1

Table 12.39 List of implements in the High Spur Site

implement type	implement stage	number
flake tool	cuspate retouch	1
Core	Unifacial	1

Table 12.40 List of implements in the High Spur Site burnt silcrete workshop.

The artefact assemblage shown in Fig 12.30 is from EWA 46, not including the burnt silcrete workshop. The large proportion of broken debitage in this case is not attributable to traffic, and would have been associated with the manufacturing activities. Except for the hammerstone, the assemblage consists of only Size Index 1 and 2, including the other implements.

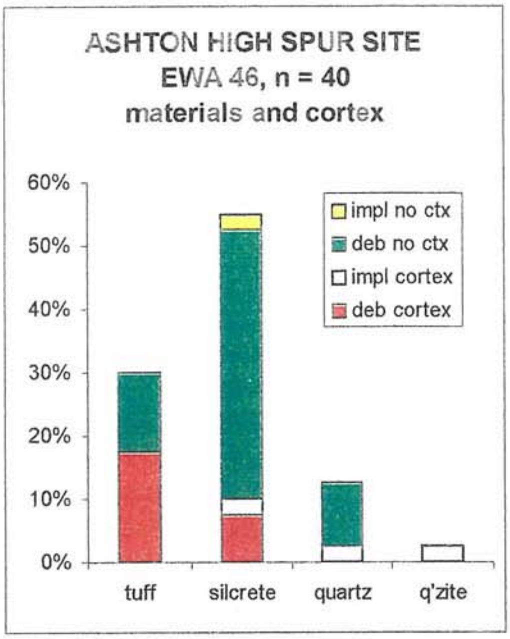


Fig. 12.29. Graph showing materials and cortex for the High Spur Site

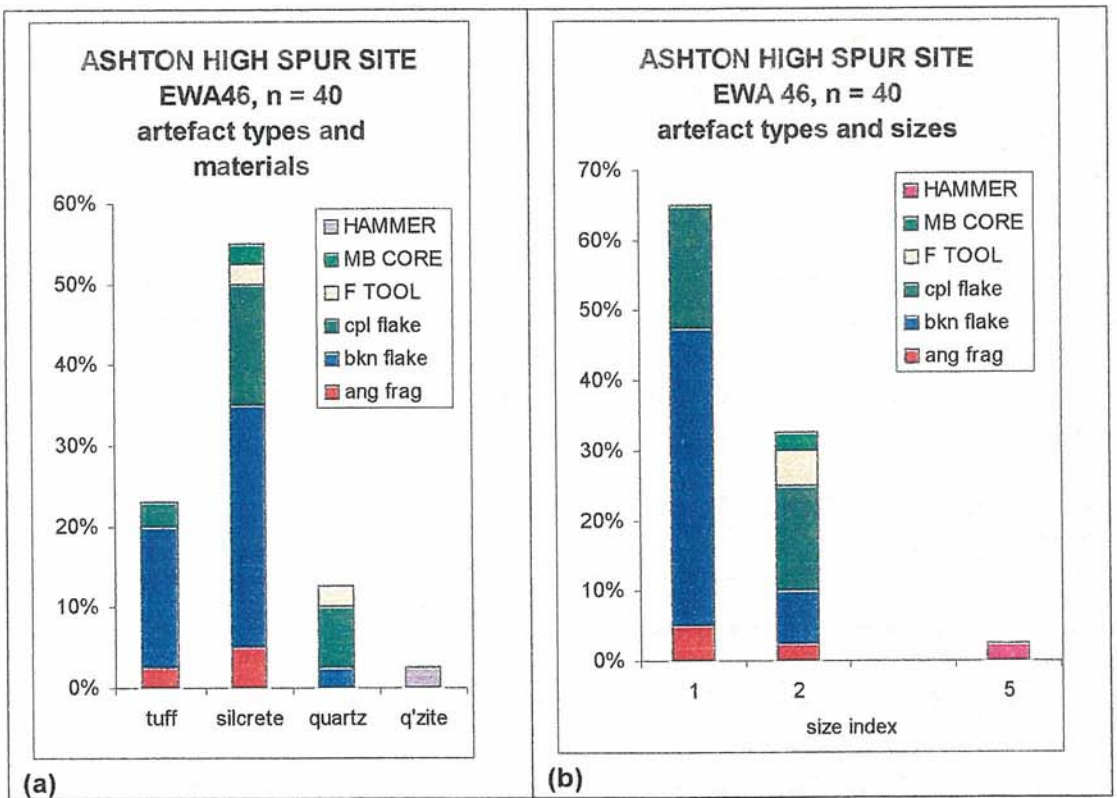


Fig. 12.30. Artefact assemblage graphs for the High Spur Site. (a) Artefact type and material and (b) artefact type and size.

The proportion of cortex and size distribution graphs are shown in Fig 12.28. This assemblage consists only of those artefacts which had been washed out and formed a talus over the erosional front. Approximately 30 additional artefacts belonging to this workshop were visible at the top of the bank of the erosional front. These were not disturbed for recording and remain *in situ*. Cortex is present on only slightly more of the debitage. The debitage is dominated by broken flakes, and large sized angular fragments are conspicuous. The appearance is the reduction of a silcrete core which had been badly affected by fire and the manufacture of complete flakes was difficult, and only a single example which was used as a tool is present.

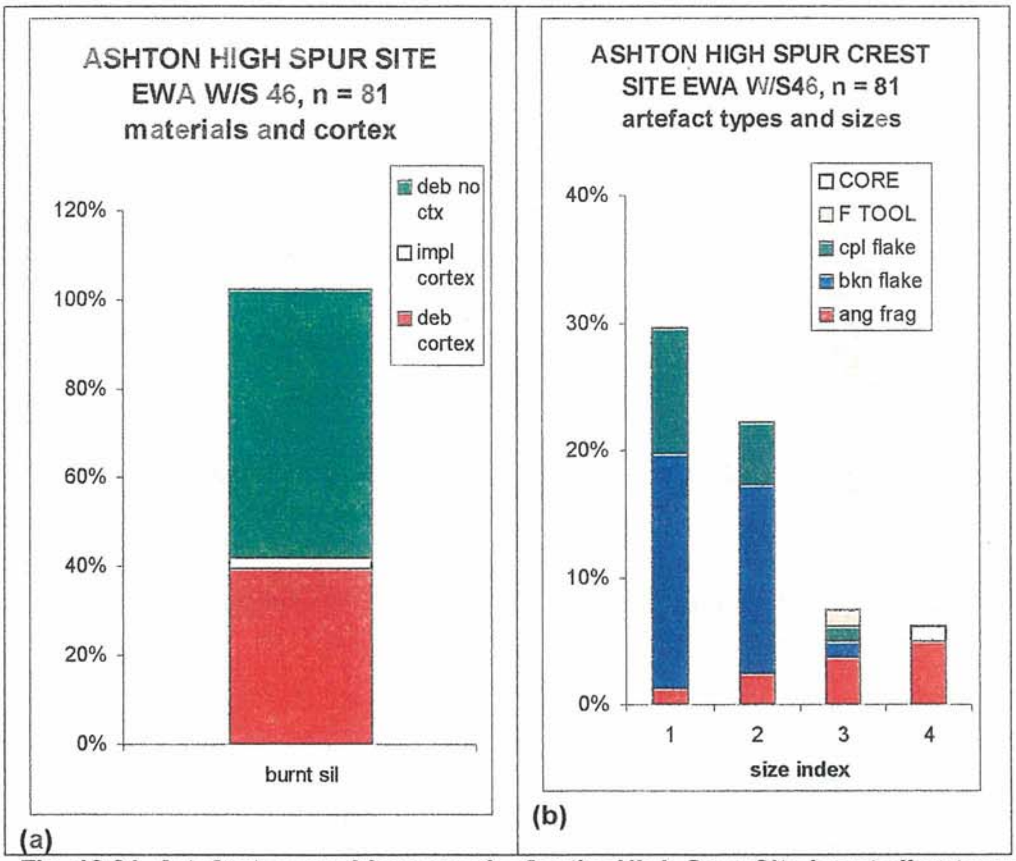


Fig. 12.31 Artefact assemblage graphs for the High Spur Site burnt silcrete workshop. (a) Cortex and materials and (b) artefact type and size.

21.19.2 Summary and Interpretation of the High Spur Crest Site

The Spur Crest Site is dominated by a single workshop event which was the reduction of a burnt silcrete core which had very poor flaking properties. However, a range of other activities is also indicted by other materials, although the flakes produced were small and the implements were few. This spur was probably provided a suitable access route to the Ashton Ridge crest from either the Hunter River or the Bowmans Creek bottoms.

12.19.3 Potential Deposit for the High Spur Crest Site

Most of the spur has been heavily disturbed by a track or a furrow running down it, and here is a gravel pit on the lower end of the spur. However, the area around EWA46 is relatively undisturbed, and it is likely that there is considerable intact deposit associated with it containing artefacts.

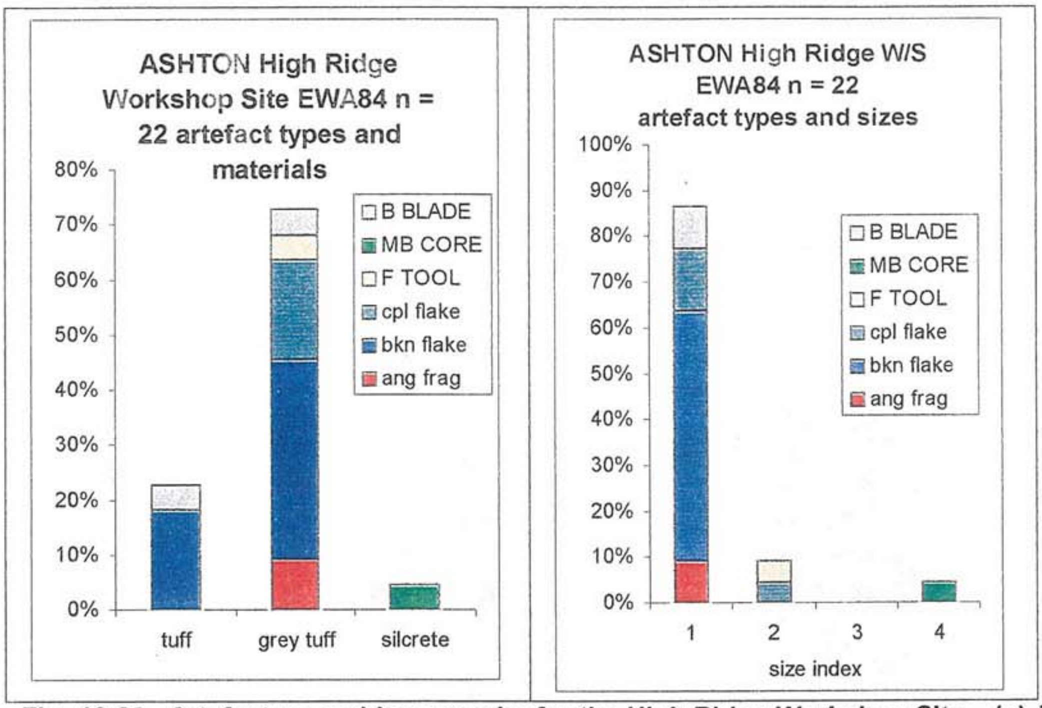


Fig. 12.26. Artefact assemblage graphs for the High Ridge Workshop Site. (a) Artefact type and material and (b) artefact type and size.

12.20 Ashton Ridge, other sites and exposures.

The remaining isolated finds on Ashton ridge are shown in Table ... This includes three flake tools s well as debitage indicating a regular pattern of activities on all parts of the ridge.

EWA	ang frag	bkn flake	cpl flake	implements
EWA 9		1	1	
EWA 11		1	1	
EWA 20	1			
EWA 21				Flake tool
EWA 24	1	1	1	
EWA 26		1	1	Flake tool
EWA 27	1			
EWA 39				Flake tool
EWA 56		1	1	
EWA 68		1		
EWA 69		1	1	
EWA 70		1		
EWA 71	2		2	
EWA 77		1	1	
EWA 78		1	1	
EWA 83		1		
EWA 88		1		
EWA 91		2		

Table 12.41 Ashton ridge isolated finds artefact types

12.21 Hunter River Valley

The slopes of the Hunter River valley had little coverage since there would be relatively little effects from subsidence. However, on the lower part of a slope in a farm track was an extensive site on a valley slope which was exposed by a farm track.

site name	survey unit	site type	easting	northing	landscape type
Hunter Valley Slope Site	EWA94&95	Open camp site	318457	6402767	Low slope crest

(a)

site name	dimen.	criteria	exposure type	vis	site contents	site condition
Hunter Valley Slope Site	100 x 10 m	Land form	A&B lag, farm track	20	110 artefacts 1hearth, scattered heat retainers	Partly eroded

(b)

Table 12.43 Hunter River Valley sites. (a) Location and (b) description.

12.22 Hunter River Slope Site.

The Hunter River Slope Site was the only occurrence during the survey where there was considerable fire baked and cracked rock manuports. These are interpreted to be heat retainers for a hearth. In addition an *in situ* hearth was found which contained charcoal and would be datable. The site was not on a flat surface but a gentle spur-like slope. The exposure was from the farm track and patchy scalding. The water flowing down the track was responsible for carrying smaller artefacts down slope and depositing them in pockets, while leaving the larger ones lagged on the hard surface. The reliability of the size analysis therefore is uncertain, and might favour the larger part of the range.

12.22.1 Hunter River Slope Site Artefacts

The implements are shown in Table 12.44, and includes more producer cores than usual for the rest of the survey. The materials in Fig 12.30 indicate that tuff, silcrete and petrified wood are present in almost equal amounts, and with little cortex, especially the silcrete. Basalt also is relatively well represented.

implement type	implement stage	number
Flake Tool	Scalar retouch	1
	Serrate edge	1
Nuclear Tool	unifacial	2
Producer core	Uniplatform	1
	Multiplatform	1
	broken	1
Microblade Core	rotated	1

Table 12.44 List of implements in the Hunter River Slope Site

In Fig 12.30(a) it can be seen that the petrified wood tended to break into angular fragments when flaked. In spite of the expected erosional bias for larger pieces the size distribution shows a strong skew towards Size Index 1 which is dominated by broken flakes. Size index 3 however is mainly complete flakes. There was a single silcrete microblade core, and no other indication of microblade products.

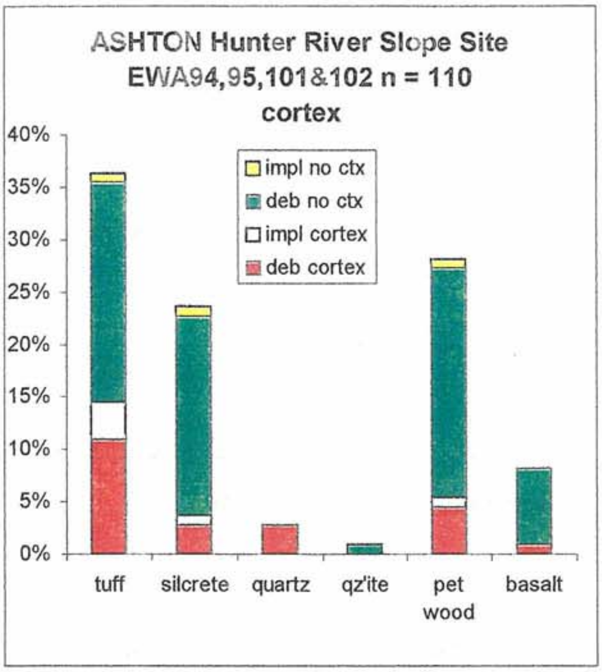


Fig. 12.32. Graph showing materials and cortex for the Hunter River Slope Site

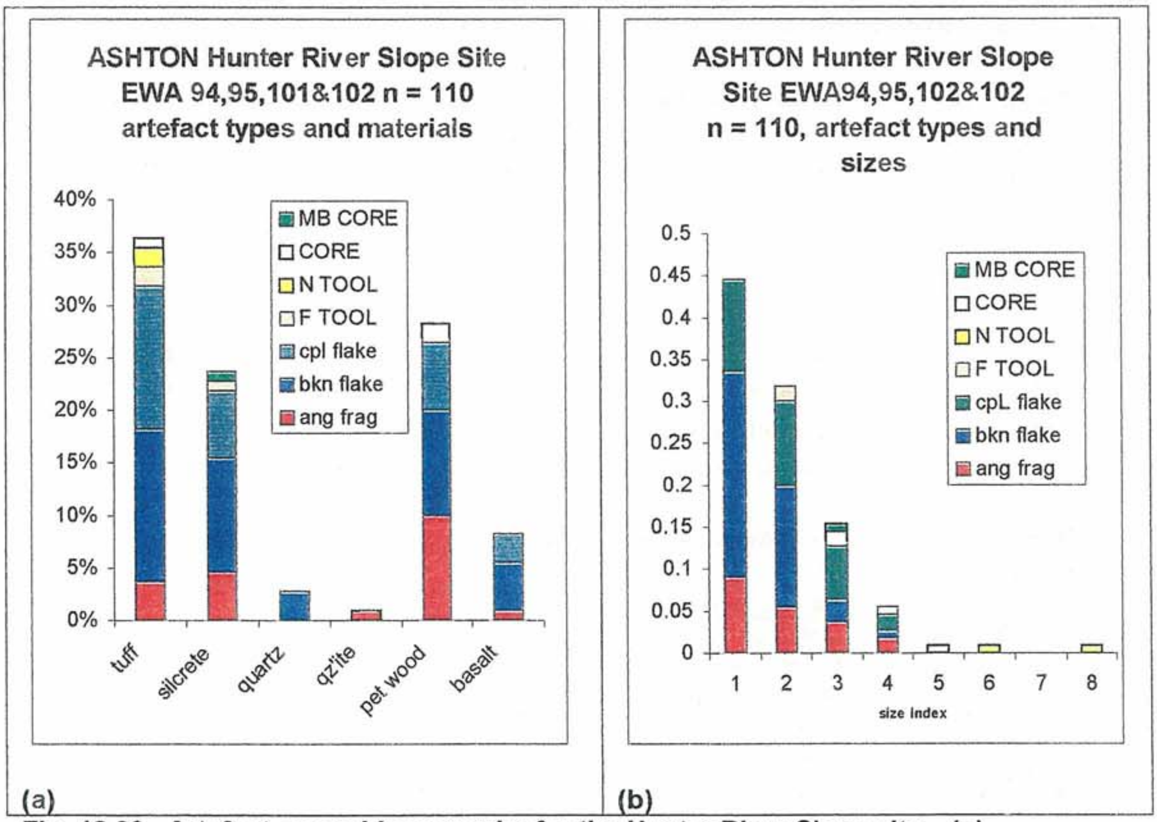


Fig. 12.33. Artefact assemblage graphs for the Hunter River Slope site. (a) Artefact type and material and (b) artefact type and size.

12.22.2 Hunter River Slope Site Summary and Interpretation

This site is anomalous compared in the Ashton study area. The burnt manuports may be similar to those reported for the Narama area. The artefact assemblage also would be similar to the high complete flake/high implement assemblage types from that area. It therefore is as if there is a boundary between the Hunter River frontage and the rest of the landscape. There also were remarkable very large and very thin flakes of silcrete and basalt which were not found elsewhere on the survey.

It is possible that this site is continuous with the river bottom and terraces, and differences in assemblage pattern may be found on those surfaces.

12.22.3 Hunter River Slope Site Potential Deposit

This deposit is eroding into the lower A horizon in the vehicle ruts, and a large part of it will be eventually guttered out. This may be accelerated by subsidence.

13. Analysis

13.1 Debitage Attribute Analysis

The debitage attributes, in addition to the debitage types measurements, were recorded as a way of defining assemblages in more detail. These data are used below to compare the three large sites found in the Ashton study area.

13.2 Waterhole Site

All of the areas from the main exposure of the Waterhole Site were combined for the debitage attribute analysis. The debitage termination and platform types are shown in Fig 13.1. About half of the flakes are feather-terminated, and the majority of the platforms are unifacial.

In Fig. 13.2 the shape types are compared with debitage types and with the platform modification. In Fig. 13.2(a) the percentages of expanded, intermediate and blade shapes are roughly equal although about half of the blades are as broken flakes. Among the flake shapes not identified, angular fragments, distal fragments and distal fragments are in about equal proportion.

The debitage shapes were plotted with the platform modification in Fig. 13.2(b). The blades are about in equal proportion of being unmodified, modified, and faceted. The intermediate flake shapes also showed some faceting, probably having been made on a blade core. Both the expanded and faceted shape flakes show some use-wear on the platform. The expanded shapes however have the most modified platforms, and this probably was mainly from use-wear.

13.3 Oxbow Site

The debitage platform and termination types from the Oxbow Site in Fig. 3.3 is similar to the Waterhole Site except that there are more bifacial platforms, and platforms with cortex. This may have been due to more reduction on bifacial nuclear tools made on cobbles.

The flake types and shapes are shown in fig 13.4(a) in which blades are notably less than in the case of the Waterhole Site. Since the conditions for the exposure of small blades was better for the Oxbow Site, this lack of blade production is a distinctive characteristic of the site. The other proportions of shapes and flake types for the Oxbow Site however is roughly similar to the Waterhole Site.

The platform modification according to flake shape is shown in Fig. 13.4(b). Blades are about 10% and with a trace of faceting, supporting the indication of little microblade core reduction. The high proportion of platform modification on the expanded flakes is consistent with the likely hood of edge damage from the use of large flake tools and nuclear tools.

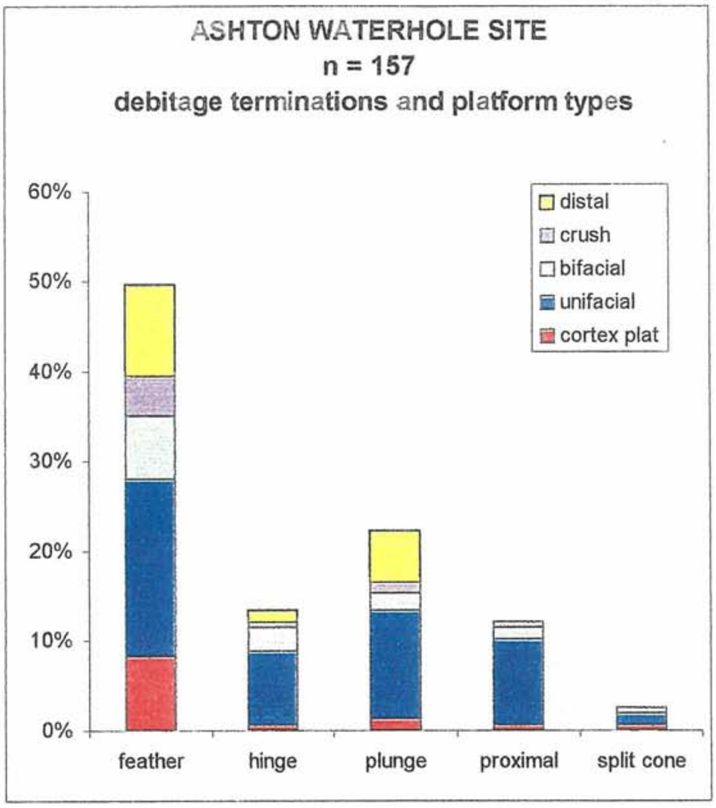
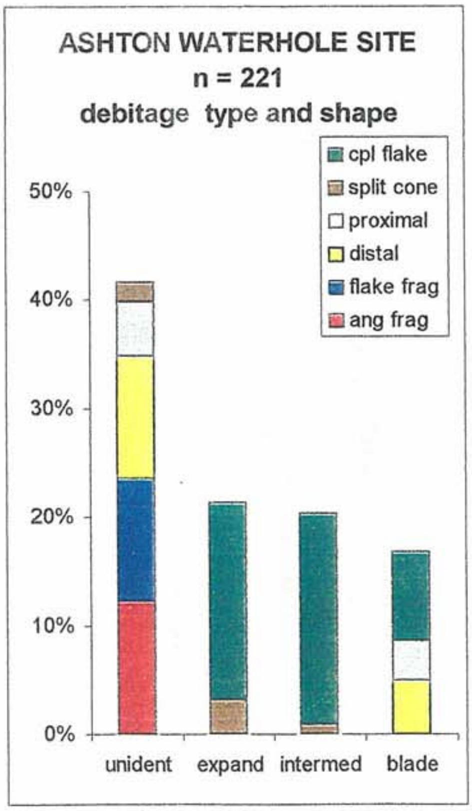
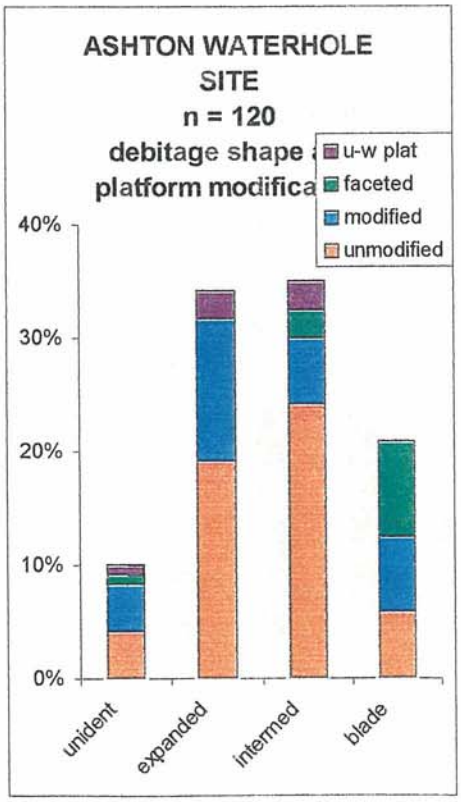


Fig. 13.1 Debitage attribute graphs for the Waterhole Site showing flake shape and platform modification.



(a)



(b)

Fig. 13.2 Debitage attribute graphs for the Waterhole Site. (a) Debitage type and flake shape. (b) Platform type and termination type.

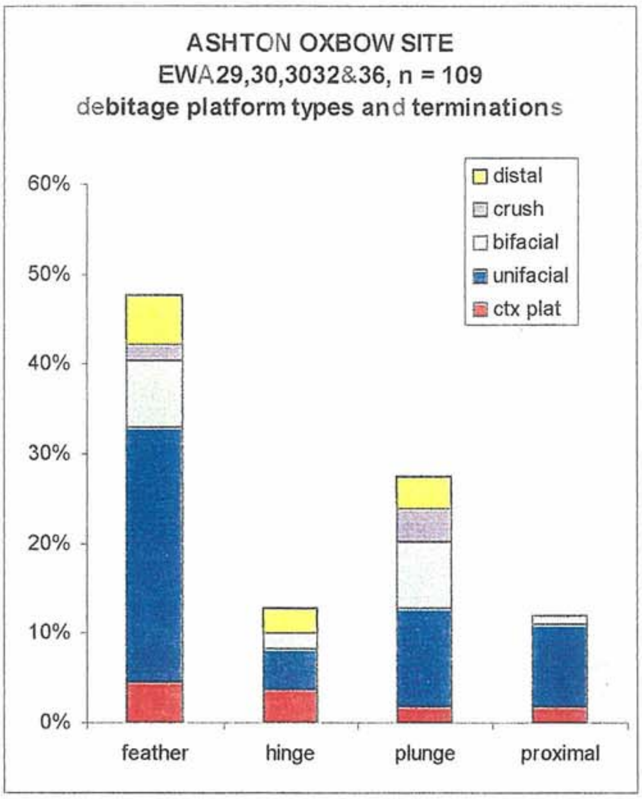
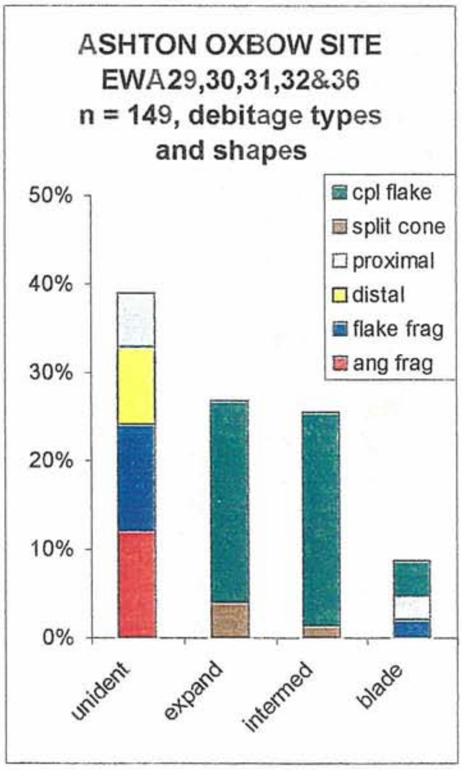
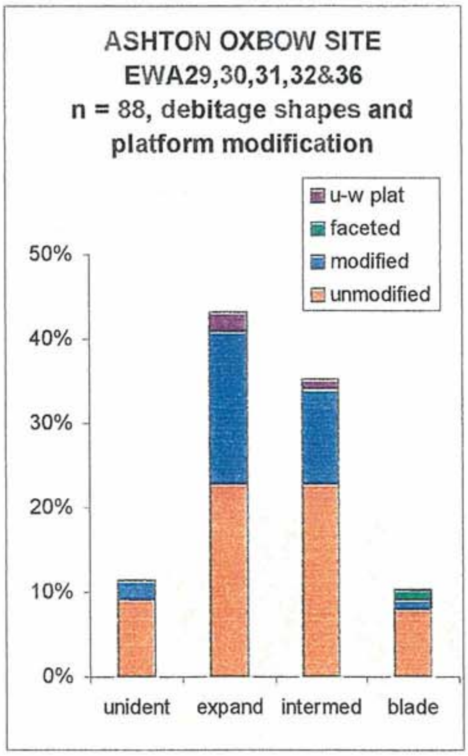


Fig. 13.3 Debitage attribute graphs for the Oxbow Site showing flake shape and platform modification.



(a)



(b)

Fig. 13.4 Debitage attribute graphs for the Oxbow Site showing. (a) Debitage type and flake shape. (b) Platform type and termination type.

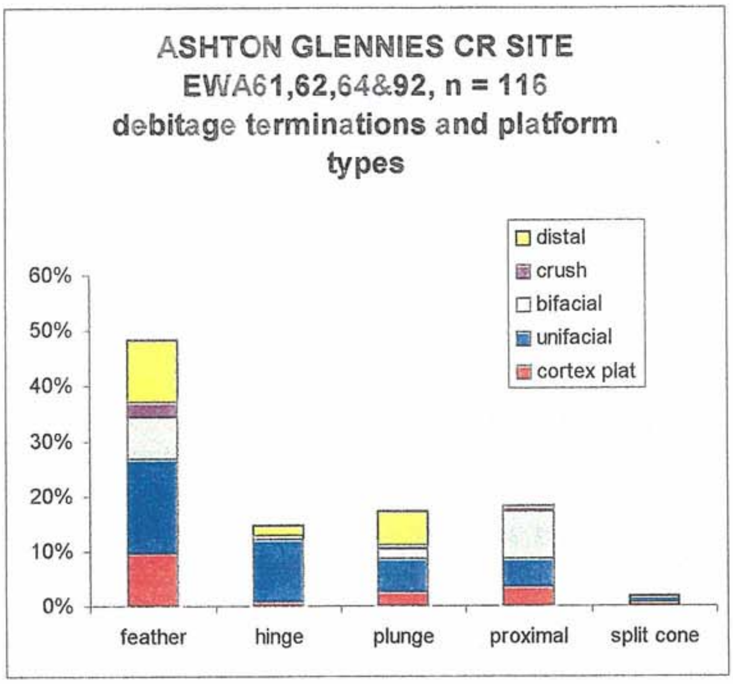


Fig. 13.5. Debitage attribute graphs for the Glennies Creek Site showing flake shape and platform modification.

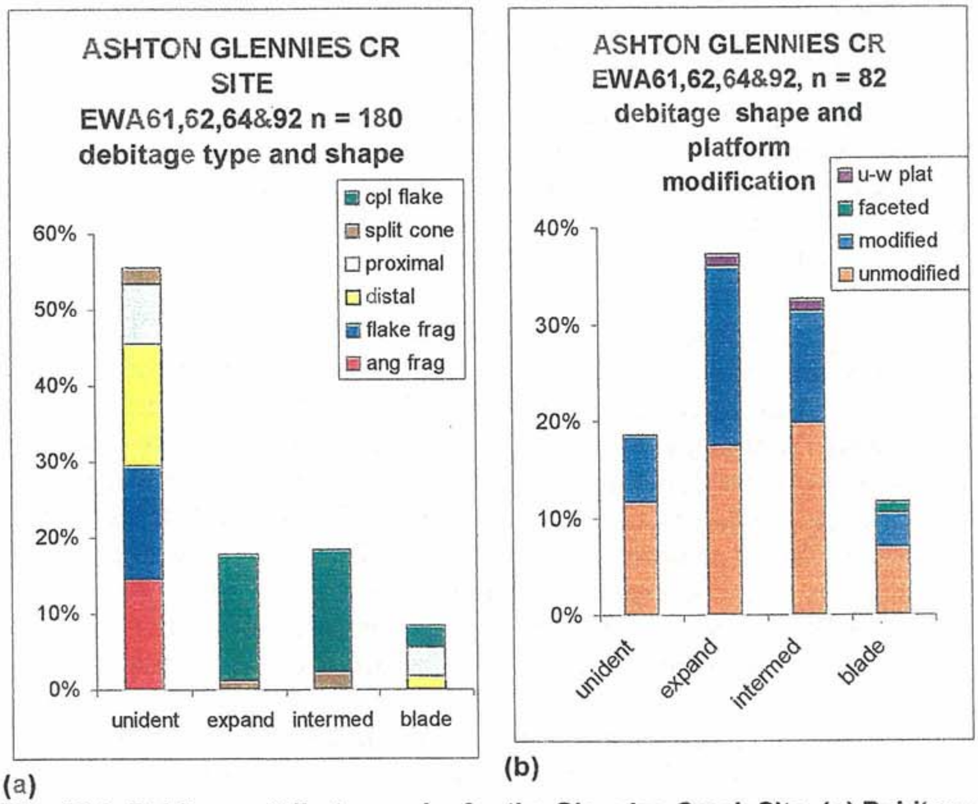


Fig. 13.6 Debitage attribute graphs for the Glennies Creek Site. (a) Debitage type and flake shape. (b) Platform type and termination type.

13.4 Glennies Creek Site

Glennies Creek debitage terminations and platform types are shown in Fig. 13.6(a). This graph is similar to those belonging to the Waterhole Site and the Oxbow Site, although there are fewer plunge terminations. The bifacial platforms are numerous as in the case of the Oxbow Site. Crushed platforms are more noticeable, and there is a slight increase in hinge flakes with unifacial platforms compared to the other two sites. This is possibly due to resharpening tools with a high angle edge. The graph in Fig 13.6(b) is very similar to the Oxbow site.

13.5. Summary of Debitage Analysis

The artefact assemblages of three big sites in the Ashton study area are remarkably similar. The detailed attribute analysis, usually consisting of over 100 pieces of debitage in each case, indicate that artefact reduction processes were nearly identical with minor variations among the three sites, and they can be collectively considered a single site type. Two salient features of these sites are as follows:

1. Little microblade production is indicated.
2. Expanded flakes are abundant

Although microblade production is indicated, no large workshops were found, and the blade component of the debitage was small, even using proximal, distal and other fragments which could be attributed as blades. This however is inconsistent with recording 36 microblade cores – a surprisingly high number. Of these microblade cores, 16 (nearly half) were identified as trials. They appear to have been attempts to prepare a core for blade production with out producing a successful series of blades. It as though it was common to collect various pieces of stone from the surface of a camp site, and then try them out as possible blade cores. The impression is that the need to produce microblades sometimes emerged in unplanned circumstances, and only a few backed blades were needed on such occasions.

The rest of the tool kit was probably large medium and heavy duty tools. In tool sharpening the edge is normally kept straight, and vertical ridges are not developed. Without the strong vertical ridge the resharpening flakes are frequently expanded in shape. This is unlike the strategy for making large flakes to be used as tools in which the vertical ridge is prominent, and the flakes are usually intermediate in shape. In the case of the Oxbow and Glennies Creek sites, about half of the expanded flakes had modified platforms. This is considerably more than the blades for those sites where platform modification would be expected as part of overhang trim and core preparation. At the Waterhole Site however, where more blade production took place, there was substantially more platform faceting and modification for blades.

The expanded blades can be best explained as resharpening flakes which frequently have usewear in the form of modification. This implies the presence of tools which are of a large size and a high angle platform so that the resharpening flakes also will be large enough to be recorded. Bifacial platforms also are relatively common, as would be expected if cobbles for nuclear tools were being used. Large nuclear tools however seem to be rare on these sites, and may have usually been transported elsewhere for use and discard, or were cached elsewhere, such as at the Bridge Site, or EWA30 on the Oxbow Site.

The numerous flake tools may have been mainly recycled resharpening flakes from large tools, although the yellow tuff workshop EWA92 at Glennies Creek shows that sometimes a producer core was reduced in order to provide a range of specialised flake tools such as projections.

The Oxbow and Glennies Creek sites can be seen to have particularly similar debitage assemblages, indicating the same kind of stone technology occurred in both places. The Waterhole Site mainly differs by having a little more of the microblade component.

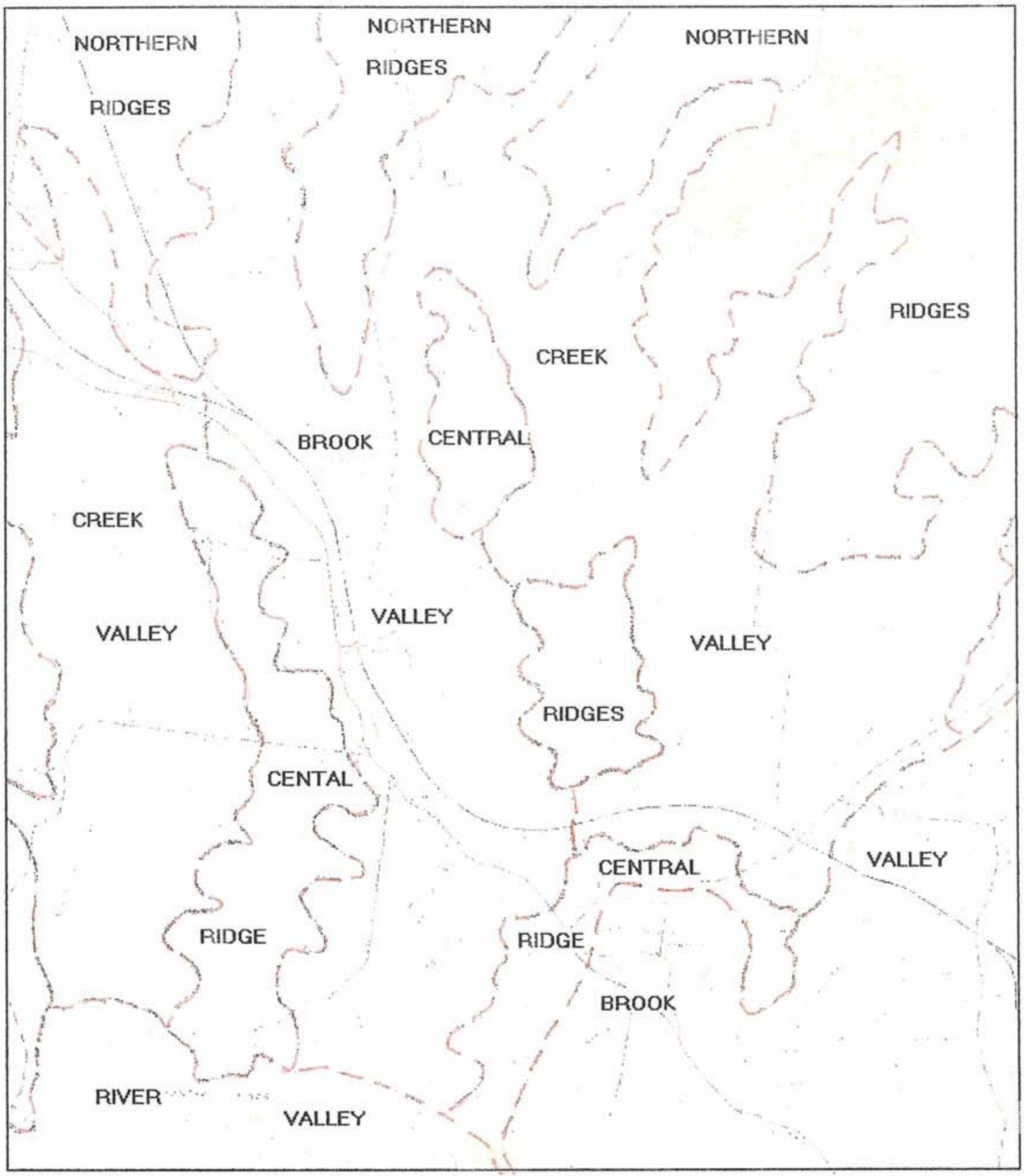
The landscape context of the Waterhole, Oxbow and Glennies Creek Sites is very different. The main similarity is that the creek channels swing close to the lower valley slopes and have narrow channels. It may be that it was these hydrological and strategic factors made the locations optimal for fish trapping during times of floods for those two sites. The Waterhole may have had a similar use, as well as other uses that depended upon it having a deep and long-lasting waterhole, and this may explain the additional microblade production.

13.6. Archaeographic Systems in the Hunter Valley.

None of the current "predictive" models for the Hunter Valley seem to be relevant to the Ashton study area. This is because different geographic parts of the Hunter Valley may have been utilised by different cultural land use strategies. This kind of distinction has been recognised for archaeological patterning further west in NSW as "archaeographic areas ". In the Hunter Valley case, the land use strategy for the Glennies and Bowmans Creek valleys seems to be mainly oriented towards the presence of constricted stream channels associated with lower valley slopes. No available model would have predicted the size of archaeological site at the locations for the three sites described above, nor would it have predicted the site contents.

It is important to recognise that the "Hunter Valley" is not a single landscape, but has different landscape patterns which were suitable for differing land use strategies. Thus some upland areas are characterised by encampments of varying sizes which are dominated by the microblade technology. Other upland areas may have less of a microblade component, apparently more associated with large swamp systems. Generalisations about the Hunter River and its terraces are difficult to suggest. However, for some parts of the Hunter Valley the pattern of the drainage network may be the best indicator of site location, size and contents. Elsewhere, other factors such as channel hydrology, may be more important. The results of this survey suggest that major encampments up the Glennies and Bowmans Creeks are most likely to continue to occur up stream where the channel is narrow and close to high ground on a valley slope.

The side valleys to these main creeks, such as for Bettys, Swamp, York, Station and Reedy Creeks can be expected to have a different type of settlement pattern. An archaeographic systems approach would therefore divide the Hunter Valley central Lowlands in the vicinity of the Aston area as follows (see Map 13.1):



Map 13.1. Example of an archaeographic systems map for the Central Lowlands of the Hunter Valley in the Ashton area.

- River Valley System. Hunter River Slope Site at Ashton and the Narama Sites – abundant hearth and fire cracked rock material, varied assemblages with large microblade workshops

- Brook Valley System. Glennies Cr, Waterhole and Oxbow Sites at Ashton, Ravendale East sites. Very large artefact concentrations, high proportion of large complete flakes, limited microblade workshops

- Creek Valley System. Extensive and dense artefact concentrations. Dominated by microblade production, occasional other assemblage types

- Central Ridge System. Ashton Ridge. Small artefact concentrations common on flattened spurs and ridge crests and sometimes in tributary heads. Assemblages are varied and there may be limited microblade workshops

- Northern Ridge Sysyem. Small artefact concentrations with occasional large microblade workshops mainly in tributary valleys.

It should be possible to describe the pattern of site distribution, site contents and landscape association for these areas. This might make the development of land use models more manageable. Even though some of these systems have now been massively affected by coalmining, it might be possible to extrapolate patterns to new landscapes threatened by mining impact. From the results of this project however, it seems difficult to seriously consider the effectiveness of any of the models for the purpose of predicting archaeological variability or distribution. Such models remain speculative, but are still of value in trying to develop an interpretive framework for known archaeological sites.

14. Significance

14.1 Research Potential

The archaeology in the study area is complex, and there are several aspects with research potential. The variability within the study area has been presented in the analysis section above, and some consideration of the variability outside of the study area has been noted in the comparative analysis section. Available information indicates that it is difficult to determine if similar heritage values are conserved outside of the region since normally the material analysed in detail is in the context of salvage excavation. However, the following points seem to be warranted:

The three large sites (Waterhole, Oxbow and Glennies Creek) seem to be unlike others reported for the Hunter Valley in respect to assemblage variability and landscape context. The archaeology of the Ashton ridge also seems to be exceptional with abundant and varied occupation indicated. The high level of activity on the ridge is probably connected to the use of the three sites, but may include unrelated activities as well. The occupation in Bettys Creek valley however may be peripheral to encampments outside of the study area on the valley bottom.

It has been suggested above that the archaeology of the study area belongs to an archaeographic system which has been little sampled by previous impact studies, and may be part of a functionally distinct type of land use, (e.g. such as fish traps). If so, then this area is representative of a highly specialised type of settlement for the region, and the potential for other undisturbed examples elsewhere on Bowmans, Glennies and perhaps Wollumbi Creeks is difficult to assess. At present the archaeology of this area needs to be treated as unique on the grounds of the precautionary principle.

14.2 Educational, Aesthetic and Aboriginal Values

The Waterhole and Glennies Creek Sites occur in the proximity of well developed waterholes. Aboriginal people consistently remark that settings of these sites invoke how life had been in the past, with people gathered in the area for play and work. The aesthetic value of the Waterhole site is to be severely compromised by the surrounding mine activity. The Glennies Creek Site however can be kept relatively pristine.

The Waterhole site however has an added educational potential. It is highly accessible and the large exposed area offers a place to demonstrate what artefact assemblages are like on the ground, and the grinding grooves are good examples of their type. Protocols and protective measures are necessary to prevent visitor damage.

The ridge peak also has an aesthetic value as a high vantage point. Aboriginal people have remarked that standing there gives a sense of the former occupants using this point to watch the valleys for the movements of people and game.

These places offer the potential for the Aboriginal people of the Hunter Valley to present evocative places for their children's cultural education, and perhaps to communicate their relationship with the landscape with non-Aboriginal people.

14.3 Management areas

A more specific assessment of significance can conveniently be discussed in terms of management areas which are discussed in the following section. The evaluation of significance in this way is to help support the management options and recommendations offered. The management areas and named sites are discussed according to information reliability, intactness, excavation potential, representativeness, rarity, and other information values.

14.3.1 Management Area A Significance

This is the eastern end of Ashton ridge where it makes a broad crest area and the slopes of Bettys Creek valley. The Ridge Top Site might be connected as part of a travel route with the chain of exposures with artefacts which run from the railway line up the tributary, onto the spur to the top of the ridge. These consist of the Railway Site, Tributary Site, and Fire Break Site which are in Management Area B, together with the Ridge Top Site in Management Area A. The significance values are discussed as follows:

1. Ashton Ridge. The dirt vehicle tracks across the ridge top area indicate small low-density artefact concentrations and a relatively high frequency of isolated finds.
    - The Ridge Top Site indicates that a variety of technologies are represented, including limited microblade production. The surface has been little disturbed and the artefact concentrations can be expected to be mostly intact. Under the present conditions of exposure there are few indications as to where excavation would be productive. It is possible that this site has a recoverable assemblage, and this may be best found by grader scraping. The assemblage variability seems to differ from elsewhere on Ashton ridge. However, this type of occupation on broad ridge crest may be generally similar to others which overlooking long-term streams in the Hunter Valley.

2. Bettys Creek Valley. Exposure from vehicle tracks on the valley slopes and near the railway tracks provided no archaeological evidence. However, this is a landscape feature where artefact concentrations can be expected to occur, probably related to occupations across the Railway line on Betty's Creek

14.3.2 Management Area B Significance

This is the north central section of the study area, and consists of the relatively steep northern slopes of Ashton Ridge and southern slopes of Bettys Creek valley, as well as part of Bowmans Creek valley bottom at the junction with Bettys Creek. This landscape was exposed by a firebreak across the slopes, scattered bare patches and tributary banks. It produced three named sites (Railway Site, Tributary Site and Firebreak Site) which follow a tributary to the ridge top Site in

Management Area A, and may connect an encampment outside of the study area on Bettys Creek with another one south on Glennies Creek, also outside of the study area. The other named site (TSR Site) seems to be related to other ridge crest activities.

1. Ashton Ridge. This landscape feature produced two artefact concentrations which are discussed below:

   - Fire Break Site. This is a low density concentration of artefacts on a spur crest which has been heavily disturbed by bulldozing and fire break construction. Analysis shows that although few artefacts were recorded, they indicate a wide variation of implements and materials. The debitage is mainly small, probably due to tool resharpening. It represents a distinctive set of activities, and a larger sample would be desirable. However, due to the disturbance and low density of artefacts it would be difficult to devise a productive excavation strategy.

   - TSR Site. This site is near the crest of Ashton Ridge at the head of a broad high tributary valley. It is an extensive area of low density artefacts exposed by bare patches. Exposure elsewhere along the ridge is probably adequate to indicate that this is a distinctive activity area. The assemblage recorded was too small for analysis, although this would have been desirable. It would be difficult to justify excavation at this site, although intensive collection might provide a workable assemblage.

2. Bettys Creek Valley. This landscape produced two sites with analysable assemblages as follows:

   - Railway Site. Analysis of the small assemblage from this site indicates mainly small-sized debitage with a variety of implements, and it was suggested to be peripheral to a larger encampment north over the railway tracks. It seems to be too disturbed and of too low a density for a promising strategy which would recover a meaningful sub-surface assemblage.

   - Tributary Site. This is a well defined site on a tributary bank. The analysis indicates it is a small camp where microblade production is a major feature but as small workshops. Most of the site seems to be intact and with good spatial integrity, and it has excellent excavation potential. The location of this site is somewhat unusual, since it is on a very minor tributary channel and distant from the main creek bottom. As noted above it may however be associated with a travel route up the tributary between Bettys and Glennies Creeks. Since this entire landscape would be destroyed by an overburden dump, it would merit special investigation. The site would appear to be a good example of similar sites located in such situations.

3. Bowmans Creek Valley. This is the valley bottom of Bowmans Creek where it is joined by Bettys Creek. The area is covered by dense grasses, as well as a layer of Post-European alluvium. The only exposure is by a

tributary bank in which the Bridge Site was recorded. This site may be an extension up stream from the large Waterhole Site discussed in Management Area D. It also may be part of activities focused on the confluence of Bettys and Bowmans Creeks in an area where there is no exposure.

- Bridge Site. This site was not analysed because of its small assemblage size. In spite of this, it produced rare artefact types such as a very large nuclear tool, a milling slab, and a burren. The exposure for the site is limited, but it seems to have not been cultivated and the spatial integrity should be excellent. The excavation potential therefore is highly promising, and it is located in a place which is unavoidable by development and preservation would not be possible.

14.3.3 Management Area C Significance

This area is the western valley bottom of Bowmans Creek, and the valley slopes to the west. The valley bottom of terraces and the flood plain is heavily covered with grasses and a layer of Post-European alluvium, although here is some limited exposure along a vehicle track. Some subsidence can be expected for this area, and the Bowmans Creek channel diversion is planned. The valley slopes to the west have been built up into an artificial landscape by mining overburden, and have settling ponds established.

The area includes an upper terrace of probable late Pleistocene age which may have had valley slope sediments washed over it, burying an early surface. Geomorphic tests by Peter Mitchell (2002) however indicate that early deposits are not indicated for this terrace.

- Brunkers Lane Site. This site provides an indication that there may be extensive occupation on the terraces, especially where tributaries cross them to enter the creek. Because of exposure limitations it is not possible to comment on the potential contents of these possible sites. However, it is likely that there has been cultivation throughout the valley bottom, and although the artefacts remain, and are important, their spatial context is disturbed.

14.3.4 Management Area D Significance

This area is to the south of the New England Highway, and east of Area C. It is the area where the major archaeology was recorded, including the three large encampments referred to as the Waterhole Site, Oxbow Site and Glennies Creek Site. These three sites have remarkably similar artefact assemblages and are associated with the higher ground next to narrow and deep sections of the main creek channels. It is suggested that they are a distinctive site type associated with an archaeographic system of long term streams with well defined channels. A specialised use for these sites is indicated, such as for fish traps or drought retreats. Considerable and varied activity is indicated on Ashton ridge in this portion which is in between Bowmans and Glennies Creeks.

1. Ashton Ridge This part of the ridge crest and upper slopes is mostly covered in pasture grasses. A pattern of dirt tracks serves as a transect system together with eroding bare patches and rill banks. The named sites are as follows: Ridge Top Site, High Ridge Workshop Site, Ridge Peak Síte and High Spur Site, and there are numerous isolated finds as well.

2. Bowmans Creek Valley. The part of Bowmans Creek Valley in this area is the eastern valley bottom and slopes. The assemblage variability for the three large sites (Waterhole, Oxbow, and Glennies Creek Sites) do not seem to have been reported previously for the Hunter Valley.

- Waterhole Site. The Waterhole Site has been analysed in detail. It features abundant debitage in which expanded flakes with platform modification are prominent. This is interpreted as indicating intensive use of large tools, most of which have been transported elsewhere. A wide variety of other tools are present, including rare types such as an axe preform, a hammerstone, a flake tool with a projection (drill-like) and an elouera. Although numerous microblade cores are represented, no clearly defined workshops were found, and a large portion of the microblade coréæ were ^{3}Çials. This si'1 has 3õre debitage of microblade production that the Oxbow and Glennies Creek Sites. The extensive exposure for this site made it possible to divide the recorded artefacts into smaller assemblages. Analysis indicates that there was appreciable spatial variation in the distribution of the flaked stone. In addition to the artefact assemblage, two sets of grinding grooves were found at the waterhole associated with the site. Most of this site has been severely disturbed and eroded down to a gravel lag. There is however an intact deposit closely associated with the waterhole and grinding grooves which would be expected to contain an archaeological deposit with good integrity. Although it has high excavation potential, if possible this deposit should be conserved.

- Oxbow Site. This site has several exposures and these have been analysed in detail. The site is in a tributary valley above the upper terrace and next to where the Bowmans Creek channel swings in close to the valley slopes. The exposure assemblages have been analysed in detail and indicate spatial partitioning in the main concentration next to the creek channel as well as small concentrations and workshops up the small tributary channels. Rare artefact types such a burren and a hammerstone were present. Although blade cores (especially trials) were numerous and backed blades were found, the debitage indicate that the stone technology from this site is extremely similar to the Glennies Creek Site (with little microblade production), even though most of the landscape details are dissimilar, except for the association of high ground to a narrow stream channel. As in the case of the Waterhole site, the most conspicuous debitage was expanded flakes with platform modification, suggesting considerable large tool resharpening. The main area of concentration for this site has a substantial area which seems to never have been cultivated and would have high spatial integrity. This would provide high excavation potential, but if possible should be conserved.

- Glennies Creek Site. This site is on the valley slopes of Glennies creek near a lagoon-like waterhole blocked by a gravel bar. Grinding grooves occur in the sandstone outcrop at the waterhole. Spatial partitioning is indicated by assemblages which were analysed from various exposures at the site. Again there are numerous microblade cores, particularly trials, and even a small microblade workshop, but overall there seems to have been relatively little microblade production. Instead, as in the case with the other two large sites, the expanded flakes with platform modification is conspicuous among debitage, indicating resharpening of large tools not present in the assemblage. A workshop of small flake tools which includes a range of specialised types, particularly drill-like flake tools with projections is of especial significance. This workshop may be the key feature to indicating the function of the three big sites. Of the three sites, this site has the most intact deposit and best potential integrity for spatial partitioning. It has outstanding excavation potential. However as an almost pristine archaeological deposit, it also has an exceptionally high value for preservation.

3. Hunter River Slope Site. This site is on the slopes at the southern end which front on to the Hunter River. This site was anomalous in assemblage characteristics to the rest of the Ashton study area, and was the only example where there were scattered heat retainers and it had a well-formed hearth with charcoal. It is tentatively suggested to be related to the material found at Narama further west and close to the Hunter River.

15. Recommendations

15.1 Management Assessment

The recommendations in this section are based on the results of the analysis of this report and the significance assessment, and discussions on site with members of local Aboriginal communities.

15.2 Conservation Options

A variety of conservation options are possible.

- Avoidance. Avoidance of impact is always the preferred heritage conservation outcome. This refers to both direct and indirect impact as well as the short and long term prevention of adverse effects.
- Impact minimisation. Where impact is inevitable, them it should manage to impact as little of the cultural resource as possible
- Conservation areas. Long term preservation for highly significant can be further ensured as conservation areas, including various provisions for statutory reservation, such as an Aboriginal Place under the NPW Act.
- Mitigation. Where destruction of cultural resources is inevitable mitigation may be in the form of salvage excavations or a collection of all surface evidence. Normally this would require analysis to assess the effectiveness of the mitigation.
- Monitoring. Monitoring of various types are possible. For example, in the case of subsidence, ongoing monitoring can be used to determine whether any adverse effects are in progress and what mitigation is needed. Another form of monitoring is during development in which the effects of heavy plant on the ground is monitored by observers. This may lead to a salvage operation or avoidance if archaeological evidence is discovered.
- Aboriginal access to sites, or possession of artefacts. The Aboriginal community may wish to obtain access to significant sites which are protected or to be able to curate collections of artefacts.

15.3 Recommendations

The recommendations are presented here as management areas (Map 15.1) which are related to the form of development proposed and the significance assessment as discussed. In general, it is considered that these recommendations are consistent with the interests and concerns which have been expressed by members of the Aboriginal community during on-site discussions.

Phase 1:

- Recommendation 1. A NPWS Sec 90 consent to collect all recorded isolated finds, or EWAs (recorded exposures with artefacts) for potential further analysis.

Phase 2:

- Recommendation 2 . At the time the top soil is being stripped the surface is monitored and any artefacts uncovered are marked. This would be after the first scrape which should not be more than 5 or 10 cm deep.
- Recommendation 3. The artefacts marked after the initial scrape be assessed and any case for salvage excavation or collection negotiated.

15.4.2 Ridge Top Site

The Ridge Top Site (EWA 1) is located in this area as a small low density artefact concentration. The site area seems to be highly confined where it is exposed by the dirt vehicle track

Phase 1:

- Recommendation. A NPWS sec 90 for a limited test excavation of this site where it is exposed at the vehicle track.

<u>15.5 Management Area B</u>

15.5.1 General

This area is to be totally destroyed by the open cut mine and the Eastern Emplacement.

Phase 1:

- Recommendation 1. A NPWS Sec 90 permit to collect all artefacts on the surface from all EWAs, for potential further analysis.

Phase 2:

- Recommendation 2. Any top soil recovery process similar to Management area A should be treated in a similar way.

15.5.2 Tributary Site.

Considering the significance values discussed, and that it will be totally destroyed the Tributary Site (EWA 14) requires salvage excavation.

Phase 1:

- Recommendation 1. A NPWS Sec. 90 permit, for a salvage excavation of this site. An adaptive sample strategy be designed for the 10 by 20 area where the archaeological deposit is expected. This would consist of an evenly distributed set of test pits and the option to expand them in the event they are sufficiently productive.

15.5.3 Bridge Site

Considering the significance values discussed and that it would be totally destroyed the Bridge Site (EWA33) requires salvage excavation. The area between EWA33 and Bettys Creek consists of grass, and on the lower terraces, a layer of Post-European alluvium which may contain extensive archaeology.

Phase 1:

- Recommendation 1. NPWS Sec 90 permit to salvage excavation of the site. An adaptive sample strategy be designed for the 150 by 50 m area where the archaeological deposit is indicated. This would consist of an evenly distributed set of test pits with the option to expand them in the event they are sufficiently productive.

Phase 2:

- Recommendation 2. Strip the area between EWA33 and Bettys Creek of grass and the Pre-European layer where present monitor to assess archaeological evidence on the terraces.
- Recommendation 3. If archaeological evidence is found it should be assessed for the potential need for salvage.

<u>15.6 Management Area C</u>

16.5.1 General

This is the western Bowmans Creek valley bottom, impacted by the creek diversion

Phase 1:

- Recommendation 1. A NPWS Section 90 Consent to collect any artefacts in area of impact.

Phase 2:

- Recommendation 2. The Bowmans Creek deviation channel be monitored for the possible disturbance of archaeological deposits. This should be after an initial removal of the grass cover and Post-European alluvium to the pre-European surface.

- Recommendation 3. If archaeological evidence is found it should be assessed for potential need to salvage.

Phase 3:

- Recommendation 4. Permanent markers for all EWA locations for the purpose of monitoring.
- Recommendation 5. A program for monitoring to visit these places on a regular basis to assess any adverse effects.
- Recommendation 6. Any additional artefactual evidence found in this process be recorded and marked.

15.6.2 Waterhole on Bowmans Creek

The proposed deviation of Bowmans creek begins at the sandstone outcrop of the waterhole which contains the grinding grooves Site GG1 and GG3 belonging to the Waterhole Site. Because the diversion channel begins at the Waterhole site especially close monitoring is required here, for any evidence of a fish trap or fish weir structure, such as possible stake or post holes. It should also be monitored for possible discard for heavy duty tools used in the construction of fishing facilities.

Phase 1:

- Recommendation 1. No work in the waterhole area before the grinding grooves (GG1) are securely fenced. (See Recommendations Waterhole Site, Area D)

Phase 2:

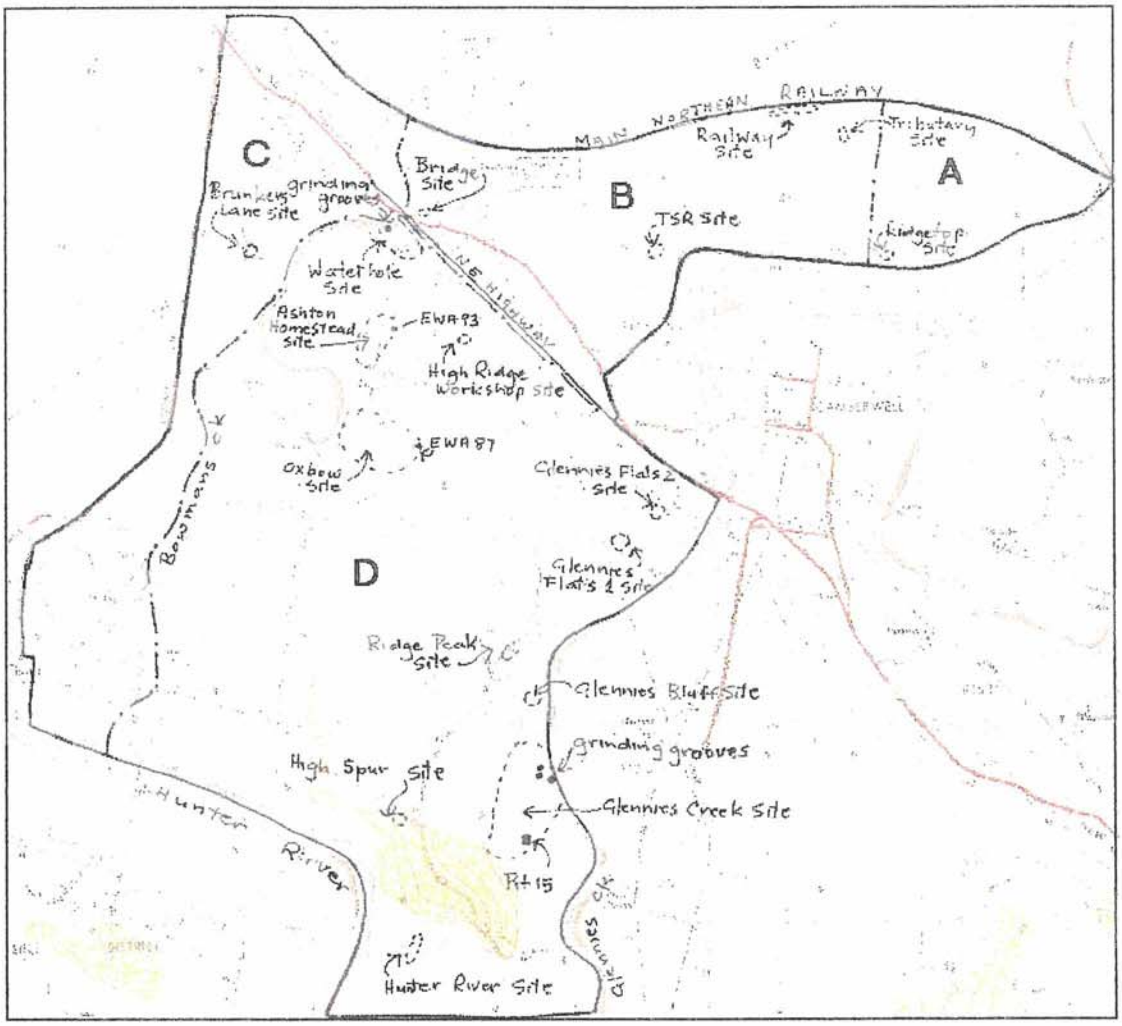
- Recommendation 2. Monitoring of the excavation of the new channel. Close inspection for possible stake or post holes or large stone artefacts.

15.7 Management Area D

15.7.1 General

This is the largest management area and consists of the subsidence zone over the proposed long wall underground mining. In addition there are potential impacts from the overburden dump for the Western Emplacement area, the haul road to it, bund walls and a power line.

It is planned to strip the top soil from the Western Emplacement Area so that the soil can be stockpiled for later rehabilitation use. There is evidence of small artefact concentrations and workshops across the upper slopes of the Ashton Ridge where the emplacement is proposed. Analysis indicates there is considerable variability among these artefact concentrations and they vary as to land unit, such as a peak on the ridge, or a spur crest. Collectively they are likely to provide a significant body of evidence about what appears to be a relatively complex use to the part of the ridge between Bowmans and Glennies Creeks.



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

Recommendations are grouped into the following stages:

Phase 1 – Post Consent (post development approval)
Phase 2 – Construction Phase
Phase 3 – Mining Phase

15.4 Management Area A

15.4.1 General

It is planned to strip the top soil from this area so that the soil can be stockpiled for later rehabilitation use. The area would be used as an overburden dump as the Eastern Emplacement. There is evidence of intermittent small artefact concentrations across the broad part of the ridge top. Individually these are probably of limited information value, but collectively they are likely to provide a significant body of evidence about what appears to be a relatively specialised use to this part of the ridge.

Phase 1

- Recommendation 1. Where impact is planned a NPWS Sec 90, to collect all recorded isolated finds and EWAs (recorded exposures with artefacts) for potential further analysis.

Phase 2:

- Recommendation 2. At the time the top soil is being stripped for the Western Emplacement the surface is monitored and any artefacts uncovered are marked. This would be after the first scrape which should not be more that 5 or 10 cm deep.
- Recommendation 3. The artefacts marked after the initial scrape be assessed and any case for salvage excavation or collection negotiated.
- Recommendation 4. A new access road is planned to be constructed from the New England Highway near Glennies Creek to the farm at the south end of Ashton ridge on the Hunter River. This road needs to be designed to avoid all recorded archaeological material and be monitored during its construction.

Because this also is a subsidence zone, additional recommendations are needed to cover the contingency of adverse effects to sites.

What are they??

Phase 3:

- Recommendation 5. Permanent markers for all EWA locations for the purpose of monitoring.
- Recommendation 6. A program for monitoring to visit these places on a regular basis and assess any adverse effects.
- Recommendation 7. Any additional artefactual evidence found in this process be recorded and marked.
- Recommendation 8. The artefacts in the subsidence zone are not collected, but left in place.
- Recommendation 9. If appreciable damage and disturbance of places with artefacts is observed during the monitoring process, a program of salvage be negotiated.

15.7.2 Waterhole Site

This is of outstanding significance as described above, and immediate protection is needed, since it is near an area of intense development. The grinding grooves are particularly susceptible to accidental damage, because foot traffic, particularly with heavy soled boots, is severely damaging to the highly friable sandstone. The undisturbed deposit near the grinding grooves is of expected high archaeological integrity, and also needs to be fenced to prevent accidental damage.

Phase 1:

- Recommendation 1. URGENT. The upper grinding grooves (GG1) be securely fenced.
- Recommendation 2. Fencing and protection of undisturbed deposit near the grinding grooves.
- Recommendation 3. A NPWS sec 90 permit to collect sensitive items, such as the axe, hammerstone, etc.
- Recommendation 4. Except for highly sensitive items the artefacts on the surface of the rest of the site should not be collected, but left for educational purposes.
- Recommendation 5. If this site is used for a telecommunications corridor, then provisions are needed to prevent impact.
- Recommendation 6. If impact from the environmental bund is unavoidable, then a sec 90 Consent will be needed for collection.

Phase 2:

- Recommendation 7. If any of this deposit is to be unavoidably disturbed by the haul road construction, a NPWS sec 90 application for salvage excavation..
- Recommendation 8. A NPWS sec 90 for the haul road which unavoidably passes through the Waterhole Site.
- Recommendation 9. Fencing of the area of Waterhole site which is not to be impacted by the haul road.

Phase 3:

- Recommendation 10. Provision be made for Aboriginal access to the grinding grooves and the EWA28 surface site during the use of the mine.
- Recommendation 11. Access to grinding grooves be controlled, visited only with a guide.

15.7.3 Oxbow Site

This is of outstanding significance as described above, and all possible conservation methods are needed. The main site needs to be protected form both livestock and accidental damage.

Phase 1:

- Recommendation 1. Design the western emplacement and settling ponds as far up the slope of Ashton ridge as possible (preferably south of the farm track) to minimise impact on this site.
- Recommendation 2. Assess the extent of the impact from the final design of the Western Emplacement, a Sec 90 NPWS to salvage excavate potential areas of deposit which would be unavoidably impacted.
- Recommendation 3. Sec 90 to salvage collect all artefacts which would be unavoidably impacted by the western emplacement.

- Recommendation 4. It is expected that impact will be unavoidable for EWA87 which is a small workshop deposit, a NPWS sec 90 application for salvage excavation
- Recommendation 5. Erect a protective fence around the main concentration and include EWA29, 30, 31,32 and 36.
- Recommendation 6. All artefacts which would not be disturbed by development should be left in place.

15.7.4 Glennies Creek Site

This site appears to be the most outstanding example of its type recorded for the Hunter Valley, and requires maximum conservation. It is only partly within the subsidence area. A major source of impact is livestock trampling, and the entire area needs to be fenced .

Phase 1:

- Recommendation 1. Fence the entire 600 x 400 m area.
- Recommendation 2. Block the access track to the site.
- Recommendation 3. Close the power line maintenance track through the site.

Phase 2:

- Recommendation 4. Provision for Aboriginal people to visit the area during the use of the mine.

Phase 3:

- Recommendation 5. Continued monitoring for damage from subsidence in the event that salvage then is required.
- Recommendation 6. This site be managed as a conservation area.

15.7.5 High Ridge Site

This site is a good example of a small microblade workshop away from a domestic camp. It would be unavoidable destroyed by the Western Emplacement.

Phase 1:

- Recommendation 1. NPWS sec 90 for salvage excavation.

15.7.6 High Spur Site

This site is on the edge of the subsistence area, but is under threat from livestock trampling.

Phase 1:

- Recommendation 1. Erect a protective fence.

15.7.7. Hunter River Slopes

Only part of this area is in the subsidence zone. In conjunction with the property owner protection is needed for a site on a farm track where the threat is more from vehicle traffic than subsidence.

Phase 1:

- Recommendation 1. NPWS Sec 90 for the collection of artefacts exposed in the road and eroding area.
- Recommendation 2. Investigate the process of road surfacing to prevent further damage.

15.8 Summary of Recommendations

The management actions outlined above are summarised below in terms of the appropriate areas or sites at various stages of mining development.

Phase 1:

Protective fencing.

- Waterhole Site grinding grooves
- Waterhole Site deposit
- Waterhole Site lag surface site.
- Main deposit of Oxbow site
- All of Glennies Creek Site

Note: These would be covered under consent conditions.

Conservation areas.

- Waterhole and grinding grooves of the Waterhole Site
- Glennies Creek Site

NPWS Sec 90 collection

- Management Area A, all.
- Management Area B, where development is planned
- Management Area D, for the Western Emplacement
- Management Area D, for the Hunter River Slope Site

NPWS Sec 90 salvage

- Ridge Top Site EWA 1.
- Tributary Site EWA 14.
- Bridge Site EWA33
- High Ridge Site
- EWA 87 of Oxbow site

Phase 2:

Monitoring for stripping during earth works:

- Management Area A (Eastern Emplacement)
- Management Area B: Bridge Site to Bettys Creek-Bowmans Creek confluence area
- Management Area C: construction of deviation channel for Bowmans Creek, especially in the waterhole area.
- Management Area D in the Western Emplacement area

Aboriginal access.

- Glennies Creek Site (possibly post construction)

Phase 3:

Monitoring for subsidence with markers.

- Management area C
- Management area D

Aboriginal access.

- Waterhole and grinding grooves of the Waterhole Site (post mining)

<u>15.8 Aboriginal Site Management Plan (Post Consent/Ongoing)</u>

As part of a longer term planning process an Aboriginal Site Management Plan is needed. This should incorporate the determinations made for the EIS concerning the above management actions. It should be linked to the various stages of mine development, and reflect a process of negotiation with the Aboriginal community. It should be understood that the processing of NPWS Consent applications can require substantial time, and that any salvage excavations required also may require considerable time. This should take into account of possible salvage work from monitoring the soil stripping.

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ASHTON COAL MINING PROJECT

ENVIRONMENTAL IMPACT STATEMENT:

ABORIGINAL ARCHAEOLOGY

by

Dan C Witter

June 2002

APPENDICES

Appendix 1. Glossary

Artefact Definitions

ARTEFACTS

Artefact, feature, and manuport	Artefacts are any material thing which has been made or modified by a human. In archaeology, this usually refers to portable objects, such as stone tools. Non-portable artefacts, such as a fire place are called features. Objects which have been moved, but not modified, such as a stone for a fire place, are called manuports.
Types, attributes, measurements and material	Types are categories of objects which consist of specific characteristics, and are used for classification. Attributes are details belonging to those objects. These may be non-metric or metric in the form of measurements. Material is what the artefacts are made of, such as stone, bone or wood.
Debitage and implements	Debitage is the waste from artefact manufacturing, such as flakes. Implements refer to the tools, or other things made by the manufacturing process. Partly made tools, or discarded objects used to make them, as in the case of cores are also included here as implements.
Flaked and ground stone implements	Flaked implements are made by the flaking technique to produce an edge or to remove flakes for a tool. Ground stone implements are ground into their final stage (often by use), and some such as axes, may be flaked into preforms before an edge is ground.

DEBITAGE

Flake Terms

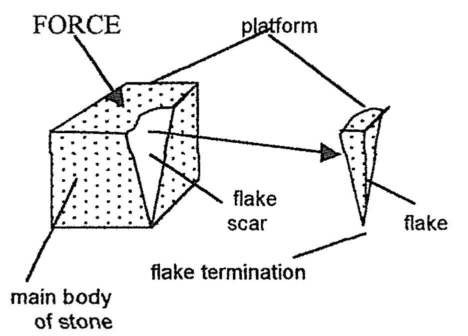
Flake A piece of stone detached by force (such as by a blow) from another piece (the main body).

Flake scar The surface left on the main body where a flake was detached.

Platform The surface on the main body of the stone where force (such as by a blow) was applied to detach the flake.

Flake platform The remains of the platform on top of the flake.

Flake termination. The bottom end of the flake, opposite the platform



Parts of a Flake

Proximal end The platform end of a flake.

Distal end The termination end of a flake.

Ventral side The under side of a flake where it was detached.

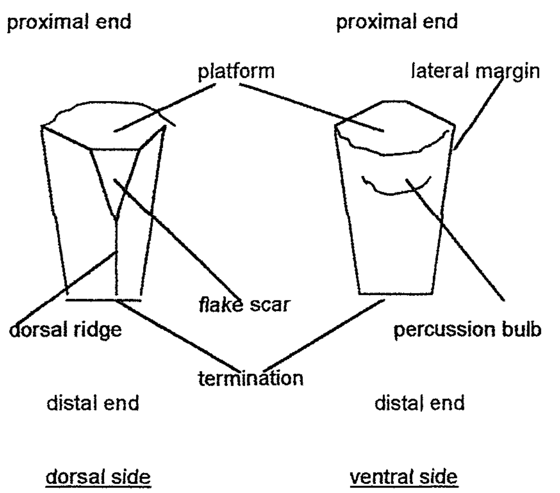
Dorsal side The top side of a flake with the surface from the main body of stone

Percussion bulb The swelling or raised bulge due to a conchoidal type of fracture.

Dorsal ridge One or more ridges running on the proximal-distal axis on the dorsal side.

Dorsal flake scars Scars from previous flake removals on the dorsal side of a flake

Lateral margins **The edges of the flake between the proximal and distal ends**



Debitage Types

Complete flake A flake which is whole and not broken

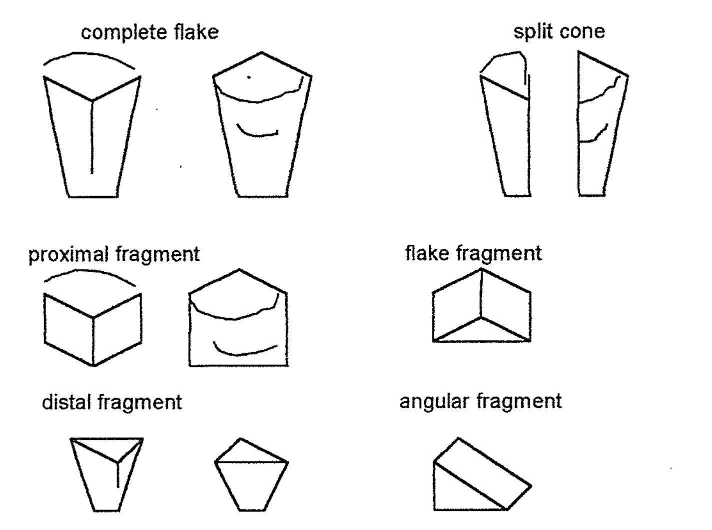
Split cone A flake which is split down the middle of the proximal-distal axis.

Proximal fragment A flake with the distal portion broken off.

Distal fragment A flake with the proximal portion broken off.

Flake fragment A flake which shows neither the proximal nor distal parts.

Angular fragment A product of flaking which does not show the diagnostic flake characteristics.

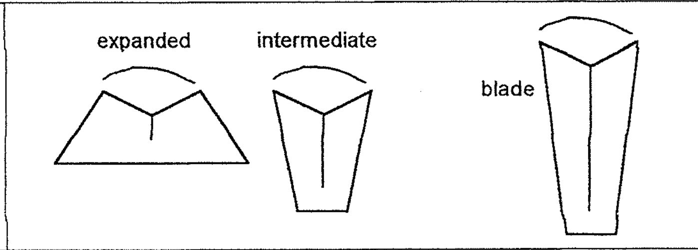


Debitage Attributes: Shape

Expanded A flake with the lateral margins wider than the proximal-distal length.

Blade A flake with the proximal-distal length over twice the lateral margin width

Intermediate A flake shape in between the expanded and blade types



Debitage Attributes: Platform

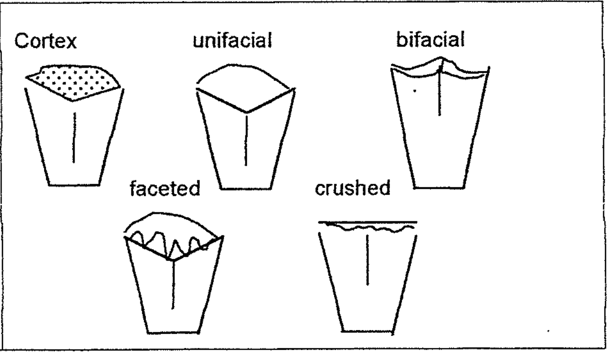
Cortex Cortex on top of the platform

Unifacial Flat platform with no cortex

Bifacial Platform surface showing two flake scars across it

Faceted Top of platform with small flake scars

Crushed Top of platform crushed away

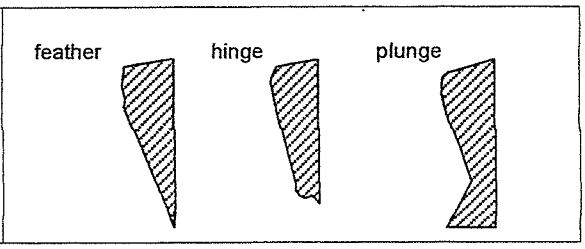


Debitage Attributes: Termination

Feather Termination with a thin taper to the end

Hinge Curved end to the termination

Plunge Termination becoming thicker, or not with a thin taper or curved end



Debitage Attributes: Dorsal Surface

Transverse flake scars Dorsal flake scars which are roughly 90 deg. To the proximal-distal axis

Crested A dorsal ridge formed by transverse flake scars

Platform modification Small retouch-like flake scars on the dorsal surface along the platform

Distal flake scars Flake scars which originate from the distal end rather than the proximal end

Blade scars Dorsal flake scars which are straight and parallel or evenly converging with the lateral margins indicating an origin from a blade core.

IMPLEMENTS

Implement Terms

Usewear Fine irregular edge damage

Retouch *Small flake scars removed from a platform, edge or lateral margin*

Backing Retouch which is perpendicular or nearly to the plane of the flake

Nuclear body A piece of stone being flaked which did not originate as a flake

Flake body A piece of stone being flaked which originated as a flake

Core A nuclear or flake body which is used to provide flakes to become implements

Rotation Changing the platform or edge of an implement for the removal of flakes

Step termination Step-like flake scar termination

Implement Types

Flake tools **Tools made on a flake showing usewear or retouch.**

Nuclear tools Tools made on a nuclear body with expanded resharpening flake scars

Producer cores Cores to make flakes for tools, with maximum length and plunge flake scars

Bipolars Cores with crushing on one or both ends

Blade cores Cores with long narrow flake scars

Backed blades *Blades or thin flakes with backing retouch*

Specialised Flake Tool Edge Types

Serrate Fine teeth set in the edge (not from cuspate retouch)

Concave Notch made into flake edge made by retouch (not a single cuspate flake)

Convex Semi-circular edge made by retouch, not due to flake contours.

Projection Sharp point made by retouch, not from an adjacent pair of cuspate flakes.

Burin A square edge made by removing a flake at right angles to the plane of a flake

Specialised Hafted Flake Tool Types

Microconvex Small, thin convex edge, usually on the distal end of a flake, presumed use as hafted. **Adze flake** Flakes with heavy step-retouch and adze-type wear on distal end **Burren** Flakes with heavy step-retouch and adze-type wear on one or both lateral margins **Elouera** Flakes with backing retouch on one margin and usewear on the other – not backed blades.	

Backed Blade Types

Bondi Elongate and asymmetrical backed blades with the end angle for one end less than 40 deg. **Geometric** Symmetrical or asymmetrical backed blades with all end angles over 40 deg. **Reject stage** Backed blade partly formed or with rough burs on backed surface **Finished stage** Backed blade fully formed and with no rough burs on backed surface	

Flake Tool Usewear/Retouch Attributes

Usewear Fine irregular edge damage. **Scalar** Fine to large scale-lime retouch scars with feather terminations. **Step retouch.** Step-terminated retouch flake scars **Cuspate retouch** Large, thick feather terminated retouch flake scars **Invasive retouch** Long thin retouch flake scars which go to the centre of the flake **Ventral retouch** Retouch on the ventral rather than dorsal surface	

Nuclear Tool Rotation Attributes

Unifacial Resharpening or edge producing flakes on one face only **Bifacial** Resharpening or edge producing flake scars on two adjacent faces **Multifacial** Resharpening or edge producing flake scars on two or more edges	

Producer Core Rotation Attributes

Uniplatform Flake production scars from one platform only. **Biplatform** Flake production scars form one adjacent platform **Multiplatform** Blake productions cars from two or more separate platforms	

APPENDIX 2

COVERAGE DATA

ASHTON COVERAGE DATA

survey uni	E	N	land form	L	W	criteria	expos type	vis %
GG1	318400	6406421	waterhole outcrop	25	10	conglomerate with ss	bare rock	80
EWA1	320932	6406264	ridge crest	20	5	vehicle track	B-lag	80
SS1	320942	6406272	ridge crest	2	50	ss boulders	bare rock	50
EWA2	320966	6406254	ridge crest	2	5	bare patches	A-lag	10
X1	320920	6406405	ridge slope	30	5	bare patches	A-lag	20
X2	320800	6406428	tributary head	10	20	eroding banks	A&B-lag	20
EWA3	320852	6406460	ridge slope, upper	20	5	rill, eroding banks	B-lag	50
EWA4	320886	6406455	ridge slope, upper	0.2	2	stock track	A-lag	50
EWA5	320984	6406537	ridge crest	0.1	2	vehicle track	A-lag	50
EWA6	320953	6406488	ridge crest	2	30	vehicle track	B-lag	20
EWA7	320957	6406420	ridge crest	2	30	vehicle track	B-lag	20
X3	320937	6406964	spur crest, lower	50	20	track, bare patches	gravel lag	80
X4	320961	6406703	trib. channel, lower	10	20	bare patches	B-lag	20
X5	320998	6406306	ridge crest	5	10	bare patches	A-lag	20
X6	321600	6406370	ridge crest	700	2	vehicle track	A,B,gravel lag	50
EWA8	320294	6406327	ridge crest, slope	50	2	vehicle track	B-lag	50
EWA9	320247	6406386	ridge slope	50	2	vehicle track	B-lag	30
EWA10	320216	6406427	spur crest	50	2	vehicle track	B-lag	30
X7	320255	6406479	spur slope	30	3	vehicle track	B-lag	40
X8	320286	6406475	tributary bottom	30	2	vehicle track	B-lag	20
X9	320413	6406654	spur crest, slope	40	3	vehicle track	B-lag	30
EWA11	320518	6406443	spur crest	20	2	vehicle track	B-lag	30
EWA12	320627	6406444	spur crest	50	5	vehicle track, disturbed	B-lag	30
X10	320732	6406428	spur slope	20	5	bare patches	gravel lag	10
EWA13	320622	6406540	spur slope	20	20	bare patch	A-lag	80
X11	320604	6406805	tributary margin	30	10	bare patch	A-lag	50
EWA14	320603	6406916	tributary margin	20	10	gully bank, bare patch	A&B-lag	20
EWA15	320384	6407026	flat spur top	75	7	track, bare patches	gravel lag	40
X12	320594	6407043	tributary margin	15	4	rill, vehicle track	A&B-lag	50
EWA16	320124	6406981	tributary bottom	15	10	bank, vehicle track	A&B-lag	20
EWA17	319974	6406963	flat spur slopes	50	2	vehicle track	B-lag	40
X13	320243	6406818	trib bottom, margin	5	5	bare patches	A-lag	80

X14	320210	6406740	trib bottom, margin	10	5	bare patches	A-lag	20
EWA18	320278	6406766	tributary slopes	40	10	bare patches	A-lag	50
X15	320195	6406825	flat spur top	40	40	bare patches	A-lag	80
EWA19	318566	6406245	flat spur top	60	2	vehicle track	B-lag	10
EWA20	319737	6406100	ridge slope	20	5	bare patches	A&B-lag	20
EWA21	319631	6406086	slope tributary	80	10	bare patches	A-lag	50
X22	319474	6406186	spur slope	50	40	bare patches	A-lag	40
SS2	319474	6406186	spur slope			boulders	bare	
X16	319548	6406465	tributary channel	30	5	rill bank	A&B-lag	20
X17	319594	6406506	spur crest, trib marg	40	30	rill bank	A&B-lag	20
X18	319619	6406366	tributary channel	40	20	rill bank, vehicle track	A&B-lag	50
X19	319679	6406368	tributary channel	30	5	gully bank	A&B-lag	50
X20	319669	6406440	flat spur, trib margin	30	30	bare patches	A-lag	10
SS3	319669	6406440	flat spur, trib marg			boulders	bare	
X21	319773	6406546	spur slope	50	2	bare patches, track	A&B-lag	20
EWA22	319874	6406535	spur crest	50	2	vehicle track	B-lag	30
EWA23	320108	6406504	spur crest	40	2	vehicle track	B-lag	50
X23	320154	6406747	spur slope, trib marg	60	2	vehicle track	B-lag	20
X24	320088	6406795	flat spur top	20	20	bare patches	A-lag	80
X25	320055	6406818	tributary bottom	40	40	rill bank	A&B-lag	20
X26	320016	6406881	slope	30	30	bare patches	A&B-lag	50
X27	319871	6406868	slope	10	4	bare patches	A-lag	50
X28	319724	6406898	flat spur top	50	2	bladed track	B-bare	20
EWA24	319546	6405851	spur crest	60	2	vehicle track	A&B-lag	30
SS4	319556	6405851	spur crest			boulders	bare	
X29	319365	6406812	spur slope, trib marg	100	2	vehicle track	A&B-lag	20
SS5	319365	6406812	spur slope, trib marg			boulders	bare	
X30	319347	6406757	tributary bottom	40	20	gully bank	A&B-lag	10
EWA25	319374	6406709	tributary bottom	60	10	gully bank	A&B-lag	20
SS6	319418	6406407	spur crest	30	5	boulders	bare	10
X31	319457	6406400	spur crest	10	10	bare patches	A-lag	20
EWA26	319727	6406284	spur crest	30	20	bare patches	B-lag	80
X32	319761	6406310	spur crest	10	4	bare patches	gravel lag	50
X33	319777	6406261	spur crest	40	20	bare patches	gravel lag	20

X34	319630	6406140	spur slope, trib marg	60	10	bare patches	A-lag	50
EWA27	319704	6406313	spur crest, trib marg	80	20	gully bank, bare patches	B-lag	20
EWA28A	318534	6406338	flat spur top	25	20	bare area	gravel lag	90
EWA28B	318534	6406338	flat spur top	20	15	bare area	gravel lag	90
EWA28C	318534	6406338	flat spur top	50	20	bare area	gravel lag	90
EWA28D	318534	6406338	flat spur top	100	50	bare area	gravel lag	80
EWA28E	318534	6406338	flat spur top	20	75	bare area	gravel lag	80
EWA28F	318534	6406338	flat spur top	50	50	bare area	gravel lag	60
EWA29	318241	6405450	tributary margin	20	10	bank, track, bare patches	A&B-lag	20
EWA30	318227	6405458	tributary margin	20	2	gully bank	talus	50
EWA31	318227	6405510	tributary margin	30	1	gully bank	talus	20
EWA32	318271	6405475	tributary margin	35	1	gully bank	talus	20
X 35	318314	6405461	tributary margin	20	5	gully bank	talus	20
EWA33	318646	6406566	terrace	130	50	eroding banks	talus, A&B-lag	10
EWA34	318375	6405345	tributary margin	40	10	bare patches	A-lag	20
EWA35	318234	6405317	tributary margin	1	40	gully bank, stock track	A&B-lag	10
EWA36	318236	6405412	tributary margin	30	20	gully bank, stock track	A&B-lag	30
X36	320889	6406322	ridge crest	20	5	bare patch	gravel lag	20
SS7	320899	6406332	ridge crest	1	10	boulders	bare	100
X37	318487	6406673	creek channel	10	2	vehicle track	alluvium	20
X38	318531	6406627	creek channel	10	2	vehicle track	alluvium	20
EWA37	319772	6406235	ridge crest, shoulder	40	10	bare patches	A-lag	20
EWA38	319738	6406284	ridge crest, shoulder	30	20	bare patches	B&gravel lag	50
EWA39	319734	6406323	slope	40	70	rill, gully bank, bare	talus, A&B-lag	20
X39	320365	6406408	slope	2	10	vehicle track	A-lag	50
X40	320541	6406600	spur crest	50	1	vehicle track	A-lag	50
X41	320455	6406783	spur crest	30	30	bare patches	A-lag	20
X42	320297	6406681	tributary margin	60	20	bare patches	A-lag	20
EWA40	318823	6404110	ridge saddle	100	2	vehicle track, mitre drain	B-lag	50
EWA41	318883	6404249	ridge crest	100	2	vehicle track	B-lag	50

EWA42	318933	6404325	ridge peak	20	2	vehicle track	B-lag	80
EWA43	318638	6403904	ridge peak	20	40	bare patches	B-lag	20
EWA44	318531	6403514	ridge peak	50	20	vehicle track, bare	B-lag	10
EWA45	318544	6403328	ridge saddle	20	1	road cut	A-horiz	80
X44	318526	6403368	ridge saddle	40	2	mitre drain furrow	A&B horiz	50
EWA46	318390	6403574	high spur crest	30	10	erosion front	talus, B-lag	50
X45	318414	6403742	spur crest	40	5	track cut	A&B horiz	10
EWA47	318193	6403644	spur crest	20	1	drainage furrow	disturbed	50
EWA48	318127	6403708	spur crest	10	1	drainage furrow	disturbed	50
EWA49	318287	6403627	spur crest	10	2	vehicle track	A&B-lag	20
EWA50	320772	6404021	tributary flat	1	2	bare patch, ant hill	A&B-lag	50
EWA51	317954	6403998	tributary flat	2	1	stock track, bare patch	A&B-lag	50
EWA52	317847	6404293	tributary flat	1	2	vehicle track	A&B-lag	80
X46	317483	6405081	flood plain	2	2	bare patch	bare alluvium	80
X47	317432	6405085	creek bank	2	50	eroding bank	bare alluvium	80
X48	317261	6404957	flood plain bank	2	10	track at gate	bare alluvium	50
X49	320720	6406609	tributary bottom	30	30	bank, bare patches	A&B lag	50
X50	320772	6406788	spur crest	2	50	track	gravel lag	20
EWA53	320680	6407045	flat spur crest	40	4	vehicle track	bladed	20
EWA54	320562	6406998	spur slope	30	30	bare patches	A-lag	10
EWA55	320588	6407026	spur slope	3	1	bare patches	A-lag	20
EWA56	318571	6404543	spur crest	5	1	stock track, anthill	A&B lag	50
X51	317976	6404615	lower spur crest	10	10	bare patch	gravel lag	50
EWA57	318001	6404205	tributary bottom	5	50	stock track,banks, bare	A&B lag, talus	20
X52	318105	6404253	tributary bottom	100	10	stock track,banks, bare	A&B lag, talus	20
X53	318217	6404384	tributary bottom	100	20	stock track,banks, bare	A&B lag, talus	20
X54	318289	6404384	tributary bottom	100	10	rill banks	A&B lag, talus	20
X55	318628	6404182	tributary bottom	100	1	stock track, bare patches	A&B lag	20
EWA58	318623	6403571	ridge slope	40	30	bare patch	A, B, gravel lag	80
EWA59	318662	6403564	ridge slope	15	5	vehicle track	gravel lag	80
x56	318668	6403488	ridge slope	50	50	bare patch	A-lag	50
X57	318733	6403477	ridge slope	30	30	bare patch	A-lag	50
X58	318729	6403446	tributary bottom	30	20	bare patch	A-lag	20

X59	318739	6403386	ridge slope	30	2	vehicle track	B-lag	50
EWA60	318798	6403400	tributary bottom	20	2	vehicle track	B-lag	20
EWA61	318947	6403600	flat spur crest	65	50	bare with litter	A&B-lag	20
SS9	318920	6403754	ridge slope	100	20	sandstone ledge	bare	80
X60	318934	6403830	spur crest	20	20	bare with litter	A-lag	80
EWA62	318948	6403776	flat spur crest	60	20	bare with litter	A&B-lag	20
EWA63	318943	6403704	spur crest	10	10	bare with litter	A-lag	10
EWA64	319065	6403786	spur crest	150	50	track,bare patches	B, gravel lag	80
EWA65	319148	6403650	terrace	20	10	track, bare patches	alluvium	50
EWA66	319054	6403999	ridge slope	70	3	rill banks, ant hill	A&B-lag, talus	10
EWA67	319059	6404050	ridge slope	75	5	erosion front	B-lag	80
X61	319050	6404127	ridge slope	10	5	erosion front	B-lag	20
EWA68	319107	6404223	ridge slope	10	5	erosion front	B-lag	80
SS10	319086	6404313	ridge crest, bluff	50	5	sandstone outcrop	bare	80
EWA69	319117	6404707	ridge crest	100	2	vehicle track	A&B-lag	10
EWA70	319141	6404775	ridge crest	30	3	vehicle track	A&B-lag	50
EWA71	319274	6404798	ridge slope	10	5	vehicle track, ant hill	B-lag	20
EWA72	319339	6404810	ridge slope	2	2	ant hill	B-lag	10
EWA73	319392	9404800	ridge slope	3	1	stock track	A-lag	20
EWA74	319410	6404860	ridge slope	50	5	stock track, bank, dam	B-lag	20
SS11	319449	6404847	ridge slope	1	1	boulder	bare	80
EWA75	319563	6404982	tributary bottom	10	5	gully bank	A&B-lag, talus	80
X62	319282	6405191`	ridge slope	70	2	track, erosion front	B-lag	80
EWA76	319197	6405285	ridge crest	100	3	vehicle track	A&B-lag	50
X63	319164	6405050	ridge crest	8	2	vehicle track	gravel lag	20
EWA77	319099	6404875	ridge crest	60	2	vehicle track	gravel lag	80
EWA78	319111	6404804	ridge crest	50	2	vehicle track	gravel lag	80
EWA79	318541	6405631	spur crest	10	10	bare patches	A,B,gravel lag	20
EWA80	317463	6405942	flat spur	50	2	vechicle track	gravel lag	20
X64	317599	6405928	terrace	40	5	channel bank	alluvium	10
EWA81	317534	6406017	terrace	50	2	vechicle track	alluvium	10
X65	317646	6406200	terrace	30	1	vechicle track	alluvium	20
X66	317673	6406272	terrace	20	1	vechicle track	alluvium	20
EWA82	317707	6406329	terrace	20	2	vechicle track, bare	alluvium	20

X67	317841	6406393	creek channel	5	5	channel bank	alluvium	50
X68	317928	6406388	flood plain	4	4	bare patch	gravel & sand	20
X69	318036	6405823	terrace	10	1	stock track	alluvium	20
EWA83	318727	6405883	spur crest	20	5	gravel pit, bare patches	gravel lag	20
X70	318727	6405853	spur crest	30	1	stock track	B-lag	20
EWA84	319096	6405565	spur shoulder	15	3	bladed vehicle track	A&B-lag	80
EWA85	319156	6405434	high spur crest	50	50	track, erosional front	A&B lag	50
EWA86	319054	6405411	tributary bottom	50	1	rill banks	A&B-lag, talus	20
X71	318907	6405411	tributary bottom	20	1	rill banks	A-lag	20
EWA87	318550	6405341	tributary bottom	20	1	gully banks	A&B-lag, talus	80
X72	319524	6405983	ridge slope	50	20	bare patches	A&B-lag	20
EWA88	319535	6406043	spur crest	50	20	bare patches	B-lag	20
X73	319424	6406076	spur crest	100	100	bare patches	A-lag	20
X74	319368	6406077	spur crest	20	5	bare patches	A-lag	20
X75	319288	6406047	tributary bottom	30	10	bare patches	A-lag	20
X76	319333	6405969	tributary bottom	20	5	bare patches	A-lag	50
X77	319403	6405684	ridge crest	15	10	bare patches	B-lag	10
X78	319408	6405615	ridge crest	10	10	bare patches	A-lag	10
X79	319434	6405583	ridge slope	30	5	bare patches	B-lag	50
EWA89	317378	6405955	terrace	50	5	bare patch	alluvium	20
EWA90	318412	6405517	low flat spur	100	2	vehicle track	A,B, gravel lag	50
SS12	319140	6403864	creek bottom	50	4	sandstone ledge	bare	80
EWA91	318572	6405733	spur crest	3	2	bare ground with anthill	gravel lag	40
EWA92	319115	6403580	flat low spur crest	12	4	vehicle track	B-lag	30
GG2	319179	6403750	creek bank	50	4	sandstone outcrop	bare, in water	100
EWA93	318420	6405948	tributary bottom	10	3	erosional front, ant hill	A&B lag, talus	80
X80	318464	6406823	creek channel	2	30	high creek bank	talus	80
X81	318818	6402980	high spur crest	30	2	vehicle track	A-lag	50
EWA94	318471	5402780	slope	3	2	exposure	A&B lag	80
EWA95	318472	6402696	slope	50	2	exposure	A&B lag	50
X82	318625	6403021	high spur crest	2	50	vehicle track	A&B lag	50

EWA96	318772	6406066	tributary bottom	20	3	rill bank	A&B lag	50
EWA97	317583	6405075	terrace edge	20	20	bare patches, track	bare alluvium	20
X83	318008	6405003	valley bottom	700	2	vehicle track	B-lag	20
GG3	318379	6406435	rock shelf	1	1	outcrop	bare rock	100
GG4	318390	6406431	rock shelf	1	2	outcrop	bare rock	100
EWA98	319047	6403438	slope	1	3	exposure	A horiz	20
EWA99	318976	6403364	slope	1	2	exposure	B-lag	50
GG5	319098	6403799	slope	2.5	1.5	outcrop	bare rock	100
GG6	319080	6403755	slope	1	0.5	outcrop	bare rock	100
EWA100	319098	6403821	slope	2	20	exposure	B-lag	50
EWA101	318498	6402851	slope	2	2	exposure	A&B lag	80
EWA102	318479	6402800	slpoe	4	1	exposure	A&B lag	80
pit 15	319138	6403338	terrace	3	4	pit	paleosol	100

APPENDIX 3

ARTEFACT DATA

	implements - UPPER CASE							deb	lower case				
			breakage		**reduction stage**				**shape**	**plat type**	**plat mod**	**term.**	
			broken		... per type				blade	cortex on plat	unmodified	feather	
			whole						intermed	unifacial	modified	hinge	
									expanded	bifacial	faceted	plunge	
	comments		burnt		road break	etc			unident	crushed platform	usewear on plat		
site name	**EWA**	**no.**	**material**	**ctx**	**type**	**Mx L**	**Mx W**	**Mx T**	**attributes**				**comment**
ridge top	1	1	tuff	n	BACKED BLADE	30	9	5	broken	bondi			road break
ridge top	1	2	tuff	y	M'BLADE CORE	43	38	33	whole	unifacial	also nuc tool	bifacial	
ridge top	1	3	tuff	y	complete flake	26	19	8	intermed	cortex platform	unmodified	hinge	
ridge top	1	4	tuff	n	proximal fragment	19	8	2	blade	crushed platform			road break
ridge top	1	5	silcrete	n	distal fragment	30	13	10	blade			hinge	
ridge top	1	6	silcrete	n	complete flake	22	12	2	blade	bifacial	unmodified	feather	
ridge top	1	7	silcrete	n	split cone frag	18	15	6	expanded	bifacial	unmodified		proximal piece
ridge top	1	8	silcrete	n	proximal fragment	11	10	2	expanded	bifacial	unmodified		
ridge top	1	9	quartzite	y	BIPOLAR CORE	28	19	10	whole	anvil rested			
ridge top	1	10	silcrete	n	FLAKE TOOL	28	18	5	whole	concave	scalar retouch	on expandeded flake	
ridge top	1	11	silcrete	n	proximal fragment	15	13	2	blade	unif	modified		road break
	2	1	quartz	n	complete flake	20	13	5	intermed	unifacial	unmodified	plunge	
	3	1	silcrete	y	FLAKE TOOL	37	22	10	whole	usewear	on split cone frag cone edge		
	3	2	silcrete	y	FLAKE TOOL	22	17	8	broken	usewear			
	4	1	tuff	n	flake fragment	12	11	5	unident				
	5	1	tuff	n	proximal fragment	25	13	7	unident	unifacial	use-wear plat		
	6	1	quartz	n	complete flake	14	12	4	intermed	unifacial	unmodified	feather	
	6	2	silcrete	n	FLAKE TOOL	44	35	18	broken	scalar retouch			
	7	1	silcrete	n	angular fragment	24	31	22	unident				
	7	2	quartzite	y	flake fragment	28	18	8	unident				
	7	3	tuff	y	flake fragment	23	16	6	unident				road break
	7	4	quartz	n	angular fragment	18	12	6	unident				
	8	1	tuff	y	FLAKE TOOL	34	20	10	broken	use-wear			
	9	1	tuff	n	complete flake	14	17	4	expanded	bifacial	modified	feather	
	9	2	tuff	n	distal fragment	11	10	4	unident			feather	
	10	1	tuff	n	complete flake	21	14	9	expanded	unifacial	modified	hinge	
	11	1	tuff	y	complete flake	24	17	7	intermed	unifacial	modified	plunge	

	11	2	tuff	n	distal fragment	28	20	6	unident			feather	road break
fire break site, ASH 14	12	1	tuff	n	angular fragment	17	7	2	unident				
fire break site, ASH 14	12	2	pet wood	n	FLAKE TOOL	30	17	12	whole	1 use-wear	2 use-wear	3 use-wear	u-w on dors ridge
fire break site, ASH 14	12	3	"chert"	n	complete flake	29	14	8	intermed	unifacial	unmodified	feather	
fire break site, ASH 14	12	4	quartz	n	flake fragment	12	10	4	unident				
fire break site, ASH 14	12	5	tuff	n	flake fragment	17	10	4	unident				
fire break site, ASH 14	12	6	tuff	n	flake fragment	15	10	4	unident				burnt
fire break site, ASH 14	12	7	tuff	y	complete flake	18	13	3	expanded	unifacial	unmodified	plunge	
fire break site, ASH 14	12	8	quartz	n	flake fragment	13	9	2	unident				
fire break site, ASH 14	12	9	tuff	n	complete flake	16	13	3	expanded	unifacial	use-wear plat	feather	
fire break site, ASH 14	12	1	tuff	y	complete flake	25	18	7	intermed	unifacial	modified	feather	
fire break site, ASH 14	12	2	tuff	y	FLAKE TOOL	59	56	23	whole	1 use-wear	2 use-wear		
fire break site, ASH 14	12	3	tuff	y	complete flake	45	38	19	expandeded	cortex platform	modified	feather	
fire break site, ASH 14	12	4	silcrete	n	M'BLADE CORE	35	29	22	broken				
fire break site, ASH 14	12	5	tuff	n	complete flake	30	23	7	expandeded	unifacial	modified	hinge	
fire break site, ASH 14	12	6	silcrete	n	flake fragment	21	18	5	unident				
fire break site, ASH 14	12	7	tuff	n	flake fragment	17	11	5	blade				
fire break site, ASH 14	12	8	tuff	n	complete flake	18	15	4	expandeded	bifacial	unmodified	feather	
fire break site, ASH 14	12	9	silcrete	n	complete flake	23	10	4	blade	unifacial	unmodified	plunge	
fire break site, ASH 14	12	10	tuff	y	flake fragment	15	14	2	unident				
fire break site, ASH 14	12	11	tuff	n	proximal fragment	18	14	7	unident				
fire break site, ASH 14	12	12	silcrete	n	angular fragment	12	9	5	unident				
fire break site, ASH 14	12	13	silcrete	n	flake fragment	19	11	5	unident				
fire break site, ASH 14	12	14	silcrete	y	flake fragment	15	13	6	unident				
	13	1	tuff	n	flake fragment	17	13	5	unident				
tributary site, Ash-9	14	1	quartzite	y	NUCLEAR TOOL	82	37	35	broken	unifacial			
tributary site, Ash-9	14	2	tuff	n	distal fragment	32	15	6	blade			plunge	
tributary site, Ash-9	14	3	tuff	y	complete flake	58	35	10	expanded	unifacial	modified	plunge	
tributary site, Ash-9	14	4	silcrete	n	proximal fragment	45	38	15	unident	unifacial	unmodified		
tributary site, Ash-9	14	5	silcrete	n	proximal fragment	28	20	9	unident	bifacial	modified		
tributary site, Ash-9	14	6	silcrete	y	complete flake	24	19	6	intermed	cortex platform	unmodified	hinge	
tributary site, Ash-9	14	7	silcrete	n	distal fragment	23	21	6	unident			plunge	
tributary site, Ash-9	14	8	silcrete	n	complete flake	13	9	2	intermed	unifacial	unmodified	feather	
tributary site, Ash-9	14	9	tuff	y	FLAKE TOOL	22	18	7	whole	use-wear lat edge	use-wear proximal fragment bre		u-w on dors ridge
tributary site, Ash-9	14	10	tuff	y	distal fragment	26	18	6	unident			plunge	

tributary site, Ash-9	14	11	tuff	y	proximal fragment	31	17	6	expanded	cortex platform	unmodified		
tributary site, Ash-9	14	12	quartz	n	distal fragment	17	10	5	unident			plunge	
tributary site, Ash-9	14	13	tuff	y	FLAKE TOOL	78	72	28	whole	1 cuspate ret	2 cuspate ret		on bifacial flake
tributary site, Ash-9	14	14	quartz	y	angular fragment	23	14	12	unident				
tributary site, Ash-9	14	15	tuff	n	complete flake	32	24	14	expanded	unifacial	unmodified	feather	
tributary site, Ash-9	14	16	tuff	y	FLAKE TOOL	51	49	16	whole	1 use-wear	2 use-wear		plat use-wear
tributary site, Ash-9	14	17	tuff	n	complete flake	16	13	5	expanded	unifacial	unmodified	plunge	
tributary site, Ash-9	14	18	quartz	n	angular fragment	10	9	6	unident				
tributary site, Ash-9	14	19	silcrete	y	complete flake	49	32	16	intermed	unifacial	modified	plunge	u-w on dors ridge
tributary site, Ash-9	14	20	silcrete	n	complete flake	31	16	4	blade	unifacial	modified	feather	
tributary site, Ash-9	14	21	tuff	n	flake fragment	18	13	4	unident				
tributary site, Ash-9	14	22	tuff	n	complete flake	38	27	8	intermed	unifacial	modified	feather	
tributary site, Ash-9	14	23	tuff	y	proximal fragment	24	22	8	unident	cortex platform	use-wear plat		
tributary site, Ash-9	14	24	tuff	n	proximal fragment	25	20	7	unident	unifacial	unmodified		
tributary site, Ash-9	14	25	tuff	y	complete flake	28	20	5	intermed	cortex platform	unmodified	hinge	
tributary site, Ash-9	14	26	tuff	n	distal fragment	25	14	5	blade			feather	
tributary site, Ash-9	14	27	tuff	y	split cone frag	34	19	17	unident	cortex platform	unmodified		u-w on dors ridge
tributary site, Ash-9	14	28	tuff	y	distal fragment	16	10	4	blade			plunge	
tributary site, Ash-9	14	29	tuff	n	angular fragment	44	22	17	unident				burnt
tributary site, Ash-9	14	30	tuff	n	angular fragment	40	22	11	unident				burnt
tributary site, Ash-9	14 w/s	1	pink silcrete	n	BACKED BLADE	21	14	3	whole	geometric			.
tributary site, Ash-9	14 w/s	2	pink silcrete	n	distal fragment	19	11	3	blade			plunge	
tributary site, Ash-9	14 w/s	3	pink silcrete	n	complete flake	21	16	4	expanded	unifacial		plunge	
tributary site, Ash-9	14 w/s	4	pink silcrete	n	distal fragment	18	11	2	blade			feather	
tributary site, Ash-9	14 w/s	5	pink silcrete	n	split cone frag	17	14	4	expanded	unifacial	modified		proximal piece
tributary site, Ash-9	14 w/s	6	pink silcrete	n	complete flake	16	8	7	expanded	unifacial	use-wear plat	feather	
tributary site, Ash-9	14 w/s	7	pink silcrete	n	proximal fragment	10	9	2	unident	unifacial	unmodified		
tributary site, Ash-9	14 w/s	8	pink silcrete	n	BACKED BLADE	10	8	4	broken	tip	bondi		
tributary site, Ash-9	14 w/s	9	pink silcrete	n	BACKED BLADE	16	16	2	broken				treadage
tributary site, Ash-9	14 w/s	1	yellow tuff	y	flake fragment	16	16	7	unident				
tributary site, Ash-9	14 w/s	2	yellow tuff	n	complete flake	27	17	4	intermed	unifacial	modified	feather	
tributary site, Ash-9	14 w/s	3	yellow tuff	n	complete flake	33	18	2	intermed	crushed platform	unmodified	feather	
tributary site, Ash-9	14 w/s	4	yellow tuff	n	distal fragment	17	14	5	blade			plunge	
tributary site, Ash-9	14 w/s	5	yellow tuff	n	complete flake	17	4	3	intermed	unifacial	unmodified	plunge	
tributary site, Ash-9	14 w/s	6	yellow tuff	n	complete flake	14	10	2	expanded	cortex platform	unmodified	feather	

railroad site, Ash-10	15	1	silcrete	n	complete flake	56	36	10	intermed	unifacial	unmodified	plunge	
railroad site, Ash-10	15	2	silcrete	n	flake fragment	35	24	8	unident				
railroad site, Ash-10	15	3	tuff	n	FLAKE TOOL	36	33	9	whole	use-wear			
railroad site, Ash-10	15	4	tuff	n	flake fragment	22	12	3	unident				
railroad site, Ash-10	15	5	tuff	y	complete flake	35	22	6	expanded	bifacial	modified	plunge	
railroad site, Ash-10	15	6	silcrete	n	BACKED BLADE	34	6	4	broken	bondi	midsection		
railroad site, Ash-10	15	7	silcrete	n	complete flake	44	20	8	intermed	unifacial	unmodified	plunge	
railroad site, Ash-10	15	8	silcrete	n	complete flake	22	18	7	expanded	unifacial	unmodified	plunge	crested
railroad site, Ash-10	15	9	silcrete	n	complete flake	29	23	7	intermed	bifacial	modified	plunge	
railroad site, Ash-10	15	10	silcrete	n	distal fragment	24	12	9	unident			plunge	
railroad site, Ash-10	15	11	silcrete	n	BLADE CORE	48	29	18	whole	faceted prismatic	bi-directional		
railroad site, Ash-10	15	12	silcrete	y	distal fragment	27	17	4	unident			feather	
railroad site, Ash-10	15	13	tuff	n	angular fragment	15	13	10	unident				
railroad site, Ash-10	15	14	silcrete	y	complete flake	28	21	12	intermed	cortex platform	unmodified	plunge	
railroad site, Ash-10	15	15	tuff	n	flake fragment	17	14	4	unident				
railroad site, Ash-10	15	16	silcrete	y	angular fragment	60	19	14	unident				
railroad site, Ash-10	15	17	tuff	y	proximal fragment	20	16	5	unident	bifacial	unmodified		road break
railroad site, Ash-10	15	18	silcrete	y	complete flake	47	31	17	intermed	unifacial	unmodified	plunge	
railroad site, Ash-10	15	19	tuff	y	FLAKE TOOL	62	32	24	whole	cuspate ret			
railroad site, Ash-10	15	20	tuff	n	complete flake	27	18	6	intermed	bifacial	unmodified	feather	
railroad site, Ash-10	15	21	tuff	y	flake fragment	34	29	10	unident				
railroad site, Ash-10	15	22	tuff	n	proximal fragment	20	13	4	unident	unifacial	unmodified		
railroad site, Ash-10	15	23	tuff	n	complete flake	19	12	7	intermed	unifacial	unmodified	plunge	
railroad site, Ash-10	15	24	tuff	n	complete flake	16	13	4	expandeded	bifacial	modified	feather	
railroad site, Ash-10	15	25	tuff	y	distal fragment	21	13	8	unident			plunge	
railroad site, Ash-10	15	26	tuff	n	FLAKE TOOL	55	53	17	whole	discoidal	1 ventral step	2 scalar retou	3 step
railroad site, Ash-10	15	27	tuff	n	proximal fragment	19	14	5	unident	unifacial	facetted		
railroad site, Ash-10	15	28	tuff	n	distal fragment	26	22	7	unident			hinge	
railroad site, Ash-10	15	29	silcrete	n	proximal fragment	30	3	7	blade	unifacial	modified		road break
railroad site, Ash-10	15	30	silcrete	n	flake fragment	21	10	4	blade				
railroad site, Ash-10	15	31	tuff	n	complete flake	26	18	7	intermed	unifacial	modified	plunge	
railroad site, Ash-10	15	32	tuff	y	split cone frag	25	12	6	intermed	unifacial	unmodified	feather	
railroad site, Ash-10	15	33	silcrete	n	flake fragment	37	21	10	blade				
railroad site, Ash-10	15	34	silcrete	n	distal fragment	23	18	8	unident			plunge	
	16	1	tuff	y	angular fragment	20	15	7	unident				

	16	2	tuff	y	complete flake	53	35	6	intermed	cortex platform	unmodified	hinge	
	17	1	tuff	y	FLAKE TOOL	58	57	19	whole	concave	scalar retouch	use-wear	
	18	1	silcrete	y	distal fragment	60	37	18	unident			feather	
	18	2	silcrete	y	angular fragment	48	32	11	unident				burnt
	18	3	silcrete	y	angular fragment	75	36	16	unident				
	18	4	tuff	n	flake fragment	26	22	6	unident				
	18	5	silcrete	n	angular fragment	20	8	8	unident				
	18	6	silcrete	n	flake fragment	17	10	3	unident				
	18	7	silcrete	n	angular fragment	16	14	7	unident				
	18	8	silcrete	n	angular fragment	37	19	18	unident				
	19	1	black chert	y	BIPOLAR CORE	22	19	4	whole				
	20	1	tuff	n	angular fragment	55	28	16	unident				
	21	1	tuff	n	FLAKE TOOL	51	44	39	whole	use-wear			on angular frag
	22	1	silcrete	y	PROD CORE	112	71	70	whole	unifacial	test core		
	23	1	silcrete	n	proximal fragment	22	20	6	unident	bifacial	unmodified		
	23	2	tuff	n	flake fragment	13	13	6	unident				
	24	1	tuff	n	complete flake	43	30	8	intermed	bifacial	use-wear plat	plunge	crested
	24	2	quartzite	y	distal fragment	22	15	10	unident			plunge	
	25	1	tuff	n	angular fragment	15	10	6	unident				
	26	1	quartz	n	complete flake	21	15	4	intermed	unifacial	use-wear plat	feather	
	26	2	tuff	y	distal fragment	64	51	17	unident			plunge	
	26	3	silcrete	n	FLAKE TOOL	38	27	12	whole	step			
	27	1	quartz	n	angular fragment	18	13	10	unident				
Waterhole Site, Ash-4	28A	1	tuff	y	complete flake	60	22	15	blade	unifacial	modified	plunge	
Waterhole Site, Ash-4	28A	2	tuff	y	complete flake	30	26	8	expanded	unifacial	modified	feather	
Waterhole Site, Ash-4	28A	3	silcrete	n	angular fragment	49	22	17	unident				
Waterhole Site, Ash-4	28A	4	tuff	n	angular fragment	39	24	18	unident				
Waterhole Site, Ash-4	28A	5	tuff	y	distal fragment	31	29	7	unident			feather	
Waterhole Site, Ash-4	28A	6	silcrete	n	complete flake	27	15	6	blade	unifacial	modified	hinge	
Waterhole Site, Ash-4	28A	7	tuff	y	complete flake	27	17	3	expanded	unifacial	unmodified	plunge	
Waterhole Site, Ash-4	28A	8	silcrete	n	distal fragment	15	10	2	unident			feather	
Waterhole Site, Ash-4	28A	9	tuff	y	distal fragment	27	20	12	unident			plunge	
Waterhole Site, Ash-4	28A	10	tuff	y	proximal fragment	22	16	8	unident	cortex platform	unmodified		
Waterhole Site, Ash-4	28A	11	tuff	y	angular fragment	27	23	8	unident				burnt
Waterhole Site, Ash-4	28A	12	silcrete	y	distal fragment	30	22	21	unident			plunge	

Waterhole Site, Ash-4	28A	13	tuff	n	FLAKE TOOL	25	21	7	whole	1 scal	2 scal	3 scal	
Waterhole Site, Ash-4	28A	14	silcrete	n	distal fragment	37	33	9	unident			feather	
Waterhole Site, Ash-4	28A	15	tuff	n	proximal fragment	24	15	4	blade	bifacial	faceted		
Waterhole Site, Ash-4	28A	16	silcrete	n	flake fragment	40	32	12	unident				
Waterhole Site, Ash-4	28A	17	tuff	n	complete flake	30	6	3	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28A	18	tuff	n	complete flake	32	32	6	expanded	bifacial	modified	feather	
Waterhole Site, Ash-4	28A	19	tuff	n	M'BLADE CORE	36	33	21	whole	trial	use-wear edge		hafted?
Waterhole Site, Ash-4	28A	20	acid vol	y	AXE PREFORM	107	73	36	whole	edge rejuvination	unground		hammerstone
Waterhole Site, Ash-4	28A	21	tuff	y	M'BLADE CORE	47	31	23	whole	faceted prismatic			expended
Waterhole Site, Ash-4	28A	22	tuff	n	split cone frag	30	20	13	expanded	crushed platform		plunge	
Waterhole Site, Ash-4	28A	23	silcrete	n	"CORE"	41	37	21	broken	indeterminate: nuclear or producer			
Waterhole Site, Ash-4	28A	24	tuff	n	complete flake	16	14	3	expanded	unifacial	umodified	feather	
Waterhole Site, Ash-4	28A	25	tuff	y	FLAKE TOOL	37	33	16	whole	scalar retouch			
Waterhole Site, Ash-4	28A	26	tuff	n	complete flake	42	15	7	blade	unifacial	unmodified	plunge	
Waterhole Site, Ash-4	28A	27	tuff	y	split cone frag	31	22	9	unident	unifacial	use-wear plat	feather	
Waterhole Site, Ash-4	28A	28	black chert	n	complete flake	24	23	3	expanded	bifacial	unmodified	hinge	burnt
Waterhole Site, Ash-4	28A	29	tuff	y	M'BLADE CORE	32	28	21	whole	multiplat			
Waterhole Site, Ash-4	28A	30	tuff	n	M'BLADE CORE	20	19	16	whole	unifacial	trial		
Waterhole Site, Ash-4	28A	31	silcrete	n	angular fragment	25	13	10	unident				
Waterhole Site, Ash-4	28A	32	tuff	n	proximal fragment	27	24	8	unident	unifacial	unmodified		
Waterhole Site, Ash-4	28A	33	silcrete	n	M'BLADE CORE	34	32	13	whole	trial			on distal frag
Waterhole Site, Ash-4	28A	34	silcrete	n	distal fragment	32	21	8	unident			plunge	
Waterhole Site, Ash-4	28A	35	quartz	n	proximal fragment	21	21	6	blade	unifacial	umnmod		
Waterhole Site, Ash-4	28A	36	tuff	y	complete flake	20	11	5	expanded	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28A	37	silcrete	n	proximal fragment	33	23	8	unident	unifacial	unmodified		
Waterhole Site, Ash-4	28A	38	silcrete	n	angular fragment	35	27	17	unident				
Waterhole Site, Ash-4	28A	30	tuff	y	complete flake	40	27	8	intermed	unifacial	modified	feather	
Waterhole Site, Ash-4	28A	40	tuff	n	angular fragment	34	25	12	unident				
Waterhole Site, Ash-4	28A	41	tuff	n	proximal fragment	24	20	6	unident	unifacial	unmodified		
Waterhole Site, Ash-4	28A	42	tuff	n	complete flake	16	16	5	expanded	bifacial	modified	hinge	
Waterhole Site, Ash-4	28A	43	basalt	n	complete flake	57	15	10	blade	unifacial	unmodified	plunge	v. weathered
Waterhole Site, Ash-4	28A	44	tuff	y	complete flake	40	26	12	expanded	unifacial	unmodified	plunge	
Waterhole Site, Ash-4	28A	45	tuff	n	complete flake	25	15	3	expanded	crushed platform		feather	
Waterhole Site, Ash-4	28A	46	silcrete	n	angular fragment	51	39	20	unident				
Waterhole Site, Ash-4	28A	47	silcrete	y	FLAKE TOOL	34	30	16	broken	scalar retouch			

Waterhole Site, Ash-4	28A	48	tuff	y	distal fragment	27	16	6	unident					fea	er			
Waterhole Site, Ash-4	28A	49	silcrete	y	distal fragment	30	22	6	unident					fea	er			
Waterhole Site, Ash-4	28A	50	silcrete	n	complete flake	26	9	4	blade	unifacial		mo	fied	fea	er			
Waterhole Site, Ash-4	28A	51	tuff	y	flake fragment	29	18	11	unident									
Waterhole Site, Ash-4	28A	52	tuff	n	complete flake	38	15	4	blade	bifacial		fac	ed	fea	er			
Waterhole Site, Ash-4	28A	53	silcrete	n	M'BLADE CORE	38	33	22	whole	unifacial		trial						
Waterhole Site, Ash-4	28A	54	tuff	n	split cone frag	16	16	3	expanded	crushe	platform			fea	er			
Waterhole Site, Ash-4	28A	55	tuff	n	complete flake	17	15	3	intermed	crushe	platform			fea	er			
Waterhole Site, Ash-4	28A	56	tuff	n	ELOUERA	33	14	9	whole	use-we	ar							
Waterhole Site, Ash-4	28A	57	tuff	n	distal fragment	23	13	8	unident					plu	e			
Waterhole Site, Ash-4	28A	58	quartz	y	NUCLEAR TOOL	50	40	22	whole	unifacia								
Waterhole Site, Ash-4	28A	59	silcrete	n	proximal fragment	31	27	18	unident	crushe	platform							
Waterhole Site, Ash-4	28A	60	tuff	n	complete flake	28	7	4	blade	unifacia		fac	, mod	hin				
Waterhole Site, Ash-4	28A	61	tuff	n	complete flake	20	18	7	intermed	bifacial		use	vear pla	fea	er			
Waterhole Site, Ash-4	28A	62	tuff	n	complete flake	14	9	3	expanded	unifacia		mo	fied	hin				
Waterhole Site, Ash-4	28A	63	silcrete	y	FLAKE TOOL	60	48	30	whole	use-we	ar							
Waterhole Site, Ash-4	28A	64	tuff	y	complete flake	25	22	5	intermed	unifacia		unn	dified	plu	e			
Waterhole Site, Ash-4	28A	65	quartz	y	angular fragment	23	19	11	unident									
Waterhole Site, Ash-4	28A	66	tuff	n	flake fragment	18	11	6	unident									
Waterhole Site, Ash-4	28A	67	silcrete	y	split cone frag	37	27	11	expanded	cortex	latform	unn	dified	fea	er			
Waterhole Site, Ash-4	28A	68	tuff	n	flake fragment	31	30	8	blade									
Waterhole Site, Ash-4	28A	69	tuff	y	complete flake	45	26	7	intermed	cortex	latform	unn	dified	fea	er			
Waterhole Site, Ash-4	28A	70	silcrete	n	FLAKE TOOL	18	13	4	whole	projecti	n	sca	r retouc	use	vear			
Waterhole Site, Ash-4	28A	71	tuff	y	complete flake	35	21	10	intermed	unifacia		unn	dified	fea	er			
Waterhole Site, Ash-4	28A	72	tuff	n	angular fragment	25	23	10	unident									
Waterhole Site, Ash-4	28A	73	silcrete	n	M'BLADE CORE	43	38	21	whole	trial								
Waterhole Site, Ash-4	28A	74	tuff	y	complete flake	35	28	7	intermed	unifacia		unn	dified	fea	er			
Waterhole Site, Ash-4	28A	75	silcrete	n	flake fragment	43	29	8	unident									
Waterhole Site, Ash-4	28A	76	tuff	y	flake fragment	30	8	3	blade									
Waterhole Site, Ash-4	28A	77	tuff	y	split cone frag	19	15	8	expanded	cortex	atform	unn	dified	hin				
Waterhole Site, Ash-4	28A	78	tuff	n	flake fragment	18	8	5	blade									
Waterhole Site, Ash-4	28A	79	tuff	n	flake fragment	11	11	3	unident									
Waterhole Site, Ash-4	28A	80	tuff	y	complete flake	24	16	4	intermed	unifacia		unn	dified	fea	er			
Waterhole Site, Ash-4	28A	81	tuff	n	split cone frag	15	13	3	unident	unifacia		mo	fied			proxim	piece	
Waterhole Site, Ash-4	28A	82	silcrete	y	angular fragment	33	23	20	unident									

Waterhole Site, Ash-4	28A	83	tuff	n	distal fragment	27	14	3	unident			feather	
Waterhole Site, Ash-4	28A	84	tuff	y	distal fragment	19	12	2	unident			feather	
Waterhole Site, Ash-4	28A	85	tuff	y	split cone frag	35	15	10	intermed	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28A	86	tuff	y	complete flake	49	32	13	expanded	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28A	87	tuff	y	proximal fragment	28	15	5	blade	unifacial	faceted		
Waterhole Site, Ash-4	28A	88	silcrete	n	complete flake	23	13	4	blade	unifacial	unmodified	plunge	distal end plat
Waterhole Site, Ash-4	28A	89	tuff	n	complete flake	25	14	4	blade	crushed platform		feather	
Waterhole Site, Ash-4	28A	90	tuff	n	split cone frag	12	11	4	unident	unifacial	modified		proximal piece
Waterhole Site, Ash-4	28A	91	tuff	y	complete flake	42	27	12	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28A	92	silcrete	n	angular fragment	21	10	10	unident				
Waterhole Site, Ash-4	28A	93	tuff	n	flake fragment	12	11	5	unident				
Waterhole Site, Ash-4	28A	94	tuff	y	complete flake	46	12	10	blade	unifacial	facet,mod	plunge	
Waterhole Site, Ash-4	28A	95	tuff	n	complete flake	16	11	2	expanded	unifacial	unmodified	hinge	
Waterhole Site, Ash-4	28A	96	tuff	y	flake fragment	16	13	2	unident				
Waterhole Site, Ash-4	28A	97	tuff	n	proximal fragment	22	14	4	blade	bifacial	faceted		
Waterhole Site, Ash-4	28A	98	silcrete	n	distal fragment	34	19	4	unident			feather	
Waterhole Site, Ash-4	28A	99	silcrete	n	flake fragment	39	21	6	unident				burnt
Waterhole Site, Ash-4	28A	100	silcrete	n	complete flake	41	18	7	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28A	101	tuff	n	flake fragment	10	9	2	unident				
Waterhole Site, Ash-4	28A	102	silcrete	n	flake fragment	17	17	4	blade				
Waterhole Site, Ash-4	28A	103	tuff	y	complete flake	39	15	13	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28A	104	tuff	y	angular fragment	27	15	9	unident				
Waterhole Site, Ash-4	28A	105	tuff	n	M'BLADE CORE	39	29	13	whole	trial			
Waterhole Site, Ash-4	28A	106	silcrete	n	angular fragment	30	22	20	unident				
Waterhole Site, Ash-4	28A	107	silcrete	n	distal fragment	19	16	6	unident			feather	
Waterhole Site, Ash-4	28A	108	tuff	n	complete flake	16	14	2	expanded	unifacial	unmodified	hinge	
Waterhole Site, Ash-4	28A	109	silcrete	n	complete flake	35	18	4	blade	unifacial	faceted	hinge	
Waterhole Site, Ash-4	28A	110	silcrete	n	flake fragment	15	14	3	blade				
Waterhole Site, Ash-4	28A	111	silcrete	n	distal fragment	20	10	5	blade			feather	
Waterhole Site, Ash-4	28A	112	tuff	n	proximal fragment	27	16	3	unident	unifacial	modified		
Waterhole Site, Ash-4	28A	113	silcrete	n	angular fragment	32	18	8	unident				
Waterhole Site, Ash-4	28A	114	tuff	y	proximal fragment	21	11	6	blade	unifacial	modified		
Waterhole Site, Ash-4	28A	115	tuff	n	distal fragment	33	10	4	blade			plunge	
Waterhole Site, Ash-4	28A	116	tuff	n	distal fragment	78	47	16	unident			feather	
Waterhole Site, Ash-4	28A	117	tuff	y	split cone frag	26	24	8	expanded	cortex platform	unmodified		proximal piece

Waterhole Site, Ash-4	28A	118	tuff	n	complete flake	18	18	10	expanded	unifacial	umodified	plunge	
Waterhole Site, Ash-4	28B	1	tuff	n	proximal fragment	24	22	5	blade	unifacial	unmodified		
Waterhole Site, Ash-4	28B	2	tuff	n	flake fragment	24	19	7	unident				
Waterhole Site, Ash-4	28B	3	tuff	n	flake fragment	17	7	3	unident				
Waterhole Site, Ash-4	28B	4	tuff	y	FLAKE TOOL	65	63	40	broken	bifacial edge			
Waterhole Site, Ash-4	28B	5	tuff	y	complete flake	61	50	17	intermed	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28B	6	tuff	y	complete flake	33	30	8	expanded	unifacial	modified	plunge	
Waterhole Site, Ash-4	28B	7	silcrete	n	flake fragment	31	21	7	unident				
Waterhole Site, Ash-4	28B	8	tuff	y	complete flake	27	12	2	blade	bifacial	unmodified	feather	
Waterhole Site, Ash-4	28B	9	tuff	n	complete flake	44	15	6	blade	bifacial	faceted	feather	
Waterhole Site, Ash-4	28B	10	tuff	y	complete flake	28	15	6	intermed	cortex platform	unmodified	plunge	
Waterhole Site, Ash-4	28B	11	tuff	y	complete flake	21	12	2	intermed	unifacial	modified	feather	
Waterhole Site, Ash-4	28B	12	tuff	y	proximal fragment	50	10	8	blade	unifacial	faceted		
Waterhole Site, Ash-4	28B	13	tuff	y	complete flake	46	24	10	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28B	14	tuff	n	flake fragment	22	21	4	unident				
Waterhole Site, Ash-4	28B	15	tuff	n	distal fragment	42	18	8	unident			hinge	
Waterhole Site, Ash-4	28B	16	tuff	n	flake fragment	29	14	6	unident				
Waterhole Site, Ash-4	28B	17	tuff	y	distal fragment	43	40	12	unident			feather	
Waterhole Site, Ash-4	28B	18	tuff	y	FLAKE TOOL	36	23	10	whole	1 scalar retouch ventr	2 scalar retouch	3 scalar retouch	
Waterhole Site, Ash-4	28B	19	silcrete	n	proximal fragment	28	23	6	unident	unifacial	modified		
Waterhole Site, Ash-4	28B	20	tuff	y	angular fragment	17	12	7	unident				
Waterhole Site, Ash-4	28B	21	silcrete	n	flake fragment	39	20	5	unident				
Waterhole Site, Ash-4	28B	22	tuff	n	complete flake	29	19	6	intermed	bifacial	unmodified	feather	
Waterhole Site, Ash-4	28B	23	tuff	n	flake fragment	16	16	2	unident				
Waterhole Site, Ash-4	28B	24	tuff	y	complete flake	32	21	8	expanded	unifacial	modified	plunge	
Waterhole Site, Ash-4	28C	1	silcrete	n	flake fragment	41	34	17	unident				
Waterhole Site, Ash-4	28C	2	tuff	y	split cone frag	27	19	4	unident			feather	distal piece
Waterhole Site, Ash-4	28C	3	quartzite	y	complete flake	41	29	11	expanded	crushed platform		plunge	
Waterhole Site, Ash-4	28C	4	tuff	n	flake fragment	25	20	12	unident				
Waterhole Site, Ash-4	28C	5	tuff	y	flake fragment	57	12	6	blade				
Waterhole Site, Ash-4	28C	6	tuff	y	complete flake	44	27	8	intermed	unifacial	modified	plunge	
Waterhole Site, Ash-4	28C	7	tuff	y	distal fragment	80	61	19	unident			feather	
Waterhole Site, Ash-4	28C	8	tuff	n	complete flake	15	11	2	intermed	unifacial	faceted	hinge	
Waterhole Site, Ash-4	28C	9	quartz	n	proximal fragment	18	14	7	unident	unifacial	unmodified		
Waterhole Site, Ash-4	28C	10	tuff	y	FLAKE TOOL	56	31	15	whole	1 use-wear	2 use-wear		

Waterhole Site, Ash-4	28C	11	hornfels?	n	flake fragment	43	38	15	unident				
Waterhole Site, Ash-4	28C	12	tuff	y	complete flake	42	32	15	expanded	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28C	13	tuff	y	complete flake	43	19	8	intermed	unifacial	faceted	feather	
Waterhole Site, Ash-4	28C	14	tuff	y	complete flake	21	20	5	intermed	unifacial	unmodified	hinge	
Waterhole Site, Ash-4	28C	15	quartzite	y	angular fragment	39	20	18	unident				
Waterhole Site, Ash-4	28C	16	tuff	n	complete flake	38	21	4	expanded	unifacial	use-wear plat	feather	
Waterhole Site, Ash-4	28C	17	tuff	y	distal fragment	55	40	15	unident			hinge	
Waterhole Site, Ash-4	28C	18	tuff	y	angular fragment	38	27	15	unident				
Waterhole Site, Ash-4	28C	19	tuff	n	complete flake	41	20	12	intermed	unifacial	unmodified	feather	burnt
Waterhole Site, Ash-4	28C	20	silcrete	y	complete flake	27	21	8	expanded	cortex platform	unmodified	plunge	
Waterhole Site, Ash-4	28C	21	tuff	n	complete flake	53	22	8	blade	bifacial	modified	feather	
Waterhole Site, Ash-4	28C	22	tuff	n	flake fragment	23	15	5	unident				
Waterhole Site, Ash-4	28C	23	tuff	n	proximal fragment	28	18	5	unident	unifacial	faceted		
Waterhole Site, Ash-4	28C	24	tuff	y	angular fragment	40	24	8	unident				
Waterhole Site, Ash-4	28C	25	tuff	n	complete flake	29	19	10	expanded	unifacial	modified	feather	
Waterhole Site, Ash-4	28C	26	tuff	y	complete flake	34	18	8	intermed	unifacial	unmodified	plunge	
Waterhole Site, Ash-4	28C	27	tuff	n	complete flake	24	16	5	intermed	bifacial	use-wear plat	plunge	
Waterhole Site, Ash-4	28C	28	quartzite	n	flake fragment	34	23	8	unident				
Waterhole Site, Ash-4	28C	29	tuff	n	complete flake	20	17	7	intermed	unifacial	umodified	plunge	
Waterhole Site, Ash-4	28C	30	quartzite	y	flake fragment	30	16	6	unident				
Waterhole Site, Ash-4	28C	31	tuff	y	complete flake	54	31	5	intermed	crushed platform		feather	
Waterhole Site, Ash-4	28C	32	quartz	y	distal fragment	30	26	17	unident			plunge	
Waterhole Site, Ash-4	28C	33	silcrete	n	complete flake	43	36	8	expanded	bifacial	modified	feather	
Waterhole Site, Ash-4	28C	34	silcrete	y	complete flake	52	24	22	intermed	unifacial	unmodified	plunge	
Waterhole Site, Ash-4	28C	35	tuff	y	distal fragment	40	25	14	unident			plunge	
Waterhole Site, Ash-4	28D	1	silcrete	y	M'BLADE CORE	72	56	44	whole	trial			
Waterhole Site, Ash-4	28D	1	silcrete	n	flake fragment	29	18	8	blade				
Waterhole Site, Ash-4	28D	2	silcrete	n	flake fragment	18	9	3	unident				
Waterhole Site, Ash-4	28D	3	tuff	n	complete flake	31	12	8	expanded	bifacial	unmodified	plunge	
Waterhole Site, Ash-4	28D	4	silcrete	n	angular fragment	38	6	6	unident				
Waterhole Site, Ash-4	28D	5	tuff	y	complete flake	40	19	7	expanded	unifacial	modified	feather	
Waterhole Site, Ash-4	28D	6	tuff	n	complete flake	18	18	3	expanded	unifacial	unmodified	hinge	
Waterhole Site, Ash-4	28D	7	tuff	y	complete flake	40	19	12	expanded	unifacial	modified	hinge	
Waterhole Site, Ash-4	28D	8	tuff	y	angular fragment	38	19	6	unident				burnt
Waterhole Site, Ash-4	28D	9	tuff	n	complete flake	37	29	6	expanded	bifacial	modified	hinge	

Waterhole Site, Ash-4	28D	10	tuff	n	flake fragment	37	14	6	unident				
Waterhole Site, Ash-4	28D	11	silcrete	n	BACKED BLADE	33	12	4	broken	bondi	finished back		
Waterhole Site, Ash-4	28D	12	tuff	n	proximal fragment	24	10	3	blade	unifacial	faceted		
Waterhole Site, Ash-4	28D	13	tuff	y	complete flake	37	24	9	intermed	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28D	14	tuff	n	complete flake	33	15	4	expanded	bifacial	unmodified	plunge	
Waterhole Site, Ash-4	28D	15	tuff	n	complete flake	42	28	9	expanded	unifacial	modified	feather	
Waterhole Site, Ash-4	28D	16	silcrete	y	flake fragment	25	19	5	blade				
Waterhole Site, Ash-4	28D	17	tuff	y	complete flake	17	12	3	expanded	crushed platform		feather	
Waterhole Site, Ash-4	28D	18	tuff	n	M'BLADE CORE	41	33	30	whole	bifacial			expended
Waterhole Site, Ash-4	28D	19	tuff	n	complete flake	18	12	5	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28D	20	tuff	n	complete flake	26	17	6	expanded	bifacial	unmodified	feather	
Waterhole Site, Ash-4	28D	21	quartzite	y	complete flake	35	22	7	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28D	22	tuff	y	complete flake	22	20	10	expanded	unifacial	unmodified	plunge	
Waterhole Site, Ash-4	28D	23	acid vol	y	HAMMERSTONE	64	48	47	whole	2 facets			
Waterhole Site, Ash-4	28D	24	tuff	n	FLAKE TOOL	24	15	6	whole	scalar retouch	use-wear		
Waterhole Site, Ash-4	28D	25	tuff	n	distal fragment	34	22	11	unident			plunge	
Waterhole Site, Ash-4	28D	26	tuff	n	complete flake	21	14	7	blade	unifacial	modified	plunge	distal end platform
Waterhole Site, Ash-4	28D	27	silcrete	y	complete flake	33	19	7	intermed	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28D	28	tuff	y	complete flake	37	19	11	expanded	cortex platform	unmodified	plunge	
Waterhole Site, Ash-4	28D	29	quartzite	y	complete flake	56	49	41	intermed	bifacial	use-wear		
Waterhole Site, Ash-4	28D	30	silcrete	n	complete flake	38	17	4	blade	unifacial	modified	feather	
Waterhole Site, Ash-4	28D	31	tuff	y	complete flake	33	20	6	intermed	cortex platform	unmodified	plunge	
Waterhole Site, Ash-4	28D	32	silcrete	n	distal fragment	38	27	12	unident			plunge	
Waterhole Site, Ash-4	28D	33	tuff	y	complete flake	36	28	15	expanded	unifacial	umnmod	feather	
Waterhole Site, Ash-4	28D	34	silcrete	n	flake fragment	63	39	12	unident				burnt
Waterhole Site, Ash-4	28D	35	tuff	n	angular fragment	46	37	13	unident				burnt
Waterhole Site, Ash-4	28D	36	tuff	n	complete flake	24	13	4	expanded	unifacial	modified	hinge	
Waterhole Site, Ash-4	28D	37	tuff	y	complete flake	34	21	6	intermed	bifacial	mod,faceted	hinge	
Waterhole Site, Ash-4	28D	38	tuff	y	M'BLADE CORE	33	27	18	whole	trial	on flake		
Waterhole Site, Ash-4	28D	39	tuff	y	M'BLADE CORE	40	30	29	whole	bifacial			expended
Waterhole Site, Ash-4	28D	40	silcrete	n	complete flake	16	13	5	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28D	41	silcrete	y	proximal fragment	51	46	20	unident	unifacial	unmodified		
Waterhole Site, Ash-4	28E	1	tuff	n	M'BLADE CORE	26	24	20	broken	prismatic			
Waterhole Site, Ash-4	28E	2	silcrete	n	BIPOLAR CORE	28	24	8	whole				
Waterhole Site, Ash-4	28E	3	silcrete	y	complete flake	49	35	17	intermed	cortex platform	modified	feather	

Waterhole Site, Ash-4	28E	4	tuff	y	flake fragment	20	10	6	blade				
Waterhole Site, Ash-4	28E	5	tuff	n	complete flake	38	23	6	intermed	unifacial	modified	feather	trans dors fl scars
Waterhole Site, Ash-4	28E	6	tuff	n	complete flake	42	11	5	blade	unifacial	modified	plunge	
Waterhole Site, Ash-4	28E	7	tuff	n	angular fragment	17	11	6	unident				
Waterhole Site, Ash-4	28E	8	black chert	y	distal fragment	18	15	8	unident			feather	
Waterhole Site, Ash-4	28E	9	quartzite	y	FLAKE TOOL	32	24	12	whole	step	scalar retouch		
Waterhole Site, Ash-4	28E	10	quartzite	n	split cone frag	25	22	3	expanded	crushed platform		feather	
Waterhole Site, Ash-4	28E	11	tuff	n	split cone frag	24	12	9	intermed	unifacial	unmodified	hinge	
Waterhole Site, Ash-4	28E	12	tuff	y	FLAKE TOOL	43	39	12	broken	scalar retouch			
Waterhole Site, Ash-4	28E	13	silcrete	n	complete flake	43	28	14	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28E	14	quartz	y	BIPOLAR CORE	37	21	16	whole				
Waterhole Site, Ash-4	28E	15	tuff	y	complete flake	18	14	4	intermed	cortex platform	modified	feather	
Waterhole Site, Ash-4	28E	16	quartz	y	complete flake	19	16	9	intermed	cortex platform	unmodified	feather	
Waterhole Site, Ash-4	28F	1	tuff	y	complete flake	32	30	11	expanded	cortex platform	modified	feather	
Waterhole Site, Ash-4	28F	2	tuff	n	complete flake	24	15	3	expanded	bifacial	use-wear plat	feather	
Waterhole Site, Ash-4	28F	3	pet wood	n	split cone frag	21	17	8	expanded	unifacial	use-wear plat	plunge	
Waterhole Site, Ash-4	28F	4	tuff	n	complete flake	32	23	4	expanded	unifacial	unmodified	hinge	
Waterhole Site, Ash-4	28F	5	tuff	y	distal fragment	20	18	5	unident			feather	
Waterhole Site, Ash-4	28F	6	quartz	y	angular fragment	26	19	12	unident				
Waterhole Site, Ash-4	28F	7	tuff	y	NUCLEAR TOOL	65	46	30	whole	multifacial			heavy battering
Waterhole Site, Ash-4	28F	8	tuff	y	complete flake	32	27	6	intermed	crushed platform		hinge	
Waterhole Site, Ash-4	28F	9	silcrete	n	BACKED PIECE	37	17	9	whole	backing in middle of blade			
Waterhole Site, Ash-4	28F	10	quartzite	y	HAMMERSTONE	73	59	53	whole	2 facets			
Waterhole Site, Ash-4	28F	11	tuff	n	complete flake	26	26	5	expanded	unifacial	modified	feather	
Waterhole Site, Ash-4	28F	12	tuff	n	complete flake	24	11	5	blade	bifacial	unmodified	feather	
Waterhole Site, Ash-4	28F	13	tuff	n	complete flake	28	17	3	intermed	unifacial	modified	feather	
Waterhole Site, Ash-4	28F	14	silcrete	n	distal fragment	18	16	4	unident			feather	
Waterhole Site, Ash-4	28F	15	silcrete	n	angular fragment	36	25	16	unident				
Waterhole Site, Ash-4	28F	16	tuff	n	complete flake	25	15	3	intermed	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28F	17	tuff	y	angular fragment	52	46	8	unident				
Waterhole Site, Ash-4	28F	18	tuff	y	angular fragment	18	12	9	unident				
Waterhole Site, Ash-4	28F	19	tuff	n	proximal fragment	27	24	8	unident	unifacial	modified		
Waterhole Site, Ash-4	28F	20	quartz	n	complete flake	28	28	6	expanded	unifacial	unmodified	feather	
Waterhole Site, Ash-4	28F	21	tuff	y	M'BLADE CORE	43	32	20	whole	prismatic			
Waterhole Site, Ash-4	28F	22	silcrete	n	angular fragment	38	29	21	unident				

Oxbow Site - east track	29	1	tuff	y	distal fragment	42	25	12	unident			plunge	
Oxbow Site - east track	29	2	tuff	y	complete flake	51	37	8	expanded	bifacial	modified	plunge	
Oxbow Site - east track	29	3	tuff	n	complete flake	13	11	2	expanded	unifacial	unmodified	feather	
Oxbow Site - east track	29	4	tuff	n	flake fragment	22	12	4	unident				
Oxbow Site - east track	29	5	tuff	n	complete flake	24	22	7	expanded	bifacial	unmodified	feather	
Oxbow Site - east track	29	6	tuff	n	complete flake	34	26	5	expanded	bifacial	modified	feather	
Oxbow Site - east track	29	7	tuff	n	complete flake	40	12	6	blade	bifacial	unmodified	plunge	
Oxbow Site - east track	29	8	tuff	n	complete flake	28	24	6	intermed	unifacial	unmodified	hinge	
Oxbow Site - east track	29	9	tuff	n	complete flake	18	17	5	expanded	unifacial	unmodified	feather	
Oxbow Site - east track	29	10	tuff	n	BACKED BLADE	17	8	4	broken	bondi	no tip		
Oxbow Site - east track	29	11	tuff	n	M'BLADE CORE	38	18	15					
Oxbow Site - east track	29	12	tuff	y	proximal fragment	22	19	7	unident	unifacial	unmodified		
Oxbow Site - east track	29	13	tuff	n	complete flake	26	25	11	expanded	bifacial	modified	plunge	u-w on dors ridge
Oxbow Site - east track	29	14	tuff	y	complete flake	29	27	11	expanded	bifacial	unmodified	plunge	
Oxbow Site - east track	29	15	silcrete	y	angular fragment	38	30	14	unident				burnt
Oxbow Site - east track	29	16	silcrete	n	angular fragment	24	17	7	unident				burnt
Oxbow Site - east track	29	17	silcrete	n	angular fragment	31	30	15	unident				burnt
Oxbow Site - east track	29	18	silcrete	n	complete flake	44	29	16	intermed	unifacial	unmodified	plunge	burnt
Oxbow Site - east track	29	19	silcrete	n	complete flake	35	31	15	intermed	crushed platform		plunge	burnt
Oxbow Site - east track	29	20	silcrete	n	angular fragment	21	19	9	unident				burnt
Oxbow Site - east track	29	21	silcrete	n	angular fragment	34	23	12	unident				burnt
Oxbow Site - east track	29	22	silcrete	n	angular fragment	22	19	15	unident				burnt
Oxbow Site - east track	29	23	tuff	n	distal fragment	25	22	8	unident			feather	
Oxbow Site - east track	29	24	tuff	y	complete flake	38	32	9	expanded	unifacial	modified	plunge	
Oxbow Site - east track	29	25	silcrete	n	complete flake	44	38	10	expanded	unifacial	modified	feather	
Oxbow Site - east track	29	26	silcrete	n	angular fragment	41	25	10	unident				burnt
Oxbow Site - east track	29	27	silcrete	n	distal fragment	32	29	14	unident			plunge	burnt
Oxbow Site - east track	29	28	silcrete	n	angular fragment	38	30	20	unident				burnt
Oxbow Site - east track	29	29	silcrete	n	complete flake	19	15	5	expanded	unifacial	unmodified	feather	burnt
Oxbow Site - east track	29	30	silcrete	n	angular fragment	47	22	10	unident				burnt
Oxbow Site - east track	29	31	silcrete	n	complete flake	26	24	10	expanded	unifacial	unmodified	plunge	burnt
Oxbow Site - east track	29	32	silcrete	y	distal fragment	37	22	14	unident			plunge	
Oxbow Site - east track	29	33	tuff	n	complete flake	34	20	14	expanded	unifacial	use-wear plat	plunge	
Oxbow Site - east track	29	34	tuff	y	complete flake	46	43	13	expanded	cortex platform	unmodified	feather	
Oxbow Site - east track	29	35	tuff	n	M'BLADE CORE	41	26	16	whole	trial	on flake		

Oxbow Site - east track	29	36	silcrete	n	angular fragment	61	42	24	unident				burnt
Oxbow Site - east track	29	37	tuff	y	complete flake	54	37	13	intermed	bifacial	unmodified	plunge	
Oxbow Site - east track	29	38	tuff	n	complete flake	21	19	5	blade	bifacial	unmodified	hinge	
Oxbow Site - east track	29	39	tuff	n	M'BLADE CORE	41	31	17	whole	faceted prismatic	bidirectional	on flake	
Oxbow Site - east track	29	40	tuff	y	complete flake	66	24	9	blade	bifacial	faceted	feather	
Oxbow Site - east track	29	41	tuff	n	M'BLADE CORE	33	21	17	whole	conical prismatic			
Oxbow Site - east track	29	42	tuff	y	M'BLADE CORE	49	30	28	whole	conical prismatic			
Oxbow Site - east track	29	43	tuff	y	complete flake	49	32	9	intermed	unifacial	unmodified	feather	
Oxbow Site - east track	29	44	tuff	n	proximal fragment	14	8	2	blade	unifacial	unmodified		
Oxbow Site - east track	29	45	tuff	y	proximal fragment	13	11	3	blade	unifacial	unmodified		
Oxbow Site - east track	29	46	tuff	y	complete flake	17	15	5	expanded	cortex platform	unmodified	hinge	
Oxbow Site - east track	29	47	tuff	n	complete flake	18	14	6	intermed	unifacial	no tip	plunge	
Oxbow Site - east track	29	48	tuff	y	NUCLEAR TOOL	82	78	45	whole	multifacial			
Oxbow Site - east track	29	49	tuff	n	complete flake	31	23	8	intermed	unifacial	umnmod	hinge	
Oxbow Site - east track	29	50	tuff	y	complete flake	24	16	6	intermed	crushed platform		plunge	
Oxbow Site - east track	29	51	tuff	y	angular fragment	30	14	6	unident				
Oxbow Site - east track	29	52	tuff	n	complete flake	31	15	5	blade	bifacial	modified	hinge	
Oxbow Site - east track	29	53	tuff	y	complete flake	40	25	6	intermed	bifacial	modified	feather	
Oxbow Site - east track	29	54	tuff	y	complete flake	37	36	11	intermed	unifacial	unmodified	feather	
Oxbow Site - east track	29	55	tuff	y	proximal fragment	26	26	12	unident	unifacial	unmodified		
Oxbow Site - east track	29	56	tuff	y	flake fragment	21	8	8	unident				
Oxbow Site - east track	29	57	tuff	n	angular fragment	12	12	5	unident				
Oxbow Site - east track	29	58	tuff	y	complete flake	30	16	6	intermed	crushed platform		feather	
Oxbow Site - east track	29	59	tuff	n	flake fragment	27	24	6	unident				
Oxbow Site - east track	29	60	tuff	y	complete flake	51	24	11	intermed	cortex platform	unmodified	plunge	
Oxbow Site - east track	29	61	tuff	y	split cone frag	28	28	11	expanded	cortex platform	unmodified	hinge	
Oxbow Site - east track	29	62	silcrete	y	FLAKE TOOL	58	53	14	whole	1 use-wear	2 use-wear		
Oxbow Site - east track	29	63	tuff	y	proximal fragment	25	21	11	unident	unifacial	unmodified		
Oxbow Site - east track	29	64	tuff	y	distal fragment	33	25	7	unident			hinge	
Oxbow Site - east track	29	65	tuff	y	FLAKE TOOL	37	39	15	whole	step			
Oxbow Site - east track	29	66	tuff	n	angular fragment	19	8	6	unident				
Oxbow Site - east track	29	67	tuff	n	FLAKE TOOL	25	20	9	whole	use-wear			
Oxbow Site - east track	29	68	tuff	n	complete flake	20	17	4	intermed	bifacial	unmodified	feather	
Oxbow Site -3 big tools	30	1	tuff	y	FLAKE TOOL	47	46	17	whole	cuspate ret	scalar retouch ventral		
Oxbow Site -3 big tools	30	2	quartzite	n	FLAKE TOOL	92	74	28	whole	use-wear			

Oxbow Site -3 big tools	30	3	tuff	y	NUCLEAR TOOL	84	80	50	whole	unifacial			also prod core
Oxbow Site -3 big tools	30	4	silcrete	n	flake fragment	23	12	7	unident				
Oxbow Site -blackchert	31	1	tuff	n	FLAKE TOOL	62	55	23	broken	1 step	2 scalar retouch		
Oxbow Site -blackchert	31	2	silcrete	n	complete flake	39	36	8	expanded	unifacial	modified	feather	
Oxbow Site -blackchert	31	3	acid vol	n	FLAKE TOOL	23	20	8	broken	scalar retouch			
Oxbow Site -blackchert	31	4	silcrete	n	complete flake	67	22	16	blade	bigfacial	unmodified	plunge	crested
Oxbow Site -blackchert	31	5	tuff	y	angular fragment	90	35	32	unident				
Oxbow Site -blackchert	31	6	silcrete	n	complete flake	35	27	12	intermed	bigfacial	modified	feather	crested
Oxbow Site -blackchert	31	7	tuff	y	complete flake	20	13	4	expanded	unifacial	unmodified	feather	
Oxbow Site -blackchert	31	8	tuff	n	complete flake	33	14	12	intermed	unifacial	umodified	feather	
Oxbow Site -blackchert	31	9	silcrete	n	complete flake	17	13	4	intermed	crushed platform		plunge	
Oxbow Site -blackchert	31	10	acid vol	y	complete flake	65	32	22	intermed	unifacial	unmodified	plunge	
Oxbow Site -blackchert	31	11	acid vol	y	angular fragment	29	20	12	unident				
Oxbow Site -blackchert	31	12	black chert	n	complete flake	38	38	17	expanded	unifacial	unmodified	feather	
Oxbow Site -blackchert	31	13	tuff	y	complete flake	46	19	10	intermed	unifacial	modified	plunge	
Oxbow Site -blackchert	31	14	tuff	n	complete flake	39	39	15	expanded	unifacial	use-wear plat	feather	
Oxbow Site -blackchert	31	15	quartzite	y	HAMMERSTONE	91	87	65	whole	3 facets			
Oxbow Site -blackchert	31	16	tuff	n	complete flake	38	28	12	intermed	bifacial	modified	plunge	
Oxbow Site -blackchert	31	17	silcrete	n	complete flake	38	36	13	expanded	unifacial	unmodified	feather	
Oxbow Site -blackchert	31	18	tuff	y	proximal fragment	12	12	3	blade	unifacial	unmodified		
Oxbow Site -blackchert	31	19	silcrete	n	distal fragment	35	25	12	unident			feather	
Oxbow Site -blackchert	31	20	silcrete	y	distal fragment	12	10	1	unident			feather	
Oxbow Site -blackchert	31	21	tuff	n	complete flake	25	15	7	expanded	unifacial	modified	feather	
Oxbow Site -blackchert	31	22	grey chert	n	BURREN	27	18	11	whole	step ret	with use-wear		
Oxbow Site -blackchert	31	23	silcrete	n	complete flake	19	14	2	intermed	unifacial	unmodified	feather	
Oxbow Site -blackchert	31	24	tuff	n	proximal fragment	50	20	5	blade	unifacial	unmodified		
Oxbow Site -blackchert	31	25	tuff	y	split cone frag	27	24	5	expanded	cortex platform	unmodified	hinge	
Oxbow Site- black chert	31	26	tuff	n	proximal fragment	37	18	7	unident	unifacial	unmodified		
Oxbow Site- black chert	31	27	tuff	n	complete flake	30	23	9	intermed	unifacial	use-wear plat	feather	
Oxbow Site- black chert	31	28	tuff	y	complete flake	50	24	9	xpand	unifacial	unmodified	feather	
Oxbow Site- black chert	31	29	silcrete	y	complete flake	37	35	8	intermed	unifacial	modified	feather	
Oxbow Site - ant hill	32	1	tuff	y	complete flake	46	37	14	intermed	unifacial	unmodified	plunge	crested dorsal
Oxbow Site - ant hill	32	2	quartz	n	proximal fragment	17	15	7	unident	unifacial	unmodified		
Oxbow Site - ant hill	32	3	tuff	n	complete flake	18	12	3	expanded	unifacial	modified	feather	
Oxbow Site - ant hill	32	1	silcrete	n	complete flake	26	20	7	intermed	unifacial	modified	feather	

Oxbow Site - ant hill	32	2	tuff	y	complete flake	28	20	5	intermed	unifacial	modified	feather	
Oxbow Site - ant hill	32	3	tuff	y	proximal fragment	23	20	6	unident	cortex platform	modified		
Oxbow Site - ant hill	32	4	tuff	n	split cone frag	27	15	12	intermed	unifacial	unmodified	feather	
Oxbow Site - ant hill	32	5	silcrete	n	flake fragment	20	14	8	blade				
Oxbow Site - ant hill	32	6	silcrete	n	flake fragment	11	11	6	blade				
Oxbow Site - ant hill	32	7	silcrete	n	BACKED BLADE	13	10	4	broken	geometric			
Oxbow Site - ant hill	32	8	silcrete	n	proximal fragment	26	15	6	unident	unifacial	modified		
Oxbow Site - ant hill	32	9	tuff	y	split cone frag	32	31	12	expanded	cortex platform	modified	feather	
Oxbow Site - ant hill	32	10	tuff	n	complete flake	21	20	6	expanded	unifacial	modified	hinge	
Oxbow Site - ant hill	32	11	tuff	n	distal fragment	33	19	9	unident			plunge	scalar ret dist end
Oxbow Site - ant hill	32	12	silcrete	y	split cone frag	20	14	7	intermed	unifacial	unmodified	feather	
Oxbow Site - ant hill	32	13	silcrete	n	distal fragment	14	12	6	unident			feather	
Bridge Site, Ash-1	33	1	silcrete	n	complete flake	18	10	3	expanded	unifacial	modified	feather	
Bridge Site, Ash-1	33	2	silcrete	n	M'BLADE CORE	22	20	11	prismatic	bidirectional			
Bridge Site, Ash-1	33	3	tuff	y	complete flake	31	30	12	expanded	crushed platform		plunge	
Bridge Site, Ash-1	33	4	tuff	y	distal fragment	15	12	4	unident			feather	
Bridge Site, Ash-1	33	5	tuff	y	complete flake	22	20	6	expanded	unifacial	unmodified	feather	
Bridge Site, Ash-1	33	6	tuff	n	complete flake	14	9	4	intermed	unifacial	unmodified	feather	
Bridge Site, Ash-1	33	7	tuff	y	NUCLEAR TOOL	188	142	58	whole	unifacial	use-wear		
Bridge Site, Ash-1	33	8	tuff	n	complete flake	56	36	12	intermed	unifacial	unmodified	plunge	
Bridge Site, Ash-1	33	9	quartz	n	angular fragment	30	14	6	unident				
Bridge Site, Ash-1	33	10	silcrete	n	angular fragment	45	30	7	unident				
Bridge Site, Ash-1	33	11	silcrete	n	SPALL TOOL	124	102	30	whole	cuspate ret	step		
Bridge Site, Ash-1	33	12	silcrete	n	PROD CORE	50	40	33	whole	multiplatform			
Bridge Site, Ash-1	33	13	tuff	n	FLAKE TOOL	44	23	11	whole	burren	scalar retouch	use-wear	
Bridge Site, Ash-1	33	14	black chert	n	proximal fragment	26	17	9	unident	unifacial	modified		
Bridge Site, Ash-1	33	15	tuff	n	complete flake	18	17	3	intermed	unifacial	modified	feather	
Bridge Site, Ash-1	33	16	silcrete	n	complete flake	23	18	7	expanded	unifacial	unmodified	hinge	
Bridge Site, Ash-1	33	17	silcrete	n	split cone frag	14	13	5	expanded	unifacial	unmodified	feather	
Bridge Site, Ash-1	33	18	silcrete	y	distal fragment	25	20	6	unident			feather	
Bridge Site, Ash-1	33	19	sandstone	n	MILLING SLAB	214	175	24	broken	1 facet	pecked surface	3/4 complete flake	
Bridge Site, Ash-1	33	20	tuff	n	proximal fragment	32	20	7	unident	unifacial	use-wear plat		
Bridge Site, Ash-1	33	21	tuff	n	M'BLADE CORE	36	35	15	whole	test			
Oxbow site - rubbish	34	1	tuff	n	flake fragment	17	16	3	unident				
Oxbow site - rubbish	34	2	tuff	n	flake fragment	13	7	5	unident				

Oxbow site - rubbish	34	3	tuff	y	flake fragment	14	11	3	unident				
Oxbow Site - cow track	35	1	silcrete	y	flake fragment	36	30	18	unident				
Oxbow Site - cow track	35	2	silcrete	n	flake fragment	60	36	8	unident				burnt
Oxbow Site - cow track	35	3	silcrete	y	split cone frag	72	28	13	expanded	cortex platform	unmodified	feather	
Oxbow Site - cow track	35	4	silcrete	n	distal fragment	31	31	6	unident			feather	
Oxbow Site - cow track	35	5	silcrete	n	flake fragment	31	24	6	unident				
Oxbow Site - cow track	35	6	silcrete	n	angular fragment	30	17	9	unident				burnt
Oxbow Site - cow track	35	7	silcrete	n	flake fragment	23	17	6	unident				
Oxbow Site - cow track	35	8	tuff	n	complete flake	17	12	3	expanded	bifacial	use-wear plat	feather	
Oxbow Site - cow track	35	9	tuff	n	flake fragment	15	12	3	unident				
Oxbow Site - cow track	35	10	tuff	y	distal fragment	29	22	5	unident			hinge	
Oxbow Site - cow track	35	11	silcrete	y	complete flake	46	34	12	expanded	unifacial	use-wear plat	feather	
Oxbow Site - cow track	35	12	tuff	n	proximal fragment	15	10	4	blade	unifacial	modified		
Oxbow Site - cow track	35	13	silcrete	n	complete flake	18	13	4	expanded	bifacial	unmodified	feather	
Oxbow Site - cow track	35	14	silcrete	y	flake fragment	18	12	3	unident				
Oxbow Site - cow track	35	15	silcrete	n	flake fragment	16	11	4	unident				
Oxbow Site - cow track	35	16	silcrete	y	complete flake	47	35	13	expanded	unifacial	unmodified	plunge	
Oxbow Site - cow track	35 w/s1	1	silcrete	n	angular fragment	18	18	8	unident				
Oxbow Site - cow track	35 w/s1	2	silcrete	n	proximal fragment	13	12	8	unident	unifacial	unmodified		
Oxbow Site - cow track	35 w/s1	3	silcrete	n	flake fragment	45	18	10	unident				
Oxbow Site - cow track	35 w/s1	4	silcrete	n	flake fragment	13	11	4	unident				
Oxbow Site - cow track	35 w/s1	5	silcrete	n	flake fragment	23	10	6	unident				
Oxbow Site - cow track	35 w/s1	6	silcrete	n	flake fragment	21	7	4	unident				
Oxbow Site - cow track	35 w/s1	7	silcrete	n	flake fragment	26	26	7	unident				
Oxbow Site - cow track	35 w/s1	8	silcrete	n	flake fragment	32	23	7	unident				
Oxbow Site - cow track	35 w/s1	9	silcrete	n	flake fragment	29	26	13	unident				
Oxbow Site - cow track	35 w/s1	10	silcrete	n	flake fragment	18	17	6	unident				
Oxbow Site - cow track	35 w/s1	11	silcrete	n	flake fragment	17	16	5	unident				burnt
Oxbow Site - cow track	35 w/s2	12	silcrete	n	M'BLADE CORE	30	30	26	prismatic	trial			
Oxbow Site - cow track	35 w/s2	13	silcrete	n	flake fragment	17	14	3	blade				
Oxbow Site - cow track	35 w/s2	14	silcrete	y	complete flake	41	28	14	intermed	unifacial	unmodified	hinge	
Oxbow Site - cow track	35 w/s2	15	silcrete	y	distal fragment	16	11	3	unident			hinge	
Oxbow Site - gate post	36	1	quartz	n	flake fragment	21	16	8	bipolar	faint crushed platform			
Oxbow Site - gate post	36	2	tuff	n	distal fragment	63	35	14	unident			hinge	
Oxbow Site - gate post	36	3	tuff	y	complete flake	50	33	14	intermed	crushed platform		plunge	

Oxbow Site - gate post	36	4	tuff	y	distal fragment	37	24	15	unident			hinge	
Oxbow Site - gate post	36	5	tuff	n	M'BLADE CORE	30	29	12	whole	trial	on flake tool		
Oxbow Site - gate post	36	6	tuff	y	complete flake	28	23	8	intermed	unifacial	modified	feather	
Oxbow Site - gate post	36	7	tuff	y	complete flake	55	45	14	intermed	unifacial	unmodified	feather	
Oxbow Site - gate post	36	8	tuff	n	flake fragment	36	32	13	unident				
Oxbow Site - gate post	36	9	tuff	y	complete flake	25	23	6	expanded	unifacial	modified	hinge	
Oxbow Site - gate post	36	10	tuff	n	complete flake	23	15	6	expanded	unifacial	unmodified	feather	
Oxbow Site - gate post	36	11	tuff	y	angular fragment	26	18	10	unident				
Oxbow Site - gate post	36	12	tuff	n	flake fragment	18	5	4	unident				
Oxbow Site - gate post	36	13	tuff	y	FLAKE TOOL	21	14	6	broken	use-wear			
Oxbow Site - gate post	36	14	tuff	y	complete flake	23	17	6	expanded	cortex platform	unmodified	hinge	
Oxbow Site - gate post	36	15	tuff	y	complete flake	24	17	7	intermed	unifacial	unmodified	feather	
Oxbow Site - gate post	36	16	tuff	y	flake fragment	23	22	9	unident				
Oxbow Site - gate post	36	17	tuff	n	flake fragment	18	18	5	unident				
Oxbow Site - gate post	36	17	tuff	y	M'BLADE CORE	33	29	22	whole	prismatic			
Oxbow Site - gate post	36	19	tuff	y	FLAKE TOOL	40	27	17	whole	step			
Oxbow Site - gate post	36	20	tuff	y	FLAKE TOOL	59	31	22	whole	use-wear	trial blade core		
Oxbow Site - gate post	36	21	tuff	y	flake fragment	29	27	9	unident				road break
Oxbow Site - gate post	36	22	tuff	n	flake fragment	14	7	3	unident				road break
Oxbow Site - gate post	36	23	tuff	n	flake fragment	17	12	3	unident				
Oxbow Site - gate post	36	24	tuff	n	flake fragment	16	10	2	unident				
Oxbow Site - gate post	36	25	tuff	y	angular fragment	15	13	7	unident				
Oxbow Site - gate post	36	26	tuff	n	BACKED BLADE	18	16	4	broken	finished			road break
Oxbow Site - gate post	36	27	silcrete	y	M'BLADE CORE	43	32	12	whole	prismatic	faceted rotated		
Oxbow Site - gate post	36	28	silcrete	y	FLAKE TOOL	61	45	18	whole	1 cuspate ret	2 scalar retouch	3 use-wear	
Oxbow Site - gate post	36	29	silcrete	n	flake fragment	47	35	19	unident				
Oxbow Site - gate post	36	30	silcrete	n	complete flake	53	44	16	expanded	unifacial	modified	feather	
Oxbow Site - gate post	36	31	silcrete	y	complete flake	30	23	6	intermed	bifacial	unmodified	feather	
Oxbow Site - gate post	36	32	silcrete	n	complete flake	38	17	9	intermed	unifacial	unmodified	feather	
Oxbow Site - gate post	36	33	silcrete	n	proximal fragment	17	17	8	unident	bifacial	unmodified		
Oxbow Site - gate post	36	34	silcrete	n	flake fragment	20	17	6	unident				
Oxbow Site - gate post	36	35	silcrete	n	flake fragment	25	24	7	unident				
Oxbow Site - gate post	36	36	silcrete	n	distal fragment	16	11	6	unident			feather	
Oxbow Site - gate post	36	37	silcrete	n	complete flake	50	40	14	intermed	unifacial	unmodified	plunge	
Oxbow Site - gate post	36	38	silcrete	n	split cone frag	30	21	12	expanded	unifacial	unmodified	plunge	

Oxbow Site - gate post	36	39	silcrete	n	complete flake	30	15	9	expanded	bifacial	unmodified	feather	
Oxbow Site - gate post	36	40	silcrete	n	flake fragment	13	11	4	unident				
Oxbow Site - gate post	36	41	silcrete	y	FLAKE TOOL	30	19	11	whole	scalar retouch	on microblade core?		
Oxbow Site - gate post	36	42	tuff	y	proximal fragment	22	21	5	unident	cortex platform	unmodified		
Oxbow Site - gate post	36	43	tuff	n	complete flake	50	24	20	intermed	bifacial	modified	plunge	
Oxbow Site - gate post	36	44	tuff	n	complete flake	43	43	13	expanded	unifacial	unmodified	plunge	
Oxbow Site - gate post	36	45	tuff	y	FLAKE TOOL	77	61	30	whole	scalar retouch			
Oxbow Site - gate post	36	46	silcrete	n	angular fragment	38	29	4	unident				
Oxbow Site - gate post	36	47	tuff	y	complete flake	41	26	6	expanded	cortex platform	modified	feather	
Oxbow Site - gate post	36	48	tuff	n	flake fragment	17	15	5	unident				
Oxbow Site - gate post	36	49	silcrete	n	M'BLADE CORE	49	24	22	whole	prismatic	on flake		
Oxbow Site - gate post	36	50	tuff	n	complete flake	41	10	7	blade	crushed platform		feather	crested
Oxbow Site - gate post	36	51	silcrete	n	complete flake	31	19	13	intermed	unifacial	unmodified	feather	transv. dors scars
Oxbow Site - gate post	36	52	tuff	n	complete flake	16	15	4	expandeded	unifacial	modified	feather	
Oxbow Site - gate post	36	53	silcrete	n	complete flake	46	42	10	expandeded	unifacial	unmodified	feather	
Oxbow Site - gate post	36	54	tuff	y	split cone frag	30	25	6	expandeded	cortex platform	unmodified	feather	
Oxbow Site - gate post	36	55	silcrete	n	distal fragment	44	31	14	unident			feather	
Oxbow Site - gate post	36	56	tuff	y	complete flake	31	30	9	expandeded	cortex platform	modified	plunge	
Oxbow Site - gate post	36	57	tuff	y	flake fragment	19	17	5	blade				
Oxbow Site - gate post	36	58	tuff	n	BACKED BLADE	26	9	4	broken	bondi	tip missing		
Oxbow Site - gate post	36	59	tuff	y	complete flake	28	23	6	intermed	cortex platform	unmodified	feather	
Oxbow Site - gate post	36	60	silcrete	y	complete flake	57	32	13	intermed	unifacial	modified	plunge	transv. dors scars
Oxbow Site - gate post	36	61	tuff	n	complete flake	21	13	5	expandeded	unifacial	modified	hinge	
	37	1	tuff	y	distal fragment	26	19	9	unident			plunge	
	37	2	tuff	y	FLAKE TOOL	57	46	26	whole	step			
	37	3	tuff	n	distal fragment	34	25	19	unident			plunge	
	37	4	tuff	n	complete flake	18	11	5	intermed	bifacial	modified	plunge	
	37	5	tuff	n	distal fragment	29	17	5	unident			hinge	
	37	6	tuff	n	complete flake	26	19	6	expanded	unifacial	modified	plunge	
Ash 8 TSR site	38	1	tuff	y	FLAKE TOOL	64	54	17	whole	use-wear			
Ash 8 TSR site	38	2	silcrete	n	FLAKE TOOL	38	27	12	whole	STEP			
Ash 8 TSR site	38	3	quartz	y	complete flake	22	16	5	intermed	cortex platform	modified	feather	
Ash 8 TSR site	38	4	tuff	y	complete flake	18	15	4	expanded	crushed platform	plunge		
Ash 8 TSR site	38	5	tuff	n	complete flake	28	22	8	intermed	bifacial	modified	plunge	
Ash 8 TSR site	38	6	tuff	n	FLAKE TOOL	32	17	7	whole	serrated			

Ash 8 TSR site	38	7	tuff	n	proximal fragment	16	14	5	unident	unifacial	umodified		
Ash 8 TSR site	38	8	tuff	n	FLAKE TOOL	41	30	15	whole	use-wear			u-w on dors ridge
	38	9	tuff	n	FLAKE TOOL	91	81	40	whole	step			
	39	1	tuff	y	FLAKE TOOL	47	38	17	whole	scalar retouch			
	40	1	silcrete	n	split cone frag	11	10	3	unident	unifacial	unmodified		proximal fragment
	40	2	tuff	y	complete flake	31	22	13	intermed	unifacial	modified	plunge	
	40	3	silcrete	n	M'BLADE CORE	30	18	17	whole	burin blade			
	41	1	silcrete	y	complete flake	55	40	16	expanded	unifacial	modified	plunge	
	41	2	silcrete	n	split cone frag	39	23	11	unident	unifacial	unmodified		proxl frag, road brk
Ridge Peak Site	42	1	tuff	y	PROD CORE	43	40	27	whole	multiplat			expended
Ridge Peak Site	42	2	tuff	y	complete flake	56	38	14	expanded	unifacial	unmodified	feather	
Ridge Peak Site	42	3	tuff	y	distal fragment	35	24	8	unident			hinge	
Ridge Peak Site	42	4	tuff	y	angular fragment	20	13	9	unident				
Ridge Peak Site	42	5	tuff	y	flake fragment	19	16	8	unident				
Ridge Peak Site	42	6	tuff	y	flake fragment	21	12	4	blade				
Ridge Peak Site	42	7	tuff	y	distal fragment	21	17	7	unident			feather	
Ridge Peak Site	42	8	tuff	n	flake fragment	17	13	6	unident				
Ridge Peak Site	42	9	tuff	n	flake fragment	15	9	3	unident				
Ridge Peak Site	42	10	tuff	y	proximal fragment	14	12	4	unident	unifacial	modified		
Ridge Peak Site	42	11	tuff	n	flake fragment	13	11	7	unident				
	43	1	silcrete	n	PROD CORE	44	39	27	whole	multiplat			.
	43	2	tuff	y	distal fragment	53	47	14	unident			hinge	fresh breakl
	44	1	tuff	n	complete flake	12	14	6	expanded	unifacial	unmodified	plunge	dorsal transverse
	44	2	silcrete	y	flake fragment	32	265	12	unident				
	44	3	silcrete	n	angular fragment	30	15	8	unident				burnt
	44	4	silcrete	y	angular fragment	28	20	8	unident				
	44	5	silcrete	y	flake fragment	20	15	4	unident				
	44	6	tuff	y	complete flake	67	45	18	indeterm	unifacial	modified	feather	
	44	7	tuff	n	proximal fragment	34	28	11	unident	unifacial	unmodified		road break
	44	8	tuff	n	complete flake	20	13	3	expanded	unifacial	modified	plunge	
	45	1	tuff	y	complete flake	78	54	20	expanded	prob potlid	unmodified	plunge	plat on dist end
	45	2	tuff	n	M'BLADE CORE	42	34	16	whole	trial			
	45	3	tuff	n	M'BLADE CORE	38	34	31	whole	bidirectional	made on flake		
	45	4	tuff	n	complete flake	38	25	14	intermed	cortex platform	modified	plunge	plat dist, trans dor
	45	5	tuff		complete flake	42	38	14	expanded	unifacial	modified	plunge	

	45	6	tuff	y	angular fragment	23	16	12	unident				
Hunter River High Spur Site	46	1	silcrete	n	flake fragment	29	18	5	unident				burnt
Hunter River High Spur Site	46	2	silcrete	n	distal fragment	17	11	3	unident			feather	
Hunter River High Spur Site	46	3	silcrete	y	proximal fragment	26	22	6	unident	cortex platform	unmodified		
Hunter River High Spur Site	46	4	silcrete	n	complete flake	20	9	4	expanded	crushed platform		plunge	
Hunter River High Spur Site	46	5	silcrete	n	complete flake	18	12	4	expanded	bifacial	modified	feather	
Hunter River High Spur Site	46	6	silcrete	n	proximal fragment	24	21	5	unident	unifacial	unmodified		
Hunter River High Spur Site	46	7	silcrete	n	complete flake	14	12	3	expanded	unifacial	unmodified	feather	
Hunter River High Spur Site	46	8	silcrete	n	FLAKE TOOL	41	30	9	broken	scalar retouch			
Hunter River High Spur Site	46	9	silcrete	y	M'BLADE CORE	28	28	12	whole	trial	on broken flake		
Hunter River High Spur Site	46	10	silcrete	n	proximal fragment	13	11	14	unident	unifacial	unmodified		
Hunter River High Spur Site	46	11	silcrete	y	flake fragment	22	22	10	unident				
Hunter River High Spur Site	46	12	silcrete	n	flake fragment	14	13	4	blade				
Hunter River High Spur Site	46	13	silcrete	n	complete flake	31	21	6	expanded	unifacial	unmodified	hinge	
Hunter River High Spur Site	46	14	silcrete	n	complete flake	26	21	6	intermed	unifacial	use-wear plat	feather	
Hunter River High Spur Site	46	15	silcrete	n	flake fragment	17	14	7	unident				
Hunter River High Spur Site	46	16	silcrete	n	distal fragment	34	22	5	unident			feather	
Hunter River High Spur Site	46	17	silcrete	n	complete flake	40	22	11	intermed	unifacial	unmodified	feather	
Hunter River High Spur Site	46	18	silcrete	n	flake fragment	15	14	4	unident				
Hunter River High Spur Site	46	19	silcrete	n	flake fragment	17	10	4	blade				
Hunter River High Spur Site	46	20	tuff	y	split cone frag	18	12	5	expanded	crushed platform		feather	all tuff same core
Hunter River High Spur Site	46	21	tuff	n	flake fragment	21	18	6	unident				
Hunter River High Spur Site	46	22	tuff	y	complete flake	36	22	17	expanded	cortex platform	unmodified	feather	
Hunter River High Spur Site	46	23	tuff	y	proximal fragment	15	9	5	unident	cortex platform	unmodified		
Hunter River High Spur Site	46	24	tuff	y	complete flake	12	9	3	intermed	cortex platform	unmodified	feather	
Hunter River High Spur Site	46	25	tuff	n	flake fragment	21	11	3	unident				
High Spur Site qz W/S start	46	1	silcrete	y	angular fragment	26	13	10	unident				
High Spur Site qz W/S	46	2	tuff	y	complete flake	37	27	9	expanded	cortex platform	unmodified	feather	
High Spur Site qz W/S	46	3	tuff	y	angular fragment	19	13	10	unident			burnt	
High Spur Site qz W/S	46	4	tuff	n	complete flake	18	11	3	expanded	unifacial	unmodified	feather	
High Spur Site qz W/S	46	5	tuff	n	flake fragment	23	18	6	unident				
High Spur Site qz W/S	46	6	quartz	n	complete flake	27	22	12	intermed	unifacial	unmodified	feather	
High Spur Site qz W/S	46	7	quartz	n	complete flake	19	16	8	intermed	unifacial	unmodified	feather	
High Spur Site qz W/S	46	8	quartz	n	proximal fragment	16	12	9	unident	unifacial	unmodified		
High Spur Site qz W/S	46	9	quartz	y	FLAKE TOOL	29	19	7	whole	scalar retouch			

High Spur Site qz W/S	46	10	quartz	n	complete flake	26	19	18	intermed	unifacial	unmodified	feather	
High Spur Site qz W/S	46	11	silcrete	n	angular fragment	26	17	5	unident			burnt	
High Spur Site qz W/S	46	12	silcrete	n	flake fragment	14	10	3	unident				
High Spur Site qz W/S	46	13	tuff	y	distal fragment	27	25	5	unident			hinge	
High Spur Site qz W/S	46	14	tuff	n	proximal fragment	22	12	6	blade	unifacial	modified		
High Spur Site qz W/S end	46	15	quartzite	y	HAMMERSTONE	68	46	30	2 opposite facets		both shattered		
High Spur Site sil W/S start	46	1	silcrete	y	distal fragment	26	18	10	unident			feather	
High Spur Site sil W/S	46	2	silcrete	n	angular fragment	26	24	13	unident				
High Spur Site sil W/S	46	3	silcrete	y	distal fragment	31	24	17	unident			plunge	
High Spur Site sil W/S	46	4	silcrete	n	complete flake	42	26	15	intermed	unifacial	unmodified	plunge	
High Spur Site sil W/S	46	5	silcrete	n	flake fragment	22	16	6	unident				
High Spur Site sil W/S	46	6	silcrete	n	complete flake	25	13	8	intermed	unifacial	unmodified	hinge	burnt
High Spur Site sil W/S	46	7	silcrete	n	complete flake	17	9	3	expanded	bifacial	unmodified	feather	
High Spur Site sil W/S	46	8	silcrete	y	angular fragment	45	27	17	unident				burnt
High Spur Site sil W/S	46	9	silcrete	y	complete flake	20	17	8	expanded	unifacial	unmodified	plunge	
High Spur Site sil W/S	46	10	silcrete	y	angular fragment	21	12	11	unident				
High Spur Site sil W/S	46	11	silcrete	y	distal fragment	37	20	17	unident			feather	
High Spur Site sil W/S	46	12	silcrete	n	angular fragment	28	17	10	unident				
High Spur Site sil W/S	46	13	silcrete	n	complete flake	28	19	7	intermed	unifacial	unmodified	feather	
High Spur Site sil W/S	46	14	silcrete	n	angular fragment	20	15	11	unident				
High Spur Site sil W/S	46	15	silcrete	n	distal fragment	14	10	3	unident			feather	
High Spur Site sil W/S	46	16	silcrete	n	angular fragment	16	14	6	unident				
High Spur Site sil W/S	46	17	silcrete	n	complete flake	32	29	12	expanded	bifacial	unmodified	plunge	
High Spur Site sil W/S	46	18	silcrete	y	angular fragment	19	11	11	unident				
High Spur Site sil W/S	46	19	silcrete	n	angular fragment	45	37	27	unident				burnt
High Spur Site sil W/S	46	20	silcrete	y	flake fragment	25	20	14	unident				
High Spur Site sil W/S	46	21	silcrete	n	angular fragment	16	13	6	unident				
High Spur Site sil W/S	46	22	silcrete	y	flake fragment	28	18	13	unident				
High Spur Site sil W/S	46	23	silcrete	y	angular fragment	32	19	17	unident				
High Spur Site sil W/S	46	24	silcrete	n	complete flake	28	15	9	intermed	unifacial	unmodified	feather	
High Spur Site sil W/S	46	25	silcrete	n	angular fragment	18	14	7	unident				
High Spur Site sil W/S	46	26	silcrete	y	complete flake	19	13	6	expanded	crushed platform		plunge	
High Spur Site sil W/S	46	27	silcrete	n	angular fragment	20	19	7	unident				
High Spur Site sil W/S	46	28	silcrete	y	split cone frag	33	22	15	intermed	unifacial	unmodified	plunge	
High Spur Site sil W/S	46	29	silcrete	n	angular fragment	24	12	11	unident				

High Spur Site sil W/S	46	30	silcrete	n	complete flake	26	14	5	intermed	unifacial	unmodified	feather	
High Spur Site sil W/S	46	31	silcrete	y	angular fragment	23	8	4	unident				
High Spur Site sil W/S	46	32	silcrete	n	angular fragment	23	12	12	unident				
High Spur Site sil W/S	46	33	silcrete	n	split cone frag	25	12	4	intermed	unifacial	unmodified	feather	
High Spur Site sil W/S	46	34	silcrete	n	flake fragment	20	9	4	unident				
High Spur Site sil W/S	46	35	silcrete	n	angular fragment	24	14	9	unident				
High Spur Site sil W/S	46	36	silcrete	n	erallier/potlid	14	13	3		prob potlid			
High Spur Site sil W/S	46	37	silcrete	y	angular fragment	18	18	8	unident				
High Spur Site sil W/S	46	38	silcrete	y	angular fragment	34	11	10	unident				
High Spur Site sil W/S	46	39	silcrete	y	angular fragment	15	12	8	unident				
High Spur Site sil W/S	46	40	silcrete	n	complete flake	15	13	4	expanded	unifacial	unmodified	feather	burnt
High Spur Site sil W/S	46	41	silcrete	n	complete flake	16	15	8	expanded	unifacial	unmodified	feather	
High Spur Site sil W/S	46	42	silcrete	n	angular fragment	17	14	8	unident				
High Spur Site sil W/S	46	43	silcrete	n	angular fragment	17	12	10	unident				
High Spur Site sil W/S	46	44	silcrete	y	proximal fragment	28	18	13	unident	unifacial	unmodified	burnt	
High Spur Site sil W/S	46	45	silcrete	n	complete flake	15	9	5	intermed	unifacial	unmodified	feather	
High Spur Site sil W/S	46	46	silcrete	n	distal fragment	15	11	7	unident			feather	
High Spur Site sil W/S	46	47	silcrete	n	angular fragment	27	26	15	unident				burnt
High Spur Site sil W/S	46	48	silcrete	n	split cone frag	25	21	12	unident			feather	distal fragment
High Spur Site sil W/S	46	49	silcrete	n	angular fragment	28	18	16	unident				
High Spur Site sil W/S	46	50	silcrete	n	angular fragment	22	12	10	unident				
High Spur Site sil W/S	46	51	silcrete	y	angular fragment	18	14	9	unident				
High Spur Site sil W/S	46	52	silcrete	n	flake fragment	19	19	7	unident				burnt
High Spur Site sil W/S	46	53	silcrete	n	angular fragment	21	11	10	unident				
High Spur Site sil W/S	46	54	silcrete	y	angular fragment	22	18	14	unident				
High Spur Site sil W/S	46	55	silcrete	y	angular fragment	21	15	13	unident				
High Spur Site sil W/S	46	56	silcrete	y	angular fragment	24	20	17	unident				burnt
High Spur Site sil W/S	46	57	silcrete	y	flake fragment	19	16	10	unident				
High Spur Site sil W/S	46	58	silcrete	n	flake fragment	21	17	7	unident				
High Spur Site sil W/S	46	59	silcrete	y	flake fragment	19	18	7	unident				
High Spur Site sil W/S	46	60	silcrete	y	INDET CORE	47	32	29	broken	unifacial			burnt
High Spur Site sil W/S	46	61	silcrete	y	angular fragment	41	22	13	unident				burnt
High Spur Site sil W/S	46	62	silcrete	n	flake fragment	16	16	5	unident				
High Spur Site sil W/S	46	63	silcrete	n	split cone frag	53	27	17	intermed	unifacial	unmodified	feather	
High Spur Site sil W/S	46	64	silcrete	n	distal fragment	24	19	9	unident			feather	

High Spur Site sil W/S	46	65	silcrete	n	flake fragment	18	18	5	unident				
High Spur Site sil W/S	46	66	silcrete	n	complete flake	40	32	7	expanded	bifacial	unmodified	feather	
High Spur Site sil W/S	46	67	silcrete	y	angular fragment	46	33	25	unident				
High Spur Site sil W/S	46	68	silcrete	y	angular fragment	36	27	21	unident				
High Spur Site sil W/S	46	69	silcrete	y	angular fragment	30	18	17	unident				burnt
High Spur Site sil W/S	46	70	silcrete	n	distal fragment	33	19	6	unident			feather	
High Spur Site sil W/S	46	71	silcrete	n	angular fragment	18	16	8	unident				
High Spur Site sil W/S	46	72	silcrete	y	flake fragment	16	16	10	unident				
High Spur Site sil W/S	46	73	silcrete	y	angular fragment	69	47	26	unident				
High Spur Site sil W/S	46	74	silcrete	y	flake fragment	32	28	13	unident				
High Spur Site sil W/S	46	75	silcrete	y	FLAKE TOOL	40	32	14	broken	cuspate ret			
High Spur Site sil W/S	46	76	silcrete	n	flake fragment	27	18	7	unident				
High Spur Site sil W/S	46	77	silcrete	n	angular fragment	17	16	4	unident				burnt
High Spur Site sil W/S	46	78	silcrete	n	flake fragment	20	17	8	unident				
High Spur Site sil W/S	46	79	silcrete	n	distal fragment	13	11	3	unident			feather	
High Spur Site sil W/S	46	80	silcrete	n	angular fragment	17	13	12	unident				
High Spur Site sil W/S end	46	81	silcrete	n	angular fragment	36	26	15	unident				
	47	1	tuff	n	complete flake	28	8	4	blade	crushed platform		feather	
	47	2	tuff	y	flake fragment	18	13	3	unident				subsq break
	47	3	tuff	n	angular fragment	12	9	9	unident				subsq break
	47	4	tuff	y	flake fragment	19	12	3	unident				subsq break
	47	5	tuff	n	proximal fragment	12	12	2	blade	unifacial	modified		
	47	6	tuff	n	proximal fragment	23	11	4	unident	unifacial	unmodified		subsq break
	47	7	tuff	n	flake fragment	10	7	3	unident				
	47	8	tuff	y	complete flake	23	18	6	intermed	cortex platform	unmodified	plunge	
	47	9	tuff	n	flake fragment	11	8	4	unident				subsq break
	47	10	tuff	y	proximal fragment	18	15	6	unident	cortex platform	unmodified		subsq break
	47	11	tuff	y	flake fragment	15	12	3	blade				subsq break
	47	12	tuff	n	complete flake	30	8	4	blade	unifacial	unmodified	feather	
	47	13	silcrete	y	complete flake	83	52	26	intermed	cortex platform	unmodified	plunge	
	47	14	tuff	n	angular fragment	28	16	11	unident				road break
	48	1	tuff	n	flake fragment	20	11	5	unident				
	48	2	tuff	y	flake fragment	16	12	11	unident				road break
	48	3	tuff	n	angular fragment	23	16	8	unident				road break
	49	1	tuff	n	proximal fragment	18	8	3	unident	unifacial	unmodified		road break

	49	2	tuff	n	flake fragment	20	18	4	unident				road break
	49	3	tuff	y	angular fragment	37	27	19	unident				road break
	49	4	tuff	n	angular fragment	35	22	13	unident				road break
	50	1	tuff	n	proximal fragment	24	20	8	unident	unifacial	modified		
	51	1	tuff	n	complete flake	18	13	4	intermed	unifacial	unmodified	feather	
	52	1	tuff	n	angular fragment	29	18	18	unident				
	53	1	q'zite	n	distal fragment	23	13	8	unident			plunge	
	53	2	Tuff	y	NUCLEAR TOOL	87	77	63	whole	unifacial	2 edges with u-w		
	54	1	silcrete	n	SPALL TOOL	72	61	35	whole	discoidal			
	55	1	basalt	y	AXE PREFORM	72	61	23	whole				
	56	1	tuff	n	distal fragmental	23	24	15	unident			feather	
	56	2	tuff	n	complete flake	18	14	5	intermed	crushed platform		hinge	
	57	1	tuff	y	FLAKE TOOL	20	12	10	broken	1 step	2 step		
	57	2	silcrete	n	proximal fragmentimal	25	21	6	unident	unifacial	unmodified		
	57	3	silcrete	n	proximal fragmentimal	18	18	5	unident	unifacial	modified		
	58	1	tuff	n	FLAKE TOOL	25	14	5	whole	projection	scalar retouch shaped		use-wear on tip
	58	2	quartz	y	BIPOLAR CORE	31	19	12	whole	crushed platform on both ends			
	58	3	tuff	n	flake fragment	18	16	6	unident				
	58	4	tuff	n	complete flake	26	23	6	intermed	crushed platform		feather	
	59	1	tuff	n	complete flake	19	17	5	intermed	unifacial	modified	feather	
	60	1	silcrete	n	proximal fragmentimal	51	49	17	unident	unifacial	modified		
	60	2	tuff	y	distal fragmental	20	14	4	unident			hinge	
	60	3	tuff	y	complete flake	20	15	6	intermed	unifacial	modified	feather	
G Cr 1 W/S non-MB tuff	61	1	pink tuff	n	complete flake	19	15	4	expanded	unfiacial	unmodified	hinge	
G Cr 1 W/S non-MB tuff	61	2	pink tuff	n	proximal fragment	20	13	2	unident	bifacial	unmodified		fresh break
G Cr 1 W/S non-MB tuff	61	3	pink tuff	n	distal fragment	20	17	5	unident			feather	fresh break
G Cr 1 W/S non-MB tuff	61	4	pink tuff	n	proximal fragment	17	16	3	unident	crushed platform			
Glennies Creek Site 1	61	1	silcrete	y	NUCLEAR TOOL	117	110	50	whole	unifacial	usewear		
Glennies Creek Site 1	61	2	tuff	y	angular fragment	33	33	14	unident				burnt
Glennies Creek Site 1	61	3	tuff	n	flake fragment	24	20	7	unident				
Glennies Creek Site 1	61	4	tuff	n	complete flake	17	14	4	expanded	unifacial	unmodified	hinge	
Glennies Creek Site 1	61	5	sandstone	n	MORTAR	169	167	46	whole	1 facet	trimmed & hammer-dressed		wear facet 9 cm
Glennies Creek Site 1	61	6	silcrete	n	complete flake	23	23	7	intermed	bifacial	unmodified	feather	
Glennies Creek Site 1	61	7	tuff	n	complete flake	22	17	6	intermed	unifacial	unmodified	plunge	
Glennies Creek Site 1	61	8	silcrete	n	split cone frag	28	18	11	unident	unifacial	unmodified	plunge	

Glennies Creek Site 1	61	9	tuff	y	complete flake	22	22	4	expanded	bifacial	unmodified	hinge	
Glennies Creek Site 1	61	10	tuff	y	distal fragment	21	14	6	unident			feather	
Glennies Creek Site 1	61	11	silcrete	n	complete flake	45	28	13	intermed	bifacial	unmodified	feather	
Glennies Creek Site 1	61	12	silcrete	n	distal fragment	17	12	3	unident			feather	
Glennies Creek Site 1	61	13	tuff	n	distal fragment	20	8	5	blade			plunge	
Glennies Creek Site 1	61	14	tuff	y	flake fragment	16	8	4	unident				
Glennies Creek Site 1	61	15	tuff	y	FLAKE TOOL	32	29	12	whole	step			
Glennies Creek Site 1	61	16	silcrete	y	angular fragment	80	68	30	unident				
Glennies Creek Site 1	61	17	tuff	n	complete flake	29	28	12	expanded	unifacial	modified	feather	
Glennies Creek Site 1	61	18	tuff	y	complete flake	19	16	3	expanded	unifacial	modified	feather	
Glennies Creek Site 1	61	19	tuff	n	distal fragment	21	13	3	unident			feather	
Glennies Creek Site 1	61	20	tuff	y	complete flake	27	25	12	expanded	unifacial	unmodified	plunge	
Glennies Creek Site 1	61	21	tuff	y	FLAKE TOOL	57	49	23	whole	1 cuspate ret	2 step		
Glennies Creek Site 1	61	22	tuff	y	angular fragment	37	32	17	unident				
Glennies Creek Site 1	61	23	tuff	y	split cone frag	27	15	15	expanded	unifacial	modified	hinge	
Glennies Creek Site 1	61	24	tuff	y	split cone frag	21	17	11	intermed	bifacial	unmodified	feather	
Glennies Creek Site 1	61	25	tuff	y	complete flake	10	8	4	intermed	cortex platform	unmodified	feather	
Glennies Creek Site 1	61	26	tuff	n	flake fragment	31	13	7	unident				
Glennies Creek Site 1	61	27	tuff	n	flake fragment	25	18	8	unident				
Glennies Creek Site 1	61	28	tuff	n	complete flake	23	15	9	intermed	unifacial	unmodified	feather	
Glennies Creek Site 1	61	29	silcrete	y	angular fragment	22	21	14	unident				
Glennies Creek Site 1	61	30	silcrete	y	FLAKE TOOL	89	74	26	broken	cuspate ret			
Glennies Creek Site 1	61	31	silcrete	n	angular fragment	35	32	12	unident				burnt
Glennies Creek Site 1	61	32	quartz	n	angular fragment	17	15	7	unident				
Glennies Creek Site 1	61	33	silcrete	n	M'BLADE CORE	40	35	30	whole	test	on angular fragment		
Glennies Creek Site 1	61	34	silcrete	n	complete flake	48	32	18	intermed	bifacial	modified	feather	
Glennies Creek Site 1	61	35	silcrete	y	complete flake	60	44	15	expanded	unifacial	unmodified	feather	u-w on dors ridge
Glennies Creek Site 1	61	36	tuff	y	flake fragment	42	23	7	unident				
Glennies Creek Site 1	61	37	tuff	n	proximal fragment	18	15	7	unident	unifacial	modified		
Glennies Creek Site 1	61	38	tuff	y	FLAKE TOOL	48	28	20	whole	step			
Glennies Creek Site 1	61	39	tuff	n	angular fragment	15	15	7	unident				fresh break
Glennies Creek Site 1	61	40	tuff	n	split cone frag	26	13	8	unident			feather	distal fragment
Glennies Creek Site 1	61	41	tuff	n	complete flake	36	16	10	intermed	unifacial	unmodified	hinge	
Glennies Creek Site 1	61	42	silcrete	n	complete flake	18	12	3	intermed	unifacial	faceted	feather	
Glennies Creek Site 1	61	43	silcrete	n	FLAKE TOOL	42	41	8	whole	projection	scalar retouch ret		

Glennies Creek Site 1	61	44	silcrete	y	angular fragment	27	23	10	unident				
Glennies Creek Site 2	62	1	tuff	n	BURIN	15	14	3	whole	made on expandeded flake		light wear	
Glennies Creek Site 2	62	2	tuff	Y	FLAKE TOOL	53	52	31	whole	step			
Glennies Creek Site 2	62	3	tuff	n	complete flake	22	16	4	intermed	unifacial	unmodified	feather	
Glennies Creek Site 2	62	4	tuff	n	complete flake	24	16	4	intermed	crushed platform		feather	
Glennies Creek Site 2	62	5	tuff	y	PROD CORE	63	37	34	whole	unifacial			
Glennies Creek Site 2	62	6	tuff	n	flake fragment	19	11	4	unident				
Glennies Creek Site 2	62	7	tuff	n	flake fragment	16	16	5	unident				burnt
Glennies Creek Site 2	62	8	tuff	n	proximal fragment	18	12	3	unident	unifacial	modified		
Glennies Creek Site 2	62	9	tuff	n	flake fragment	18	12	2	unident				
Glennies Creek Site 2	62	10	tuff	n	distal fragment	12	6	2	blade			feather	
Glennies Creek Site 2	62	11	tuff	n	complete flake	12	6	3	blade	unifacial	unmodified	hinge	
Glennies Creek Site 2	62	12	tuff	n	angular fragment	23	17	8	unident				
Glennies Creek Site 2	62	13	silcrete	n	distal fragment	11	10	3	unident			feather	
Glennies Creek Site 2	62	14	silcrete	n	distal fragment	22	17	6	unident			plunge	
Glennies Creek Site 2	62	15	silcrete	n	split cone frag	38	17	10	intermed	crushed platform		feather	
Glennies Creek Site 2	62	16	silcrete	y	flake fragment	26	22	5	unident				
Glennies Creek Site 2	62	17	silcrete	n	flake fragment	24	11	9	unident				
Glennies Creek Site 2	62	18	tuff	n	distal fragment	22	21	7	unident			hinge	
Glennies Creek Site 2	62	19	tuff	n	complete flake	21	10	2	intermed	bifacial	modified	feather	
Glennies Creek Site 2	62	20	tuff	n	distal fragment	29	23	5	unident			hinge	
Glennies Creek Site 2	62	21	tuff	n	angular fragment	13	12	3	unident				
Glennies Creek Site 2	62	22	tuff	y	FLAKE TOOL	61	59	28	whole	1 scalar retouch	2 use-wear		
Glennies Creek Site 2	62	23	tuff	n	complete flake	25	20	6	expanded	unifacial	modified	hinge	
	63	1	tuff	y	proximal fragmentimal	37	32	14	unident	cortex platform	unmodified		
Glennies Cr 3 - impl	64	1	silcrete	n	FLAKE TOOL	51	35	14	whole	1 use-wear	2	use-wear	
at 120 to 130	64	2	tuff	n	FLAKE TOOL	47	40	13	whole	scalar retouch			
	64	3	tuff	n	M'BLADE CORE	51	34	19	whole	trial	on flake		
Glennies Cr 3: 0 to 10	64	1	tuff	y	FLAKE TOOL	39	23	11	whole	1 scalar retouch	2 use-wear		
Glennies Cr 3: 0 to 10	64	2	tuff	y	angular fragment	25	13	7	unident				fresh break
Glennies Cr 3: 10 to 20	64	1	silcrete	n	distal fragment	33	17	8	blade			plunge	
Glennies Cr 3: 10 to 20	64	2	tuff	y	complete flake	50	33	19	intermed	cortex platform	modified	feather	
Glennies Cr 3: 10 to 20	64	3	tuff	y	complete flake	37	23	8					
Glennies Cr 3: 10 to 20	64	4	acid vol	n	proximal fragment	34	24	10	unident	unifacial	unmodified		
Glennies Cr 3: 10 to 20	64	5	tuff	y	complete flake	65	44	19	expanded	cortex platform	modified	plunge	

Glennies Cr 3: 10 to 20	64	6	acid vol	y	complete flake	50	50	31	expanded	cortex platform	modified	plunge	
Glennies Cr 3: 10 to 20	64	7	porcelanite	y	split cone frag	23	16	10	intermed	unifacial	unmodified	feather	
Glennies Cr 3: 10 to 20	64	8	silcrete	n	complete flake	40	35	11	expanded	bifacial	modified	feather	
Glennies Cr 3: 10 to 20	64	9	tuff	y	complete flake	21	21	6	expanded	cortex platform	modified	feather	
Glennies Cr 3: 10 to 20	64	10	silcrete	y	M'BLADE CORE	38	32	17	whole	faceted			
Glennies Cr 3: 10 to 20	64	11	silcrete	y	complete flake	24	19	8	expanded	bifacial	modified	plunge	
Glennies Cr 3: 10 to 20	64	12	silcrete	n	flake fragment	19	16	4	unident				
Glennies Cr 3: 10 to 20	64	13	silcrete	y	FLAKE TOOL	26	20	14	broken	cuspate ret			
Glennies Cr 3: 10 to 20	64	14	silcrete	n	M'BLADE CORE	42	41	22	whole	trial			
Glennies Cr 3: 10 to 20	64	15	silcrete	y	proximal fragment	18	10	4	blade	unifacial	modified		
Glennies Cr 3: 10 to 20	64	16	silcrete	y	proximal fragment	30	21	5	blade	cortex platform	modified		fresh break
Glennies Cr 3: 10 to 20	64	17	silcrete	n	distal fragment	13	11	3	unident			feather	
Glennies Cr 3: 10 to 20	64	18	silcrete	y	distal fragment	34	24	6	unident			feather	
Glennies Cr 3: 10 to 20	64	19	silcrete	y	flake fragment	27	22	8	unident				
Glennies Cr 3: 10 to 20	64	20	silcrete	n	angular fragment	34	34	23	unident				
Glennies Cr 3: 10 to 20	64	21	silcrete	n	angular fragment	22	17	9	unident				
Glennies Cr 3: 20 to 30	64	1	quartz	n	proximal fragment	13	12	4	unident	bifacial	unmodified		road breaks
Glennies Cr 3: 20 to 30	64	2	quartz	n	flake fragment	15	9	4	unident				road breaks
Glennies Cr 3: 20 to 30	64	3	quartz	n	flake fragment	13	12	9	unident				road breaks
Glennies Cr 3: 20 to 30	64	4	quartz	n	angular fragment	17	10	3	unident				road breaks
Glennies Cr 3: 20 to 30	64	5	quartz	y	BIPOLAR CORE	22	16	12	whole	battering both ends			
Glennies Cr 3: 20 to 30	64	6	tuff	n	split cone frag	16	9	8	unident	unifacial	unmodified		proximal fragment
Glennies Cr 3: 20 to 30	64	7	silcrete	y	distal fragment	19	17	5	unident			feather	
Glennies Cr 3: 20 to 30	64	8	silcrete	y	angular fragment	28	21	22	unident				burnt
Glennies Cr 3: 20 to 30	64	9	silcrete	n	angular fragment	25	18	5	unident				burnt
Glennies Cr 3: 20 to 30	64	10	silcrete	y	angular fragment	23	18	6	unident				
Glennies Cr 3: 20 to 30	64	11	silcrete	n	angular fragment	25	19	15	unident				burnt
Glennies Cr 3: 20 to 30	64	12	tuff	n	flake fragment	16	12	5	unident				
Glennies Cr 3: 20 to 30	64	13	silcrete	n	proximal fragment	20	14	4	blade	bifacial	modified		
Glennies Cr 3: 20 to 30	64	14	tuff	n	complete flake	21	19	4	expanded	unifacial	modified	feather	
Glennies Cr 3: 30 to 40	64	1	tuff	n	complete flake	22	13	5	intermed	unifacial	modified	feather	
Glennies Cr 3: 30 to 40	64	2	silcrete	n	flake fragment	24	16	4	unident				road breaks
Glennies Cr 3: 30 to 40	64	3	silcrete	y	split cone frag	33	33	10	unident	cortex platform	unmodified		proximal fragment
Glennies Cr 3: 30 to 40	64	4	tuff	n	complete flake	15	14	9	expanded	unifacial	unmodified	plunge	
Glennies Cr 3: 30 to 40	64	5	tuff	y	complete flake	31	14	5	blade	unifacial	unmodified	feather	

Glennies Cr 3: 30 to 40	64	6	tuff	y	proximal fragment	19	14	5	unident	cortex platform	unmodified		
Glennies Cr 3: 40 to 50	64	1	tuff	n	proximal fragment	26	23	9	unident	bifacial	modified		
Glennies Cr 3: 40 to 50	64	2	tuff	n	flake fragment	19	19	4	unident				
Glennies Cr 3: 40 to 50	64	3	tuff	y	distal fragment	39	33	16	unident			plunge	
Glennies Cr 3: 50 to 60	64	1	tuff	n	complete flake	58	25	12	blade	bifacial	unmodified	feather	
Glennies Cr 3: 50 to 60	64	2	silcrete	y	distal fragment	28	22	9	unident			feather	
Glennies Cr 3: 50 to 60	64	3	silcrete	n	proximal fragment	13	11	4	blade	unifacial	unmodified		
Glennies Cr 3: 50 to 60	64	4	tuff	n	proximal fragment	28	18	8	unident	bifacial	modified		
Glennies Cr 3: 50 to 60	64	5	tuff	y	proximal fragment	29	29	7	unident	cortex platform	unmodified		
Glennies Cr 3: 50 to 60	64	6	tuff	y	FLAKE TOOL	61	48	26	whole	1 scalar retouch	2 scalar retouch		
Glennies Cr 3: 60 to 70	64	1	tuff	y	distal fragment	20	18	7	unident			plunge	
Glennies Cr 3: 70 to 80	64	1	tuff	y	M'BLADE CORE	39	31	17	whole	burin blade			
Glennies Cr 3: 80 to 90	64	1	tuff	n	M'BLADE CORE	29	28	14	whole	rotated			
Glennies Cr 3: 80 to 90	64	2	tuff	n	complete flake	19	16	5	expanded	unifacial	unmodified	hinge	
Glennies Cr 3: 80 to 90	64	3	tuff	y	complete flake	54	41	10	intermed	crushed platform		feather	
Glennies Cr 3: 90 to 100	64	1	quartzite	y	BIPOLAR CORE	36	25	13	whole				
Glennies Cr 3: 90 to 100	64	2	silcrete	y	split cone frag	64	50	17	expanded	cortex platform	unmodified	feather	
Glennies Cr 3: 90 to 100	64	3	tuff	n	complete flake	23	16	7	intermed	unifacial	unmodified	hinge	
Glennies Cr 3: 90 to 100	64	4	tuff	n	angular fragment	16	15	7	unident				
Glennies Cr 3: 90 to 100	64	5	tuff	n	complete flake	33	21	12		crushed platform		plunge	plat on distal end
Glennies Cr 3: 90 to 100	64	6	tuff	y	PROD CORE	42	37	34	whole	unifacial			
Glennies Cr 3: 90 to 100	64	7	tuff	n	distal fragment	56	29	13	unident			plunge	fresh break
Glennies Cr 3: 90 to 100	64	8	tuff	n	complete flake	22	14	9	expanded	unifacial	modified	hinge	
Glennies Cr 3: 90 to 100	64	9	tuff	y	angular fragment	34	28	28	unident				fresh break
Glennies Cr 3: 90 to 100	64	10	tuff	n	complete flake	25	23	11	intermed	unifacial	unmodified	feather	
Glennies Cr 3: 90 to 100	64	11	tuff	n	M'BLADE CORE	18	14	10	broken				
Glennies Cr 3: 90 to 100	64	12	tuff	y	complete flake	22	14	7	expanded	cortex platform	unmodified	hinge	
Glennies Cr 3: 90 to 100	64	13	tuff	n	angular fragment	32	21	12	unident				
Glennies Cr 3: 90 to 100	64	14	silcrete	n	flake fragment	28	16	8	unident				
Glennies Cr 3: 115 to 120	64	1	tuff	n	FLAKE TOOL	39	25	14	whole	use-wear			
Glennies Cr 3: 115 to 120	64	2	tuff	n	complete flake	52	31	19	intermed	bifacial	modified	plunge	
Glennies Cr 3: 115 to 120	64	3	silcrete	y	complete flake	35	17	11	expanded	cortex platform	modified	feather	
Glennies Cr 3: 115 to 120	64	4	tuff	y	complete flake	52	32	10	expanded	unifacial	unmodified	hinge	
Glennies Cr 3: 120 to 130	64	1	tuff	y	complete flake	19	11	6	intermed	unifacial	unmodified	hinge	
Glennies Cr 3: 120 to 130	64	2	tuff	n	M'BLADE CORE	41	24	10	whole	burin blade			

Glennies Cr 3: 120 to 130	64	3	silcrete	y	PROD CORE	70	46	46	whole	uniplatform			
Glennies Cr 3: 120 to 130	64	4	tuff	n	complete flake	28	27	13	expanded	unifacial	unmodified	feather	
Glennies Cr 3: 120 to 130	64	5	silcrete	n	M'BLADE CORE	42	39	22	whole	trial			
Glennies Cr 3: 130 to 140	64	1	silcrete	n	M'BLADE CORE	47	25	14	broken				
Glennies Cr 3: 130 to 140	64	2	tuff	y	complete flake	44	31	19	expanded	cortex platform	modified	feather	
Glennies Cr 3: 140 to 150	64	1	tuff	n	split cone frag	33	19	12	intermed	unifacial	modified	feather	
Glennies Cr 3: 140 to 150	64	2	tuff	y	complete flake	35	29	13	intermed	cortex platform	modified	feather	
Glennies Cr 3: 140 to 150	64	3	tuff	n	complete flake	33	22	16	intermed	unifacial	unmodified	feather	
Glennies Cr 3: 140 to 150	64	4	tuff	n	complete flake	20	18	8	expanded	unifacial	unmodified	hinge	
Glennies Cr 3: 140 to 150	64	5	silcrete	y	angular fragment	33	20	12	unident				
Glennies Cr 3: 140 to 150	64	6	tuff	y	complete flake	31	23	9	intermed	bifacial	modified	feather	
Glennies Cr 3: lower impl	64	1	tuff	y	NUCLEAR TOOL	76	57	18	whole	unifacial			
Glennies Cr 3: lower impl	64	2	tuff	y	FLAKE TOOL	56	28	15	whole	1 step	2 scalar retouch		
Glennies Cr 3: lower impl	64	3	porcelanite	n	FLAKE TOOL	32	18	15	broken	step			
G Cr 3 est 20 more artefacts													
G Cr 4 w/s, ctx = 9	65	1	acid vol		distal/complete??	63	35	13					
Glennies Cr 4 W/S	65	2	acid vol		dist	73	51	9					
Glennies Cr 4 W/S	65	3	acid vol		dist	41	30	8					
Glennies Cr 4 W/S	65	4	acid vol		cpl?	52	43	12					
Glennies Cr 4 W/S	65	5	acid vol		dist?	67	48	13					
Glennies Cr 4 W/S	65	6	acid vol		fk frag	37	28	9					
Glennies Cr 4 W/S	65	7	acid vol		core?ang frag	93	73	63					
Glennies Cr 4 W/S	65	8	acid vol		core?ang frag	76	52	37					
Glennies Cr 4 W/S	65	9	acid vol		N TOOL	123	104	49	use-wear				
Glennies Cr 4 W/S	65	10	acid vol		FLAKE TOOL	84	76	19	cuspate				
Glennies Cr 4 W/S	65	11	acid vol		ang frag	28	17	10					
Glennies Cr 4 W/S	65	12	acid vol		cpl?	50	34	10					
Glennies Cr 4 W/S	65	13	acid vol		fl frag	23	18	5					
Glennies Cr 4 W/S	65	14	acid vol		fl frag	21	21	4					
Glennies Cr 4 W/S	65	15	acid vol		fl frag	19	11	6					
G Cr 4, est 10 more artefacts	65												
	66	1	tuff	n	FLAKE TOOL	52	39	14	whole	scalar retouch			
	66	2	silcrete	n	complete flake	35	26	17	expanded	unifacial	modified	feather	
	66	3	tuff	n	complete flake	25	11	5	intermed	bifacial	modified	feather	
	66	4	tuff	n	flake fragment	18	6	2	unident				

Glennies Bluff	67	1	tuff	n	complete flake	18	10	3	blade	crushed platform		feather	
Glennies Bluff	67	2	tuff	n	flake fragment	11	10	2	blade				
Glennies Bluff	67	3	tuff	n	FLAKE TOOL	30	11	8	broken	scalar retouch			
Glennies Bluff	67	4	tuff	n	complete flake	34	18	8	intermed	unifacial	unmodified	feather	
Glennies Bluff	67	5	tuff	y	FLAKE TOOL	44	39	15	whole	scalar retouch			
Glennies Bluff	67	6	tuff	n	FLAKE TOOL	43	21	9	broken	step			
Glennies Bluff	67	7	silcrete	n	complete flake	13	11	2	expanded	unifacial	unmodified	feather	
Glennies Bluff	67	8	silcrete	y	complete flake	44	27	17	intermed	bifacial	unmodified	plunge	
	68	1	tuff	y	split cone frag	34	28	18	unident	unifacial	unmodified		proximal fragment
	69	1	tuff	n	flake fragment	23	21	8	unident				
	69	2	tuff	n	complete flake	32	29	8	expanded	crushed platform	hinge		
	70	1	silcrete	y	proximal fragment	25	17	11	unident	cortex platform	unmodified		
	71	1	hornfels?	n	complete flake	47	37	10	intermed	unifacial	unmodified	feather	
	71	2	silcrete	n	angular fragment	18	16	9	unident				
	71	3	tuff	n	complete flake	14	12	2	expanded	bifacial	modified	feather	
	71	4	silcrete	n	angular fragment	10	9	3	unident				
	72	1	tuff	n	complete flake	10	10	2	intermed	unifacial	unmodified	feather	
	73	1	tuff	y	distal fragment	29	29	4	unident			feather	
	73	2	tuff	y	flake fragment	21	14	6	unident				
	74	1	silcrete	n	PROD CORE	53	42	29	whole	multiplat			
	74	2	quartzite	y	FLAKE TOOL	82	80	29	whole	semi-discoidal		cuspate ret	
	74	3	silcrete	n	complete flake	24	8	4	blade	crushed platform		feather	
	74	4	quartzite	y	NUCLEAR TOOL	86	65	23	whole	unifacial			
	74	5	acid vol	y	split cone frag	46	29	9	intermed	unifacial	unmodified	plunge	
	74	6	silcrete	n	angular fragment	17	14	5	unident				
	74	7	tuff	n	angular fragment	17	11	6	unident				fresh break
	74	8	tuff	n	flake fragment	17	16	4	blade				fresh break
	74	9	tuff	y	distal fragment	45	28	12	unident			plunge	burnt
	74	10	tuff	y	distal fragment	23	16	10	unident			plunge	
Glennies Cr Dairy Sheds	75	1	tuff	n	complete flake	30	15	8	intermed				
	75	2	tuff	y	complete flake	36	21	5	intermed				
	75	3	tuff	y	complete flake	29	22	7	intermed				
	75	4	silcrete	n	flake fragment	14	12	4	blade				
	75	5	tuff	y	complete flake	54	19	6	expanded	cortex platform	modified	hinge	
	75	6	silcrete	n	M'BLADE CORE	46	34	20	whole	trial	on angular fragment		

	75	7	silcrete	n	M'BLADE CORE	53	44	26	whole	trial	on angular fragment		
	75	8	tuff	n	complete flake	39	34	10	expanded	unifacial	modified	hinge	
	75	9	tuff	y	distal fragment	13	13	4	blade			plunge	
	75	10	basalt	n	axe preform	116	77	37	early stage		thinning a large flake		
	75	11	tuff	y	complete flake	39	26	12	intermed	cortex platform	modified	feather	
	75	12	tuff	n	complete flake	46	35	11	expanded	bifacial	modified	feather	
	75	13	tuff	y	complete flake	44	44	22	expanded	cortex platform	unmodified	plunge	
	76	1	tuff	n	flake fragment	17	13	9	unident				
	76	2	quartz	n	angular fragment	17	12	8	unident				
	76	3	tuff	y	angular fragment	11	10	5	unident				
	76	4	tuff	y	complete flake	18	13	4	intermed	cortex platform	unmodified	feather	
	77	1	tuff	y	complete flake	50	31	14	intermed	bifacial	modified	feather	
	77	2	tuff	n	proximal fragment	24	16	5	unident	bifacial	unmodified		
	78	1	tuff	y	complete flake	39	32	12	expanded	bifacial	unmodified	plunge	
	78	2	tuff	y	proximal fragment	35	22	10	unident	unifacial	modified		fresh break
	79	1	silcrete	y	complete flake	22	20	8	intermed	unifacial	unmodified	feather	
	79	2	tuff	n	flake fragment	16	11	6	unident				
	80	1	tuff	n	distal fragmental	40	29	11	unident			feather	
	80	2	tuff	n	complete flake	25	10	7	intermed	unifacial	unmodified	plunge	
	81	1	tuff	n	distal fragmental	22	14	6	unident			feather	
	82	1	silcrete	n	proximal fragment	25	24	10	unident	unifacial	modified		
	82	2	acid vol	y	split cone frag	17	11	5	expanded	unifacial	modified	plunge	
	82	3	tuff	n	complete flake	10	6	3	intermed	crushed platform		feather	
	82	4	orange chert	y	angular fragment	10	5	3	unident				
	82	5	tuff	n	flake fragment	13	8	2	unident				
	82	6	quartzite	n	flake fragment	20	15	8	unident				
	82	7	quartz	n	complete flake	10	4	2	intermed	unifacial	modified	feather	
	82	8	acid vol	n	flake fragment	18	13	3	unident				
	82	9	silcrete	n	angular fragment	12	4	2	unident				
	82	10	tuff	n	flake fragment	11	5	3	unident				
	82	11	silcrete	y	flake fragment	10	7	3	unident				
	83	1	tuff	n	split cone frag	38	23	6	expanded	unifacial	modified	plunge	
High Ridge W/S Site	84	1	grey tuff	n	proximal fragment	11	10	3	blade	bifacial	faceted		fresh break
High Ridge W/S Site	84	2	grey tuff	n	BACKED BLADE	23	14	4	whole	geometric	finished		
High Ridge W/S Site	84	3	grey tuff	n	complete flake	14	14	2	blade	unifacial	faceted	hinge	

High Ridge W/S Site	84	4	grey tuff	n	split cone frag	18	7	2		unifacial	unmodified	feather	
High Ridge W/S Site	84	5	grey tuff	n	distal fragment	25	15	3				plunge	fresh break
High Ridge W/S Site	84	6	grey tuff	n	flake fragment	17	15	6					
High Ridge W/S Site:	84	7	grey tuff	n	flake fragment	13	10	3					fresh break
High Ridge W/S Site new	84	8	grey tuff	n	F TOOL	29	17	12	whole	u-w	made on dist plunge		
High Ridge W/S Site new	84	9	grey tuff	n	fl frag	16	13	3	blade				
High Ridge W/S Site new	84	10	grey tuff	n	cpl	14	12	2	intermed	crushed		feather	
High Ridge W/S Site new	84	11	grey tuff	n	ang frag	10	7	5					burnt
High Ridge W/S Site new	84	12	grey tuff	n	cpl	42	29	6	intermed	bifacial	modif	hinge	
High Ridge W/S Site new	84	13	grey tuff	n	fl frag	10	9	4	inid				
High Ridge W/S Site new	84	14	grey tuff	n	cpl	11	6	3	expand	bifacial	modified	feather	
High Ridge W/S Site new	84	15	grey tuff	n	dist	10	6	1	blade			feather	
High Ridge W/S Site new	84	16	grey tuff	n	ang frag	15	6	2					
High Ridge W/S Site	84	1	tuff	y	flake fragment	16	14	3					fresh break
High Ridge W/S Site	84	2	silcrete	y	M'BLADE CORE	41	41	30	whole	faceted prismatic	converted from bifacial blade core		
High Ridge W/S Site	84	3	tuff	y	flake fragment	15	13	5					
High Ridge W/S Site	84	4	tuff	y	prox	24	17	7	unid	cts pat	unmodif		
High Ridge W/S Site	84	5	tuff	n	GEOM	20	14	5	broken	finished			fresh break
High Ridge W/S Site	84	6	tuff	n	fl frag	11	8	5					
	85	1	tuff	y	flake fragment	18	13	5	unident				
	86	1	tuff	n	flake fragment	35	19	11	unident				.
Oxbow Trib Site W/S star	87	1	yelo tuff	y	distal fragment	19	14	3				plunge	fresh break
Creek W/S Site	87	2	yelo tuff	y	proximal fragment	12	5	2	blade	unifacial	unmodified		
Creek W/S Site	87	3	yelo tuff	n	proximal fragment	16	10	5	blade	unifacial	unmodified		
Creek W/S Site	87	4	yelo tuff	n	flake fragment	14	10	4					
Oxbow Trib Site W/S end	87	5	yelo tuff	y	complete flake	35	27	7	intermed	cortex platform	modified	hinge	
Oxbow Trib Site	87	1	silcrete	n	complete flake	22	20	4	expanded	unifacial	unmodified	feather	
Creek W/S Site	87	2	silcrete	n	split cone frag	25	12	8	intermed	unifacial	unmodified	hinge	
Creek W/S Site	87	3	tuff	n	M'BLADE CORE	20	15	9	broken				
Creek W/S Site	87	4	tuff	n	M'BLADE CORE	31	30	13	whole	burin blade	3 platforms		
Creek W/S Site	87	5	tuff	n	complete flake	37	18	3	blade	unifacial	modified	feather	
Creek W/S Site	87	6	tuff	n	complete flake	16	8	1	intermed	crushed platform		hinge	
Creek W/S Site	87	7	silcrete	y	distal fragment	20	18	7				plunge	
Creek W/S Site	87	8	tuff	n	distal fragment	14	12	3				hinge	fresh break
Creek W/S Site	87	9	tuff	y	distal fragment	17	15	3				plunge	fresh break

	88	1	tuff	n	distal fragment	20	13	5	unident			feather	
	89	1	silcrete	n	flake fragment	43	32	10	unident				
	90	1	tuff	y	distal fragment	49	43	18	unident			plunge	plat on distal end
	91	1	tuff	n	distal fragment	13	7	2	blade				old 98
	91	2	tuff	y	flake fragment	21	21	5	unident				
G Cr 5 p-line yel tuff W/S start	92	1	yellow tuff	n	complete flake	29	24	8	expanded	cortex platform	modified	feather	
G Cr 5 p-line yel tuff W/S	92	2	yellow tuff	y	complete flake	45	24	14	expanded	unifacial	unmodified	plunge	
G Cr 5 p-line yel tuff W/S	92	3	yellow tuff	n	FLAKE TOOL	30	28	8	whole	step			
G Cr 5 p-line yel tuff W/S	92	4	yellow tuff	y	complete flake	21	8	3	blade	unifacial	unmodified	feather	
G Cr 5 p-line yel tuff W/S	92	5	yellow tuff	y	complete flake	34	11	5	blade	unifacial	modified	plunge	
G Cr 5 p-line yel tuff W/S	92	6	yellow tuff	n	complete flake	39	37	9	expanded	cortex platform	use-wear plat	feather	
G Cr 5 p-line yel tuff W/S	92	7	yellow tuff	y	FLAKE TOOL	30	27	12	whole	projection	discoidal	use-wear tip	
G Cr 5 p-line yel tuff W/S	92	8	yellow tuff	n	FLAKE TOOL	37	30	9	whole	use-wear			
G Cr 5 p-line yel tuff W/S	92	9	yellow tuff	n	distal fragment	23	21	4				feather	
G Cr 5 p-line yel tuff W/S	92	10	yellow tuff	n	FLAKE TOOL	21	17	5	whole	scalar retouch			
G Cr 5 p-line yel tuff W/S	92	11	yellow tuff	n	FLAKE TOOL	37	32	9	whole	1 concave	2 concave	pressure scalar retouch	
G Cr 5 p-line yel tuff W/S	92	12	yellow tuff	n	FLAKE TOOL	39	38	8	whole	use-wear		fresh damage	
G Cr 5 p-line yel tuff W/S	92	13	yellow tuff	y	complete flake	15	10	3	expanded	unifacial	unmodified	feather	
G Cr 5 p-line yel tuff W/S	92	14	yellow tuff	n	FLAKE TOOL	24	20	11	whole	concave	step ret		
G Cr 5 p-line yel tuff W/S	92	15	yellow tuff	n	proximal fragment	23	19	6		unifacial	modified		
G Cr 5 p-line yel tuff W/S	92	16	yellow tuff	n	flake fragment	20	14	5					
G Cr 5 p-line yel tuff W/S	92	17	yellow tuff	n	complete flake	21	18	4	intermed	unifacial	use-wear plat	hinge	
G Cr 5 p-line yel tuff W/S	92	18	yellow tuff	y	complete flake	30	21	17	expanded	cortex platform	unmodified	feather	
G Cr 5 p-line yel tuff W/S	92	19	yellow tuff	y	FLAKE TOOL	51	27	15	whole	projection	made by concave scalar ret		twist use-wear
G Cr 5 p-line yel tuff W/S	92	20	yellow tuff	n	FLAKE TOOL	34	32	11	whole	projection	biconcave	tip snap by use	
G Cr 5 p-line yel tuff W/S	92	21	yellow tuff	n	FLAKE TOOL	27	24	7	whole	use-wear	all margins		
G Cr 5 p-line yel tuff W/S	92	22	yellow tuff	y	flake fragment	16	14	3					
G Cr 5 p-line yel tuff W/S	92	23	yellow tuff	n	distal fragment	13	13	3				feather	
G Cr 5 p-line yel tuff W/S	92	24	yellow tuff	y	proximal fragment	22	16	8		unifacial	unmodified		
G Cr 5 p-line yel tuff W/S	92	25	yellow tuff	n	complete flake	34	31	7	intermed	unifacial	umnodified	feather	
G Cr 5 p-line yel tuff W/S	92	26	yellow tuff	n	FLAKE TOOL	54	30	7	whole	projection	fine use-wear on tip		
G Cr 5 p-line yel tuff W/S	92	27	yellow tuff	y	FLAKE TOOL	15	15	4	broken	scalar retouch			fresh break
G Cr 5 p-line yel tuff W/S	92	28	yellow tuff	n	distal fragment	14	11	3				feather	fresh break
G Cr 5 p-line yel tuff W/S	92	29	yellow tuff	n	FLAKE TOOL	19	9	4	broken	scalar retouch			fresh break
G Cr 5 p-line yel tuff W/S	92	30	yellow tuff	y	FLAKE TOOL	20	19	4	whole	microcvx	discoidal	pressure ret	step u-w all margs

G Cr 5 p-line yel tuff W/S	92	31	yellow tuff	n	proximal fragment	15	15	5	blade	unifacial	faceted		
G Cr 5 p-line yel tuff W/S	92	32	yellow tuff	n	FLAKE TOOL	27	21	12	whole	use-wear			
G Cr 5 p-line yel tuff W/S	92	33	yellow tuff	n	FLAKE TOOL	20	15	5	whole	microcvx			
G Cr 5 p-line yel tuff W/S	92	34	yellow tuff	n	FLAKE TOOL	18	12	4	whole	scalar retouch 3 edge	bone saw wear		
G Cr 5 p-line yel tuff W/S	92	35	yellow tuff	n	complete flake	21	15	4	intermed	unifacial	modified	plunge	
G Cr 5 p-line yel tuff W/S	92	36	yellow tuff	n	FLAKE TOOL	12	12	2	whole	projection	use-wear	broken tip	
G Cr 5 p-line yel tuff W/S	92	37	yellow tuff	n	flake fragment	10	7	3					
G Cr 5 p-line yel tuff W/S end	92	38	yellow tuff	n	proximal fragment	11	10	3		bifacial	modified		
G Cr 5 p-line Site	92	1	porcelanite	n	ELOUERA	24	14	8	whole	rounded usewear			
G Cr 5 p-line Site	92	2	tuff	y	complete flake	47	32	12	intermed	unifacial	unmodified	feather	
G Cr 5 p-line Site	92	3	tuff	y	complete flake	23	12	10	expanded	cortex platform	modified	plunge	
G Cr 5 p-line Site	92	4	tuff	n	flake fragment	21	17	5					
G Cr 5 p-line Site	92	5	tuff	n	proximal fragment	21	13	4		unifacial	unmodified		
G Cr 5 p-line Site	92	6	tuff	y	complete flake	44	25	4	intermed	unifacial	modified	feather	
G Cr 5 p-line Site	92	7	tuff	n	proximal fragment	28	13	7	blade	unifacial	unmodified		
G Cr 5 p-line Site	92	8	tuff	n	FLAKE TOOL	22	18	8	whole	double proj	microcvx?		
G Cr 5 p-line Site	92	9	tuff	y	flake fragment	23	19	10					
G Cr 5 p-line Site	92	10	tuff	n	flake fragment	11	9	4					
G Cr 5 p-line Site	92	11	tuff	y	complete flake	31	20	6	intermed	bifacial	unmodified	feather	
G Cr 5 p-line Site	92	12	tuff	y	complete flake	18	13	4	intermed	cortex platform	unmodified	feather	
G Cr 5 p-line Site	92	13	tuff	n	flake fragment	15	12	4					
G Cr 5 p-line Site	92	14	tuff	n	complete flake	26	24	13	expanded	unifacial	modified	feather	
G Cr 5 p-line Site	92	15	tuff	y	FLAKE TOOL	31	23	6	whole	scalar retouch	pressure		
G Cr 5 p-line Site	92	16	quartz	n	angular fragment	30	24	16					
G Cr 5 p-line Site	92	17	quartz	y	proximal fragment	21	18	4	blade				
G Cr 5 p-line Site	92	18	quartz	n	flake fragment	18	9	4					
G Cr 5 p-line Site	92	19	quartz	n	FLAKE TOOL	17	10	9	broken	scalar retouch			
G Cr 5 p-line Site	92	20	silcrete	n	angular fragment	21	14	3					
G Cr 5 p-line Site	92	21	silcrete	n	angular fragment	45	23	21					road damage
G Cr 5 p-line Site	92	22	silcrete	y	distal fragment	26	18	12				plunge	
G Cr 5 p-line Site	92	23	black chert	y	flake fragment	21	19	9					
	93	1	tuff	y	complete flake	21	12	8	intermed	bifacial	unmodified	plunge	
	93	2	silcrete	y	FLAKE TOOL	63	53	30	whole	1 cuspate ret	2 use-wear		
	93	3	silcrete	y	angular fragment	26	24	13	unident				
	93	4	silcrete	n	flake fragment	12	13	5	unident				

	93	5	silcrete	y	FLAKE TOOL	42	37	18	whole	cuspate ret	step		
	93	6	silcrete	y	flake fragment	32	17	6	unident				
	93	7	silcrete	y	angular fragment	24	15	12	unident				
	93	8	tuff	y	angular fragment	17	12	6	unident				
Hunter River slope site	94	1	tuff	n	distal	14	13	4	blade			feather	
	94	2	tuff	n	fl frag	21	16	5	blade				
	94	3	sil	n	ang frag	22	13	7					
	94	4	q'ite	n	ang frag	42	35	25					
	94	5	tuff	y	fl frag	28	25	9					
	94	7	tuff	y	proximal	19	16	4		ctx plat	unmod		fresh break
H R concrete tank site	95	1	tuff	y	N TOOL	80	64	35	whole	unifcial			
	95	2	quartz	y	fl frag	34	27	12					
	95	3	tuff	n	distal	31	31	11				plunge	fresh break
	95	4	sil	n	cpl	69	36	11	intermed	unifacial unmodif	father		
	95	5	quartz	y	proximal	29	22	7		ctx plat	unmodif		
	95	6	basalt	n	distal	28	19	7				feather	fresh break
	95	7	sil	n	fl frag	28	12	5					
	95	8	tuff	n	proximal	27	22	6		bifacial	unmodif		fresh break
	95	9	sil	n	fl frag	28	12	5					
	95	10	sil	n	fl frag	24	17	7					fresh break
	95	11	sil	n	fl frag	17	14	4	blade				.
	95	12	sil	y	fl frag	18	16	6					burnt
	95	13	sil	n	fl frag	18	11	5					
	95	14	sil	n	cpl	29	20	7	intermed	unifacial	unmodif	plunge	
	95	15	basalt	n	fl frag	27	18	4					
	95	16	pet wood	n	split cone	17	15	7	prox	unifacial	unmodif		
	95	17	sil	n	proximal	23	10	7		unifacial	faceted		fresh break
	95	18	basalt	n	ang frag	18	11	5					
	95	19	tuff	n	cpl	16	10	3	intermed	crushed		feather	
	95	20	tuff	n	proximal	14	8	3	blade	unifacial	modified		
	95	21	quartz	y	distal	18	10	5				feather	
	95	22	tuff	y	and frag	25	18	11					
	95	23	sil	n	ang frag	17	12	8					
	95	24	sil	n	fl frag	15	11	4					
	95	25	tuff	y	ang frag	13	11	5					

	95	26	sil	n	cpl	15	7	4	blade	unifacial	unmod	feather	
	95	27	basalt	n	cpl	93	51	10	expand	unifacial	unmod	feather	?axe thinning
	95	28	basalt	y	distal	74	45	16				plunge	
	95	29	tuff	n	cpl	38	31	10	intermed	unifacial	unmodif	plunge	
	95	30	tuff	n	F TOOL	34	18	7	whole	scalar ret	dors&vent	made on blad	fresh break
	95	31	tuff	n	distal	32	28	9				feather	
	95	32	tuff	n	cpl	22	21	10	expand	unifacial	unmodif	plunge	
	95	33	sil	n	fl frag	30	16	4	blade				
	95	34	tuff	y	cpl	28	18	6	intermed	unifacial	unmodif	hinge	
	95	35	basalt	n	fl frag	30	16	4					fresh break
	95	36	tuff	n	cpl	32	20	5	expand	unifacial	unmodif	feather	
	95	37	tuff	y	N TOOL	137	69	49	whole	unifacial	made on cobbel		
	95	38	sil	n	ang frag	30	23	16					
	95	39	tuff	n	fl frag	40	18	5					
	95	40	tuff	n	fl frag	20	14	3					fesh break
	95	41	tuff	n	cpl	21	13	7	intermed	unifacial	unmodif	hinge	
	95	42	sil	n	cpl	24	13	6	blade	unifacial	unmodified	feather	
	95	43	tuff	y	ang frag	16	16	7					
	95	44	tuff	n	fl frag	19	8	6					
	95	45	tuff	y	cpl	27	22	8	intermed	unifacial	unmodified	plunge	
	95	46	tuff	y	cpl	27	17	6	intermed	ctx plat	unmodif	hinge	.
	95	47	tuff	n	cpl	32	22	7	intermed	unifacial	modified	feather	
	95	48	pet wood	y	distal	54	41	18				plunge	fresh break
	95	49	basalt	n	cpl	45	34	14	intermed	unif	modified	feather	
	95	50	tuff	n	distal	24	23	10				feather	
	95	51	tuff	y	F TOOL	51	51	17	whole	serrate	step ret	cuspate ret	
	95	52	tuff	y	cpl	55	37	19	intermed	unifacial	modified	feather	crested dorsal
	95	53	sil	y	cpl	25	25	11	intermed	unifacial	unmodified	feather	
	95	54	tuff	n	ang frag	30	30	18					
5 Mar near NEHwy	96	1	quartz	n	complete flake	18	12	4	intermed	unifacial	unmodified	feather	
	97	1	quartz	n	complete flake	21	16	5	intermed	bifacial	modified	feather	
	97	2	tuff	n	complete flake	55	39	13	intermed	unifacial	modified	feather	
	97	3	tuff	n	flake fragment	18	11	6	unident				
Glennies Cr	98	1	s'stone	y	MILL SLAB	213	147	32	whole	single facet			
Glennies Cr anthill w/s	99	1	red sil	n	prox	27	11	4	blade	unifacial	faceted		

	99	2	red sil	n	prox	17	19	4		unifacial	faceted		
	99	3	red sil	n	dist	23	21	11				plunge	
	99	4	red sil	n	cpl	17	9	3	intermed	curshed		feather	
	99	5	red sil	n	fl frag	11	7	2					
	99	6	sil	n	fl flag	22	18	7					
	99	7	red sil	n	cpl	35	31	4	blade	unifacial	modified	feather	
	99	8	red sil	y	ang frag	26	18	4					potlidded
	99	9	red sil	n	fl frag	21	18	4	blade				
	99	10	tuff	n	cpl	28	13	9	intermed	unifacial	unmodif	feather	
	99	11	red sil	n	dist	27	16	4				feather	fresh break
	99	12	tuff	n	cpl	34	18	18	intermed	unifacial	unmodif	feather	
Glennies Cr Site	100	1	tuff	n	dist	22	16	7	unid			hinge	
	100	2	qaurtz	y	fl frag	32	21	7	unid				
	100	3	sil	n	prox	30	28	11	unid	unifacial	modified		
	100	4	tuff	n	F TOOL	40	37	17	whole	step ret	scal ret		
	100	5	tuff	n	dist	33	23	7	dist			feather	
	100	6	tuff	n	ang frag	35	13	11	unid				
	100	7	tuff	n	cpl	17	15	5	intermed	unifacial	unmod	feather	
	100	8	tuff	n	cpl	22	21	8	expand	unifac	modfied	feather	
Hunter River slope site	101	1	pet wood	n	CORE	55	55	43	whole	unifacial			
	101	2	pet wood	n	complete flake	54	30	12	intermed	unifacial	unmod	plune	
	101	3	pet wood	y	ang frag	34	32	15					
	101	4	pet wood	n	distal	27	24	8				feather	
	101	5	pet wood	n	ang frag	40	26	17					
	101	6	pet wool	n	proximal	34	16	11	unid	unifacial	modified		
	101	7	pet wood	n	complete flake	39	22	12	expand	bifacial	unmod	plunge	
	101	8	pet wood	n	fl frag	22	19	11					
	101	9	pet wood	n	complete flake	30	12	7	blade	bifacial	unmodif	plunnge	
	101	12	pet wood	n	distal	37	32	17				plunge	
	101	13	pet wood	n	complete flake	26	8	7	blade	unifacial	faceted	feather	
	101	14	petwood	y	fl frag	28	16	10	blade				
	101	15	pet wood	y	ang frag	32	19	10					
	101	16	pet wood	n	ang frag	25	22	10					potlid
	101	17	pet wood	n	fl frag	20	15	4					
	101	18	pet wood	n	ang frag	19	10	10					

	101	19	pet wood	n	complete flake	29	28	11	expand	unfiacial	unmodif		
	101	20	pet wood	y	ang frag	21	20	7					
	101	21	pet wood	n	ang frag	18	16	9					
	101	22	pet wood	n	ang frag	22	10	10					
	101	23	pet wood	n	fl frg	16	11	10	blade				
	101	24	pet wood	n	ang frag	18	12	9					
	101	25	pet wood	n	ang frag	29	16	10					
	101	26	pet wood	n	fl frag	16	10	6					
	101	27	tuff	y	CORE	33	30	27	broken				
	101	29	tuff	y	complete flake	18	13	4	expand	unifcial	modif	fether	
	101	29	tuff	n	fl frag	11	10	3					
	101	30	pet wood	n	fl frag	19	15	5					
	101	31	pet wood	y	ang frag	29	19	9					
	102	1	pet wood	n	P CORE	37	27	17	whole	multiplatform			
	102	2	sil	y	ang frag	57	43	18					burnt
	102	3	sil	y	ang frag	52	44	19					burnt
	102	4	sil	n	proximal	54	51	15	inld	unifacial	unmodif		burnt
	102	5	sil	n	MB CORE	33	27	24	whole	rotated			
	102	6	tuff	n	distal	36	33	9	unld			hinge	
	102	7	pet wood	n	biolar fl	33	30	19	crushed ends				
	102	8	sil	n	distal	22	18	8				plunge	
	102	9	sil	n	proximal	19	14	7	blade	unifacial	unmod		
	102	10	tuff	n	fl frag	21	11	9					
	102	11	pet wood	n	cpl	19	16	4	expnd	unifacial	unmod	feather	
	102	12	basalt	n	cpl	50	33	14	expand	unifacial	unmod	plunge	
	102	13	tuff	n	cpl	32	29	1	expand	unifacial	unmodif	plunge	
	102	14	tuff	y	cpl	59	43	24	intermed	ctx plat	unmod	feather	
	102	15	tuff	n	cpl	46	33	12	intermed	unifacial	unmod	feather	
	102	16	tuff	n	proximal	36	30	11		unifacial	unmodif		
	102	17	basalt	n	distal	30	30	6				feather	
	102	18	sil	n	F TOOL	36	13	13	broken	scalar ret			
	102	19	sil	n	cpl	35	21	7	inermed	unifacial	modified	plunge	
	102	20	tuff	y	cpl	38	22	9	intermed	ctx plat	unmodif	fether	
	102	21	sil	n	cpl	30	21	6	intermed	unifacial	modified	feather	

APPENDIX 4

ABORIGINAL COMMUNITY CORRESPONDENCE

Lower Wonnarua Tribal Council
31 ST ANDREWS STREET
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4th June 2002

Dr Dan Witter
Witter Archaeology
Sedgemere, R.D.3
Leeston
New Zealand
Phone: 001164-33242378
Fax : 001164-33242379

Dear Dan,
As to the Draft Archaeology report for the Ashton Coal Project for White Mining Limited by yourself and Alison I have reviewed this and have put this response to you.

Following the consultation with yourself and Mr Ian Callow of the WML.

We the LWTC agree with this report and all the recommendations that have been put forward in it, and that all recommendation are taken on by WML & NPWS.
Our main concern at this point of time is the large site along Glennies Creek and the fencing off of this site to protect the Artefacts from the cattle that is aggisted on the property.
We would like to have access to this site at all times while the mine is in operation for it is of High Significances to the Aboriginal Community for its Cultural & Heritage .

Regards,
Barry Anderson

LWTC Co ordinator

APPENDIX 5

GEOMORPHOLOGY

Groundtruth Consulting
(ABN: 66 179 449 249 BN NSW: 83452028)

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groundtruth@optusnet.com.au

13 May 2002

Geomorphology of the Ashton Coal Project site in relation to archaeology.

Camberwell, Hunter Valley NSW.

Draft.

Dr P.B. Mitchell prepared this report for White Mining Pty Ltd and covers additional work conducted under the NPWS Preliminary Research Permit (PRP) No 1328 issued on 23 April 2002. The work was undertaken to address issues listed in a letter from National Parks and Wildlife Service (NPWS) (ref 01/00608) to White Industries, dated 14/3/02 and matters discussed at a meeting held at NPWS Head Office on 21/3/02 between Ms M Koettig (NPWS), Mr A. Wells (HLA-Envirosciences), Mr I Callow (White Mining), Dr P.B. Mitchell (Groundtruth Consulting) and Dr D. Witter (Archaeologist).

The geomorphic investigation was intended to further elucidate valley fill stratigraphy in those parts of the lease that will be subject to disturbance by mining, including areas of land subsidence. The principle focus was to confirm the extent of previously identified geomorphic features (Mitchell 2002) that may contain buried land surfaces and to test for the presence or absence of buried surfaces by excavation of a number of backhoe pits along four approved cross valley transects.

The report elaborates on the contents of an earlier report by Groundtruth Consulting (Mitchell 2002) and can be read as a stand-alone document. Copies of the draft report are being circulated to all Aboriginal groups involved in the consultation process for comment before completion of a final document that will be integrated with an archaeological report being prepared by Dr Witter.

Background to the survey.

As part of the environmental impact assessment process White Mining Pty Ltd undertook Aboriginal site survey and a brief geomorphic investigation of the Ashton coal lease in the Hunter Valley. Archaeological site survey initially located 24 open sites within the valleys of Bowmans and Glennies Creeks (White Mining Pty Ltd 2001 EIS Appendix L) and several additional sites have been found during re-survey (Witter pers. com.).

The original brief for the geomorphic investigation (Mitchell 2002) sought to identify any areas of the lease that might contain palaeo-landscapes, which in turn might contain older Aboriginal sites. That report did identify one buried soil profile in an open pit on Glennies Creek (here referred to as Pit 15) and two small areas of high terrace on Bowmans Creek that were considered to be older than Holocene. No soil exposure was visible on the Bowmans Creek terrace and the recommendation was made that excavation of the proposed creek diversion channel through it should be monitored.

NPWS criticised the Groundtruth Consulting report (Mitchell 2002) on several matters (NPWS Reference 01/00608) that were discussed in the meeting referred to above. Consequently an application for a PRP for further work including excavation for geomorphic purposes was made to NPWS. Subsequent to that meeting consultation concerning the PRP was undertaken with Aboriginal groups in the Hunter Valley by Dr Witter with additional telephone calls and exchange of information by e-mail, fax and mail from Dr Mitchell.

All Aboriginal groups were advised of the date of the excavations and invited to attend the site at their convenience during the period of the fieldwork. Two groups were represented in the field observing the backhoe excavations. The groups and people consulted and to whom this draft report is being sent for comment are:

Upper Wonnarua Tribal Council. Mr Victor Perry, Ms Rhoda Perry and Mr Laurence Perry.

Wonnarua Local Aboriginal Land Council. Mr Noel Downs (Co-ordinator), Ms Bev Van Vliet, Ms Christine Mathews and Mr Rodney Mathews.

Lower Wonnarua Tribal Council, Mr Barry Anderson.

Wonnarua Nation, Mr Robert Lester.

Fieldwork was conducted between 29 April and 1 May. Fifteen backhoe pits were excavated on 30 May in the presence of Mr Barry Anderson of the Lower Wonnarua Tribal Council, Ms Christine Mathews and Mr Rodney Mathews of the Wonnarua Local Aboriginal Land Council.

Geomorphic aspects of central lowlands archaeology.

In a review of Hunter Valley archaeological site potential Dean-Jones and Mitchell (1993) concluded that most of the soil mantles in the central lowlands were relatively young (Holocene) and that they were constantly being reworked. They suggested that only four geomorphic circumstances seemed likely to provide conditions where older land surfaces might be preserved. These were:

1. Burial of a surface by advancing sand dunes.
2. Sequential burial by alluvial sediments on a floodplain, or in overlapped terrace surfaces.
3. Burial in alluvial sediment by switching channels on distal alluvial fans.
4. Burial at stream junctions where one stream had greater sediment supply rate than the other.

Since that review, further search by those authors and others has confirmed that buried soils do occur in some of these circumstances, but finding a palaeo-land surface and then finding evidence of Aboriginal occupation on that surface are two very different things. Chance plays a major role because exposures are almost always limited.

On the Ashton lease, land surface type 1 does not occur, as there are no sand dunes present. Type 2 was considered generally unlikely by Dean-Jones and Mitchell as most east-Australian terraces appear to be inset rather than overlapped and this has been confirmed on the lease during this investigation. Land surface types 3 and 4 have been identified elsewhere in the central lowlands of the Hunter Valley and these provided a focus for field inspection of the lease and the targets for backhoe excavation.

Within the central part of the Hunter Valley, alluvial and colluvial sequences have been found to contain buried land surfaces of probable Pleistocene age (Hughes 1999) and in at least one example at Nowlands Creek (Erskine 1991), these have contained Aboriginal archaeological material. Few of these buried landscape features are exposed in natural cuts. One has recently been recognised in an excavated trench between Swamp Creek and Bowmans Creek on the adjacent Glendell Coal Lease and is the subject of current investigation under PRP No 1325 by Umwelt Pty Ltd (Dean-Jones pers. comm.). This buried soil is not yet known to contain Aboriginal material and in fact the chances of finding archaeological sites preserved in these situations is limited as most such soils were low-lying, often swampy creek flats that are not usually favoured as camp sites. A similar buried soil was investigated on Ravensworth East mine site during 2001 but it did not contain any archaeological material (Mitchell 2000, 2001). However identification and subsequent archaeological testing of any such site is important and the research reported here set out to determine if any buried land surfaces could be found on the Ashton lease.

The lease covers a ridge of Permian sandstones and conglomerates separating the lower floodplains and terraces of Bowmans (Foy Brook) and Glennies (Fal Brook) Creeks near their junctions with the Hunter River. The highest point on the ridge is just northwest of Camberwell village at 116m and maximum relief is 56m. Both main streams are linked to short first and second order drainage lines that rise on the lease. Many of these are gullied and expose soils and sediments across the floodplains and the three terraces of the main creeks. Floodplains are up to 600m wide but high terrace remnants are much smaller. The lower reaches of both Bowmans Creek and Glennies Creek merge with the Hunter River floodplain on the lease and both valleys contain at least two terrace levels and remnants of a third. The lower reaches of the streams lie within the 1:100 flood level of the Hunter River and were known to have accumulated post-European sediments. Little is known of the valley floor and stream channel morphology prior to the large floods of the 1950s but it is known that the upper section of Bowmans Creek on the Ashton lease and parts of Glennies Creek have been highly modified by river management works about 30-40 years ago. Neither creek bank exposures previously examined, nor any geotechnical test pits excavated (White Mining EIS) have revealed any buried land surfaces or preserved soils and the only example known on the lease is that exposed in Pit15.

The original archaeological site survey of the lease (Appendix L of the EIS) used a morphometric classification of landform units to stratify the search. Seven landform units were identified and this classification was an effective non-genetic description of the lease. Soils on the lease are solodic texture contrast (duplex) profiles on the hill slopes and uniform or gradation loams to clays on the alluvial landforms. General descriptions of these soil types and details of geotechnical test pits and bore logs on the lease are provided in Appendices I, H and N of the EIS.

Appendix L of the EIS described 24 open sites recognised by the presence of stone flakes at the surface. Several sites were ranked as having high significance. The most important sites occurred in Landform Units 2 and 3, these being major creek lines and first and second order streams. No other archaeological remains were identified and the stone materials and patterns of distribution seemed typical of much of the central lowlands of the Hunter Valley. As noted above, additional survey has located new sites (Witter pers. comm.) including a very large open site adjacent to grinding grooves on sandstone on the right bank of Glennies Creek just outside the expected area of mining impact.

Objectives of the investigation.

The purpose of this additional investigation was to extend knowledge of the geomorphology of the Ashton Coal Project Site by amplifying the work reported by Mitchell (2002). There were four key objectives:

1. To more fully document the extent of post-European landscape disturbance of geomorphic features on the lease.
2. To further define valley floor landscapes that may contain buried land surfaces.
3. To test the identified landscapes by trial excavation using a backhoe to improve understanding of the stratigraphy of the valley fills and to confirm the presence or absence of buried surfaces.
4. To assess the significance of any sites where buried land surfaces were located and to make recommendations for further archaeological work as appropriate.

These objectives are addressed below.

Objective 1. To more fully document the extent of post-European landscape disturbance of geomorphic features on the lease.

Nineteenth century Portion Plans covering the Lease, and air photos taken in 1958, 1967, and 1974 were obtained from NSW Land and Property Information. An enlarged colour air photo taken in July 2001 was made available by White Mining Pty. Ltd. Earlier air photos taken in the 1930s were not available in Sydney.

Using the 2001 photo as a base map, all the data sources were compared and a composite image produced depicting areas of gross soil disturbance on the lease (Figure 1).

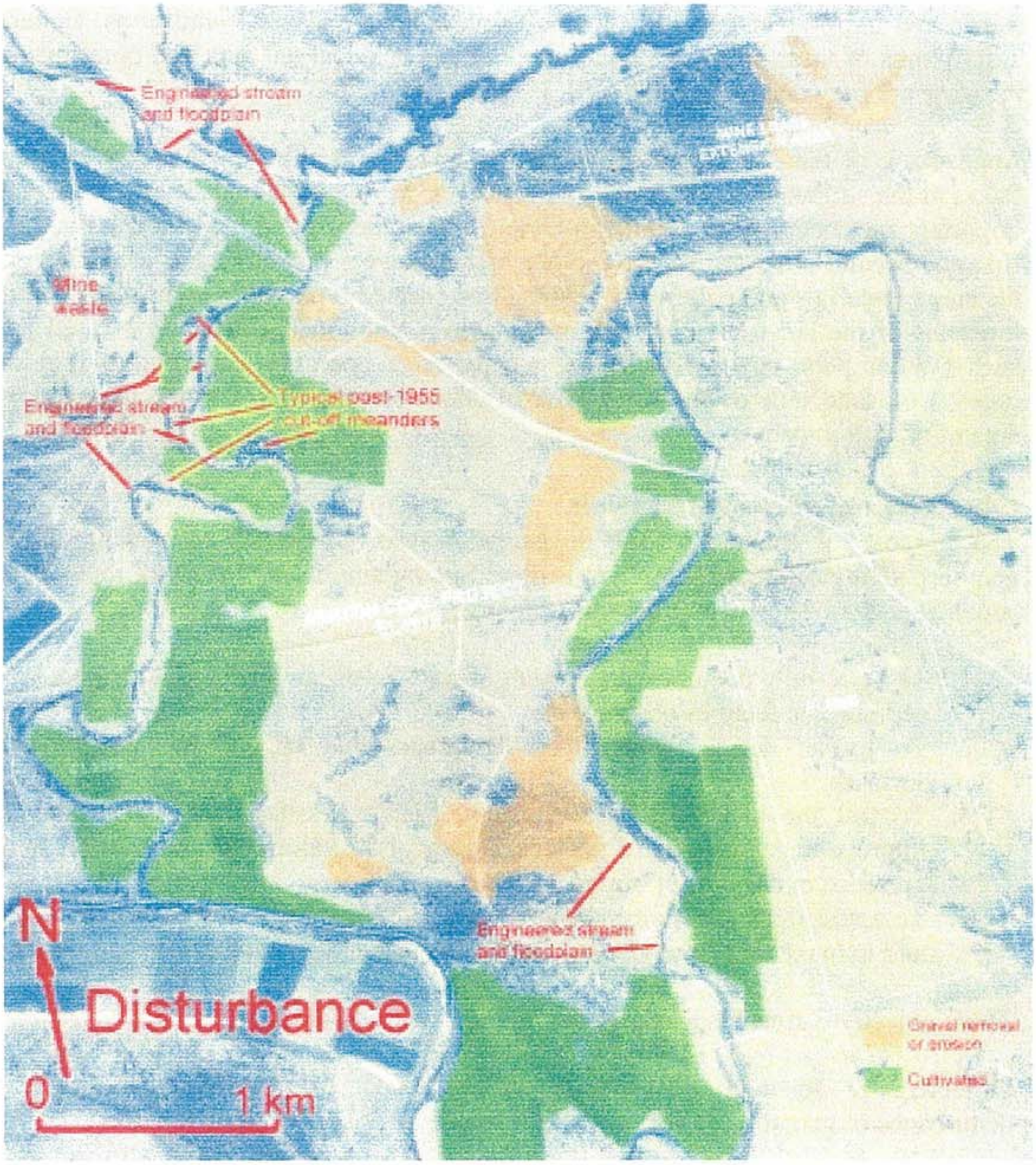

Figure 1. Composite image of areas of gross soil disturbance on the Ashton lease as interpreted from air photos dating back to 1958.

Three categories of disturbance were recognised:

1. Ground that had been cultivated at some time for crop production. This category does not include land that has been sown to improved pasture.

This category covers virtually all of the floodplains of the main streams and the Hunter River. Soil in these areas can be expected to be homogenized by ploughing to a depth of 25-30cm., it should be noted that the same areas were also subject to extensive sedimentation and possibly local sheet erosion during the 1955 flood (see below and Figure 2).

2. Ground from which soil had been removed by gravel stripping, or which has been subject to moderate to severe sheet or gully erosion.

The 1958 air photos show that hill slopes on the lease had very limited tree cover and that both sheet and gully erosion were widespread. The extent of the area mapped in Figure 1 is minimal as smaller gully side features and more diffuse sheet erosion now covered by vegetation has not all been included. Eroded areas and gravel scrapes do contain Aboriginal sites, but any archaeological work conducted on these areas will need to consider the degree of disturbance.

3. Stream channels and floodplains that have changed course in the past since 1955, or which are known to have been subject to engineering river 'improvement' works.

This category includes areas covered by sediments that were mainly deposited during the 1955 flood (Figure 2). The flood of that year was the largest recorded event in the Hunter River and its tributaries and its limits coincide approximately with the 1:100 flood event. Flood modelling for this event is reported in Appendix N of the EIS and the calculated limits of a flood of this magnitude have been compared with topography in the field to produce the flood inundation map of Figure 2. This map should not be relied on for flood planning as it is only intended to provide an indication of the extent of inundation and, in the context of this report, to define the floodplains and terraces and the extent of post-European (PE) flood deposited sediments.

Given the large vertical range of floodwater depth in the valleys, some standardisation is needed in defining terraces and floodplains. For the purposes of this report the low floodplain is here defined as the relatively bare gravel banks and steps within the channel and up to the limit of the 1:5 flood event. Its upper boundary is usually clear in the field as it marks a break between weed covered gravels and sands, and better pastures on soil. Above the low floodplain two terraces are evident, the lowest of which (first terrace) is apparently flooded by 1:20 events and the second terrace is flooded by 1:100 events. These terraces can be identified in the field because they carry a mantle of PE sediments but in any one creek section both terraces are not always present. In very limited areas remnants of a third (highest and oldest) terrace are found and these do not carry PE sediments and are beyond the reach of normal flooding.

Effectively the 1:100 floodplain extends beyond the active channels and low benches, across two poorly defined terraces, each 1 to 2m high and laps the edge of the third terrace where it is preserved against the bedrock hill slopes. The entire area of the 1:100 floodplain carries 10-30cm of PE sediments burying the pre-1955 land surface. No Aboriginal archaeological materials will be visible on this surface unless they have been exposed by erosion or turned up by cultivation. Aboriginal sites however may be preserved beneath this recent mantle but would be extremely difficult to locate without large area stripping.

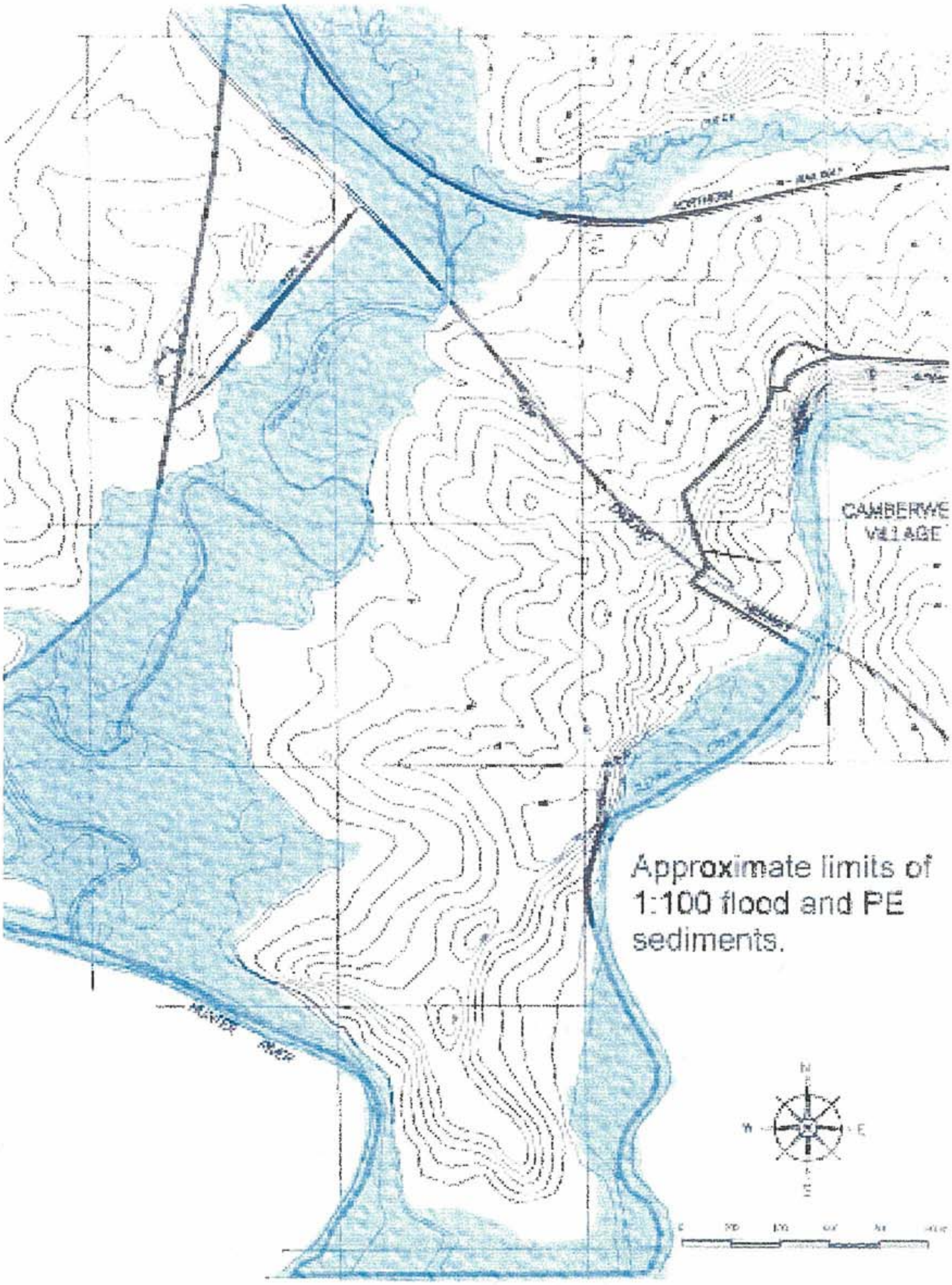

Figure 2. Approximate limits of the 1:100 flood, which covers the low floodplain, first and second terraces and which carries a blanket of PE sediments up to 50cm thick.

In seeking evidence of channel change both the Portion Plans and air photos were used. Unfortunately geographic data on the Portion Plans were not sufficiently accurate to reliably measure the extent of channel relocation since the nineteenth century. However changes are visible in the sequential air photos.

The entire width (up to 200m) of the low floodplains of Bowmans and Glennies Creek were stripped bare in the 1955 flood and at least nine sections of the pre-1955 channel on both creeks were cut off as the main channel straightened and incised. All these cut off features are evident on the 2001 air photo as abandoned meanders. Examples are marked on Figure 1, some of which may have been created by the 1970s engineering works.

River 'improvement' works were confirmed on the ground and appear to have been constructed in the late 1970s at about the time that the New England Highway was relocated and new bridges constructed. They consist of channels and low floodplains that were reshaped by earthmoving equipment and stabilised with willow planting at fixed intervals. Cut bank sections were protected from erosion by the installation of heavy wire mesh supported on steel cables strung from driven railway line (Figure 3).

Figure 3. An intact section of engineered channel in Bowmans Creek showing the railway line piles, cables and mesh holding a constructed gravel bank.

In later air photos it is evident that the low floodplain slowly stabilised and tree density (willows and river oak) increased but the main channels today are only quasi-stable. Upstream of the highway bridge on Bowmans Creek mid-channel gravel bars (Figure 4) are advancing, the 1970s stabilisation works are failing (Figure 5), and the gravel bed is subject to scour (Figure 6). In this section of Bowmans Creek a large wave of gravels is moving through the system and now reaches almost to the DLWC gauging station.

Figure 4. Large gravel bar advancing downstream in Bowmans Creek near the northwest edge of the lease. The bar is burying recent tree falls in its passage. The lobes at the front of the bar are 50cm high.

Figure 5. A section of engineering works that has failed where the face of second terrace is being eroded. Bowmans Creek upstream of the highway bridge. The surface of the terrace has nearly 60cm of PE sediment over silty clay alluvium.

Figure 6. Bed and part of the low floodplain of Bowmans Creek upstream of the highway bridge showing the effects of recent scour. Even small floods are moving pebbles up to 25cm in diameter as bed load.

Similar fluvial activity is evident in Glennies Creek with a large gravel bar lodged within dense river oak at the downstream end of a rock pool where grinding grooves on sandstone were found below water level. The water level in this pool has been raised in recent years by the gravel bar and as the bar moves downstream in future floods the level can be expected to fall.

The archaeological significance of all these fluvial changes are that any Aboriginal sites other than fixed features such as grinding grooves are unlikely to be visible anywhere on the low floodplains, and many have probably been destroyed by major changes in channel positions, bed scour or earthmoving. Sites on the first and second terraces will be buried by PE sediment.

Objective 2. To further define valley floor landscapes that may contain buried land surfaces.

Having defined the extent of recent disturbance (Figure 1) and the extent of the 1:100 flood events and the PE sediment mantle (Figure 2) it was then possible to identify the small areas of third terrace located between the sandstone hill slopes the flood limits (Figure 7). The previous survey had noted that these were of very limited extent and had identified three areas (Areas A, B and C on Figure 7) where this terrace level was present. Further inspection of the lease confirmed these locations except for Area A, opposite Brunkers Lane, as this turned out to be a low angle sandstone hillslope.

All creek bank and road cut exposures of soils and sediments were inspected and another review of the geotechnical test pit logs (Appendix N, EIS) was undertaken to focus further work but none of these sources gave any indication of the presence of buried land surfaces.

To test the possibility of the existence of buried surfaces four section lines were selected crossing the creek valleys from sandstone hill slopes and to include the highest terrace (Lines 1, 2 and 4) and/or a steep interface between hill slopes and valley floor (Line 3). Sections were selected to take advantage of existing exposures and to avoid known Aboriginal sites. In the case of Line 4 the newly recorded Aboriginal site was found to extend onto this alignment and the three pits excavated there were limited to a smaller area than originally intended.

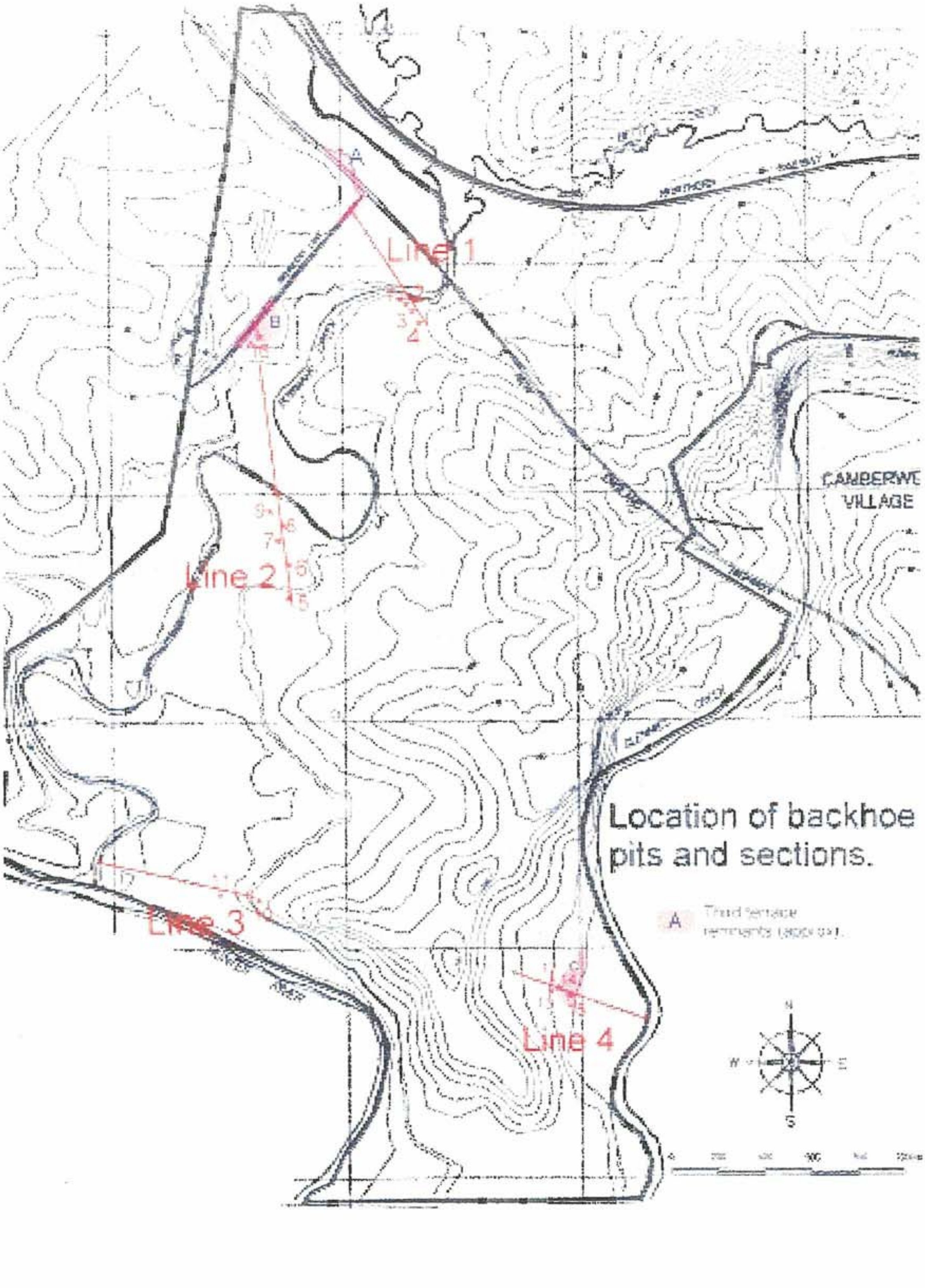

Figure 7. Location of third terrace remnants, backhoe pits and transect lines on the Ashton Lease. Note that Area A was subsequently found to be a bedrock slope not a terrace.

Objective 3. To test the identified landscapes by trial excavation to improve understanding of the stratigraphy of the valley fills and to confirm the presence or absence of buried surfaces.

In total 15 backhoe pits were excavated and backfilled on 30 May. This work was conducted in the presence of three Aboriginal observers (see above) and no Aboriginal artifacts were revealed in any test pit other than Pit 15 where they had previously been noted on the spoil heap (Mitchell 2002). No samples were taken. GPS locations and descriptions of the backhoe pits are presented in Appendix 1. Pit locations are shown on Figure 7 and summaries of the cross-valley stratigraphy are presented in Figures 8 to 11.

All the stratigraphic sections are similar and reveal a simple valley fill stratigraphy dominated by coarse creek sediments in the northern half of the lease grading to finer sediments that interface with Hunter River sands and loams in the southern half of the lease. The overall vertical and downstream sequence of sediments are fining cycles and there appears to be a consistent basal layer of coarse gravels above bedrock beneath most of the valley fill. No material was found that could be used for age dating but it is expected that third terrace sediments and basal gravels will be of Pleistocene age and all other sediments are expected to be Holocene or contemporary. Each section line is discussed below.

Line 1 - Pits 1 to 4.

Line 1 extended from a texture contrast soil developed on sandstone exposed in a road cutting in Brunkers Lane, across a second terrace and Bowmans Creek, through four backhoe pits and another second terrace to a sandstone hillslope (Figure 8).

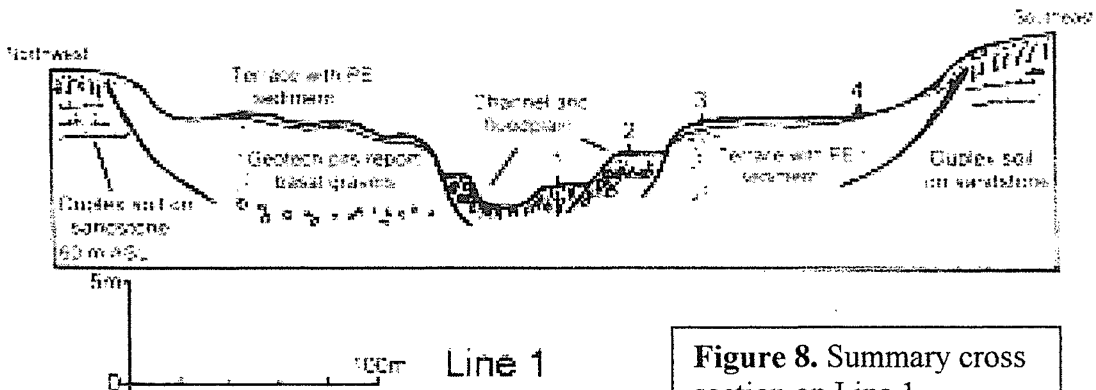

Figure 8. Summary cross section on Line 1 Bowmans Creek.

The low floodplain consisted of incoherent open gravels and sands that are subject to movement during floods. Geotechnical pits in the vicinity of this line report basal gravels beneath the second terraces at depths of 4 to5m. Both terraces had a mantle of PE sediments up to 45cm thick covering pre-1955 topsoils and the relationship between the terraces and the low flood benches appeared to be that the younger (lower) units were inset into the second terrace.

Line 2 - Pits 5 to 9 and Pit 16.

This long section was located some 900m downstream of Line 1 and was sited to sample the small remnant of third terrace near Brunkers Lane (Area B Figure 7). This area was identified by Mitchell (2002) as having some potential for the preservation of an old land surface and because it was on the alignment of the proposed Bowmans Creek diversion channel it was recommended that excavation of this channel should be monitored.

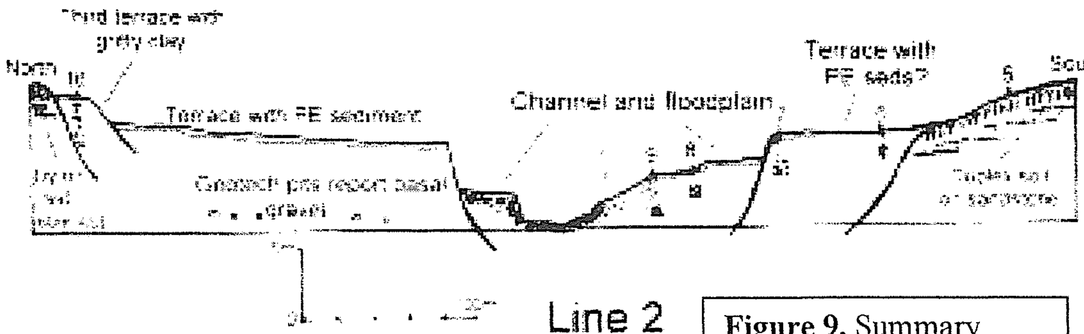

Figure 9. Summary cross section on Line 2 Bowmans Creek.

The geomorphology and stratigraphy of Line 2 (Figure 9) is essentially similar to Line 1. The modern channel and low floodplain is wider and its bedload gravels are finer. PE sediments blanket the higher benches of the low floodplain and the second terrace to a maximum observed thickness of 15cm and the bedrock hill slopes on either side of the valley carry a texture contrast soil profile. Pit 16 was excavated to 2.3m and contained a dark brown texture contrast profile at the surface with sparse soil carbonate nodules at 90-100cm depth. This soil profile lay over a brownish black gritty clay layer 90cm thick with a slight concentration of fine charcoal. Although the colour was suggestive of a buried soil no other pedological structures were present and the clear sedimentary relationship between this unit and material above indicated that it was simply finer, slightly organic sediment.

Both the second and third terraces were interpreted to have an inset relationship with one another and with the low floodplain units. Interpretation of this section was confirmed in a long excavated drain across the second terrace on the right bank of Bowmans Creek.

<u>Line 3 - Pits 10 and 11.</u>
Line 3 was located 1700m south of Line 2 on the junction between a steep sandstone hillslope and the Hunter River flats and was intended to test the possibility that a colluvial mantle may have accumulated at the hillslope junction and to test the valley sediments for any possible buried surfaces. It was expected that the Hunter River would have deposited most of the sediment in the valley but it was also possible that some Bowmans Creek sediment may have constructed landforms in the same sequence.

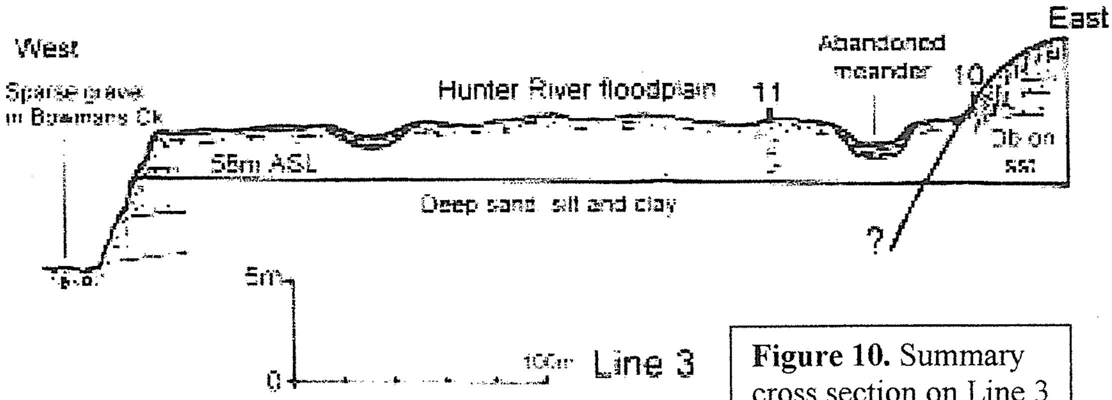

Figure 10. Summary cross section on Line 3 Bowmans Creek.

The stratigraphy of Line 3 was simple (Figure 10). The hillslope mantle carried a brown texture contrast soil and although the A-horizon at the base of the slope was thicker than average no significant thickness of colluvial accumulation was found. Pit 11 contained similar bedded sediments of brownish black fine sandy, sticky clay loams to those exposed in the deep banks of Bowmans Creek at its junction with the Hunter. Within Bowmans Creek very little gravel was found as bedload material but basal gravels and sandstone bedrock are exposed in the valley fill upstream of this point confirming that the depth of sediment across the valley flats is only 8 to 10m.

<u>Line 4 - Pits 12 to 15.</u>

Line 4 sampled a section across Glennies Creek about 1.6km upstream from its junction with the Hunter River. The line included the third terrace remnant in which a pit had previously been described containing a buried soil and from which artefacts had been recorded on the dump (Mitchell 2002).

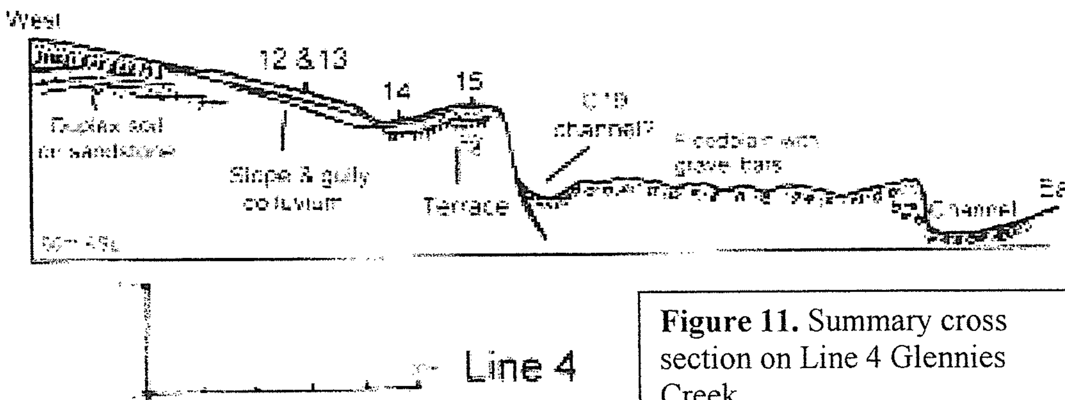

Figure 11. Summary cross section on Line 4 Glennies Creek.

The section (Figure 11) crossed a very wide floodplain with active gravel bars inset within second and third terraces with steep eroded faces. On the right hand margin of the gravel floodplain a shallow abandoned channel is bordered by large river oak and this is believed to be the nineteenth century course of Glennies Creek. If this is correct the modern creek has incised about 2m into the valley floor.

Above the third terrace remnant the lower parts of the hillslope have a shallow alluvial fan connected to a first order streamline extending up the hill. Pits 12 to 14 were placed here to explore the relationships between the hill slopes and the third terrace. This hillslope area is now known to be part of an extensive open site therefore the pits were kept small and only covered a limited area. The stratigraphy of this section is more complex than the other sections in that Pit 15 does contain a buried soil (Figure 12) that was also located in Pit 14. The gully fan has deposited layers of sticky, gritty clay on the margin of the terrace. The nature of these fan sediments is quite different from the upper soil in Pits 14 and 15 and the suggested explanation (Mitchell 2002) that this soil was developed in sediments deposited on an alluvial fan is shown to be erroneous. The colluvial sediments of the fan and the two profiles in Pits 14 and 15 are separate entities.

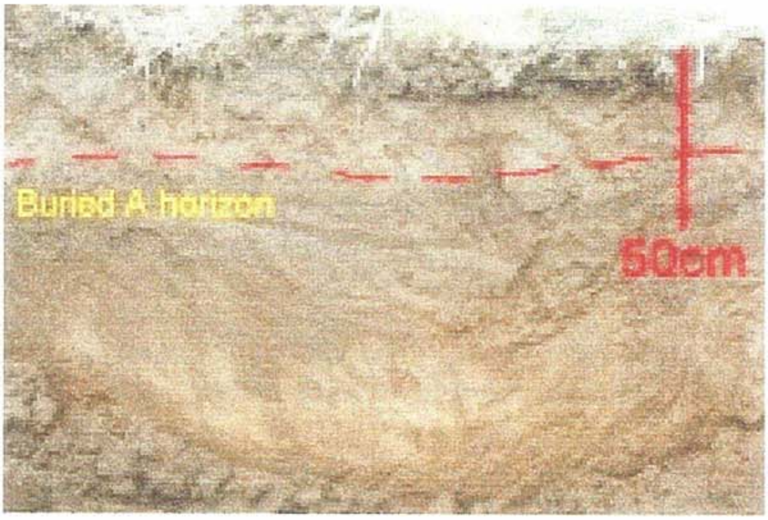

Figure 12. Buried soil profile exposed in Pit 15 on the third terrace of Glennies Creek.

No artefacts were exposed in Pits 12 to 14 and the soil in this area was damp from seepage and stained by manganese oxides. In Pit 15 however where artefacts had previously been recorded on the dump, three flakes were found in the eroded walls. Two were located in the A2-horizon of the upper topsoil and the third was found at a depth of 55cm, some 15cm into the layer interpreted as a buried topsoil (Figure 13).

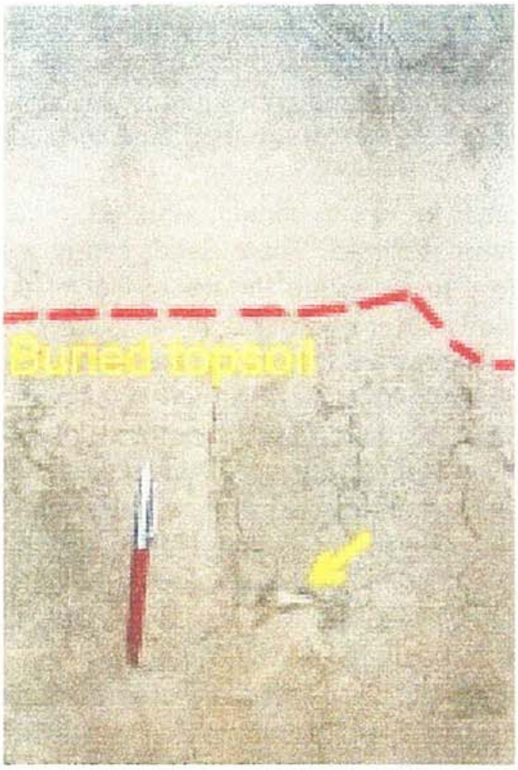

Figure 13. A single stone flake protruding from the exposed and slightly eroded face of Pit 15. The flake located some 15cm into the layer interpreted as a buried topsoil. The pen is 13cm long.

Objective 4. To assess the significance of any sites where buried land surfaces are located and to make recommendations for further archaeological work as appropriate.

The investigations reported here mainly confirm and extend the conclusions drawn by Mitchell (2002). These are:

- The geomorphology and valley fill stratigraphy of the lower reaches of Bowmans Creek, Glennies Creek, and this part of the Hunter River comprises a maximum of three fluvial terraces each with an inset relationship to one another with the fragments of the highest (third) terrace being the only one of possible Pleistocene age and the only one in which any evidence of a buried land surface has been located.
- The 1955 flood has modified most sections of the Bowmans and Glennies Creek channels and engineering works intended to stabilise them.
- All areas of the low floodplains and first and second terraces have been extensively disturbed by cultivation, erosion and the deposition of a blanket of PE sediments during the 1955 flood. Visibility of Aboriginal sites in these areas is virtually nil and any sites that exist beneath the PE sediments are likely to be disturbed.
- Hillslope areas of the lease have been subject to extensive sheet and some gully erosion in addition to direct disturbance by road and building construction etc. Where sheet erosion is the main agent of disturbance this can increase Aboriginal site visibility but must also affect site patterning to an unknown extent.
- Three third terrace sites were previously noted (Areas A, B and C on Figure 7) as having some potential for further investigation. Of these, Area A turned out to be of no significance as it is a bedrock hillslope.
- Pit 16 tested area B on Bowmans Creek, but this pit did not reveal any important stratigraphy that would encourage further excavation. However a

note of caution is necessary as a single pit may miss an important feature that could be revealed in a larger excavation. Such a large excavation is planned for the creek diversion channel and it is again recommended that excavation of that channel should be monitored for any evidence of a buried land surface or archaeological material.

- Area C on Glennies Creek was previously known to contain a buried soil and stone flakes had been found in the dump of Pit 15. These flakes can now be provenanced as this pit is located close to or within the bounds of a large surface site that was not previously known. The two flakes in the A2-horizon are not unexpected but the deeper flake (Figure 13) is potentially more important. If the interpretation of the dark layer as a buried A-horizon is correct, then this flake could be older than flakes on the surface. Without further exploration there is no way of determining how old this soil and any associated archaeology is, other than by making an estimate based on the comparative morphology of the soil profiles involved. This criterion is notoriously inaccurate but it does suggest that an early Holocene or possibly, a late Pleistocene age for the buried profile is possible.
- Further investigation of Area C and the associated Aboriginal site may be justified in the future, but given that the site is outside the area of mining impact, including predicted land subsidence it is recommended here that this area should be considered as a potential archaeological and geomorphological conservation zone in which no further work is recommended at this time.

Conclusions and recommendations.

After review of the EIS information, examination of the air photos and Portion Plans, pit excavations and further field inspection, it is concluded that no further work is immediately justified in searching for palaeo-land surfaces on this lease.

Three recommendations are made:

1. That the new open site and the associated geomorphic features, especially the third terrace remnant at Area C on Glennies Creek (Figure 7) should be considered for reservation as an archaeological and geomorphological conservation zone.

2. That the excavation of the Bowmans Creek diversion channel, particularly where it crosses the third terrace remnant across Area B (Figure 7) should be monitored during construction for any evidence of a buried land surface and for any archaeological material.

3. That the final version of this report be circulated to all parties involved with the lease development.

References.

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Hughes P. 1999. A geomorphic assessment of the proposed Carrington Mine Site, Hunter Valley, NSW. Report to ERM Mitchell McCotter P/L.

Mitchell P.B. 2000/01. Reports to ERM Aust. P/L concerning geomorphology of Ravensworth East Mine site. Groundtruth Consulting

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White Mining Ltd. 2001. Ashton Coal Project. Environmental Impact Statement. HLA-Envirosciences Pty. Ltd.

Appendix H. Groundwater hydrology and impact assessment.

Appendix I. Soil and land capability assessment report.

Appendix L. Archaeological survey – Ashton Mine, near Camberwell Hunter Valley, NSW.

Appendix N. Bowmans Creek diversion report.

Appendix 1.

Location and summary descriptions of backhoe pits excavated to explore the valley stratigraphy.

GPS positions are based on AGD1984. Positions potted on Figure 7 are not as precise as the GPS locations and these should be used if relocation is necessary.

Pit 1. See Figures 7 and 8.
318185E 6406435N Left hand side of Bowmans Creek immediately above creek bed estimated 2.5m above water level. Contemporary bed load gravels.

Pit 1.2m deep in loose, bedded gravels up to 20cm diameter showing three fining upward cycles. Clasts are well rounded and fresh and interpreted as active bed load.

Pit 2. See Figures 7 and 8.
318193E 6406413N Low grassed bench 1m above Pit 1. Modern bed load gravels with a thin veneer of PE sand over weakly developed pre-1955 topsoil.

0-70cm. Brown 7.5YR4/3m, sands showing slight traces of bedding but penetrated by grass roots. Slightly darker sand at the base of the unit may be pre-1955 soil. Sharp boundary to:

70-120cm+. Open fresh gravels identical to those in Pit 1.

Pit 3. See Figures 7 and 8.
318201E 6406397N Edge of second terrace 1.0m above Pit 2. PE sand and gravel over pre-1955 weakly developed topsoil.

0-10cm. Dense grass root mat in brown, porous fine sands. PE sediment, clear to:

10-45cm. Mixed brown sands and fresh gravel with clasts to 5cm. PE sediment, sharp to:

45-70cm. Dark brown 7.5YR3/3m, buried A-horizon of loamy sand with moderate bioturbation and charcoal fragments throughout. Interpreted as pre-1955 topsoil. Clear to:

70-180cm+. Open porous slightly stained rounded gravels to 10cm diameter.

Pit 4. See Figures 7 and 8.
318280E 6406334N On second terrace immediately below the sandstone hillslope. Patchy PE fine sand and silt over slightly developed pre-1955 soil profile that is unlikely to be older than mid-Holocene.

0-15/20cm. Brown 7.5YR4/3m, fine sand and silt with abundant grass roots. PE sediment. This sediment layer has a patchy distribution across the higher parts of the terrace, clear to:

15/20-50cm. Brownish black 7.5YR3/2m, compact, moderately bioturbated sandy loam with a lighter colour of dull yellow brown 10YR5/3m toward the base. Interpreted as the pre-1955 topsoil, profile development is minimal, gradual to:

50-240cm+. Alternating fine brown sands and thin, discontinuous gravel layers with rounded clasts to 5cm diameter.

Pit 5. See Figures 7 and 9.

318022E 6405082N A texture contrast profile on the sandstone hillslope.

0-15cm Dense grass root mat in greyish yellow brown 10YR4/2m, clay loam with good crumb structure. Clear to:

15-55cm+. Dark reddish brown 5YR3/6m, tough gritty clay B-horizon with moderate blocky pedality. Developed in situ from underlying sandstone exposed in trench.

Pit 6. See Figures 7 and 9.

317938E 6405186N On the higher part of the second terrace. PE sediment is absent from this hole but present in Pit 7 slightly lower on the same terrace. The soil profile is a reasonably developed texture contrast profile with drab colours in the B-horoizon on alluvial clay. The A_1-horizon appears to have been stripped by sheet erosion. On morphological grounds it could be mid-Holocene in age.

0-15cm. Light brownish grey 7.5YR7/1d, bleached A_2-horizon of silty loam. Grass roots moderately developed but no evidence of any darker organic topsoil. Clear to:

15-34cm. Brown 7.5YR4/4m, stiff pedal clay, gradual to:

34-80/120cm. Brown 7.5YR4/6, tough alluvial clay with coarse prismatic structure.

Pit 7. See Figures 7 and 9.

317896E 6405300N On the lower edge of the second terrace. A thin and patchy drape of PE silt is present over a texture contrast/gradational profile comparable to Pit 6.

0-5cm. Light grey 10YR7/1d, very fine sand and silt with grass roots throughout. Clear to:

5-35cm. Brownish grey 10YR4/1m, pedal, tough clay loam, interpreted as the pre-1955 topsoil, gradual to:

35-140cm+. Dull brownish black 10YR2/3m, with olive patches indicative of occasional waterlogging, coarsely pedal tough medium clay. Subsoil grading to alluvial clay.

Pit 8. See Figures 7 and 9.

317878E 6405354N On the edge of a 1m high step in the middle of the first terrace. PE fine sands over a weakly developed pre-1955 uniform profile in alluvial sediments with fresh gravels at 1.5m.

0-15cm. Fine sandy silt in grass roots, PE sediment with clear boundary to:

15-25cm Brownish black 10YR2/2m, blocky clay loam, gradual to:

25-80cm Brownish black 10YR3/2m, massive and compact medium clay B-horizon with slight accumulation of soil carbonate at depth. Gradual to:

80-150cm. Dark brown alluvial clay, sharp to:

150-160cm+. Unweathered river gravels.

Pit 9. See Figures 7 and 9.

317870E 6405373N On lower edge of the first terrace. PE fine sands over a weakly developed pre-1955 uniform profile in alluvial sediments with fresh gravels at 2.0m. Comparable to Pit 8.

0-20cm. Brown, medium to fine sands with some silt PE sediment with abundant grass roots. Clear to:

20-55cm. Dark brown 10YR3/3m, pre-1955 topsoil of crumb structured sandy loam, no evidence of a bleach, gradual to:

55-200cm. Brown, medium grained sandy loam, clearly bedded at depth with alternating incoherent beds and slightly compacted beds, clear to:
200cm+. Stained river gravels, open structure that would carry shallow groundwater at times.

Pit 10. See Figures 7 and 10.
317605E 6403790N Just above the foot of a steep sandstone hillslope abutting Hunter River floodplain. Sited to test for possible accumulation of colluvial debris at the break in slope. Texture contrast profile with thicker than average A-horizon (45cm) but no evidence of any buried surface.

0-15cm. Brownish black 10YR3/2m, crumb structured clay loam with dense grass roots and faecal pellets, gradual to:
15-45cm As above with fabric changing to 1cm polyhedral. Clear to:
45-65cm. Brownish black 10YR3/1m, pedal blocky clay merging gradually to:
65-85cm Brown 10YR4/4m, sandy clay with relic sandstone structure and clasts of completely weathered bedrock.

Pit 11. See Figures 7 and 10.
317492E 6403833N On a slight rise on the Hunter River floodplain. Site is frequently cropped and the expected PE sediments are not evident because they have been homogenized by cultivation. A deep pit with no evidence of buried surfaces. The soil profile development is unlikely to be more than of Holocene age.

0-75cm. Very dark brown 7/5YR2/3m, fine sandy clay loam with moderate to well developed pedality, deep root penetration and bioturbation, gradual to:
75-250cm+. Brown 7/5YR4/3m, sandy loam alluvium, with faint bedding.

Pit 12. See Figures 7 and 11.
319032E 6403398N On the right hand side of Glennies Creek at the margin of a large open archaeological site. Pit is on the sandstone hillslope immediately above a first order stream and contains a shallow texture contrast profile. Upslope from the pit artefacts are evident on the surface where about 5 to10cm of the A-horizon has been eroded.

0-18cm. Greyish yellow brown 10YR4/2m, porous sandy loam with patches of bleach toward the base. Moderate grass root development and a stone layer at the base. Clear to:
18-30cm. Dark brown 10YR3/3m, sticky clay with blocky peds to 2cm, gradual to:
30-70cm Dark reddish brown 5YR3/6m, sticky clay and in situ weathered sandstone.

Pit 13. See Figures 7 and 11.
319029E 6403376N. In the centre of the first order drainage line below Pit 12 at the head of a small alluvial fan that spreads onto the third terrace where Pit 15 is located. Undifferentiated colluvial/alluvial layers from the catchment. The sediments carry occasional or seasonal shallow groundwater flow and deeper units are heavily stained with manganese oxides. No buried surfaces are evident and almost no profile development.

0-10cm. Sandy loam continuous with the surface layer of Pit 12, bleach moderately developed at the base of the layer, clear to:

10-60cm. Bedded gritty loam, and sticky clays of hillslope wash and gully floor alluvium. High degree of bioturbation in moist soil with dense grass cover. Clear to:

60-80cm. Quartzose sandstone pebbles to 1cm and coarse sand in greyish brown 10YR4/2m, tough clay matrix, clear to:

80-170cm+ Brownish black 10YR2/1m, gritty clay with coarse blocky structure and shiny black manganese cutans on ped surfaces. This is not a buried soil and the dark colour is attributed to the manganese staining precipitated from shallow groundwater.

Pit 14. See Figures 7 and 11.

319065E 6403360N. Sited in a shallow depression on the surface of the third terrace between the alluvial fan and Pit 15. The soil in the Pit is comparable to that exposed in Pit 15 but no stratigraphic connection can be seen between the fan and the terrace soils. Interpretation of the 40-80cm layer is that it is the same buried A-horizon as described in Pit 15.

0-20cm. Dark brown 10YR3/3m, loamy sand with abundant grass roots, gradual to:

20-40cm. Light grey 10YR8/2d, fine loamy sand, bleached A_2-horizon, clear to:

40-80cm. Dark brown 7.5YR3/3m, clay with weak pedality, gradual to:

80-170cm+ Brown slightly sandy, clay loam and tough clay comparable to deeper units in Pit 15.

Pit 15. See Figures 7, 11, 12 and 13.

319140E 6403334N This is an open pit located on the third (oldest) terrace. Two stone flakes had previously been found on the spoil heaps and a buried soil profile was exposed in the pit walls (Figure 12). Both soil profiles are of fairly minimal development as uniform or gradational profiles with less pedogenic organisation than the soil found on the second terrace. During this investigation three stone flakes were found exposed by rainwash in the face of the pit and one of these was located in the buried profile (Figure 13). The soil layers in this pit are comparable to those described above in Pit 14.

Pit 16. See Figures 7 and 9.

317567E 6406127N. On the third terrace on the right hand side of Bowmans Creek approximately 500m upstream of the DLWC gauging station. Interpretation of this pit was aided by a long section exposed in a drain on the second terrace 150m to the northeast. The pit contains a well developed texture contrast profile over multiple alluvial units, one of which (100-190cm) was darker in colour and contained fragmentary charcoal. No confirmatory evidence was found to demonstrate that this was a buried soil.

0-30cm. Greyish brown 7.5YR5/2m, grading to brownish grey 7.5Y/R6/1d, sandy loam with a clear boundary to:

30-90cm. Dark brown 7.5YR3/3m, heavy clay with coarse blocky pedality. Roots penetrate along ped surfaces only. Clear to:

90-100cm. Brown 7.5YR4/3m, dense gritty clay with occasional pebbles to 2cm and sparse pieces of soil carbonate. Clear to:

100-190cm. Brownish black 7.5YR3/2m, medium to heavy clay with fine charcoal fragments. Clear to:

190-230cm+. Brown 7.5YR4/4m, sandy clay with moderate porosity, clearly bedded alluvium.