# CHAPTER 7

# MACROSCALAR PROCESESS AND DISTRIBUTION OF ARCHAEOLOGICAL MATERIAL

***Mor'room-bee-ja.*** *The Murrumbidgee River. At times (or often) has overflown, or turned aside (Richards 1902b: 136)*

## 7.1 INTRODUCTION

This chapter aims to examine the dynamics of macroscalar processes occurring on the Hay Plain during the mid to late Holocene, through an analysis of the spatial and temporal distribution of archaeological material. The 'intertwining of environment, agency and history' (Schroeder 2004) provides the theme and the explanatory framework.

A GIS mapping exercise provides an initial overview of the distribution compared to the hydrology and the geomorphology which is then examined in more detail. It documents the distribution of mounds and other archaeological material across the existing landforms of the Hay Plain, and also documents associations between types of archaeological material. The distribution patterns also provide evidence about relationships between different types of archaeological material and wetlands that have ceased to function. Together with the dates discussed in previous chapters this provides evidence of change over time. Other relevant factors such as trends from east to west in large-scale topography, palaeochannel systems and modern wetland ecosystems are described. Two areas outside the Hay Plain are compared with the Hay Plain to test some of the assumptions about distribution and behavioural dynamics.

## 7.2 RESEARCH METHODOLOGY

### *7.2.1 Sample Survey of the Hay Plain and Selected Areas*

Sample areas on the Hay Plain were surveyed to obtain data on the distribution and variation of archaeological material. The sampling was undertaken at various levels of detail so an idea of the regional distribution of mounds and other site types was obtained as well as the finer-grained distribution within elements of the region. The sampling was undertaken as part of several different consultancy projects as well as survey specifically designed for this project. Although a less than ideal way to do a survey, the huge size of the Hay Plain and the lack of research funding for the project made it a necessity. In some ways the rather disjointed survey was effective as it was reassessed along the way and each new stage was designed for maximum effect. The 1995 burials management plan survey formed the original data set (Martin 1996a) and was supplemented by data recorded for my PhD project in 1999-2000. The consultancy undertaken for NSW NPWS by Colin Pardoe and myself (Pardoe and Martin 2001) was especially useful as it was fully funded for a four person field crew and I was able to use my existing data base to target areas of the plain and specific landforms that had not been sampled previously, thus filling in gaps in the existing survey record to obtain a wider coverage and less biased sample than was previously available. I am thankful that the 2001 project supervisor Harvey Johnston allowed this freedom. The 2001 survey covered a larger area (The Murrumbidgee Province) than the definition of the Hay Plain used for this project, and only the data within my project area is used in this analysis.

In addition archaeological material already on the NSW NPWS AHIMS site register has been included. The numbers of sites in the three databases is influenced by the introduction of hand held GPS units by 1996 which made is easier to accurately locate material, and throughout 1999-2001 GPS were used to pinpoint every site or large feature, whereas before 1996 we tended to record clusters of mounds, burials or ovens. Thus in the Martin 1995-2000 and AHIMS databases many of the earlier recorded 'sites' are clusters of material (e.g. a cluster of 21 mounds), rather than individual features (e.g. each mound in the cluster individually recorded). For example in the Martin 1995-2000 database 85 mound sites were recorded, but this included a total of 167 mounds. In the Pardoe and Martin 2001 database every mound, burial, oven and scarred tree was recorded individually with a unique GPS reading. This system, designed for GIS use and research, allows detailed mapping of all types of archaeological material, unlike the earlier systems where clusters of and different types of material were recorded under 'mound' or 'open campsite'or 'midden'. A summary of the total database (grid references removed) is found in Appendix 7.1.

*Table 7.1 Databases Used for the GIS Distribution Mapping on the Hay Plain*

| Data Base | sample size | mounds | ovens | middens | burials | artefact scatters | ashy deposit | camp/ open site | soak/well |
|---|---|---|---|---|---|---|---|---|---|
| Pardoe & Martin 2001 | 234 | 88 | 60 | 17 | 22 | 6 | 0 | 40 | 1 |
| Martin 1995-2000 | 135 | 85 | 10 | 4 | 20 | 13 | 3 | 0 | 0 |
| AHIMS | 227 | 84 | 0 | 26 | 47 | 0 | 0 | 70 | 0 |
| total | 596 | 257 | 70 | 47 | 89 | 19 | 3 | 110 | 1 |

A three tier system of recording forms were used which were similar to forms I had used in previous work in far western NSW, adapted from a recording format designed by former Western NSW NPWS archaeologist Dan Witter. Samples of these forms are included in Appendix 7.2. The Murrumbidgee Survey form records landscape and environmental features, exposure, visibility, background, and types of archaeological material. The Window form is used for more detailed recording of the archaeological material. The Window Sample form is used for recording of stone tool data from sample areas within the 'window'. The word 'window' describes an area of exposed archaeological material, rather than attempt to delineate a bounded 'site'. After 1995 the recording became faster and more accurate due to the implementation of GPS instead of laborious use of maps and airphotos on the endless and seemingly featureless plains. Surveys from 1999 onwards used a Garmin 1998-1999 GPS using the Australian Metric Grid (AMG) system and the Australian Geodetic Datum (AGD). This system is accurate to about 5 metres. The survey forms designed for 1999-2000 survey were also used for the Pardoe & Martin (2001) survey, although much of the information was superfluous for the survey report. Sample area quadrat eastings and northings were recorded by GPS to enable mapping and size estimate of the sample areas.

The three databases (Table 7.1) have considerable differences in survey methods. The Pardoe and Martin 2001 survey and the 1999-2000 surveys for this study were systematic with sample areas being 100% walked by a team and all material recorded. The earlier 1995 surveys were undertaken with a specific purpose of working with the Hay LALC to locate burials and sites such as mounds or middens which were likely to contain burials. This survey was undertaken from a vehicle until areas of interest were located and then these were walked by a team. The 1995 sample areas were often large and coverage was reduced by the combined vehicle/walking methods. Mounds and scalded areas were targeted and easily visible, but less visible material such as individual ovens or small artefact scatters may have been missed away from areas of focus. The coverage of the 1995 survey is estimated to be 50% for larger sample areas and 100% for smaller sample areas. The AHIMS database consists of numerous surveys over a long period of time and therefore has variable methodology. However, the majority of the sites in this database were recorded by Judith Littleton for her survey of burials and other sites on the Hay Plain South West, and Jan Klaver for her survey of the eastern section of the Central Murrumbidgee at Uardry Stock Reserve and Cooey Point Lagoon. In both cases the coverage was systematic and thorough with areas 100% walked. Unfortunately, the rest of Jan Klaver's survey between Cooey Point and Hay has not been included in the AHIMS data base, but I was able to access some of this information in a preliminary report (Klaver 1995). The AHIMS database also includes transect surveys such as powerline surveys, and small-scale archaeological surveys which also have good coverage (eg. Kelton 1998). However, coverage, visibility, exposure and site definition in the three data bases varies according to methods, recorder, landform and seasonal variation. The lack of directly comparable data has precluded a detailed statistical analysis of the distribution of archaeological material on the Hay Plain. However, the data is sufficiently comparable to determine broad distribution trends and the sample quadrats used in 1995, 1999, 2000, and the Pardoe & Martin (2001) survey, gives some control over the data.

The sample survey took into account the various layers used for the GIS mapping, including geomorphology, soils, hydrology and archaeology. Vegetation was noted on the recording forms but was considered unsatisfactory as a GIS layer because of the historical and recent changes to the vegetation due to changes in river regulation and landuse. This includes historical changes mainly due to overgrazing, logging and rabbit infestation, and more recent changes due to the intensive land clearing, levelling, cropping and irrigation related to rice farming and other irrigated crops, as well as die back of once dominant species such as *Atriplex vesicaria* (Old Man Saltbush) (Porteners 1993, Eardley 1999). The reduction of flood pulses due to river regulation and large-scale irrigation has affected large areas of wetland vegetation (Page et al. 2005). The GIS layers were supplied by NSW NPWS for the Pardoe & Martin (2001) survey, and were the most detailed available at the time.

Two areas were selected to compare with the Hay Plain outside of those areas already known to contain large numbers of mounds such as the Murray River floodplain around Echuca and Swan Hill, and Central and Western Victoria. The Balranald area was sampled as it is on the junction of the Murray Mallee Region and the Murrumbidgee Region, of which the Hay Plain forms a major part (Eardley 1999). This was sampled in order to determine if mounds or other aspects of archaeology of the Hay Plain continued along the Murrumbidgee into this very different landform consisting of sandplain, sand dunes and mallee vegetation. The Balranald area was sampled as part of the Pardoe and Martin (2001) survey. One area on the western side of the Murrumbidgee River was surveyed (Auley) and this is embedded in the Mallee region red sandy soils (Eardley 1999). Tala Lake (Goolparle Station), was also surveyed and is located the eastern side of the Murrumbidgee. It encompasses a large lake, two lunettes, floodway and creek straddling the boundary between the dark cracking clay soil of the Murrumbidgee floodplain and the Mallee region red sandy soils, the lake and lunettes embedded in the Mallee region, and the inlet creek and floodway in typical dark clay soils of the Murrumbidgee Riverine Plain. The second area, the Menindee Lakes and adjacent Darling River, was sampled to determine the similarities and differences in the archaeology of this separate but in many ways similar landform. This area was also chosen because it was already known that ashy cultural deposits and heat retainer features were common (Martin et al. 1994 ) but no mounds had been recorded there. The Balranald and Menindee areas provided contrasting comparative data to test concepts of heat retainer feature and mound distribution and attributes, some of which is also used in Chapter 8.

### *7.2.2 Detailed Recording of Archaeological Material*

The sample surveys aimed to record the range of archaeological data including:

- Mounds and mound attributes including spatial patterning, sizes (length, width, height), structure and stratigraphy (often some exposure due to rabbits, erosion, machinery), features such as ovens, pits, concentrations of various contents (recorded for mound surfaces or exposures), colour and contents (recorded for mound surfaces or exposures), stone tool technology (recorded for mound surfaces or exposures) & burials (recorded for mound surfaces or exposures).

- Material off mounds but definitely/possibly associated, including burials and burial clusters, ovens, stone tool technology, middens, non-mounded archaeological deposits.

- Material not associated with mounds, including ovens, stone tool technology, middens, burials & non-mounded archaeological deposits.

- Other materials and information associated with historic or contemporary places of significance to the local Aboriginal community were recorded but not included in this analysis, see Pardoe & Martin (2001): historic artefacts, fishing places, camping places, ceremonial places, historic burial places.

- Scarred trees were recorded during surveys but do not form part of this analysis. Large numbers of scarred trees have been recorded along the Murrumbidgee River and rarely on distributary creeks. Vast areas of the Hay Plain are treeless or do not have any trees of sufficient size, and therefore do not have scarred trees. See Pardoe and Martin (2001) and Klaver (1998) for details on scarred trees including distribution and characteristics.

## 7.3 DISTRIBUTION OF ARCHAEOLOGICAL MATERIAL ACROSS MAJOR LANDFORMS OF THE HAY PLAIN

### *7.3.1 Distribution of Sites by Hydrology*

Map 1 shows that hydrology correlates with the overall site distribution on the Hay Plain. The narrow floodplains or confined traces of the Murrumbidgee and Lachlan, the Lowbidgee distributary system, and the Gum Creek palaeochannel system in the South East where it leaves the Murrumbidgee, and lower down where it becomes the Abercrombie Creek system in the Hay Plain Southwest have the highest density of sites. The large open water lakes such as Tala Lake on the Lower Murrumbidgee or Ita Lake on the Lachlan, also have a high density of sites. The palaeochannels with modern creeks such as Mirrool Creek in the North-East, also appear to have a high site density, but this area has not been as extensively sampled.

### 7.3.2 Distribution of Sites by Geomorphology and Soils

The 'site' database was mapped over the geomorphology (Maps 2 - 6) which also closely reflects the soils and pre-European vegetation of the Hay Plain (Eardley 1999). When the total site database is considered, sites are widely spread over the Hay Plain and the various geomorphic categories. However, it is immediately obvious that different kinds of sites have different distributions. Geomorphological landforms which overall have a higher density of sites include confined traces (Murrumbidgee and Lachlan Rivers), plain with channels, plain with depressions, and channelled plain. Smaller landforms such as lunettes and lakes also have a higher than average site density, although they only cover a small area of the region. Pardoe and Martin (2001:79) considered soils separately and found that on a broad scale the percentage of the region of each soil type is approximately equal to the percentage of sites for that soil type. Thus sites (without differentiating types) are relatively evenly distributed over the various soil types, but when site types are considered the distribution is uneven.

### 7.3.3 Distribution of Mounds by Geomorphology

Map 2 shows the distribution of mounds compared to the geomorphology. Mounds are found on a number of landforms including confined traces or river channels, plain with channels, plain with depressions, plain with scalds and scalded plain. However, they are largely confined to particular parts of the Hay Plain and this distribution does not reflect the geomorphology. Mounds are particularly dense along the confined traces, the Lowbidgee and the western section of the plain. Very few mounds are found on the Hay Plain Southeast, and none on the Hay Plain Northeast, they are however found in large numbers on the Murrumbidgee River flowing through the eastern plains. Mounds on the western side of the plain are distributed over numerous geomorphological categories, indicating that geomorphology is not the controlling factor. The same geomorphological categories are found on the eastern side of the plain, which has few or no mounds.

### 7.3.4 Distribution of Other Site Types by Geomorphology

Other site types have been mapped over the geomorphology using the 3 databases combined (Table 7.1). Map 3 shows the distribution of middens that are clearly clustered along the confined traces of the major rivers and also on the large open water lakes with lunettes such as Tala Lake near Balranald. Middens appear to be concentrated in the area of the Murrumbidgee near Hay, but this may be a sampling issue reflecting additional archaeological survey in the Hay urban/horticultural development area. Tala Lake had the biggest number of middens (seven) in any of the sample areas.

Map 4 shows the distribution of burials which are concentrated on the western half of the Hay Plain in a similar way to mounds. Like mounds, the distribution of burials does not reflect the geomorphology. Klaver (1998) did not record one burial in her survey from Narrandera to Hay, even at the vast complex of mounds, ovens and middens she recorded at Cooey Point Lagoon. Burials are however recorded on the Murrumbidgee near Hay in middens (Martin 1996a), usually singular burials or in clusters of two or three. The high concentration of burials on the western half of the plain is actually underestimated, as many 'sites' are multiple burials and not all mounds with burials have been recorded as burials as well. In this area burials are commonly located in mounds, or in small tightly bounded burial plots associated with and usually about 100 metres from a mound. Burials are also common on the lunettes of the large open water lakes such as Yanga Lake, Tala Lake and Ita Lake.

Map 5 shows the distribution of the two categories 'artefacts' and 'open sites'. Unlike mounds, middens and burials, these sites are wide spread over the plain. Ovens are also widespread over the plain (Map 6), they are under-represented as a category as the older NPWS recording system combined mounds and ovens, and most ovens are probably included under the category 'open site'. Map 1 shows the distribution of the ashy deposits on the inlet creek of Ita Lake and along the Lachlan River. It also shows the well or reservoir recorded on the Hay Plain Southeast, north east of Booroorban.

### *7.3.5 Density of Mounds by Major Landform*

An estimate of the actual mound densities across the major sections of the Hay Plain was calculated using the figures from the survey sample areas (Table 7.2). The Martin 1995-2000 and Pardoe and Martin (2001) sample surveys were combined and each individual mound counted within mound complexes and sample area. In addition, Klaver's sample areas for the Central Murrumbidgee from Cooey Point to Hay, and her sample areas to the south of this area on the Hay Plain Southeast were included to increase the sample size and mound numbers in these two areas (Klaver 1995). The sample area sizes were calculated using Autocad software and totalled for each major landform. The densities of mounds in the major sections of the Hay Plain calculated and compared. The total number of mounds divided by the total number of km$^2$ gave an average or expected number of mounds per km$^2$ to aid in the comparison. The results are influenced by the type of landform and the size of the sample areas. For example the confined traces of the Murrumbidgee and Lachlan Rivers have the highest densities, which partly results from the fact that sample areas were long and thin along the river edges and did not enter other landforms that are unlikely to have mounds. In contrast the large paddock sample areas of the Hay Plain Southwest and Lowbidgee entered into landforms that were unlikely to have mounds, as well as those that were likely to have mounds. However the result was expected, the confined traces have the highest density of mounds followed by the western sections of the Hay Plain. The Hay Plain Southeast has a lower density, and the Hay Plain Northeast has no mounds. Although the Northeast has a smaller sample area, spot checks in the area and the AHIMS register confirmed this distribution pattern. The Auley and Goolparle sample areas were also smaller, but tended to confirm the lack of or lower numbers of mounds on the junction of the Hay Plain and the Mallee Sandplain.

*Table 7.2 : Sample Area Size & Mound Density by Major Landform*

| SECTION OF HAY PLAIN | sample area km$^2$ | number of mounds in sample area | expected number of mounds/km$^2$ | mounds /km$^2$ |
|---|---|---|---|---|
| Murrumbidgee East | 26.6 | 91.0 | 0.8 | 3.4 |
| Lower Lachlan | 4.9 | 37.0 | 0.8 | 7.6 |
| Hay Plain Northwest | 8.7 | 13.0 | 0.8 | 1.5 |
| Hay Plain Southwest | 191.0 | 121.0 | 0.8 | 0.6 |
| Lowbidgee | 128.5 | 64.0 | 0.8 | 0.5 |
| Hay Plain Southeast | 37.6 | 9.0 | 0.8 | 0.2 |
| Hay Plain Northeast | 2.8 | 0.0 | 0.8 | 0.0 |
| Goolparle-Tala Lake | 2.1 | 1.0 | 0.8 | 0.2 |
| Auley | 0.9 | 0.0 | 0.8 | 0.0 |
| Totals | 403.0 | 336.0 | | |

### *7.3.6 Distribution Relationship between Mounds and Ovens*

The distribution of heat retainer hearths or 'ovens' is difficult to delineate because of the difficulties of differentiating between ovens and small mounds, and scattered ovens and remnant mounds. The AHIMS database also unfortunately tends to lump mounds and ovens together into the one category. However it is clear from the distribution data and maps that in some areas mounds are not associated with individual heat retainer hearths, while other areas they appear to be associated with individual heat retainer hearths. In addition, large areas of the Hay Plain that do not have mounds are characterised by individual heat retainer hearths and associated artefact scatters. It therefore appears that the distribution of heat retainer hearths and mounds coincide in some areas, but are separate in other areas. Klaver states that:

> It is suggested that oven mounds and small ovens are the aggregate and elemental evidence, respectively, of the same activity, which produces essentially the same range of residues. Incipient mounds and agglomerated small ovens fall within a continuum. This is supported by identical regional distribution of oven mounds and small ovens, although their proportionate numbers vary considerably. One hundred and forty six occurrences of small ovens were recorded. Although the majority occurred as individual piles of baked clay heat retainer, interpreted as rakeout from oven pits, there were also instances where tight groups of up to 4 discrete piles were present. Oven mounds are more than twice as numerous as small ovens in the Eastern and Western Alluvial Valley Plains, whereas they have an approximate ratio of one to one in the Eastern and Western plains lands. (Klaver 1998:278).

However, when the whole Hay Plain is considered, Klaver's statement cannot be supported, although it may be the pattern in the Murrumbidgee East which was the focus of her work. Immediately to the north and south of this section of the river the archaeology is characterised by large open sites containing numerous individual ovens and artefact scatters, but no mounds or aggregations of ovens. In areas of the Hay Plain Southwest, individual ovens are not found in association with large groups of mounds located around swamps such as Baldon Swamp, Tchelery 1 swamp, Ravensworth 1-5 Lake, St Pauls/Jeraly South swamp. However, in this same general area ovens are found in open sites without mounds, such as Dry Lake 11 or Tchelery 6. They may also be found in association with mounds on raised palaeochannel ridges overlooking the flooded country, such as found near Kerri East homestead. Ovens and artefact scatters occur without mounds on the largest palaeochannel ridges which were covered in mixed woodland prior to overlogging. Ovens occur, usually in low numbers, with mounds or remnant mounds along the edges of the floodplain and on floodplain highs in the Lowbidgee system.

Thus in some areas ovens may be incipient mounds (but not necessarily so), while in other areas they are not. The large clusters of individual ovens on areas of the Hay Plain Southeast, for example South Burrabogie, and Northeast, for example Mirrool Creek, indicate a pattern of location reuse but not long term oven reuse or mound building. There is therefore a large-scale pattern in the distribution of ovens away from the rivers. The eastern half of the Hay Plain has ovens that are most commonly not associated with mounds, but in the western half ovens are not found with some mound complexes, are found with other mound complexes, or may be located in areas without mounds. This indicates that mounds and individual ovens often represent different activities, corresponding to research in North America that large earth ovens coalesce into burned rock middens, but that small discrete hearths with burned rock do not, and that these two different features represent different subsistence activities (Collins et al. 1998 in Amick 2004:194-198). Excavation of three ovens at Gundaline (Chapter 5) showed that ovens had different ways of operating. Two ovens still had the heat retainer in the pit, but the third oven had the heat retainer scooped out to the side of the pit ready to be used again.

### *7.3.7 Distribution Relationship between Mounds and Burials*

A change in burial location occurs on the western side of Hay near Pevensy, where the Lowbidgee system begins. This demarcation was first noticed by Bonhomme (1990b). Klaver did not locate any burials in mounds or associated with mounds, or indeed any burials at all in her extensive surveys of the eastern section of the Central Murrumbidgee River (Klaver 1998). On the river near Hay, burials usually occur as single burials or small groups (2 or 3) along the river levee and often in middens. To the west of Hay burials are more common and occur in larger groups, including some sites that have been called cemeteries (Bonhomme 1990b, Littleton 1999, 2002, Pardoe 1995). However, Littleton (2002) discusses at length why these larger groups of usually around 20 burials are different to the cemeteries of the Murray River (see Chapter 2).

Burials on Hay Plain Southwest are commonly associated with mounds, either in mounds or in separate tightly bounded burial clusters located usually about 100m from mounds (see Littleton 2002 and Figure 5.12). However, burials are also found in open sites with ovens and artefacts, for example Dry Lake 11. Approximately 54% of recorded mounds on the Hay Plain Southwest contain evidence of burials on the surface or in exposures such as rabbit burrows (Table 7.3).

Burials on the Lowbidgee occur in larger mounds such as at Murrumbudgee near Maude, and approximately 32% of recorded mounds had visible burials. Lowbidgee burials are also found on palaeochannel systems such as Maude Cattleyards, highs on floodplains or edges of floodplains. Burials on rare well-defined source bordering dunes or 'sandhills' are reported from Pevensy (now quarried away), Nap Nap, Toogimbie, and Ibbotson Sandhills near Maude (now wind blown from original location). Thus mounds in the Lowbidgee system also have a high number of burials, but this landform displays a greater variety of burial locations than the Hay Plain Southwest. The Lachlan River and Hay Plain Northwest landforms tend to have few burials in mounds, although burials were recorded in ashy deposits. Mounds on the Murrumbidgee East landform apparently do not contain burials, however, middens contain singular or up to 2-3 burials (Table 7.3). The marked east-west change in burial distribution and tendency for burials to be located in or beside mounds on the western Hay Plain appears to be strongly affected by social factors in addition to demographics.

*Table 7.3 : Percentage of Mounds with Burials within Major Landforms*

| Section of Hay Plain | Number of Mounds in Sample | % Mounds with Burials per Sample |
|---|---|---|
| Murrumbidgee East | 91.0 | 0 |
| Lower Lachlan | 37.0 | 2.7% |
| Hay Plain Northwest | 13.0 | 0 |
| Hay Plain Southwest | 121.0 | 54.4% |
| Lowbidgee | 64.0 | 32% |
| Hay Plain Southeast | 9.0 | 0 |
| Hay Plain Northeast | 0.0 | 0 |
| total | 336.0 | n/a |

### 7.3.8 Distribution on Minor Landforms

The distribution of archaeological material across the finer landform scale was recorded throughout the surveys, but a detailed analysis is beyond the scope of this study. The distribution of archaeological material on minor landforms has been summarised in Appendix 7.2 Tables 7.2.1 and 7.2.2 and a number of examples are described below to illustrate how archaeological material is distributed within the minor landforms. Similar minor landforms across the Hay Plain are the focus of location for archaeological material, but that the archaeological material may vary across different major landforms. Figure 7.1 shows typical distribution of material on the Murrumbidgee East near Hay. The levee bank on the outer bend of the river has a long midden consisting of fragmented and whole river mussel with some ash, and rare heat retainer and stone artefacts. The levee continues towards the black box lined billabong and forms a slightly higher elevation near the junction of the levee and billabong. In this elevated area three burials were located by the Hay Local Aboriginal Land Council and fenced in. The burials occur in the midden and three ovens and four small mounds also occur on the midden or just off the midden in this area, aligned parallel to the edge of the billabong. A further two ovens and seven small mounds were recorded around the outer edges of the billabong.

The Lowbidgee has diverse minor landforms across its wide floodplain, and this results in a higher density and wider variety of archaeological material including mounds, middens, ovens and burials compared to the Murrumbidgee East. Figure 7.2 shows a section of the Murrumbidgee River below Hay where the floodplain spreads out at the very beginning of the Lowbidgee. A diffuse elongated midden occurred along a stretch of the river on the second levee about 30 metres behind the river bank. In the area where the river landforms became more complex with a deep river bend, high and low ground, a creek and a billabong, middens and mounds were recorded. A midden and a mound were recorded on high ground near a deep bend and adjacent to the billabong, and another mound was located on the billabong bank and a cluster of 3 mounds and an 'open site' consisting of a large area of ovens, scattered heat retainer and artefacts located just to the east of billabong on high ground. The edges of the floodplain and floodplain highs behind this section of river have a range of archaeological material including remnant mounds, burials, ovens and artefact scatters, all adjacent to low lying floodplain backswamps with lignum

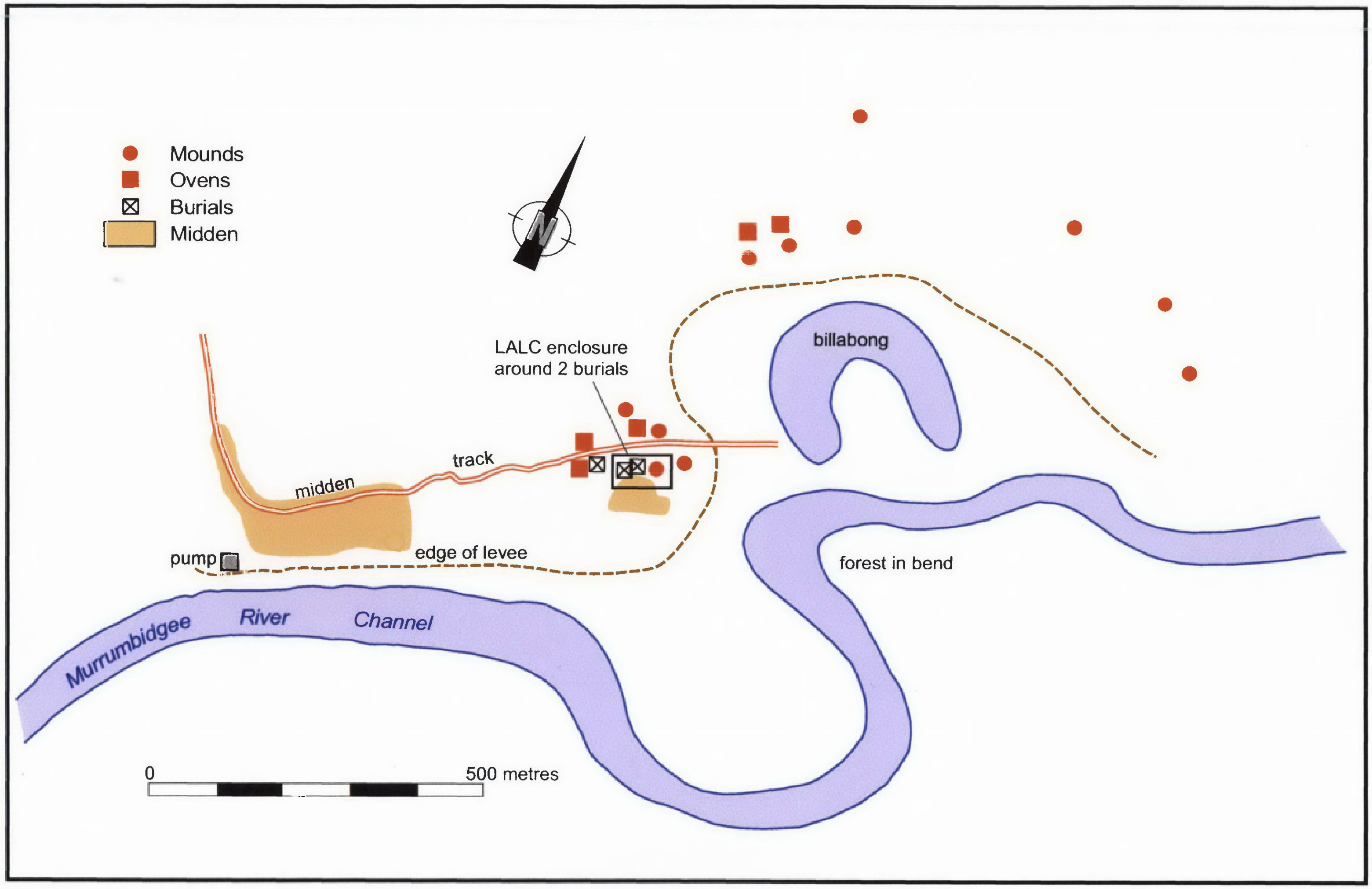



**Figure 7.1:** Mounds and Associated Sites in Illiwara Sample Area

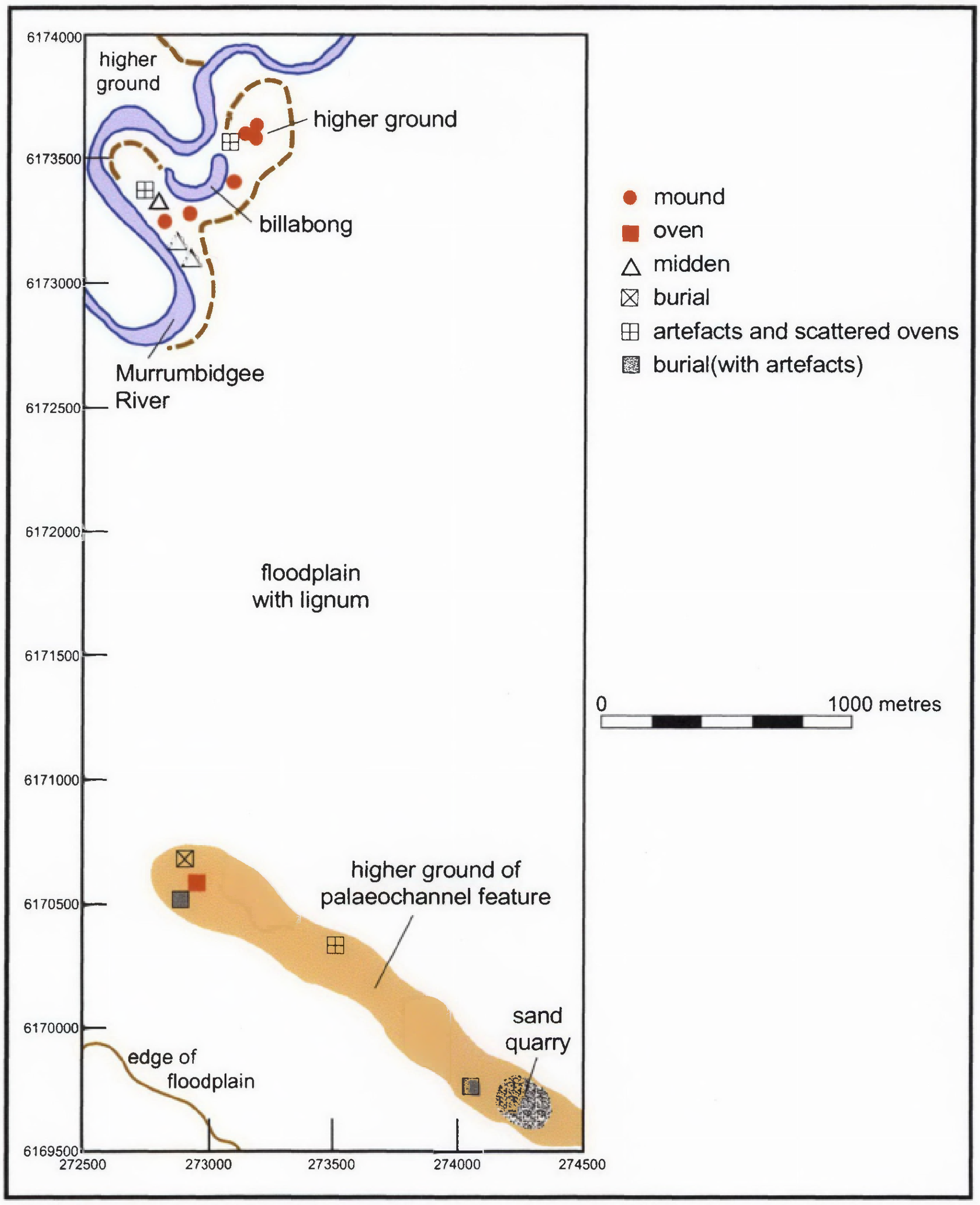



**Figure 7.2:** Plan of Pevensy West

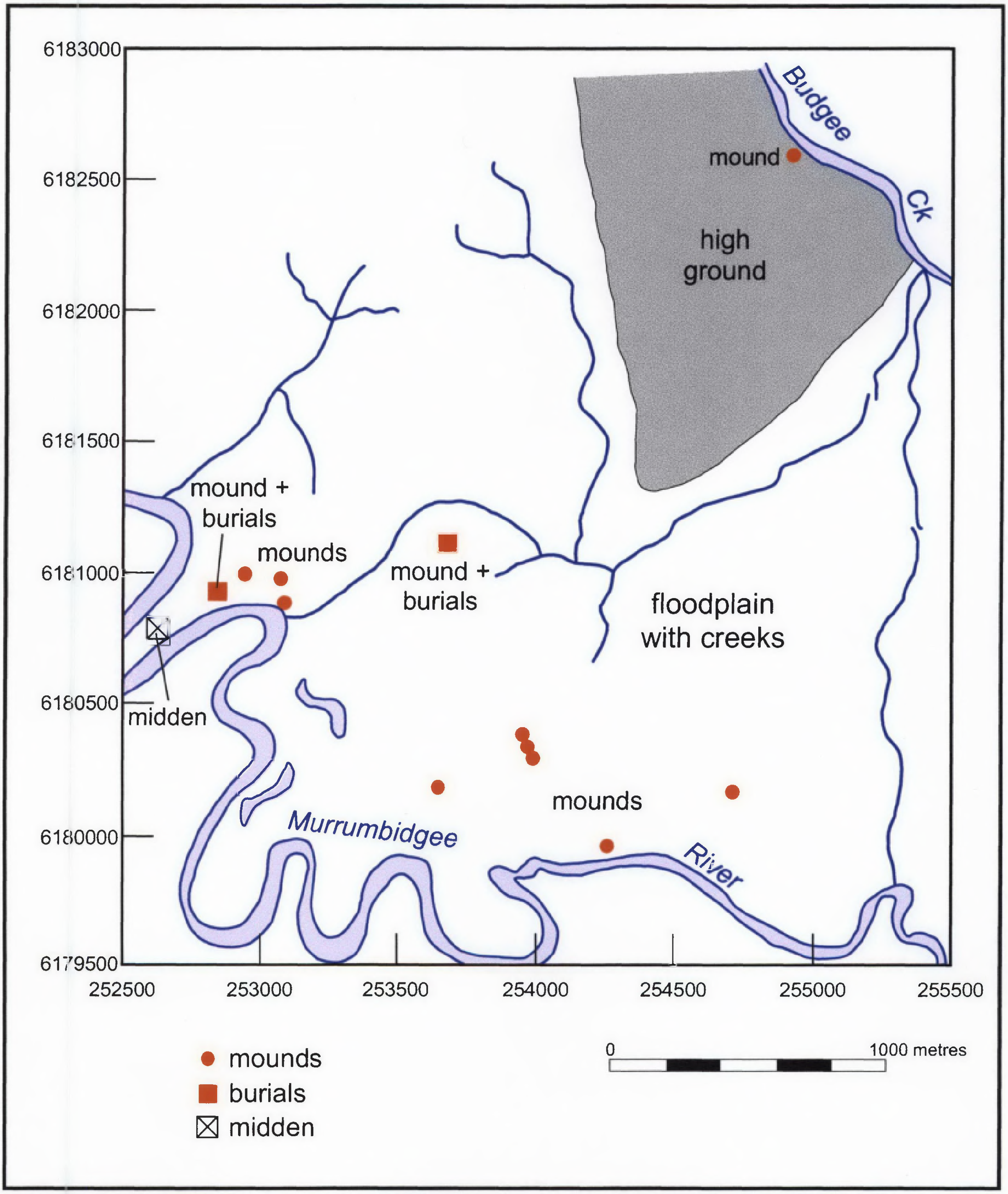



**Figure 7.3:** Location of Archaeological Material in Lowbidgee Sample Area

(*Muehlenbeckia* spp.). Figure 7.3 shows a section of the Murrumbidgee River further downstream in the Lowbidgee landform. In this area the floodplain is enclosed by a large anabranch creek (a palaeochannel), and contains creeks, billabongs and swamps. Large mounds are located near the anabranch creek, on the river levee, and several highs on the floodplain. Some mounds contain burials and a mound near the river has an unusually high shell content.

The Tchelery 1 mound complex consists of 4 large mounds and 4 smaller mounds located around a small swamp, and is also associated with a burial cluster identified as Tchelery 1 Burials (Figure 5.12). This mound complex is situated on a slightly raised palaeochannel feature on an otherwise flat plain of grey cracking clay rich soil. The Tchelery burial cluster is situated on a similar low rise on the plain between Tchelery 1 and the ephemeral Dry Lake which has a major complex of mounds, campsites, microblade workshops and burials.

The Ravensworth mounds 1-5 and features such as the lake, fences and the lunette type feature are shown in Figure 5.2. In April 1999 the irrigation runoff water in the lake was lowered and a relatively dense scatter of artefacts and heat retainer was located and recorded on the beach of the lake. The three shallow lakes to the east of the Ravensworth 1-5 complex all have a lunette like feature on the eastern margin which is the focus of the location of mounds and a burial cluster. Another mound previously recorded by the Hay Local Aboriginal Land Council is located to the south of the lakes on a palaeochannel deposit.

Ashy deposits have been recorded on the Lachlan River near the junction of Ita Creek and the Lachlan, and on the Lachlan in McFarlane's State Forest (Map 1). The Ita Creek ashy deposit is located on the creek levee and close to mounds related to a back swamp formed between the river and Ita Lake lunette. The McFarlane's State Forest ashy deposits are located on the river levee near where Pimpara Creek leaves the Lachlan. The ashy deposits in the Macfarlane's State Forest have 2-3 small mounds located on top of the deposit, and also contain burials. A cluster of mounds recorded adjacent to reed beds and open water lake on the edge of the Great Cumbungi Swamp system above the junction of the two rivers, was located on high sandy ground adjacent to the wetlands dominated by River Red gum, *Typha* and *Phragmites*.

On the Hay Plain Southeast, two small mounds were located in an unusual situation near a 'well' at South Burrabogie by the Pardoe and Martin (2001) survey. A large complex of artefact scatters, ovens and two small mounds are located in the vicinity of a 'well' designed to drain water from a raised sand ridge surrounded by hard scalded country. The amount of archaeological material surrounding this water catchment indicates that it was pre-European although it was later used for the homestead water supply. The mounds and four ovens are close together and below the high scalded country next to a swampy area, and large numbers of individual ovens are also located in the same general area. The two mounds are 18 x 17 metres and 14 x 11 metres and approximately 30cm high. Artefacts included fragments of grinding dish and bipolar and semibipolar cores and flakes/blades as well as some silcrete cobbles with cortex and larger flakes. In the second area scattered heat retainer and one oven were located with a large low density artefact scatter. In the third area 20 individual ovens plus an area of 8 closely spaced ovens (or one complex oven partly exposed) were recorded. This area is part of a raised palaeochannel or sandridge which travels from Narrandera to Moulamein via the Tchelery sandridge.

In summary, archaeological material is found on a range of minor landforms, with a strong tendency to be located on slightly raised sandier palaeochannel features. However, some mounds have been recorded on the low side of swamps and lakes or in floodways, in some cases on the black clay soils. There is a tendency for archaeological material of **all** types to be located on palaeochannel features to take advantage of the slightly raised sandier soils, thus mounds are no different to other types of material in this respect.

### *7.3.9 Distribution of Sites on the Hay Plains by Large Scale Topography*

The GIS maps do not delineate why the mounds are concentrated on the Hay Plain Southwest and Lowbidgee, and to lesser extent the Hay Plain Northwest, in other words, on the western half of the plain. The burials have an even more pronounced concentration on the western half of the plain, first noted by Bonhomme (1990b). Therefore factors other than geomorphology at this level of definition must influence this east-west distribution as the same or similar soils and landforms are found on both sides of the plain.

The different distribution of sites on the western compared to the eastern half of the Hay Plain does not directly relate to soil or geomorphology layers on the GIS mapping and therefore the distribution reflects another factor. When the distribution of mounds is considered against the topographic contours it is clear that mounds are concentrated on the lower half of the plain. The Plain slopes gently but consistently from east to west at an average gradient of 20cm per kilometre (Soil Conservation Service NSW 1990). The Hay Plain Southwest and Lowbidgee has a high concentration of mounds including the largest mounds. The mounds are confined to palaeochannel features and edges of swamps and ephemeral lakes, usually but not always on the eastern lunette-like feature. The Hay Plain Northwest has mounds around extent creeks, lakes and swamps, including the Great Cumbungi Swamp. The Hay Plain Southeast has very few mounds compared with the western plain, and more open sites with artefacts and individual ovens. The Hay Plain Northeast has no mounds, even around Mirrool Creek, other creeks, swamps and ephemeral lakes. Instead large open sites with individual ovens are found on source bordering dunes and levees of palaeochannels captured by modern creeks such as Mirrool Creek, and swamp edges and ephemeral lakes. Mounds are found on the confined trace or modern river channel of the Murrumbidgee East, but in a very narrow corridor and related to wetland features such as billabongs.

The plain slopes down until it abuts the high ground of the Murray Mallee near Balranald which deflects the water south to the Murray. Prior to the water control schemes of the last 100 years the western half of the Hay Plain including the Great Cumbungi Swamp acted as a sump collecting seasonal floodwater and excess rainfall in the numerous creeks, ephemeral lakes and swamps. Although the vegetation has changed radically over the last 150 years (Eardley 1999), it appears that mounds were concentrated around swamps, creeks and shallow lakes forming the 'reed beds' and 'lignum swamps' described in the ethnography and history (Chapter 8), and more recent ecological research (Eardley 1999, Porteners 1993, Kingsford 2003). This Murrumbidgee-Lachlan junction area or Lower Murrumbidgee area is often termed the 'Lowbidgee' (Page et al. 1996), a particularly apt name. Thus the broad scale topography of the Hay Plain is another layer that has to be added to the GIS analysis, although the original assumption was that the relative flatness of the plain meant that the broad scale topography was not a factor that would affect distribution of sites (Chapter 3).

The concentration of mounds on the Wakool, Edwards and Murray Rivers immediately to the south of the Hay Plain can be explained by similar topographic sinks and associated wetlands. The low areas of the 'Lowbidgee' and the Wakool, Edwards, Murray to the south are only separated by a slightly raised palaeochannel feature belonging to the Kerarbury System dated to 55-35 ka (Page et al. 1996).

## 7.4 THE INFLUENCE OF MODERN RIVERS AND PALAEOCHANNELS ON THE DISTRIBUTION OF MOUNDS

### *7.4.1 The Murrumbidgee River Channel*

The patterning of archaeological material along the Murrumbidgee River (photo 49) and also the Lachlan also reflects landform features that are too fine grained for the GIS survey of Pardoe and Martin (2001) or Maps 1-6. The distribution of sites can only be explained by a detailed examination of the topography and landform features along the rivers. Mounds are concentrated in particular areas of the Murrumbidgee and Lachlan channels that once again are strongly influenced by palaeochannel morphology. Middens have a different fine-grained distribution to mounds, tied to the morphology of the modern rivers, but this in turn is influenced by the ancestral Murrumbidgee and Lachlan. The Murrumbidgee is divided into sections with different morphology according to the interaction of the modern channel and the landform features left by the various palaeochannels. The Gum Creek ancestral system controls the course of the modern river between Carrathoool and Darlington Point and consists of a meander belt incised 1-3 metres below the surface of the plain. The meander cut offs, or lagoons on the maps, are much larger than the modern meanders and form distinct features on the flooplain that are filled by the floodwaters of the modern river. Mounds are concentrated in areas where such as large incised meanders form billabongs thus providing diverse habitats. These ancestral meanders decrease in size downstream (Page et al. 1996:318), but large 'lagoons' can still be clearly seen on the maps as far west as Cooey Point Lagoon which was a major focus of Klaver's work and included a large concentration of mounds and other sites. Between Cooey Point Lagoon and Hay smaller lagoons relate to the modern river system (Page et al. 1996:319), but mounds still tend to be clustered where there is interaction between the modern river and palaeochannels. For example 15 km upstream from Hay the Oolambeyan branch of Gum Creek palaeochannel cuts the modern river at the bend containing the Barham mound complex, and a section continues upstream to hit where the Illilwara site complex (Figure 7.1) is located. The palaeochannels in this area have several effects on the channel and floodplain morphology, including providing high sandy ground next to the river channel and influencing the position of modern meanders and billabongs. At Illilwara midden material is located on a high palaeochannel deposit forming the levee or outer bend of the modern river, while ovens and small mounds are located around the edge of a meander system with forest and billabong. However, the modern river morphology including the high bank with midden and the meander with mounds are affected by the palaeochannel system which crosscuts the river in this area. In the Hay area of the river, mounds tend to be small and lack diversity and density of associated material types such as stone artefacts or burials, reflecting the small billabongs they are associated with.

### *7.4.2 The Lowbidgee System*

To the west of Hay the Gum Creek and Kerarbury palaeochannels continue to exert influence but change character. They form further distributaries and begin to loose surface expression in the swampy region near Maude where they are largely obscured by deposition of recent fine-grained sediment and dense lignum (Page et al. 1996:319). Unfortunately much of this lignum has been recently cleared for irrigation crops on both sides of the river (Kingsford 2003). An exception to this is the Uara Creek reach dated to between 35-25 ka (Page et al. 1996:312), part of the Gum Creek palaeochannel system which branches from the southern side of the Murrumbidgee on the western side of Toogimbie and follows a sinuous course until it terminates in a complex set of relict lakes including Lake Kia and Lake Yanga near Balranald. Uara Creek follows a low ridge (formed from its palaeochannel levees), perched one or two metres above the lignum swamps either side which are (or were) flooded during seasonal floods (Page et al. 1996:319). These lignum swamps are very finely divided distributaries of the modern river and include Fiddler, Pollen and Nimmie Creek which leave the river near Toogimbie and Maude and follow a similar course to Uara Creek. Thus in this area palaeochannels with or without 'captured' modern creeks such as Uara Creek influence and alternate with the modern distributary networks. In the Toogimbie, Maude, Nap Nap, Jeraly area the location focus of mounds is on the slightly higher palaeochannel levees adjacent to the distributary creeks and lignum swamps. Further to the southwest, Uara Creek continues through the Yanga Nature Reserve which has a complex of mounds. Another creek similar to Uara ends up at Tala Lake, an open water lake with a series of lunettes, which is considered in the section on the Balranald sample area. In the Toogimbie-Pevensy area between Hay and Maude, more diffuse palaeochannel features form high ground at edge of the floodplain which is low enough to form 'back-swamps' similar to a photo in Page et al. (1996). Mounds tend to be located on the higher ground at the edge of the gradually widening floodplain, and prior to water regulation these mounds would have been adjacent to back swamps that were regularly flooded. Mounds are also located on high spots within this floodplain (photos 34-36), which are also expressions of palaeochannel features (see Pevensy West area in Section 7.3.8).

### *7.4.3 The Gum Creek/Abercrombie Creek System*

To the south of the Uara Creek system other palaeochannels and their modern 'captured' creeks such as Abercrombie Creek carry floodwater out onto the plains and the complex interaction between the palaeochannels and their modern creeks and the topography resulting from palaeochannel features and their reworking is the focus of the 'back paddocks' of Ravensworth, and the St Pauls, Tchelery, Dry Lake, Kerri East, Kerri Kerri and Baldon areas (photos 6-8, 14-16, 27-33). On these plains sites are found on palaeochannel features and around ephemeral lakes and swamps. The palaeochannel features vary considerably, but originated as channels, levees, meanders and source bordering dunes of relict systems. These relict systems may still operate in floods, as they may have a modern creek incised into the ancient channel (for example Abercrombie Creek) and this can fill the floodout areas, swamps and lakes. Other palaeochannels form raised ridges which are not easily identified as former river systems. These are known as 'sand creeks' by locals or 'elevated old river bed' on some maps. Such features cannot carry water being elevated and without a channel, however they still influence the flow of flood waters by acting as a dam wall and banking up water on the plain thus forming shallow swamps. A complex array of mounds, burials, ovens and artefact scatters are found on these ridges, especially where they overlook floodout areas, swamps and lakes. Some of the swamps or lakes have a low lunette-like feature on the eastern side, and this is often a focus of mound location. However, these may not be typical lunettes, but may have originated as meander scrolls or other source bordering dunes that have been reworked by aeolian and fluvial processes. The Abercrombie Creek system is part of the Gum Creek palaeochannel that leaves the Murrumbidgee River much further to the east than the Lowbidgee distributaries. Gum Creek leaves the Murrumbidgee River just to the west of Darlington Point, running through Gundaline and then branching out to form Abercrombie Creek, and other unnamed creeks which head out across the plains. Several branches also head back to the Murrumbidgee to places such as Tom's Point, Cooey Point and just west of Hay. Presumably this system accesses floodwater from the river in these places as well. It is also possible that in extremely high floods the Gum Creek-Abercrombie Creek system to the west of Hay may join with the Lowbidgee system. The large mounds complexes on the Hay Plain southwest areas of Ravensworth, Tchelery, Dry Lake, Kerri East, Kerri Kerri and Baldon as well as other stations that were not part of the survey, are located on this system. Mounds are not common on the upper reaches of this system, for example in the Gundaline back paddocks, but are concentrated on floodouts, swamps and lakes of the lower reaches.

### *7.4.4 The Hay Plain North West and Lachlan River*

The location of mounds along the Lachlan and the northwest plain follow similar patterns to those described above. Mounds recorded so far include the Toopuntal mounds on the edge of the Great Cumbungi Swamp, which are located on higher sandy areas adjacent to swamps and reed beds. The Great Cumbungi Swamp is located near the junction of the Murrumbidgee and the Lachlan, and forms part of the 'Lowbidgee'. Mitchell describes this lower end of the Lachlan as being of quite different character to the 'muddy holes' above; '...the river Lachlan is in no part better defined than where it enters the basin of the Murrumbidgee. Water, which had been so scarce in other parts, was abundant where its channel and immediate margins assumed the reedy character of the greater river' (Mitchell 1839 Vol. II:78).

At Ita Lake mounds were recorded in the vicinity of the inlet creek and the higher ground near floodplain backswamps, but not on the lake itself or the lunette. Nearby sections of the lower Lachlan River are characterized by middens and large ashy deposits on river levees, some associated with small mounds. The Hay Plain north-west has a number of palaeochannels with captured creeks flowing from the Lachlan to the Murrumbidgee (for example Pimpara Creek). Initial survey indicates that the situation may be similar to the Hay Plain southwest, where mounds are concentrated on the lower reaches of these creeks rather than the upper reaches.

### *7.4.5 Summary of Modern River and Paleochannel Influences*

There are a number of different sections of the Hay Plain with mound complexes, and it is probable that there will be variations in the mound characteristics in these diverse landforms:

- The eastern section of the Central Murrumbidgee, from Cooey Point Lagoon eastwards, contains large palaeo-meanders or 'lagoons' which are the focus of mound location.

- The western section of the Central Murrumbidgee around Hay is occasionally cut by palaeochannels which influence mound location by creating more diverse landscapes to locate mounds, such as higher sandier levees, larger than normal meanders and billabongs.
- The 'Lowbidgee' section of the Murrumbidgee displays interaction between the modern river and its finely divided distributary channels branching out across the low plains and a system of palaeochannels, some with modern creeks, provides floodplain back-swamps and alternating swampy areas and high ground with mounds being located on the higher palaeochannel levees.
- On the Hay Plain Southwest to the south of the 'Lowbidgee' system the Gum Creek system with captured modern creeks such as Abercrombie creek channel water out to the back plains where the interaction between the low lying plains and the diverse palaeochannel features form a variety of floodouts, swamps and ephemeral lakes, and the higher sandier palaeochannel features next to the floodouts, swamps and lakes are the focus of location for mounds.
- The Hay Plain Northwest has a number of anabranches and creeks that are the focus of mound location, particularly in the lower reaches.
- The Lachlan River east of Oxley has a similar type of site location as the western Central Murrumbidgee, but also has ashy deposits as well as middens and mounds.
- The Lachlan River west of Oxley forms a widening floodplain with large swamps, which becomes part of the Lowbidgee system and mounds are located on higher ground around the Great Cumbungi Swamp, distributary creeks, swamps and shallow lakes.

## 7.5 THE RELATIONSHIP BETWEEN THE MURRUMBIDGEE AND LACHLAN RIVERS AND WETLANDS

By examining the results of the location of mounds across the Hay Plain we can now start to ask in more detail why mounds are confined to certain areas. It is clear that mounds are located on very specific combinations of landforms and different landforms from east to west across the plain and north to south across the plain. A variety of features such as incised large palaeo-lagoons, as well as swamps/ephemeral lakes are being targeted across the Hay Plain. The swamps/ephemeral lakes in the Lowbidgee area are a focus of mound activity, but not similar looking features on the northeast or south east part of the plain and it is postulated that the swamps/ephemeral lakes of the Lowbidgee area have been targeted because the low lying area retains water for longer periods than the more elevated and sloping eastern parts of the plain. This is borne out by the vegetation of the two areas, with the eastern part of the plain previously dominated by *Acacia pendula* which does not withstand long term flooding (photo 26). The *Acacia* woodlands have been reduced by clearing and agriculture, and the grasslands result from overgrazing of the Acacia woodland community, which formerly had an *Atriplex nummularia, Atriplex vesicaria, Maireana aphylla* understorey (Porteners 1993:51-53). The pre-pastoral *Acacia pendula* community was found on the same kind of soils (grey and brown clays) and landforms (level to depressed plains adjacent to streams or in depression) (Porteners 1993:51) as found on the western side of the Hay Plain, but it occupied slightly higher levels on the eastern plains (Porteners 1993:62). The *Acacia pendula* Woodland community is located on higher country and therefore largely out of the distribution of mounds. The original distribution of *Acacia pendula* is frequently covered by a grassland disclimax, but grasslands can also result from a disclimax of communities other than *Acacia pendula* (Porteners 1993:64-71). Swamps in the southeastern Hay Plain tend not to have mounds, but simple oven features are common (Kelton 1999, Martin 2000a). The Hay Plain Northeast has a lack of mounds despite features such as creeks, swamps and lakes (photo 50), which appear to be similar to features that are a focus of mound location on the Hay Plain Southwest. In this area simple ovens and large artefact scatters are common particularly along creeks such as Mirrool Creek.

It is necessary to recreate the pre-water regulation landscape to understand what the flood regime and wetlands were at that time. The Lowbidgee was a nationally important wetland covering at least 303,781 ha at the beginning of the 20th century. Downstream from Hay, about 85% of floodwaters overflowed into wetlands as the main channel below Hay could only carry about 15%. Floods were carried across the floodplain by the distributary creeks (Fiddlers, Uara, Caira, Nimmie, Pollen, Waugorah, Talpee, Monkem, Kietta, Yanga and Paika) that form a highly interconnected network including complex wetland systems (Kingsford 2003:71).

The building of 26 storages over the last 140 years on the Murrumbidgee River has destroyed or degraded at least 76% of the floodplain and remaining wetland is considerably altered. During the 1980's and 1990's the Lower Murrumbidgee (shortened to Lowbidgee) floodplain was rapidly developed for irrigation (Kingsford 2003:69,72,73, Frazier et al. 2005:302). Such development in itself was one of the driving forces behind the push by the Hay LALC to have its heritage recorded and protected. The regulation and diversion for irrigation has reduced median outflows at the junction of the Murrumbidgee and Murray to 25% of natural levels, and dry years that formally occurred 5% of years now occur in 57% of years (Kingsford 2003:71). The Lowbidgee area was also affected by the development in the 1960's -1980's of confinement systems which prevented water from flowing out from the distributary creeks into the swamps, for example Caira Cutting near Maude. After 1980, channels, levee banks and regulators constricted water to floodways and special habitat areas, with there now being over 2,000 km of levees and 394 km of channels on the (mostly southern) Lowbidgee. The reduction in flows and irrigation development on the Lowbidgee resulted in the loss of 76% of the floodplain habitat, loss of floodplain vegetation, and loss of waterbirds, fish, frogs and aquatic invertebrates (Kingsford 2003:74-5). The distributary creeks, such as Abercrombie Creek, that formerly flooded the Hay Plain Southwest ceased to function normally well before the Lowbidgee distributary creeks listed above, probably in the early part of the 20th century when the large upstream infrastructure of Burrinjuck Dam, Berembed Weir, Yanko Weir, MIA Main Canal were constructed (Kingsford 2003:72). Thus the swamps which are the focus of mound location in the Tchelery, Dry Lake, Ravensworth, Kerri East, Baldon, Kerri Kerri areas may have been substantially dry for about 100 years except for rare exceptional flood years such as 1956 or 1975. In fact they may have been substantially dry for considerably longer. In 1863, on a flood-time trip from Moulamein to the Murrumbidgee across open plains 'surrounded with water' and 'not being able to procede for the Lignum Marshes', Westwood stopped at 'Dry Lake, so called ... because for a long time it has been destitute of water, although this year, strange to say, it is quite full, and abounds with wild geese, ducks, and waterhens, in great variety, and plenty of good barley grass for the horses growing on the margin' (Westwood 1865:355).

An interesting feature of mound location is that large open lakes with high sandy lunettes such as Tala, Yanga and Ita Lakes are not important areas for mounds, tending to be characterised by large shell middens and significant numbers of burials. The mounds at Ita Lake are located in the area between lake and the river and near the inlet creek and a backswamp, not on the lunette or lake margins. This suggests that either these lakes were too deep or the sediment unsuitable for the resources processed in mounds. An 1846 account of Tala Lake from G. A. Robinson indicates that Tala and Yanga were 20 feet deep in winter but contained mussels, waterbirds and fish;

> Reached Tala near the junction of the Lachlan a shallow bason [sic]of fresh water three miles in circumference abounding in water fowl, fish and aborigines... Tala shallow and Yangha, but deep in winter, 20 feet water. Number [of] ducks and wildfowl: native companion, pelican, crane, and swans. ... Upwards of 100 or 200 pelicans, crane, white, large number of ducks, plovers, miles of swans, white spoon bills ...descended to a large camp on beach, went through the camp about 300 natives altogether, men, women and children, very civil. Walgerre [Walgeers] , Tala, Yanga, and other blacks present. Said women fishing for shells. One large cod caught... (Clark 2000:31-32).

In meandering rivers with well-developed flood plains, flood pulses have major ecological impact, sediment begins to be deposited on the floodplains, wetlands are progressively inundated and there is a connection between the channel and floodplain habitats. Flooding of floodplains and wetlands is the major force controlling biota in river-flood plain systems and the bulk of riverine biomass is derived directly or indirectly from production within the floodplains and not from downstream transport of organic matter (Page et al. 2005:567).

The amount of biomass produced by flooding is related to the duration of channel to wetland connection, ie. whether it connects at bankfull or before bankfull and how long this lasts. It is also related to the width of the floodplain, the wider and more complex the floodplain the more biologically productive. The Murrumbidgee floodplain width varies from between 1-4 km wide between Wagga Wagga and Gundagai, increasing to 10 km wide upstream from Narrandera where an extensive region of anabranches, palaeochannel remnants and backswamps exist. After passing through the narrow gap at Narrandera it enters the riverine plain but flows through a narrow floodplain of between 2-6 km, characterised by the palaeomeanders discussed above which provide significant wetland habitats. Downstream of Carrathool the Murrumbidgee follows a sinuous course confined to the Holocene floodplain less than 1km wide. Near Maude (actually from the Pevensy/Toocimbie area between Hay and

Maude) it enters the extensive Lowbidgee region where the floodplain gradually increases to a maximum width of 45 km (Page et al. 2005: 569).

The Lowbidgee region discussed above has a number of ways of increasing floodplain width and complexity including the vein like network of distributary channels discussed above, and the interplay between modern river features and the numerous palaeochannel systems. One aspect of this region is that extensive swamps fill with water through natural breaches in the river banks at a level below bankfull, which means that they could (before water regulation) fill often from lower floodpulses as well as the higher flood pulses. The large capacity of the Lowbidgee wetlands results in a significant lowering of flood peaks downstream, for example in the Balranald area. The wetlands have to fill before there is a significant flood peak at Balranald (Page et al. 2005:576). It is also significant that water escapes the river channel into the wetlands at low flood pulses as well as high flood pulses, thus providing more opportunity for water to reach the wetlands. This is reflected in the Wiradjuri meaning of Murrumbidgee: '*Mor'room-bee-ja.* At times (or often) has overflown, or turned aside' (Richards 1902b: 136*).* The general low lying nature of the Lowbidgee would then have the effect of retaining water longer in wetlands because of the lower gravitational pull of water back into the main channel. The Balranald area would therefore have fewer flood pulses than the Lowbidgee area, because the Lowbidgee captures much of the floodwater in its extensive wetlands. This may help explain why no mounds were found on the narrow floodplain at Auley, or the floodplain between Tala Lake and the Murrumbidgee, near Balranald. This more fully explains the conclusions drawn in 7.3.8 that the western half of the Hay Plain had more mounds because it forms a low-lying 'sink' for floodwaters.

The recent concept of network dynamics provides a framework for understanding how the spatial structures of different areas of the Murrumbidgee-Lachlan total system and time varying watershed influences create and maintain habitat heterogeneity and potentially promote biological diversity and productivity in such a riverine ecosystem (Benda et al. 2004). Although writing about North America, the idea is applicable to the Murrumbidgee and Lachlan Rivers despite the very different spatial structures and the unique flooding and sedimentological patterns. As the Lachlan and Murrumbidgee head towards their junction, anabranches and distributary creeks increase and often flow between the two rivers, thus adding a confluence density effect that increases diversity and productivity. The junction or confluence of the two rivers has created the major wetland habitat of the Great Cumbungi Swamp, and is in form similar to a delta with high input of sediment and nutrients. The wide floodplain of the Lower Murrumbidgee has a network of anabranches and distributaries which increases the habitat diversity and productivity compared to the confined trace of the Murrumbidgee to the east of Hay. This geometry and increased confluences combined with the increased flood overflows creates the rich wetland areas that have influenced the distribution of archaeological material.

## 7.6 DISTRIBUTION OF ARCHAEOLOGICAL MATERIAL IN THE BALRANALD MURRAY MALLEE SANDPLAIN

The previous sections outlined reasons for the distribution of mounds on the Hay Plain. By comparing the distribution on the Hay Plain and adjoining but different landforms we can test some of the previous conclusions. The Murray Mallee near Balranald and immediately adjacent to the Hay Plain was chosen because it is a continuation of the Murrumbidgee system but a radically different geomorphology, soils and landform. The Balranald area was sampled as part of the Pardoe and Martin (2001) survey. One area on the western side of the Murrumbidgee River was surveyed (Auley) and this is embedded in the Mallee sandplain red sandy soils (Map 2) (Eardley 1999). Tala Lake on Goolparle on the eastern side of the Murrumbidgee was also surveyed (Map 2). Tala Lake encompasses a large open water lake, high sandy lunette (with older lunette behind), floodway and outlet creek straddling the boundary between the dark cracking clay soil of the Murrumbidgee floodplain and the Mallee region red sandy soils, the south and east edges of the lake etched into the Mallee region, and on the western side the inlet creek and floodway characterised by typical dark grey cracking clay soils of the Murrumbidgee Riverine Plain. Tala Lake is the termination of Monkem Creek which flows through a palaeochannel system which leaves the Murrumbidgee River at Nap Nap.

The survey on Auley (photo 38), on the western side of the Murrumbidgee River just to the north of Balranald, included the area where the floodplain and Mallee sandplain abutted, and sample area included areas of floodplain and sandplain. Very little archaeological material was located in these sample areas, despite extensive sampling of the relatively confined floodplain with lignum, canegrass, nardoo and various sedges, creeks, channels and river levee. One ploughed oven with three silcrete flakes were recorded on a sandhill on sandplain adjacent to the floodplain, and several scarred trees including a large canoe tree were recorded on the floodplain.

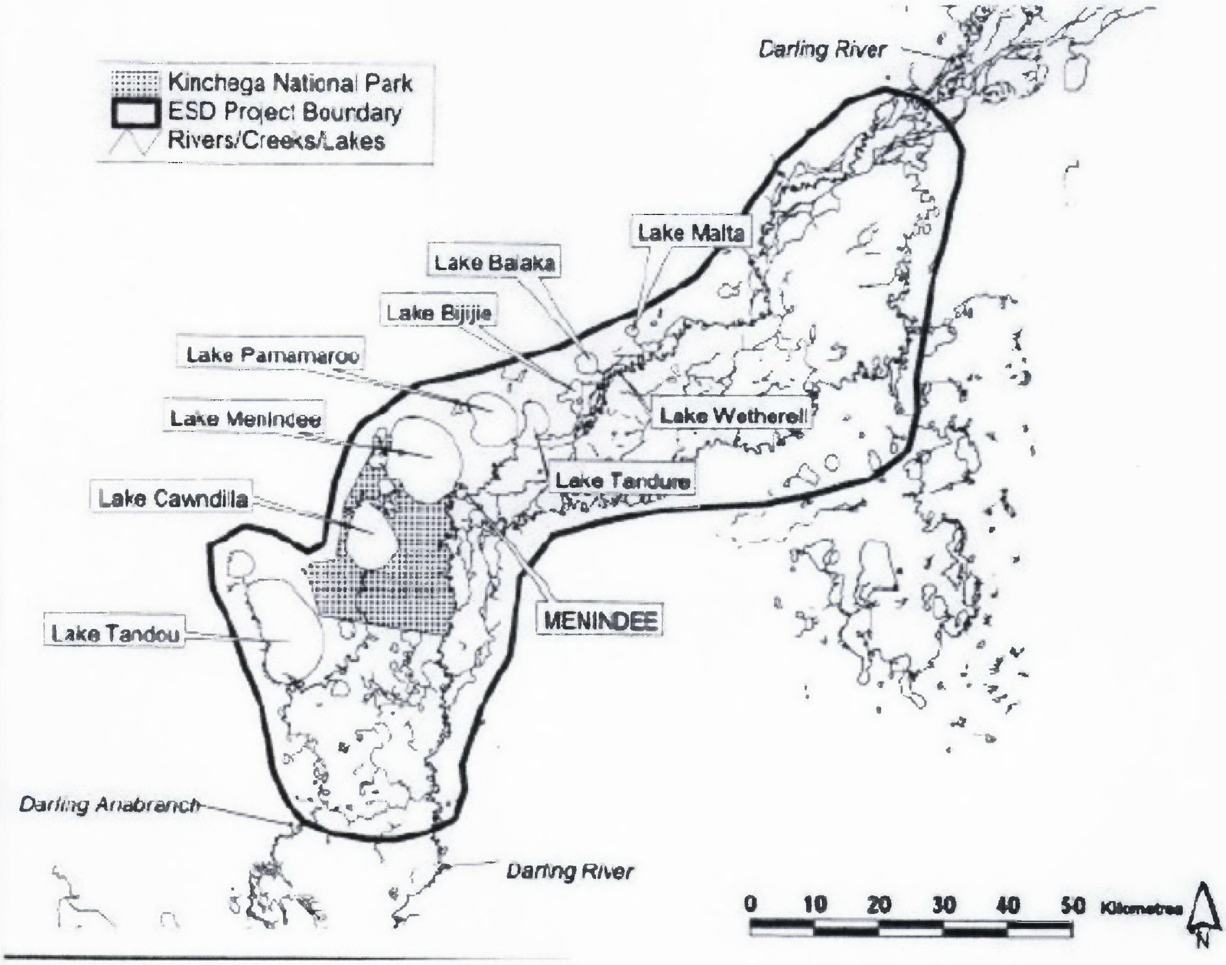
The survey on Goolparle Station eastern side of the river included Mallee sandplain where it abutted and overlooked the river floodplain, and the southern edge of Tala Lake (photo 37), its outlet creek and some Murrumbidgee floodplain. Numerous sites were recorded around Tala Lake including a burial and several shell middens. One very small mound or large oven was located on the lunette, and a shell midden near the outlet creek/lake junction was also defined as a mound for the 2001 survey, although it was more typical of a large shell midden and was found in association with a number of shell middens of varying sizes. No mounds or other sites were found on the river floodplain or the lake outlet creek. Some ovens and artefacts were located on the second lunette of Tala Lake where it abuts the Mallee sandplain.

The sample survey of the Balranald area indicates that the western boundary of mound distribution is defined by the boundary between the Riverine Plain and the sandplains of the Southern Mallee. Similarly after the Murray River flows into the Southern Mallee it tends to have large middens but the AHIMS register does list any mounds on the Murray River after it enters the Mallee sandplain. This suggests that while mounds are found on the Murray riverine plain, they not found in the Murray Mallee sandplain.

## 7.7 DISTRIBUTION OF ASHY DEPOSITS IN THE MENINDEE LAKES/DARLING RIVER

The Menindee Lakes and adjacent Darling River was compared to the Hay Plain because it is on a different river system but one with similarities to the Murrumbidgee River and which could reasonably be expected to have mounds. The Menindee Lakes are a series of large overflow lakes fed by the modern Darling River, through inlet/outlet creeks that run across the floodplain (Figure 7.4). The modern Darling River and its floodplain channels, anabranches, billabongs, and lakes; and the ancestral river (Talyawalka/Darling River Anabranch) cross each other to the east of Lake Cawndilla and near the southern end of the Menindee Lakes system. Palaeo-features relating to the ancestral system, often characterised by whitish sand deposits, can also be seen on the floodplain near Menindee and near the northern lakes.

Figure 7.4 The Menindee Lakes and Darling River (from Martin 2001 and courtesy of the Menindee Lakes ESD Project)




This complex riverine geomorphology was sampled to determine if mounds were present. Although Klaver suggests the Darling River system does not have mounds, she suggests that 'the potential for oven mounds to be present in this region, where repetitive use of richer localised microenvironments occurs, should not be discounted' (Klaver 1998:308). Possible small mounds or ashy deposits have been found near Bourke (Martin 1995a), and mounds have been recorded on the tributaries of the Darling including the Macquarie Marshes (Balme and Beck 1996), and a single mound has been located at Narran Lake (Martin 1979 and Solomon 1998). The presence or absence of mounds at Menindee was tested to further delineate factors affecting the distribution of mounds.

The lower three Menindee Lakes (Tandou, Cawndilla and Menindee), and to some extent Pamamaroo, have been the subject of several archaeological surveys beginning with N.B Tindale in 1938 (Tindale 1938-39). However, the higher lakes, Tandure, Bijijie, Malta and Balaka, and the Darling River adjoining the higher lakes had been largely ignored until a large-scale GIS survey of the Menindee Lakes and the adjacent Darling River was carried out in 2001 as part of the Menindee Lakes Ecologically Sustainable Development Project (Martin 2001, Pardoe & Martin 2002). During these surveys we recorded ovens with ashy deposits, ashy deposits exposed at ground level or buried, and ashy deposits with height above ground level, indicating that features with similarities to ashy deposits and mounds of the Hay Plain are widespread. The ashy deposits were confined to wetland environments such as large billabongs and backswamps on the river floodplain, and lake inlet and outlet creeks. Figure 7.5 shows ashy deposits on the inlet and outlet creeks of the shallow Lake Bijijie on the left, and on a large billabong of the Darling River on the right. Previous to this, a large ashy deposit was recorded at Lake Cawndilla (Martin et al. 1994). In 2002-2003 additional survey was carried out at Menindee to delineate some of the ashy deposits in more detail for this thesis, and to provide a data base for comparison with the Hay Plain mounds (Martin 2003).

The Menindee deposits are labelled ashy grey deposits because they have some significant differences to the Hay Plain mounds as well as similarities. They are composed of similar almost black, dark grey to paler grey or grey-brown deposit with variable amounts of ash, charcoal and heat retainers. The heat retainers are similar in size and are distributed through the deposit as well as occurring in individual oven remains. The deposits are often built up between 5-50 cm, although averaging only 16 cm. Some deposits are flat and exposed at ground level and up to 40cm in depth. They have similar carbonised or calcined and fragmented faunal remains including fish, mussel, yabby, bird, and small and larger mammals. The Menindee ashy deposits are also similar to the Hay Plain mounds in that they often contain burials, despite that fact that burials in the Menindee area are not usually seen in occupation deposits such as middens,

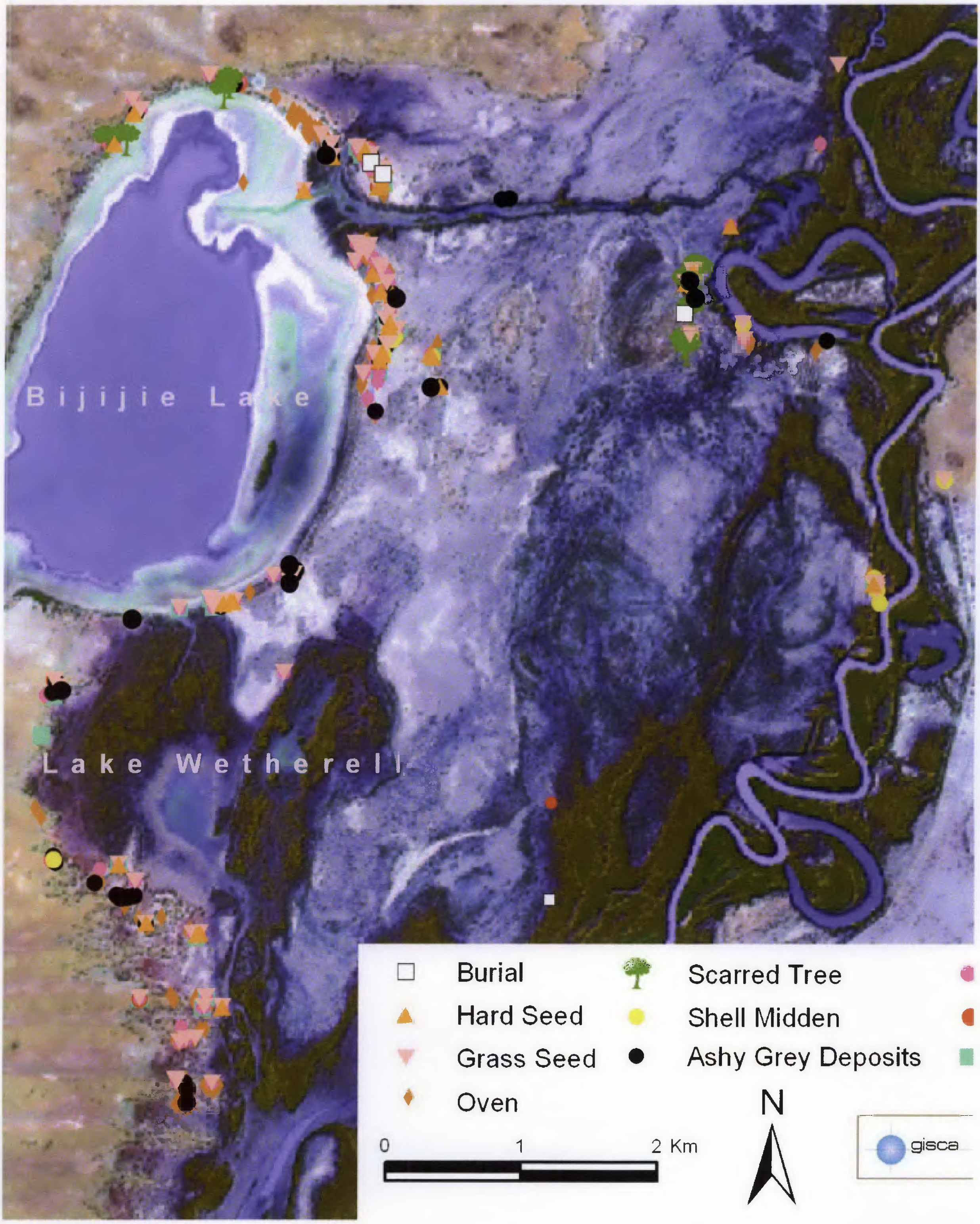



Figure 7.5 Bijijie Lake and Darling River showing ashy deposits located on a large billabong, lake inlet and outlet creeks (adapted from Pardoe & Martin 2002)

but are usually found on source bordering dunes, lunettes or occasionally linear dunes that poke out into the floodplain. In 2002 a large burial ground on the edge of Cawndilla Creek was exposed due to the lowering of the artificially high water levels in Cawndilla Lake, and the remaining in-situ burials were located within a dark ashy deposit with heat retainer and burnt bone (Martin 2003). A similar deposit was recorded on the opposite side of the lake and this also contained burials, although most of the many burials around Cawndilla Lake were recorded from the lunette or dunes (Martin et al. 1994).

The significant differences between these deposits and the Riverine Plain mounds are;

i. They tend to lack 'roundness', ie. are not formed into round or oval based deliberately mounded up deposits (Chapter 8.2). The outline is often irregular and elongate following the natural topographic feature they have been built on such as levee bank or source bordering dune.

ii. They tend to lack 'moundedness' ie. are usually not formed into deliberately mounded up deposits (Chapter 8.2). The impression is that they grew from similar material but the desire to shape and mound was lacking, although in some erosion has scoured around the edges and created an impression of 'moundedness' (photo 4).

iii. The heat retainers used at Menindee vary considerably, usually termite mound near sandplain, baked clay near the river or rarely other material such as broken up grinding dishes or flaked artefacts, sandplain calcrete or soft river sandstone. The same type of material is found in individual ovens and ashy deposits throughout the Menindee area. Surveys show that usually the closest available material was used (Table 7.4), so this is not significant except that the materials other than baked clay do not break down as readily and would not contribute as much sediment to the deposit. Some of the largest ashy deposits recorded at Menindee contain baked clay, which suggests this is one factor influencing the build up of ashy deposits.

*Table 7.4 : Variation in Heat Retainer Material at Menindee (each sample >100)*

| Location | Data Base | Termite mound | River sandston e | calcrete | T.mound+ calcrete | T.m+ silcrete artefact | Tm+cal+ grinding dish | Baked clay |
|---|---|---|---|---|---|---|---|---|
| Menindee & Cawndilla Lakes | Martin, Witter& Webb 1994 | 67.7% | 0 | 10.8% | 17.2% | 3.2 | 1.1% | 0 |
| Location | Data Base | Termite mound | T.m + calcrete | T.m + river sandstone | T.m + baked clay | Baked clay+ Tm | Tm/baked clay/river sandstone | Baked clay |
| Pamamaroo Lake& sandplain | Pardoe &Martin 2002 | 100% | | | | | | |
| Balaka Lake DarlingRiver Floodplain | Pardoe &Martin 2002 | 39.4% | | 6.7% | 32.7% | 1% | 1% | 19.2% |
| Lake Bijijie & sandplain | Pardoe &Martin 2002 | 74% | 24.7% | 1% | | | | |

iv. Stone artefacts reflect the type and density of stone material found on other sites in the Menindee area, and the types of food processing employed. The amount and type of grinding/pounding material indicates that both hard and soft seed grinding was important, and the ethnography indicates pounding of *Bolboschoenus* corms was also important (Chapter 4). Menindee ashy deposits therefore contain a high density of flaked stone material and grinding/pounding material. The artefacts are on average much larger than the Hay artefacts, although small backed blade technology similar to that found on the Hay Plain mounds is also present on these sites.

v. Some of the ashy deposits display intact ovens, dinnertime shell middens, and stone flaking activity areas recognisable on the surface, that is some of the Menindee ashy deposits show less of a 'raked over' or 'dug up' appearance than the Hay Plain mounds.

vi. The Menindee ashy deposits have evidence of a greater range of activities carried out on them. Evidence for this includes the density and variety of grinding and pounding equipment indicating that a range of plant foods were processed on these sites, dinner time middens indicating that individual shellfish meals were eaten on site, small clusters of intact small river gastropod shells suggesting that line fishing was carried out from sites immediately adjacent to the river (assuming the body was used for bait as it still is used by Paakantji today -personal observation).

vii. The Menindee ashy deposits also include areas that are not built up, but just exposed on the surface by recent erosion or those that are exposed in banks of lakes and the river. Therefore not all ashy deposits at Menindee are currently built up above the existing ground level. Many are actually buried beneath 5-10cm of leaf litter and wind blown material, and the deposit may have a depth of 30-40cm. Some of these are exposed in cross section of banks and do not appear to be buried 'mounds', but buried layers of deposit. These deposits are similar to the ashy deposits recorded in MacFarlane's State Forest on the Lachlan River, Hay Plain.

In some areas there was a clear progression of erosion in one location from ashy deposit containing 'raked over' heat retainer and individual ovens, to isolated individual ovens with ashy deposit beneath the cap of heat retainer, to scattered heat retainer and artefacts forming a lag over an erosional surface. This progression is a direct result of the erosion of an ashy deposit and is similar to the residual mounds of the Hay Plain except that the deposit has little height and there are more individual ovens, ie. the deposit was less 'dug over' and densely packed with heat retainer. In other areas a pavement of heat retainer and artefacts formed after the ashy deposit has been blown away, similar to remnant mounds on the Hay Plain. Such a pavement will only form after the erosion of a reasonably thick deposit with a large amount of heat retainer, not just widely spaced individual ovens. Other areas at Menindee, including lake lunettes or cliff edges, are characterised by numerous individual ovens which are too widely spaced to have been part of an ashy deposit.

At Menindee the ashy deposits and shell middens formed a continuum from ashy deposits with burnt, fragmented and dispersed shell to ashy deposits incorporating delineated lenses of whole, broken and fragmented shell and/or dinner time middens, to middens with whole or large pieces of shell but also containing some ovens or dispersed heat retainer, to middens consisting almost entirely of lenses of whole and broken shell. This continuum is not seen on the Hay Plain, where middens are confined to sections of modern river channel levee or lunettes on large open lakes, and mounds incorporate variable amounts of fragmented, burnt and always dispersed shell. Individual lenses or dinner-time clusters of shell cannot be delineated in the

Hay Plain mounds, as the faunal material is burnt, fragmented and mixed.

In summary, the ashy grey deposits of the Menindee area are similar to Hay Plain mounds in colour, presence of ash, charcoal, sediment, heat retainers, burnt faunal material and stone artefacts, and various degrees of dug over appearance. Some are also built up, but as low irregularly shaped deposits that follow the outline of the underlying topography. Some exist as buried or partly buried deposits. The material of the heat retainers and stone artefacts is similar to other sites in the Menindee area, and different to and more variable than the Hay Plain mounds. The variety and density of stone artefacts is similar to other sites in the Menindee area, characterised by high density of varying technologies including microblade, split pebble, utilitarian flaked and a high density and variety of both soft seed and hard seed grinding equipment. Imported flaked artefacts including tulas and pirri points are relatively common (Martin et al. 1994, Pardoe & Martin 2002). The ashy grey deposits are located in analogous landforms to the Hay Plain mounds, that is in biologically productive and predictable wetland habitats where the river overflows to fill billabongs, floodplain swamps, lake inlet/outlet creeks and shallow lakes. There is also a similarity between the Menindee ashy deposits and the Lachlan River ashy deposits in location, shape, size and content, although stone artefacts are very different in each area.

In the Darling River system less predictable and frequent flooding means that dense stands of semi-aquatic plants such as *Bolboschoenus* are restricted to areas that are closely attached to the river system and flood frequently, such as billabongs and lake inlet and outlet creeks and some gently shelving shallow lake edges. Ashy deposits are not widespread on the Darling River floodplain as it does not flood frequently enough in most areas for permanent wetlands. Grass and *Acacia* seeds more important in these areas (Allen 1972, 1974). Early writers noted that the Darling River was characterised by 'extensive polygonum [lignum] flats, and the absence of reed beds' (Blandowski 1858:128). Although some *Typha* grew on the Darling, and still does, there were no extensive reed beds such as found on the Murrumbidgee, Lachlan and Murray riverine plains. Other types of semi-aquatic resources such as *Bolboschoenus* corms were the focus of cooking in ovens in the Menindee wetland areas, and in the non-wetland floodplain and hinterland, dry-land roots such as *Vigna* (Chapter 4) and 'a conglomerate of roots which they steamed in their ovens' (Bulmer in Campbell 1994:52) were the focus. Thus the cooking of carbohydrate-rich 'roots' in ovens was significant and resulted in widespread individual heat retainer ovens in non wetland areas, and in the semi-permanent wetlands on the Menindee Lakes-Darling River floodplain it resulted in large ashy deposits. In the permanent, predictable wetlands such as the Macquarie Marshes the focus on wetland plants resulted in large heat retainer-rich deposits in the form of mounds similar to the Hay Plain mounds.

## 7.8. DISTRIBUTION OF STONE ARTEFACT TECHNOLOGY ON THE HAY PLAIN

### *7.8.1 Recording of Stone Artefacts*

The aim of this section is to delineate patterns of technology and stone artefact spatial and temporal distribution that are then used for comparison with patterns of distribution of archaeological material discussed above. Stone artefact assemblages of the Hay Plain have been studied in detail by Martin and Klaver (Klaver 1998, Martin 1996a, 1996c, 2000a, Pardoe & Martin 2001) and additional data from an isolated survey has been incorporated (Edmonds 1995). The excavation of the mounds Tchelery 1 and Ravensworth 3 also provided some chronological context as artefacts were found throughout their 4,300 BP to 3,700 BP history. Sites sampled for analysis were chosen on a major and minor landform basis across the Hay Plain and general locations are shown in Figure 5.1. Unfortunately the sites recorded on the Murrumbidgee River and Lachlan Rivers tended to have too few artefacts for detailed analysis.

Stone artefacts provided the only archaeological method of looking for patterns across the entire Hay Plain, including areas with and without mounds. Stone artefacts provided comparative material within mound complexes, between mound complexes, and between mounds and non-mound archaeological sites. The Window Sample form was used to record artefacts (Appendix 7.2), and this was adapted from forms used in western NSW for stone artefact recording by the writer, based on Dan Witter's forms. The forms record material, artefact type, platform and termination type, size, and percentage of cortex. Size measurements included length, width and thickness. For flakes and blades, the length is taken as the 'percussion length', or the length from the point of impact along the flaking axis to the termination. The width is measured at right angles to the length and approximately midway along the length axis, or 'width at mid-point' (Holdaway & Stern 2004:137-139). Thickness is taken at the same place as the width measurement, or 'thickness at mid-point' (Holdaway & Stern 2004:140). These measurements are not necessarily the maximum measurements. Samples of sufficient size were converted into 'Witter' reduction charts (Appendix 2) to assist in site comparison and interpretation of the technology (Witter 1992).

### *7.8.2 Hay Plain Southwest Stone Artefact Technology*

i. Bipolar Microblade Technology

The Hay Plain is dominated by a distinctive Microblade Technology which is characterised by maximum reduction of cores and the production of minute flakes and blades (Charts 1-6 Appendix 2). This technology dominated throughout both the Ravensworth 3 and Tchelery 1 excavations, which are dated to between 4,300 BP and 3,700 BP. Cores are very small, usually less than 20mm in the longest dimension. Bipolar flaking methods have been employed because of the small inertial mass. Most cores have been bipolar split after they reach a reduced stage and final discard is represented by tiny blocks with crushing on both ends and flaked on one or two sides. Discarded bipolar spit cores can be recycled as tool such as adzes or burins. Although defined as Microblade, in fact the small core size and average quality of material has made the production of classic blades (straight sides, thin, and with blade scars) very difficult. The products have nevertheless been utilised for the production of backed 'blades'. The geometrics are all small, ranging in length from 20mm to 8mm, some of them so small the backing can only be identified using a hand lens. Minor use-wear is common on the chord of finished geometrics. Unfinished geometrics are common, indicating that they were being manufactured on some mound sites. The geometrics are usually crescentic in shape with backing on three sides. Bondi points have been made from slightly larger cores, either earlier in the production stage or the Bondi points may have been brought in as finished items. Burins also occur in low numbers. Other stone tools found on the mound sites include unspecialised microblade/flakes with use-wear and/or scalar retouch, and rare micro-convex or snapped blades with retouch and/or use-wear.

Almost all cores and products are less than 20mm in length, the average length of flakes/blades being 14mm. Geometrics and Bondi points are occasionally larger and therefore cluster together on the right-hand side of the reduction charts (Charts 1-6 Appendix 2), forming a rough high angle regression line. The expected blade production low angle regression line is not present in the reduction charts because so few classic thin blades are produced in these sites, in contrast to Microblade sites in other regions Blocks are grouped on the left-hand side of the artefacts, and bipolar split cores tend to sit on the top. Ground edge axes (traded from Mt William in Victoria or similar source) are indicated by flakes removed through use damage or for resharpening purposes. Seed grinding equipment is rare on most sites, the Tchelery 1 excavation had small fragments of seed grinding equipment but the Ravensworth 3 excavation had none.

Dry Lake TSR4 site is a Microblade workshop located adjacent to a medium sized mound. Chart 6 (Appendix 2) shows a low angle regression line indicating that blades were flaked at the site and backed to form geometric microliths. Recorded densities of areas with good visibility and exposure on mounds or on the surrounding pediment range from $43.5/m^2$ at Baldon 4(5) to $< 0.1/m^2$ at many mounds. A high density at one mound will not necessarily be reflected at adjacent mounds of the same complex. The open sites away from mounds tend to have relatively low densities.

ii. Non- Mound Sites

Dry Lake 11 is located on a sandy palaeochannel deposit and contains artefacts, ovens and burials some distance back from the lake and the mound sites around the lake. It is characterised by a combination of the bipolar Microblade Technology as found on the mound sites but also evidence of Utilitarian Technology represented by a few larger and thicker flakes (Chart 7 Appendix 2). Some other open sites were noted in 1995 on a large sand ridge (palaeochannel feature) in the same general area which also had a combination of Microblade and Utilitarian Industries. This suggests that the mound sites are dominated by the Microblade Technology, but that non-mound open sites also display Utilitarian Flake and Core Technology (Witter 1992).

In 1999 the irrigation runoff water levels in the Lake at Ravensworth were reduced and the dry shoreline exhibited scattered baked clay heat retainer and artefacts which had been exposed by water erosion of the sediment. In-situ dead chenopod bushes indicated the erosion by 30-40 cm of root exposure, suggesting that other lake/swamps in the region may contain similar archaeological material obscured by post pastoral sedimentation. A small sample was recorded and found to be significantly different to the nearby Ravensworth 3 mound excavation artefact sample. This is discussed in more detail in Section 5, but briefly the Lake artefacts are larger and include a significant number of fragments of grinding dish/topstone and mortar/pestle indicating that different activities were carried out at the two locations.

There are no stone material sources on the Hay Plain Southwest and therefore all material has been brought into the plain. Evidence from the cortex present on both silcrete and quartz artefacts indicates that the material was brought in as small nodules and pebbles. Hence the bipolar technology is a result of the source material characteristics rather than a simple function of distance from the source. If conservation of energy carrying the material in were the only factor, material would have been trimmed of waste cortex before leaving the source quarry. The small size of the source material results in only bipolar technology being feasible because of the small inertial mass of the cores. The mound sites are typically heavily dominated by one material type, most commonly by a mottled red-grey silcrete, however, some mound sites are dominated by quartz. The material may vary between individual mounds within a cluster of mounds, for example TSR 4 is dominated by silcrete and the nearby Dry Lake 10 is dominated by quartz. Quartzite, hornfels and other stone such as chert or meta-volcanics are rare on these mound sites, although the Dry Lake 11 open site has some quartzite used in the Utilitarian Technology (Figure 7.6).

### *7.8.3 Lowbidgee Stone Artefact Industries*

Sites recorded in the Lowbdigee did not have sufficient numbers of artefacts for analysis, but the flaked material is similar to of the Hay Plain southwest. The Waimea Downs-Toogimbie area has a higher number of grindstone fragments than the rest of the western side of the Plain. Mounds at Waimea Downs also have a large number of unusual disk-shaped 'mini' grindstones of unknown use. They are perfectly circular in outline and thin in cross section, with polished upper and lower surfaces and rounded edges, possibly backing hammerstones made out of fragments of muller. Some appeared to have been deliberately perforated by anvil use, and were possibly reused as net weights. Other tool types found on these sites include bone point sharpeners with narrow grooves and tiny backing hammerstones for retouching artefacts. Anvils are usually small and often have pits on every available surface, sometimes even the corners are utilised (photo 51 Appendix1).

### *7.8.4. Hay Plain South East Stone Artefact Industries.*

i. Non-mound Sites

A total of 174 artefacts were collected during salvage at Gundaline (Appendix 5.6)(Martin 2000a). Of these 159 artefacts salvaged belong to a microblade technology consisting of blade cores, bipolar blade cores, geometric backed blades and a range of small flake and blade tools. The microblade technology found at Gundaline G-OS-1 is very similar to that recorded on the Hay Plain Southwest although there is a component of non-bipolar manufacture in addition to bipolar. The other artefacts collected consist of seed grinding equipment including seven pieces refitted to form a partly complete grinding dish, and other fragments of grinding dish or top stone used for grinding soft seeds like grass seeds. One broken mortar bowl was found, which was used for smashing up and grinding hard seeds such as nardoo or acacia.

The six cores from the sample includes one prismatic blade core, incomplete because one side of the piece of stone was unsuitable for flaking. This core is much larger than the others, which are typical bipolar blade cores. These have been split in half on an anvil in an attempt to reduce the stone further. The flaked tools make up just fewer than 10% of the total, which is about average. Tools are all small (one geometric backed blade is only 10.8 mm) and a hand lens had to be used to determine which artefacts had retouch and/or use-wear. Tools include 3 geometric backed blades, flake and blade tools with scalar retouch and/or use-wear on the sides, one tiny micro adze with heavy step flaking, one broken thumbnail scraper, and one blade tool with a notch and snapped point which may have been used to engrave bone or wood.

The majority of the flaked stone material is debitage, or unused and/or waste material. This includes the dominant category of flake and blade fragments, as well as whole flakes and blades, and flakes and blades broken in half (proximal and distal flakes). None of the blocks in this sample have been used as tools and appear to be the result of failed flaking of bipolar cores.

Many of the flakes show crushing of the platform, which is characteristic of the bipolar flaking method. However, of those that were not crushed a focal unifacial platform and feather termination is the most common. Focal platforms result from careful striking with the hammerstone near the edge of the platform, which is expected because of the small size of the core and the need to remove lots of small thin flakes.

The unidirectional core is much larger (60 mm) than the bipolar cores, however the blades removed from this core are only 29 to 25 mm. The bipolar cores all fall between 15mm to 20 mm in length, indicating that the artefacts found at G-OS-1 are almost all the product of bipolar flaking of very small cores, the cores and the products having very similar lengths. The flaked material is characterised by extremely thin flakes and blades, the average thickness of whole flakes and blades is 3.5 mm but many are less than 2 mm thick. This indicates that the object of the bipolar flaking of cores was to get as many thin flakes and blades off these tiny cores as possible, thus conserving the raw material. Artefacts of all material types have some cortex (silcrete 18%, quartz 13.5% and quartzite 21%) and the quartz and quartzite artefact cortex indicates that the main source of these materials is from small, rounded river pebbles or small nodules of silcrete.

### *7.8.5 Murrumbidgee East Stone Artefact Technology*

i. Mound and Non-Mound Sites

Klaver (1998) has examined a number of sites along the eastern Murrumbidgee including Goonerah, Cooey Point and Euwarderry Lagoons. The Euwarderry Lagoon site includes a bipolar core and a modal length of 10-15mm for debitage. Goonerah Lagoon includes an assemblage with blades, backed blades and flake tools with straight or notched edges. The flaked debitage mainly falls into the 10-20mm length range. Cooey Point Lagoon is dominated by microblade technology, with a backed blade and 18 blade cores. The small size of cores and intensive reduction with blocky cross section is suggestive of bipolar reduction. Half of the debitage is under 15 mm in length (Klaver 1998)

### *7.8.6 Hay Plain North East Stone Artefact Industries*

This area is more variable than the rest of the Hay Plain, reflecting a range of industries and raw materials.

i. 'Utilitarian' Core and Flake Tool and Split Cobble Technology

Mirrool Creek 1 displays distinctive split cobble and core and flake tool technology characteristic of sites in the Hay Plain Northeast. It is exposed on a deflating palaeochannel levee adjacent to Mirrool Creek and connected lignum swamps. The production of flakes on site seen as a high angle regression line in Reduction

Chart 12 (Appendix 2). Medium to large split cobble tools are also a dominant characteristic of this site, the heavy step-flaking signifying medium to heavy duty wood-working tools which are totally absent from the sites to the south of the Murrumbidgee River. Flake tools are dominantly small to medium sized, thick flake scrapers that tend to have heavy duty use-wear, and although rare, discoidal, nosed and notched tools were recorded on this site. The reduction chart for this site indicates the difference in size between Mirrool Creek 1 artefacts and artefacts recorded elsewhere in the province. The majority of artefacts are 3 times the size of bipolar microblade artefacts, a direct result of the type of raw material and technology employed. Mirrool Creek 1 is 350 x 200 metres, but has a relatively low density of stone artefacts ($0.15/m^2$), which is typical for sites on the Hay Plain Northeast. A small sample recorded site in the middle of the One Tree Plain (Chart 11 Appendix 2) is a western extension of the split pebble tool technology. It contained a burial, scattered heat retainer and a low density of artefacts, 50% derived from split cobbles. Sidonia Road, a spot check on a source-bordering dune beside a palaeochannel is very similar to One Tree and Mirrool Creek. Cores were common and core cortex and decortification flakes indicated that most cores were originally cobbles, brown-green and black metasediments, quartzite and quartz dominated. Finished tools included fine grey quartzite discoidals and flake tools.

The Wyvern sites recorded by Edmonds (1995) are the mostly easterly and therefore closest to the supposed sources of river cobbles. Three sites were recorded, in the vicinity of the Barren Box Outfall Channel and the Mirrool Creek system. Wyvern 1 and Wyvern 9 are characterised by large flakes and cores, and split cobble technology. Jasper (probably the same as the hornfels in Martin's data) and quartzite cobbles are present, and split cobbles are noted. The Wyvern 13 site contains backed blades and two small cores that indicate the presence of Microblade Technology as well.

The Berangerine 4.1 (Chart 9) site includes core and flake Technology, and minor amounts of split cobble tools, but it is dominated by a Microblade technology.

ii. Bipolar and Semibipolar Microblade Technology

The Wongalea Road 1 site is characterised by a semi-bipolar and bipolar Microblade Technology that differs in some aspects to that found on the sites further south. This site is located on a sandy elevation associated with a palaeochannel system, and has been exposed on a graded dirt road. The reduction chart (Chart 8 Appendix 2) resembles the southwest mound sites but this is deceptive because most of the larger flakes/blades are broken. Although the data came from a site exposed on a dirt road, the breaks do not appear to the result of recent grading activity. The breaks could have occurred during production of the relatively thin blades, or could have been deliberately snapped. The average length of whole flakes/blades is 17.8 mm, but some of the larger snapped blades are 20-25mm and would have originally been 30-40mm long. This is much larger than the Hay Plain Southwest microblades, which average 14mm in length. Other attributes in this assemblage include the frequent trimming of overhang, lower percentage (30%) of platform crushing, and blades with classic characteristics including blade scars, straight sides, and even thickness. However, no backed blades were recorded on this site although a relatively large sample was obtained (N=112). Flake/blade tools recorded on the site are all either side scrapers or end scrapers with use-wear, scalar and/or step retouch. No specialised tools were recorded. It appears that blades were removed from the site to be backed elsewhere, unless the blades were being used for a different purpose, for example snapped and used in jagged spears (Martin 1996a, 1996c).

iii. Bipolar Microblade Technology

Old Galah 3.3, further south-west, consists of small size, thin flakes and blades, and the small microblade cores including a very reduced bipolar split core, indicate that the Microblade Technology found in other sites in the region is present (Chart 10 Appendix 2). The nearby sites of Old Galah 3.2 and 3.4 both had a geometric microlith recorded. Berangerine 4.1 contains very small and thin flakes/blades and microblade cores, particularly the very reduced microblade bipolar cores, but also Core and Flake Tool technology (Chart 9 Appendix 2).

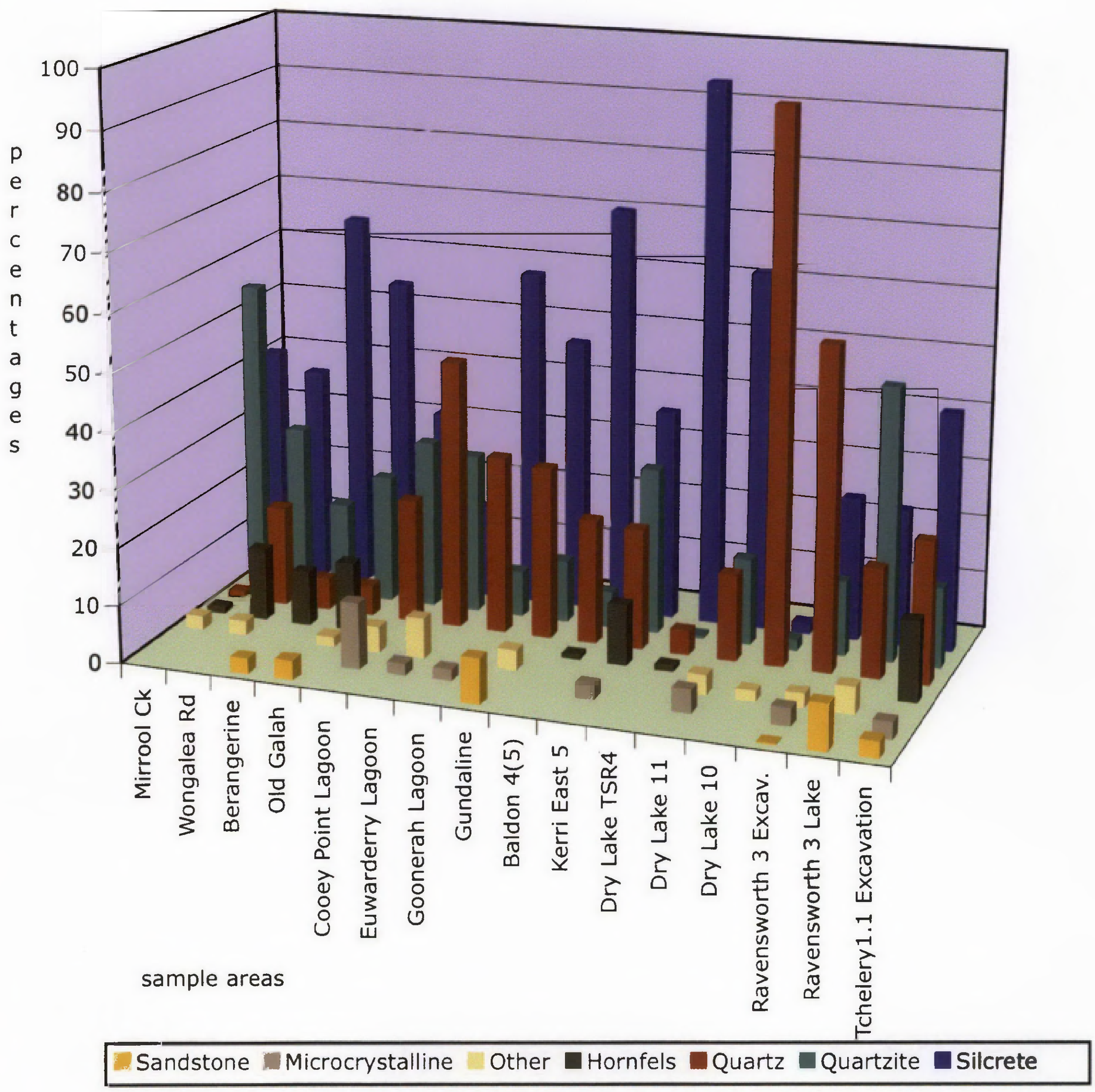
### *7.8.7 Broad Trends in Stone Artefact Technology across the Hay Plain*

The Hay Plain is largely dominated by a bipolar microblade technology, characterised by remarkably small artefacts and very reduced cores. This technology dominates the areas to the south of the Murrumbidgee River, but is also found to the north of the river where it is mixed with other industries. The microblade technology dominates mound sites but is also found on sites without mounds. There is little variation in the overall microblade technology, as can be seen by comparing the assemblage at Gundaline in the southeast to the assemblages in the southwest, nearly 150 km apart. This Hay Plain microblade technology appears to be a specialised form of microblade production aimed at making very small to tiny geometrics, Bondi points, and a range of very small flake and blade tools. The Wongalea Road 1 assemblage in the northeast appears to be a variation of this microblade technology, semi bipolar and bipolar microblade methods are used, and the blades produced tend to be larger classic shaped blades with straight sides and uniformly thin. There is more evidence of platform preparation and less bipolar crushing. Wongalea Road 1 products may be a result of access to better quality raw material, including larger pieces to make cores, or may indicate a specific strategy to make a bigger, better blades for purposes other than making the small backed blades found in the south.

Utilitarian Core and Flake Technology (Witter 1992) occurs in non-mound sites in the southern areas, but dominates in the north and northeast of the region together with a variation labelled here Split Cobble Technology. This results from the proximity of cobble sources located in the foot slopes to the northeast of the Hay Plain. The Microblade Technology is also found in association with the other industries in some of the Northeast sites, although some sites in this area do not have any Microblade Technology at all. Sites such as Mirrool Creek 1 are characterised by much larger artefacts including thick flake production aimed at medium to heavy duty wood working tools and characteristic medium to heavy duty split cobble and block tools.

There are also broad trends in the raw material distribution across the region (Figure 7.6). Quartz is more common in the Hay Plain Southeast and the Murrumbidgee East, indicating a source in the eastern foothills. Quartz occasionally dominates sites in the Hay Plain Southwest as well, sometimes being the main stone type in one mound but not necessarily adjacent mounds in a complex. Much of the quartz found in the region has cortex indicating a rounded pebble source. There is very little quartz in sites in the Hay Plain Northeast. Quartzite and hornfels become more dominant in the Northeast, reflecting proximity to cobble bed sources. Silcrete dominates large areas of the region, from the southeast to the east and northeast. The southern silcrete raw material seems to be quite uniform; a relatively fine red and grey silcrete occurring as small nodules. In the north, the silcrete is highly variable in both colour and grain size. Large flakes with cortex indicative of large cobbles are found on sites in the northeast, suggesting a relatively local source of poor to average quality. Other sites such as Wongalea have fine grained excellent quality silcrete from used for blade

Figure 7.6 Percentages of Raw Materials in Samples across the Hay Plain



production. This silcrete is variable in colour and is from unknown sources, possibly from the Cobar pediplain further north.The major trends in this analysis are the widespread distribution of a characteristic bipolar microblade technology, and Utilitarian technology. The Hay Plain Northeast has a distinctive Utilitarian technology incorporating spit cobble technology which is related to the proximity to cobble beds. The overarching theme is the dominant role played by the nearest available raw material type and size on the technology. The recycling of larger stone artefacts (photo 51) such as grinding equipment is a corollary to this, seen in the southern areas a result of the paucity of anything other than small pebbles. Ground edge axes and grinding and pounding equipment were traded from more distant sources, in contrast to flaked technology that concentrated on nearest available sources.

## 7.9 THE INTERTWINING OF ENVIRONMENT, AGENCY AND HISTORICAL PROCESSES

### *7.9.1 Summary of Distribution*

Distribution is examined in various spatial and temporal scales, from large scale GIS mapping to more detailed environmental issues and distribution on finer grained landforms. It concludes that archaeological material is distributed evenly across the plain, but that different types of material have unique distribution patterns and associations. The distribution is controlled on the broadest scale by the topography of the plain, with mounds and burials concentrated on the lower western side of the plain, and ovens and artefact scatters characterising the higher eastern side of the plain. This is related to the character of the hydrological regimes, as mounds and associated burials are closely related to the biologically diverse and dependable wetlands of the western side of the plain, with an additional restricted distribution of mounds (but not burials) around specific floodplain features such as billabongs on the narrow Murrumbidgee River East floodplain. The location of mounds at the finer landform scale indicates that they are located on different landforms in different areas, but that they have a tendency to be located on higher sandier palaeochannel landforms. The distribution of all archaeological material types on the Hay Plain is strongly correlated with palaeochannel systems, which provide higher sandier ground for location, but also influence the modern hydrology which is superimposed on the ancestral features. Distribution of stone artefacts provides another set of patterns.

Distribution of the tiny bipolar microblade technology is widespread in all major landforms. It is found on mound sites, but also off mound sites together with Utilitarian artefacts. The nearest available raw material type and size is the major influence on technology, thus the small bipolar artefacts are a result of small raw material for cores, such as pebbles. The very different Utilitarian and split cobble technology found in the Hay Plain Northeast is also a direct result of access to raw material, in this case much larger but average quality cobbles sourced from slopes to the north-east of the plain. The boundary of this split cobble technology on the Hay Plain appears to be sudden and does not reflect gradual distance decay situation.

### *7.9.2 Relationships between Environment and Agency*

- Focus on Wetland Plant Foods

Mounds of the Hay Plain are located adjacent to current or 'fossil' highly productive and predictable wetland habitats, which feature resources such as *Typha, Bolboschoenus* and *Triglochin* that were baked/streamed in heat retainer ovens (Chapters 4-6). This includes permanent and semi-permanent wetlands of the Lowbidgee, Hay Plain Southwest and Northwest, and restricted areas on the confined channel of the Murrumbidgee East. The appearance of mounds and mound complexes around 4,300 BP, and increase in mound numbers after 2,000 BP indicate that the exploitation of wetlands, and particularly the carbohydrate-rich plant foods found in wetlands, intensified in the mid-late Holocene.

- Focus on Smaller Ranges and Increased Sedentism

The rapid-build up of large mounds (Chapters 4-6), and concentrated clustering of mounds around wetlands suggest that people began to focus on specific parts of the landscape. The focus on specific areas and maximising energy value of carbohydrate rich-plant foods by cooking in heat retainer ovens suggests smaller ranges or more restricted mobility within ranges also occurred during the mid to late Holocene.

- Change Over Time

The dates for mounds on the Hay Plain and adjacent areas indicate that mounds were being built on the Abercrombie Creek system by about 4,300 BP, and that in the region mound building increased after about 2,000 BP. The dates and the distribution of archaeological material on the Hay Plain indicates that mound building began in different areas at different times, and that in some areas mound building was constrained by habitat potential.

- Role of Ecology and Agency in Increasing Focus on Wetland Plants

The spatial and temporal distribution of mounds on the Hay Plain indicates that the idea of mound building appeared much later than the wetlands, and they are not a direct response to evolving wetland habitats. Therefore mounds reflect complex social strategies constrained by habitat potential. For example the large palaeo-lagoons on the Murrumbidgee River to the east of Hay belong to the 35-25,000 year old Gum Creek system have been continuously connected to the superimposed Holocene river (Page et al. 2005:569). These lagoons are characterised by large numbers of mounds which date from the late Holocene, for example Cooey Point Lagoon where mounds were dated to between 1,000 BP and 400 BP (Klaver 1998). Thus mounds appeared a substantially long time after the connection between the palaeo-lagoons and modern river developed. The palaeochannels of the Gum Creek system which incorporates the Abercrombie Creek system also existed in the Pleistocene and early Holocene (Page et al. 1996). The Abercrombie Creek system of the Hay Plain Southwest, which contains the dated Tchelery1 and Ravensworth 3 mounds, possibly ceased to be a permanent wetland system some time after 3,500 BP, afterwards capturing floodwater only in very high floods. The environments suitable for the growth of dense predictable crops existed in the early Holocene or even earlier. The Ravensworth 3 and Tchelery 1 mounds date from around 4,300 BP to 4,100 BP, indicating that the mounds on the Abercrombie Creek system were initiated around 4-5,000 BP, thus mounds appeared a long time after the evolution of wetlands suitable for *Typha* and other food crops.

7.9.3 Historical Processes

The spatial and temporal distribution patterns of archaeological material outline historical processes that were operating on the Hay Plain during the mid to late Holocene, including;

- the movement of mound building from one area to another, reflecting the movement of ideas
- different burial patterns occurring in separate areas with mounds, for example the Hay Plain South West has different burial patterns to the Murrumbidgee

East, suggesting that different socio-cultural groups made mounds

- movement of stone material suggests a long term difference in trade-networks between the people of the north-east of the plain, and those living on the west and south of the Hay Plain.

- Individual mounds within clusters on the Hay Plain South West often have distinctly different ratios of stone material, suggesting that mounds within a cluster are non-contemporaneous and grew sequentially, or different kin groups used different mounds within a cluster.

- The distribution of mounds and large ashy deposits suggest a temporal or spatial dichotomy and historical processes. Large ashy deposits with small mounds placed on their surface may indicate the adoption of mound building after increased focus on cooking wetland plants in heat retainer ovens occurred.

### *7.9.4 Behavioural Dynamics and a Macro-scalar Model*

The results of the spatial and temporal distribution analysis indicate that there was rapid change in the behaviour of people living in some areas of the Hay Plain during the mid to late Holocene. Changes included increased focus on permanent wetlands and particularly wetland plants, maximisation of energy obtained from carbohydrate rich plant foods through cooking in heat retainer ovens, focus on smaller ranges or smaller sections of ranges, and reduced mobility. The chronology indicates that the idea of mound building appeared much later than the wetlands, and mounds are therefore not a direct response to evolving wetland habitats but reflect complex social strategies constrained by habitat potential. These changes appear to fit the 'intensification' model proposed by Lourandos (1980, 1983,1997), and this is discussed further in 9.4.1. The distribution analysis also gives insights into historical processes occurring in the same time frame, including movement of ideas and materials. The spatial and temporal distribution indicates that patterns of mound building, burials and stone materials reflect cultural processes that varied across the plain. The distribution of ovens, mounds, and ashy deposits suggests different activities and scales of activities related to heat retainer cooking occurred and evolved differentially across the plain.