Silverton Wind Farm, NSW: Stages 2 and 3 and Powerline route (Broken Hill to Red Cliffs) Aboriginal Heritage and Non Indigenous Heritage

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A report to nghenvironmental on behalf of
Silverton Wind Farm Developments

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1. SUMMARY

1.1 Introduction

New South Wales Archaeology Pty Ltd was commissioned by nghenvironmental on behalf of Silverton Wind Farm Developments in November 2007 to compile an archaeological and heritage review of the proposed Silverton Wind Farm Stages 2 and 3 and a proposed overhead transmission line between Broken Hill and Red Cliffs. The purpose of this review is to identify any issues and/or constraints which are likely to arise in relation to the proposal and to recommend strategies for the mitigation of impacts.

Silverton Wind Farm Developments proposes to develop a wind farm near Silverton, northwest of Broken Hill, for the purpose of electricity generation.

The proposed wind farm is defined as a Major Project under Part 3A of the Environmental Planning and Assessment Act 1979. This report will be submitted to the NSW Department of Planning to support a Concept Approval application.

1.2 Description of Impact

Silverton Wind Farm Stages 2 and 3

The turbine envelope (the indicative area in which turbines would be positioned) for all stages of the proposed Silverton wind farm measures approximately 32,100 hectares in area. Stage 2 and 3, located adjacent to Stage 1, represents approximately 75% of this area. It is understood that tracks, turbine footings and hardstand areas will be required within discrete locations of the turbine envelope.

Overhead Transmission Line: Broken Hill to Red Cliffs

The proposed transmission line extends from an existing substation on the western outskirts of Broken Hill to Red Cliffs in Victoria immediately adjacent to an existing 132 kV line. The proposed power line will duplicate the existing high voltage power line, and measures approximately 300 kilometres in length. The majority of the route is within New South Wales however, 1.3 kilometres is in Victoria.

The power line will require pole footings to be excavated at discrete intervals of approximately 250 – 500 metres. It is understood that the line voltage of the power line would require an easement of approximately 50 metres to be created and maintained adjacent to the existing easement. Clearing would be required where trees occur prior to line raising. There may be scope to overlap easements, reducing the new easement width to 25 metres in some areas.

1.3 Objectives

The aim of this review is to:

- Document any archaeological and heritage sites known to be present in the proposal area;
- Provide a predictive statement in regard to type of archaeological sites and heritage features which may be situated within the proposal area and not yet listed on heritage databases; and
- Outline any issues or constraints which are known, or predicted to arise, in relation to the proposal; and
- Provide a series of recommendations which outline as much as feasible proposed strategies to mitigate impacts to cultural heritage relating to the proposal.

Indigenous

The review of the Indigenous archaeological and heritage context of the proposed impacts areas has sought to:

- Document the results of the NSW Department of Environment and Climate Change (NSW DECC) Aboriginal Heritage Information Management System site searches;
- Provide a summary review of relevant previous heritage studies conducted in the region;
- Outline a predictive model of site location relevant to the impact areas.

Non Indigenous

The review of the historical archaeological and heritage context of the proposed impacts areas has sought to:

- Document the results of heritage database searches;
- Provide a summary review of the historical context of the proposal area;
- List the historical themes relating to the area;
- Outline a predictive model of site location relevant to the impact areas.

1.4 Archaeological Context

A review of previous archaeological investigations in the area has been undertaken in order to provide an analytical context to the assessment.

Two previous studies are directly relevant to this assessment and are listed as follows:

Silverton Wind Farm Stages 2 and 3

The archaeological and heritage assessment relating to the Silverton Wind Farm Stage 1 project forms the primary basis for the assessment of the proposed Stages 2 and 3 areas. This assessment is documented in Dibden (2008) and the results from that work will be utilised in this report to provide a heritage context, informed assessment in regard to potential site significance and appropriate strategies of impact mitigation in regard to Stages 2 and 3.

Indigenous sites were found to be widespread across the Stage 1 proposal area. A total of 262 Aboriginal object locales were recorded during the field survey. The majority (N=166; 63.4%) of locales consist of predominantly quartz stone artefacts distributed across individual survey units. In addition 78 quartz outcrops with evidence of exploitation – Stone Procurement Areas, fourteen locales comprising stone artefacts with heat retaining hearths, three isolated artefacts and a complex of two small circular stone arrangements were recorded (Dibden 2008).

Overhead Transmission Line: Broken Hill to Red Cliffs

The existing overhead transmission line was surveyed in 1977 and the results from that work are directly applicable to the proposed transmission line (McIntyre 1977; 1981). A total of 132 sites comprising 106 open camp sites, five shell middens, ten PADs (potential archaeological deposit), seven burial sites and four isolated finds were recorded (McIntyre 1981: 9).

1.5 Database Searches

A number of searches of the New South Wales Department of Environment and Climate Change (the NSW DECC) Aboriginal Heritage Information Management System (AHIMS) have been conducted for the project areas. The results of these searches are listed below.

Silverton Wind Farm Stages 2 and 3

AHIMS #21076 – 18th December 2007. The search was conducted over an area measuring 682 square kilometres encompassed by Eastings: 517000 - 539000 and Northings: 6474000 - 6505000. There are 22 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register. These sites consist of stone artefact locales described as either open camp sites or isolated finds.

Overhead Transmission Line: Broken Hill to Red Cliffs

Four searches of the NSW DECC Aboriginal Heritage Management Information System have been conducted for the overhead transmission line route:

Pine Creek (AHIMS # 20888 – 3rd December 2007) - The search was conducted over an area measuring 1425 square kilometres, encompassed by Eastings: 535000 - 550000 and Northings: 6370000 - 6465000. This area includes the powerline route between Broken Hill and the southern extent of the Pine Creek catchment. There are 45 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register. These sites consist of stone artefact locales described as open camp sites, isolated finds or quarries. 16 of these sites

are artefact scatters and stone quarries located in a cluster close to the transmission line, immediately south west of the Broken Hill substation. An additional four sites are stone artefact scatters situated close to the transmission line at Pine Creek.

Ana Branch (AHIMS # 20889 – 3rd December 2007) - The search was conducted over an area measuring 2700 square kilometres, encompassed by Eastings: 545000 - 575000 and Northings: 6280000 - 6370000. This area includes the powerline route between the southern extent of the Pine Creek catchment and the route crossing at the Ana Branch. There are 85 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register. These sites consist of stone artefact locales described as open camp sites and isolated finds, scarred trees, stone arrangements and burials. None of these sites are located within 1 kilometre of the proposed transmission line.

Darling River (AHIMS # 20890 – 3rd December 2007) - The search was conducted over an area measuring 1440 square kilometres, encompassed by Eastings: 570000 - 606000 and Northings: 6240000 - 6280000. This area includes the powerline route between the Ana Branch and the route crossing at the Darling River. There are 61 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register. These sites consist of stone artefact locales described as open camp sites and isolated finds, stone arrangements, hearths, midden and burials. 16 of these sites are situated either in or within close proximity of the proposed transmission line route on the east side of the Darling; these sites are stone artefacts scatters, scarred trees and one hearth.

Buronga Gol Gol (AHIMS # 20891 – 3rd December 2007). The search was conducted over an area measuring 875 square kilometres, encompassed by Eastings: 600000 - 625000 and Northings: 6205000 - 6240000. This area includes the powerline route between the Darling River and Murray River. There are 72 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register. These sites consist of stone artefact locales described as open camp sites and isolated finds, scarred trees, ceremonial site, hearths, midden and burials. Three of these sites are situated within close proximity of the proposed transmission line on the Murray River alluvial floodplain at approximately 2 kilometres northeast of the Red Cliffs substation (Site #'s 46-3-0007 and 46-3-0081 are middens and Site # 46-3-008 is a scarred tree).

Searches have also been undertaken of historic databases including the Australian Heritage Database, the NSW Heritage Inventory and National Trust Register. One previously recorded heritage item (Day Dream Smelter) is listed on the State Heritage Register and the National Trust of Australia (NSW) Register as being present immediately adjacent the Stages 2 and 3 area; there are no previously listed heritage items located within areas of direct impacts. Nonetheless, historical research and the results of a recent heritage study across the Unincorporated Area (Hope 1996) indicate that there are a number of potential heritage items within the proposal areas and it is likely that field survey would reveal additional sites. This is particularly true in Stages 2 and 3 and to a lesser extent in areas along the transmission line where the route intersects river courses and old roadways. Historical themes that are most likely to be evidenced are mining, pastoralism and the transport industry.

1.6 Conclusions

Background research has revealed that there are many previously recorded sites and heritage items known to exist across the region and within the local area in which impacts are proposed. A predictive model based on prior local and regional archaeological work has resulted in an assessment that there is a high potential for Indigenous sites to be present in majority of the proposed impact areas. Indigenous heritage is likely to include stone artefacts, stone procurement areas, scarred trees, heat retainer hearths, middens, ceremonial sites and burials.

There is a similarly high potential for historical features associated with mining, transport and pastoral activities to be present within the Stages 2 and 3 areas. Along the proposed overhead transmission line route the potential for heritage items is more variable and encompasses a wider array of possible items including those associated with river trade; the areas of highest potential are in and around areas where the transmission line route intersects water sources and old roadways.

It is concluded that while Indigenous objects and Non Indigenous heritage items can be expected to be present within impact areas there is low probability that they will pose a constraint to the proposal. The scientific and cultural significance of Indigenous and Non Indigenous heritage is predicted to range for low to high. Accordingly a range of management strategies will need to be formulated taking into consideration significance values and the nature of impacts. It is proposed that appropriate management strategies are likely to include:

- Unmitigated impacts – unmitigated impacts are appropriate when sites are assessed to be of low heritage significance;
- Mitigated impacts – mitigated impacts are appropriate when avoidance of impacts is not feasible and when sites are assessed to possess higher significance values. Mitigated impacts can take the form of partial site conservation and/or salvage excavation;
- Conservation – avoidance of site impacts is appropriate when a site is assessed to be of high scientific or cultural significance.

1.7 Recommendations

- As a result of the review undertaken during this study it is recommended that providing appropriate impact mitigation strategies are implemented prior to construction there is unlikely to be any overall constraints relating to the proposal.
- The proposed impact areas should be subject to an appropriate level of field survey and assessment for the purposes of identifying Indigenous objects and Non Indigenous heritage sites.
- The field assessment should be undertaken in partnership with the local Aboriginal community.
- Any Indigenous and Non Indigenous heritage sites located in the proposed impact areas should be subject to a site significance assessment in order to formulate appropriate mitigation and management strategies.
- Following a comprehensive field survey and significance assessment the proponent should develop a Cultural Heritage Management Protocol prior to the commencement of construction, which documents the procedures to be followed for impact avoidance or mitigation. Personnel involved in the construction and management phases of the project should be trained in procedures to recognise and avoid disturbance to cultural heritage places and items.

2. INTRODUCTION

2.1 Introduction

The principal aim of this study has been to identify within the proposal area previously recorded Indigenous objects and Non Indigenous items, to outline a predictive model of site type and location and identify any potential cultural heritage constraints, and to propose strategies for the mitigation of impacts.

The predictive statements are based on a review and assessment of current knowledge regarding site patterning from the local and regional areas. While every effort has been made to provide accurate and comprehensive assessments of potential constraints, this is only a preliminary study and should not be considered a substitute for field survey and site assessment.

The proposal is outlined below.

Silverton Wind Farm Stages 2 and 3

The turbine envelope (the indicative area in which turbines would be positioned) for all stages of the proposed Silverton wind farm measures approximately 32,100 hectares in area. Stage 2 and 3, located adjacent to Stage 1, represents approximately 75% of this area. It is understood that tracks, turbine footings and hardstand areas will be required within discrete locations of the turbine envelope.

Overhead Transmission Line: Broken Hill to Red Cliffs

The proposed transmission line extends from an existing substation on the western outskirts of Broken Hill to Red Cliffs in Victoria immediately adjacent to the existing 132kV line. The proposed power line will duplicate the existing line and measures approximately 300 kilometres in length. The majority of the route is within New South Wales however 1.3 kilometres of the route is in Victoria.

The power line will require pole footings to be excavated at discrete intervals of approximately 250 – 500 m. It is understood that the line voltage of the power line would require an easement of approximately 50 m be created and maintained adjacent to the existing easement. Clearing would be required where trees occur prior to line raising. There may be scope to overlap easements, reducing the new easement width to 25 m in some areas.

This report aims to document:

- the aims of the project;
- the methodology implemented during the study;
- the environmental setting of the study area in order to establish background parameters;
- a review of archaeological and relevant literature, heritage listings on the NSW DECC Aboriginal Heritage Information Management System and other relevant registers;
- any Aboriginal archaeological and heritage sites known to exist within the study area;
- a synthesis of local and regional archaeology;
- an overview of European history of the region and the local area;
- a predictive model of site location for the study area;
- the archaeological sensitivity of the study area and the potential impact of the proposed development on the known and potential archaeological and cultural heritage; and
- recommendations for the mitigation of impacts.

3. STUDY METHODOLOGY

This study has included the following components:

- A NSW DECC Aboriginal Heritage Information Management System site search to determine whether or not previously recorded Aboriginal Objects are present within the study area and to give consideration to the type of sites known to be present within the local area.
- A search of historical site registers.
- A review of local and regional archaeological reports and other relevant documents in order to provide a contextual framework to the study and heritage management context.
- Consultation with Harvey Johnston, regional archaeologist for NSW DECC in Buronga, regarding the current state of knowledge of archaeological resources within the area and the potential for other, as yet unrecorded sites, to occur.
- The formulation of predictive statements for both Indigenous and Non Indigenous cultural heritage regarding potential site types and locations.
- The formulation of a set of management recommendations ensuing from the above.

3.1 Literature Review

A range of documentation has been used in order to assess the current archaeological and historical knowledge for the region. In regard to Indigenous archaeology, literature sources consulted have included the New South Wales Department of Environment and Climate Change (NSW DECC) Aboriginal Heritage Information Management System and its associated catalogue of archaeological reports. Historical sources have included local environmental plans, previous heritage studies and various state and national heritage registers.

Background research has been conducted to determine if known Aboriginal and Non Indigenous sites are located in the vicinity of the project area and to facilitate site prediction on the basis of known regional and local site patterns in order to place the study area within an archaeological research and heritage management context.

The following information sources were accessed for this study:

- NSW DECC Aboriginal Heritage Information Management System
- State Heritage Register and Inventory (NSW Heritage Office)
- Register of the National Estate (Australian Heritage Commission)
- The National Trust Register
- Wentworth Heritage Study
- Wentworth Local Environmental Plan 1993
- Unincorporated Area Heritage Study
- Broken Hill Local Environment Plan 1996
- Relevant archaeological reports and site cards held in the NSW DECC Cultural Heritage Unit
- Primary and secondary historical sources relating to European exploration and settlement
- Primary and secondary ethnographic sources relating to Aboriginal communities in the nineteenth century
- The Broken Hill, Menindee, Ana Branch and Mildura 1:250,000 topographic maps and associated land systems maps
- Academic reports and theses relevant to the area
- Publications held in the National Library of Australia
- Publications held in the AIATSIS Library (Australian Institute of Aboriginal and Torres Strait Islander Studies)

3.2 Methodology

Predictive modelling is a means through which one can provide predictions regarding what sorts of sites might exist in areas that have not as yet been adequately surveyed. Predictive modelling is an integral part of a

desktop review such as this particular study as it incorporates analysis of previous archaeological work at the local and regional level and uses this information to aid the direction of any future stages of archaeological survey and research. An important component of predictive modelling is the formulation of predictive statements.

For the purposes of this study predictive statements have been formulated regarding both Indigenous objects and Non Indigenous items in order to provide a more comprehensive assessment of what is known of the archaeology of the area than that which is currently available from previous studies. The predictive statements are based on analysis of those previous studies and aim to deliver information regarding potential site types as well as the potential archaeological sensitivity of various landscape zones based on factors such as topography, vegetation, proximity to water, geology, soils and previous disturbance impacts.

It should, however, be stressed that the predictive statements provided in this report are only based on results of previous studies. No field survey was undertaken for this project; as such it can only be regarded as a preliminary study and should not be considered a substitute for field survey and an on the ground site assessment.

4. LANDSCAPE CONTEXT

A consideration of the landscape is necessary in archaeological work in order to characterise and predict the nature of Aboriginal occupation across the land (NPWS 1997). In Aboriginal society landscape could be both the embodiment of Ancestral Beings and the basis of a social geography and economic and technological endeavour. The various features and elements of the landscape are/were physical places that are known and understood within the context of social and cultural practice.

Given that the natural resources that Aboriginal people harvested and utilised were not evenly distributed across landscapes Aboriginal occupation and the archaeological manifestations of that occupation will not be uniform across space. Therefore, the examination of the environmental context of a study area is valuable for predicting the type and nature of archaeological sites which might be expected to occur. Factors which typically inform the archaeological potential of a landform include the presence or absence of water, animal and plant foods, stone and other resources, the nature of the terrain and the cultural meaning associated with a place.

Additionally, geomorphological and humanly activated processes need to be defined as these will influence the degree to which archaeological sites may be visible and/or conserved. Land which is heavily grassed will prevent the detection of archaeological material while land which has suffered disturbance may no longer retain artefacts or stratified deposits. A consideration of such factors is necessary in formulating site significance and mitigation and management recommendations.

The proposed impact areas are located within the Murray-Darling Basin which is the largest river system in Australia covering over one million square kilometres. The Darling group of rivers drains from Queensland; the Murrumbidgee group drains central and southern NSW while the Murray group drains parts of southern NSW and the northern half of Victoria (Craib 1992). The following sections provide information in regard to the landscape context of the proposal areas.

4.1 Silverton Wind Farm Stages 2 and 3

The proposed Silverton Wind Farm is situated on the eastern margin of the Australian arid zone; average annual rainfall is below 250 mm and pan evaporation exceeds 2000 mm in most areas (Fanning 1999). Precipitation variability is high and seasonality of rainfall is weak.

The proposed wind farm is in the Barrier Ranges, immediately to the north of Silverton. The topographic context of the proposal area is shown on Figure 1.

The Barrier Ranges form a series of north-east and north-west trending ridges rising up to 300 m above the surrounding plain. The proposed turbines are situated on ridges within two land systems, the Barrier land system (Br on Figure 2) which is defined as ranges with narrow incised drainage and relief to 80 metres and the Umberumberka land system (Ub on Figure 2) which is defined as rugged ranges with narrow incised drainage and relief to 200 metres (Broken Hill Land Systems Series Sheet SH 54 -15). The Barrier land system conforms to a low hills landform pattern; that is with a typical relief of between 30 – 90 m (*cf.* McDonald *et al.* 1998). The Umberumberka land system conforms to a hills landform pattern; that is with a typical relief of between 90 - 300 m (*cf.* McDonald *et al.* 1998).

The rocks of the Broken Hill region are a part of the Adelaide Fold Belt province and include two main sequences, the Willyama Supergroup and the Toorowangee Group (Branagan & Packham 2000). The Willyama Supergroup rocks are the oldest. These rocks were mainly sandy and shaly sedimentary and silicic volcanic rocks which have since been subjected to large earth movements resulting in their transformation into a variety of metamorphics including schists and gneisses (Branagan & Packham 2000).

Soils in the Umberumberka land system are lithosols with some texture-contrast soils while soils in the Barrier land system are lithosols and red texture-contrast soils (Broken Hill Land Systems Series Sheet SH 54 -15). Generally soils in the turbine impact areas of Stage 1 were found to be skeletal and highly eroded (*geomorphological processes are outlined below*); land surfaces are rocky with low outcrops and generally high levels of rock shatter. It is likely that soils in Stages 2 and 3 will be comparable.

The Stage 1 area contained large numbers of quartz outcrops. These were generally small and isolated pockets, often less than 10 square metres in area but are in some instances were found to be large. Quartz quality varies from poor to very high. Again it is likely that quartz outcrops will be abundant in the Stages 2 and 3 areas.

There are no major watercourses present in the Stages 2 and 3 areas however, several ephemeral watercourses exist. These include the upper catchment of Stephens Creek, Lakes Grave Creek, Lakes Creek, Eldee Creek, Dense Camp Creek, Sandy Gum Creek, and Big Aller Creek. While these streams flow for a short time only after rain, bedrock and other features within channels are likely to have held water for longer periods of time. These features generally however, no longer exist because they have been buried with Post Settlement Alluvium or completely destroyed by channel incision and knickpoint retreat (Fanning 1999). Holdaway *et al*. (2000) have argued that concentrations of curated artefacts in the Stud Creek catchment in Sturt National Park are located adjacent to features that are interpreted to be infilled waterholes in the Stud Creek channel. Accordingly the archaeology in the region may well point to the presence and location of previous water holes.

The vegetation communities present in the Stages 2 and 3 areas include the following (nghenvironmental 2008):

Mulga – dead finish on stony hills

This tall open shrubland is dominated by Mulga (*Acacia aneura*) and Dead Finish (*Acacia tetrogonophylla*) with Belah (*Casuarina pauper*) also present. It occurs on skeletal or shallow, stony soils on steep slopes, hillcrests, midslopes and terraced flats of elevated landscapes.

Prickly wattle open shrubland of drainage lines

This shrubland is found in both stony hills and ranges and the low hills of the Barrier Range along ephemeral drainage lines. The dominant shrub in this community is Prickly wattle (*Acacia victoriae*) while the understorey of chenopod shrubs includes black bluebush (*Maireana pyramidata*) and Thorny saltbush (*Rhagodia spinescens*).

Bluebush shrubland on stony rises and downs of the arid zone

This chenopod shrubland community comprises numerous bluebush species; Black bluebush (*Maireana pyramidata*), Pearl bluebush (*M. sedifolia*), copperburrs (*Sclerolaena* spp) and Ruby saltbush (*Enchylaena tomentosa*) form a major component of this community. It has been identified in the area where red or brown clays or red loams occur.

Bladder saltbush shrubland on stony plains and downs of the arid zone

This vegetation community is dominated by Bladder saltbush (*Atriplex versicaria*) with many other chenopod species also present such as copperburs and bluebush.

River red gum open woodland

This open woodland community occurs on sandy or loamy soils in sandy creeks and is dominated by River red gum (*Eucalyptus camaldulensis* subsp. *obtusa*).

River red gum woodland of rocky creeks

While this vegetation community is also dominated by River red gum the presence of species such as Mulga and Dead finish typically associated with rocky hills, indicate the landscape position of this community which is confined to gravelly creeks on hillsides or rocky gorges. Sticky hopbush (*Dodonea viscosa* subsp. *angustissima)* and Cough bush (*Cassinia laevis*) provide a very sparse shrub layer in places. Grasses such as Kangaroo grass (*Themeda australis*) and *Digitaria brownii* contribute to a very sparse ground layer of vegetation.

Porcupine grass – red mallee – gum coolibah hummock grassland / low sparse woodland

This community is dominated by Red Mallee (*Eucalyptus socialis*) and Gum Coolibah (*Eucalyptus intertexta*).

Black bluebush low open shrubland of the alluvial plains and sand plains of the arid and semi-arid zones

This vegetation community is found on the Mundi Mundi Plain on the Barrier Range Alluvial Fans and is generally dominated by black bluebush and other chenopods such as copperburrs and occurs primarily on deep, sandy-loam soils of drainage depressions.

Sand plain Mulga

This tall open shrubland is dominated by Mulga with other shrub species such as Belah (*Casuarina pauper*), Turpentine bush (*Eremophilia sturtii*) and Punty Bush (*Senna* form taxon '*filifolia*'). In the

area, it occurs in the small patches near ephemeral drainage lines and on sandy areas in the eastern portion of the study area.

Black oak woodland

This low open woodland is dominated by Black Oak (*Casuarina pauper*) and Western Rosewood (*Alectryon oleifolius*). It occurs locally on rocky hills.

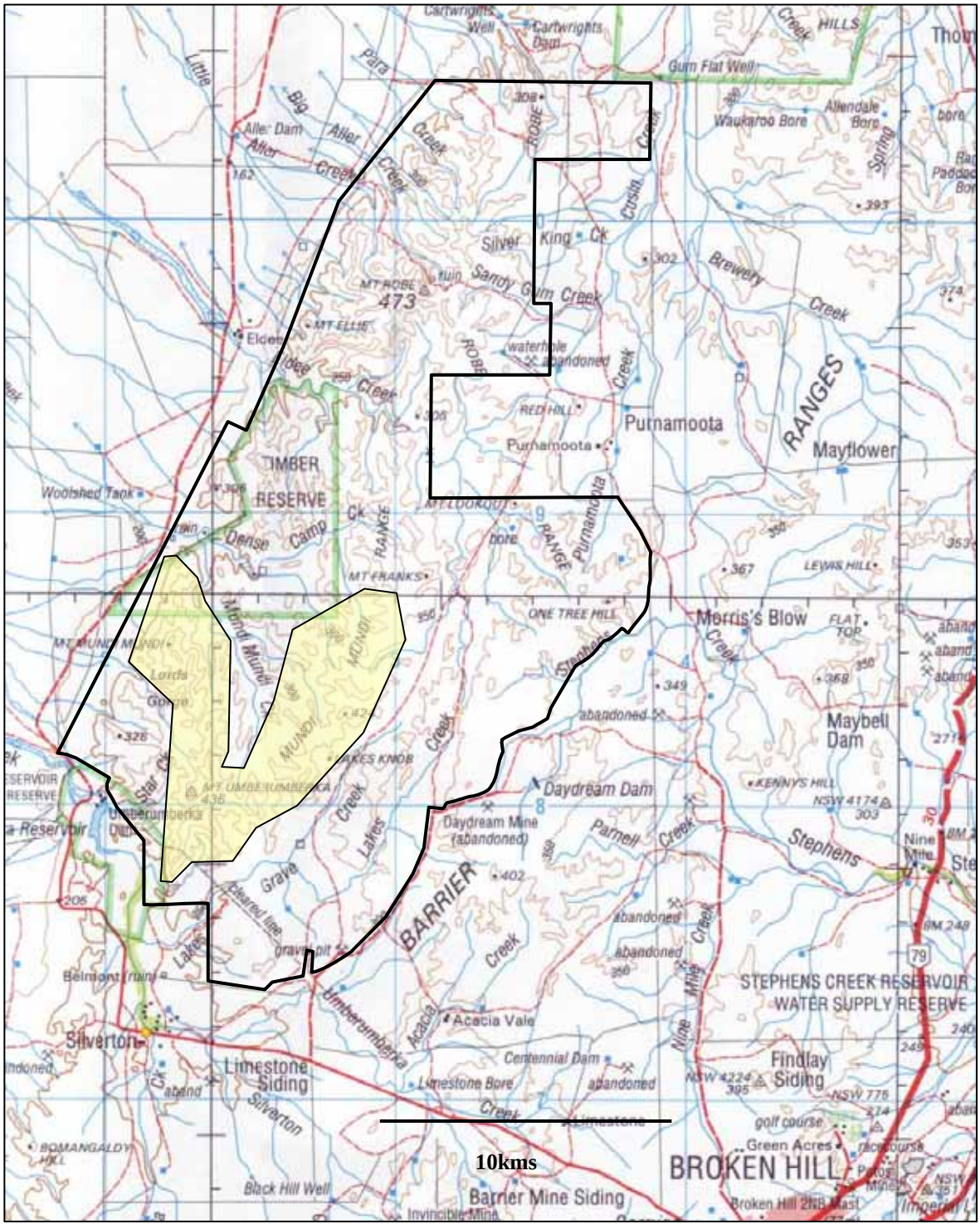

Figure 1. The area in which Stages 2 and 3 are located in a broad topographic context; shaded area corresponds to Stage 1 (Broken Hill SH54-15 2nd ed. 1:250 000 topographic map).

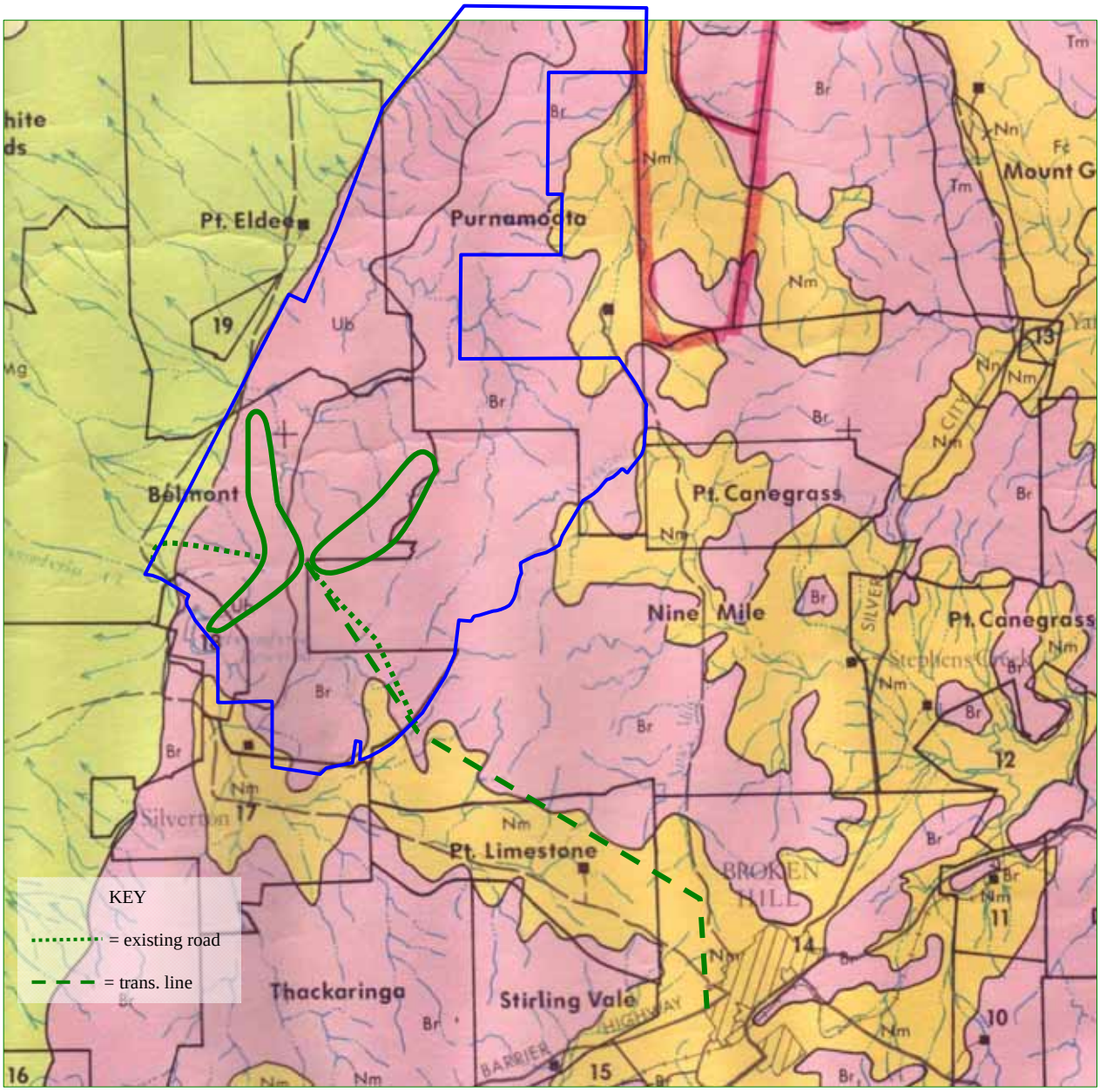

Figure 2. Location of the Silverton Wind Farm Stage 1 (outlined in green), and 2 and 3 (outlined in blue), in relation to defined land systems (Broken Hill Land Systems Series Sheet SH 54 – 15).

Prior Impacts and Geomorphology

The primary landuse of the region is sheep and cattle grazing on native vegetation, predominantly the chenopod shrublands (Fanning 1999). Within the proposed Stages 2 and 3 turbine envelope extensive mining has also occurred; most recent landuse to which the ranges are subject is goat management programs. These prior and existing land uses have caused significant changes to geomorphological processes in the area, with an associated effect on the archaeological resource.

The Silverton/Broken Hill area was originally covered with woody mulga scrub. Indeed, when the first explorers arrived in the district they reported such heavy vegetation that men had to walk their horses as it was too closely wooded for them to ride (Barrier Miner 2007). However the arrival of Europeans with sheep and later with their requirements for timber for use in the mining and pastoral industries, as well as the construction and operation of townships they built, resulted in the denudation of the broader landscape (Murray/Darling Study Group 2004).

The wool industry between 1840 through to 1900 was the dominant export commodity in Australia. In the Western Division, pastoralism, in particular the grazing of sheep on native vegetation, became the dominant

landuse practice. The development of riverine transport along the Darling, Murray and Murrumbidgee Rivers in the 1850s and 1860s facilitated this spread of pastoralism.

The area west of the Darling River was taken up by sheep farmers between 1859 and 1876 as new settlers were required to move out from the already occupied margins of the Darling in search of new grazing land (Lunney 2001). When Gow and Thornton explored the Barrier Ranges in 1861 looking for land suitable for pastoral use, they observed the tracks of horses and cattle, indicting that domestic stock had already found their way into that country beforehand. As wool exports increased, sheep numbers in the region dramatically surged in the late 1800s.

Opportunities which arose as a result of legislative changes to land tenure from the 1860s through to the 1880s patterned land occupation in the Western Division; these changes were accompanied by unforseen implications in relation to landscape and ultimately the history of land use. The Western Division was created as an entity as a result of the introduction of the Crown Lands Act 1884 (Lunney 2001). In addition, leasehold lands were divided into two equal parts with one part, the resumed area, made available to new settlers. As a result of this the original settlers were forced into the position of having to graze all their sheep on half the original land area they had utilised; the new settlers then grazed their sheep on the residual or resumed land (Lunney 2001). This resulted in more intensive grazing and higher levels of impacts to native vegetation.

Pastoralism in the western district during the late 1800s became fraught as vulnerability to droughts increased due to over stocking and the deterioration of the landscape. At this time wool production and the corresponding incomes of pastoralists became unreliable (Lunney 2001). Nevertheless before the end of the 1880s a large part of the country's overall increase in wool production occurred in this region, in part assisted by the widespread introduction of bores. Also around this time paddock fencing and vermin proof fences were constructed over most of the grazing land in New South Wales. Sheep numbers were still increasing at this time and as well, by the 1880s, rabbit populations. At the end of the century the Western District experienced a severe drought which in combination with a depression, caused by the death of huge numbers of sheep, and saw falling wool prices.

Mulga was the principal tree species to be affected by pastoral management. It is documented to have been cut for drought feed early in the 1890s and regeneration was prevented in most areas by continued drought feeding and grazing by both sheep and rabbits (Oxley 1987).

In addition to the use of mulga as feed for sheep, this species was also widely exploited for fencing. The earliest fences were made of mulga bushes piled up in lines to about 1 metre in height. One such brush fence, 1.16 kilometres long, was the first fence installed around a selection on Purnawilla Station near Wilcannia in December 1882 (Pickard 1992). Wire strung fences had begun to be used from the 1870s. Fencers were paid per mile of erected fencing and where possible they cut the fence posts locally from living trees. Mulga was the favoured species for posts and this style of fence construction was still in wide use up until about World War II when steel posts started to be more commonly used. While the first steel posts were advertised in 1908, in western New South Wales they were not to have been used extensively for another forty or so years for reasons of cost (Pickard 1992).

By the turn of the century the negative effects off pastoralism on the landscape were beginning to be appreciated and this was recognised in the 1901 Royal Commission of the Western Lands when it acknowledged that the carrying capacity of the land had been greatly over estimated. The Commission recognised that overstocking and the impacts of rabbits had resulted in the destruction of almost all vegetation.

The discovery of ore bodies in the region in 1883 led to the establishment of the local mining industry which had a voracious appetite for wood to fire steam machinery and make pit props (Murray/Darling Study Group 2004). Compounding this was the need for wood to build townships, for use in domestic fires and thereafter to power locomotive steam engines; following the mineral discoveries at Thackaringa and Umberumberka in 1883 local business people formed the Silverton Tramway Company in 1885 to build a railway line from Silverton to the South Australian border. Then with the silver-lead-zinc discovery at Broken Hill the railway line was extended from Silverton to Broken Hill in 1887 (Cockburn 2007). At the same time paddle steamer trade was also demanding wood for engines.

The result was that almost all the trees were cut down within a few days travel of Broken Hill (Murray/Darling Study Group 2004). When most of the local timber was removed builders and miners brought timber in from Adelaide (NSW NPWS 1991).

Dust storms plagued Broken Hill in the early days. While at one time the vegetation was so thick there were stories of people losing their way in the scrub, the cumulative impacts of European settlement created a landscape heavily denuded of trees for hundreds of kilometres in every direction (Pritchard 2004). The resultant effect was the exposure of bare soils which were susceptible to aeolian erosion. When strong winds blew the layers of soil were stripped from the bedrock and phenomenal amounts of sand and dust became airborne. When this occurred the township of Broken Hill became inundated with sand drifts which piled up on its outskirts and covered its streets.

The region suffered drastic effects following the 'Federation Drought', which began in the mid 1890s and lasted until 1902. At this time Kinchega Station occupied lands west from the Darling River to the Barrier Ranges. During this severe drought Archer Russell walked the road from Menindee to Broken Hill. 'It was a hot track' wrote Russell, 'hot and long and abominably dusty. The sand upon it lay two feet thick. The plains through which it led marched away in great red wastes. Sometimes they ran up into rippled sand ridges and fell away into great scored hollows—the product of incessant wind-storms. As often as not there was no track at all—the wind had buried it in drift-sand' (Cited in Freeman 2002). When surveyor Randolph Bedford was appraising the Broken Hill township at about that time he wrote that "Argent Street was a huge dust heap…a two chain wide road knee deep in dust".

In 1908 Albert Morris, who is now remembered as a conservationist for starting the first revegetation program at Broken Hill, wrote of the degraded surrounding landscape: "The extending country stretched for miles without a vestige of any green thing and each stone or old tin had a streamer of sand tailing out from it. The fences were piled high with sand, inside and out and it looked as if the intended railway lines would just be buried every dusty day, which was every windy day" (Morris 1908, in Mining Hall of Fame Pty Ltd 2004).

Great windstorms filled the skies with red sand during drought years in the 1930s and 1940s. Botanist Barbara Briggs indicates that her first recollection of Broken Hill as a child in the 1930s was a dust-storm she experienced while walking home from kindergarten with her older sister: "We clung to a wire fence while wind-blown sand stung our faces and we tried to keep grit and dust out of our eyes". Such storms and widespread sand-drift were frequent in the 1930s in Broken Hill, when the city was surrounded by "treeless wasteland, the result of overgrazing and cutting timber" (Briggs 2001). Others recall dust storms so heavy that the sun was obscured and the day seemed like night.

Botanist Noel Beadle was of the opinion that the dust storms of the 1940s were more frequent and more severe than those experienced during the 'Federation Drought". One such storm had buried roads near Menindee, blown down a town store and caused a train derailment after the railway line was buried by deep sand drifts. Across the district these dust storms had ripped away or buried all remaining feed. The Soil Conservation Service feared a 'moving sand desert' of reactivated dunes would put an end to grazing in the western district (Freeman 2002).

While many earlier accounts tended to attribute much of the cause of land degradation and the ensuing soil losses and dust storms to rabbit infestation, more recent assessments recognise that the initial introduction of sheep and their subsequent overstocking were the primary reasons. The introduction of rabbits and then goats served only to compound the problems initiated by pastoral enterprise, as the grazing habits of these animals curtailed regrowth.

Rabbits were introduced to Australia in 1859 by a wealthy Victorian grazier keen on the sport of hunting. They first arrived in the Broken Hill region 1883, well after the introduction of sheep and the earliest occurrence of severe dust storms. Reports by pastoral inspectors during the early 1890s indicated the seriousness of the rabbit problem. In one report the inspector stated that ". . . the years 1890 and 1891, though splendid season as far as rainfall was concerned, were in reality, so far as feed for stock was considered, droughts. Rabbits had swarmed over the whole country, and the ground appeared incapable of growing anything. Many persons thought that the rabbits had poisoned the ground as nothing grew after such a good rainfall".

Rabbits competed directly with the domestic herbivores for palatable herbage and shrubs and so exacerbated the already high stocking rates. It is indicated that virtually no regeneration of Mulga occurred between 1899 and the 1950s, when rabbit numbers decreased (Oxley 1987). David Lord, the owner of Thackaringa Station, has indicated that because each rabbit consumes about 250 grams of dry matter per day, just one or two rabbits per square kilometre can cause very significant environmental damage by completely suppressing the regeneration of plants. With regard to *Acacia carnei* trees there has been an increase in regeneration of *1700* percent since rabbits were excluded from areas within that station. Similarly, caging experiments at Kinchega National Park indicated that the rabbit was primarily responsible for the observed lack of regeneration of a range of Acacia *carnie* and that the control of rabbits is essential to initiate regeneration.

Goats were originally brought to Australia by European settlers in 1788 in the first of many introductions. They were introduced to inland areas by early settlers, miners and railway construction workers for use as a source of meat and milk, and in 1861 angora and cashmere goats were introduced for a specialty wool trade. Feral goats bred from escapees and deliberate releases from these flocks. Historically, feral goat numbers have increased on several occasions because of the collapse of the goat fibre industry. When this industry failed in the late 1800's, goats were abandoned leading to an increased feral population. The goat fibre industry experienced resurgence in the early 1900's only to decline around the same time as the wool crash in the 1960's (Southwell *et al.* 1993). Australia now supports the biggest feral goat population in the world.

The grazing of goats on many semi arid zone plant species has been found to have a deleterious effect with regard to both established trees and plant regeneration. However goats are selective grazers so that their impact on different plant species is varied. During times of drought or under conditions of heavy stocking, goats have been found to severely impact established trees and to eliminate new sprouts. Stocking at moderate rates however does not preclude regeneration. Nevertheless, given the plant selectivity of goats, it has been found that the overall effect of their continued grazing in a given area is the replacement of palatable shrubs by unpalatable ones (Harrington 1989). When both rabbit and goat populations occupy the same area the combined effect of the grazing habits of both species has been found to inhibit plant regeneration on a broad scale (Auld 1993).

Condon (1983) and Wasson and Galloway (1986) have noted that the cover of vegetation in the area around Broken Hill has undoubtedly increased during the last 30 years, and that as a result the rates of erosion have fallen. Much of the reason for this moderate recovery has been attributed to a drop in the rabbit population.

The implications of these prior impacts in regard to geomorphological processes and impacts on archaeological sites is set out below. In summary, previous landuse in the region has resulted in a highly eroded and degraded landscape. These prior impacts will have caused significant changes to the archaeological resource in the proposal area.

The sequence of geomorphic change that has occurred in the Barrier Ranges has been viewed in terms of pre-European and post-European phases. Generally, pre-European events are seen as being driven by climatic shifts, while post-European changes are attributed in large part to humanly activated processes (Cupper 2005; Fanning 1999; Holdaway *et al.* 2002; Wasson and Galloway 1986).

Geomorphic evidence for recent, widespread landscape change in the region comes from a number of sources ranging from the measurement of processes responsible for topsoil loss, descriptions and dating of regolith sequences in valley fills, monitoring of channel enlargement and knickpoint retreat and observations of the burial of land surfaces and the erosion of cultural heritage features and infrastructure (Fanning 1999). These processes and changes need to be considered in the context of archaeological analysis as they have the potential to cause significant impacts to archaeological features.

Wasson (1979) examined the Mundi Mundi Alluvial Fans. The catchment for these fans falls entirely within the Barrier Ranges, and reflects the geomorphological history of those ranges. Wasson (1979) found the fans to consist of five well-defined and easily recognised stratigraphic units. The earliest stratigraphic unit recognised is the Umberumberka unit believed to have been deposited as the result of a period of increased moisture during the last glaciation of southeastern Australia, and ceased to accumulate as a result of increasing aridity.

The Belmont Palaeosol, deposited over the Umberumberka unit, represents a period when the fan surfaces were inactive between 16,000 and 13,000 years B.P. Over this the Korkora unit is a thin and discontinuous unit. The streams which deposited this latter unit were often less than 50 cm deep. It is suggested that the Korkora unit was deposited during a short period of increased moisture (Wasson 1979).

The final period of major deposition on the fans is represented by the Mundi Mundi unit. The sediments of this unit are indistinguishable from those of the Umberumberka unit, except that the mud content of the Mundi Mundi unit is lower than in the older unit. The Mundi Mundi unit began to accumulate about 6000 years B.P. as a result of an increase in rainfall. Pollen evidence from the unit suggests that vegetation about 4500 years ago was little different from that of today showing that the increase in rainfall of the time was not substantial at Broken Hill. Into this, the Thackaringa unit was deposited between ca 1000 and 500 BP as an inset fill within trenches cut into the fans. The deposition of this unit appears to have been the result of a slight increase in moisture recorded in lakes in southern Australia. Wasson's overall findings were that climatic changes were the dominant 'secondary control' in the evolution of the Mundi Mundi Alluvial Fans (Wasson 1979).

A marked acceleration in pre-European sediment yield from the Barrier Ranges between 6000 BP and 3000 BP was later documented by Wasson and Galloway (1986), which they argue resulted in the formation of the Mundi Mundi unit. This increase in the depositioning of sediment has chiefly been attributed to a period of higher temperature and rainfall.

Wasson and Galloway (1986) in their comparative study of the sediment yield in the Barrier Ranges before and after European settlement, suggest that "…it is generally agreed that European settlement of Australia's rangelands altered the biota and increased rates of soil erosion". Their investigation found a dramatic change in the catchment occurred when Europeans and domestic stock arrived, with a rate of sedimentation between 1915 and 1982 many times higher than the pre-European period. The average post-settlement sediment yield was found to be 50 times greater than the average yield for the 3000 years preceding settlement. They indicate that although at present the rate of erosion has fallen, it is still continuing at a pace far above the pre-1850 rate.

Fanning's (1999) research, conducted across a number of upland catchments between Broken Hill and Tibooburra in arid far western NSW, likewise found that modern rates of soil erosion are approximately 145 times the 'natural' rates occurring before European occupation. This reflects the acceleration of geomorphic processes such as sheetwash, rilling, gullying and wind drift set in play as the result of European land use. At the same time channel enlargement and knickpoint retreat were found to be active in many catchments, resulting in destabilisation of riparian areas and causing impacts to infrastructure such as roads and fences, and to cultural heritage.

Fanning (1999) describes two broad geomorphological processes causing impacts in the area. Erosion: - which entails widespread stripping of surface alluvium causing extremely high rates of soil loss; and aggradation: - resulting in channel infilling which generally occurs in localised areas, in downstream locations.

The source of the material deposited on the floodplains derived from the erosion of the hillslopes of the Barrier Range regolith. With the introduction of domestic grazing, and feral animals, and other vegetation impacts, the hydrologic balance shifted toward surface runoff, an increase in the erosiveness of flows on hillslopes and the subsequent loss of topsoil; topsoil loss has been found to exceed soil formation (Fanning 1999). On hillslopes evidence such as presence of lichen lines on rocks and the widespread exposure of tree roots points to an average lowering of the land surface of at least 10 cm.

The aggradation of Post Settlement Alluvium in valley floors has been found to vary in depth between 10 cm and one metre in catchments across the region (Fanning 1999). These sediments either overlie the original land surfaces (sometimes containing charcoal, ash, bone, stone artefacts and heat retaining hearths: for example at Giles Creek at Mutawintji) or an eroded surface (Fanning 1999).

Radiocarbon dating of charcoal retrieved from three Aboriginal fireplaces buried beneath this sediment indicates that many were in use immediately prior to European settlement of the area about 140 years ago. Fanning (1999) concludes that the red sandy alluvium had been deposited over the floodplain surface very close to the time of European settlement, and most likely as a result of the initial disturbance of the catchment when sheep grazing was introduced.

The loss of topsoil on valley floors is also observed by examination of Aboriginal heat retaining hearths. The stones of these hearths, which originally lined sunken cooking pits, are often found exposed as a high point of the land surface, having protected the soil beneath from the impact of rain-splash erosion. At the same time the surrounding unprotected land surface had been eroded away, clearly demonstrate that surface lowering had occurred since the fireplaces were in use (Fanning 1999).

Prior to European induced geomorphic change the upland creek systems in valleys comprised shallow, sinuous channels. However when the hillslope source of sediment was depleted, the stream flows became more erosive within the valley floors; this led to a triggering of channel incision into the valley fills buried under the highly erodible sandy Post Settlement Alluvium. The commencement of this entrenchment began at about 140 years ago (Fanning 1999). Gullying is causing streams to widen, and to become straight sided with flat floored gullies. The process continues as banks become undercut and collapse. In addition to gullying enlargement, knickpoint retreat is widespread across the region. These processes cause significant erosion and loss of valley fill with the associated loss of the archaeological resource which may be present within it.

While the studies outlined above have been conducted outside the proposal area it is believed that they can be extrapolated across the region. During field survey of the Stage 1 proposal area evidence of these geomorphological processes was noted and therefore it is assumed that likewise the Stages 2 and 3 areas will have suffered similarly and to have caused impacts to the archaeological resource in the turbine envelope.

Hillslopes are likely to have been denuded of topsoil via erosion with an associated impact of archaeological objects. Fanning and Holdaway (2001) have attempted to quantify the effects of these processes on artefact distribution. They have argued that at even low gradients artefact size and slope angle are significantly related; smaller artefacts are moved at greater distances than larger artefacts and that as slope angle increases this phenomena is enhanced. In valleys both erosion and aggradation is likely to have resulting in disturbance and removal or the burying of archaeological objects; gullying enlargement and knickpoint retreat of the valley fills will have entirely removed archaeological material from the former stream margins.

Summary

The impact areas relating to the proposed Silverton Wind Farm Stages 2 and 3 are situated in the hills of the Barrier Range and associated creek valleys.

Prior to historic impacts which have caused significant degradation to the vegetation communities the hills are likely to have been utilised by Aboriginal people for hunting numerous animal species including mammals and reptiles. Plant species would also have been harvested for fruit, seeds (including staples such as mulga) and medicine. Quartz outcrops throughout the hills will have provided an abundant and readily accessible supply of stone for tool manufacture. Fresh water is present in the hills as an ephemeral source only. The hilly areas area predicted to have been utilised for low levels of Aboriginal occupation associated with hunting and gathering forays conducted away from base camp locations. It is predicted that in the hills artefact discard is likely to have been correspondingly low, commensurate with low levels of utilisation. In summary the hills are predicted to contain stone artefacts distributed in low density.

Numerous creeks are present within the ranges and these areas contrast to the environmental context of the hills. The open depression landforms through which these creeks flow are relatively flat and are significantly less rocky than the adjoining hillslopes. The biodiversity within the open depressions is greater than that which is found on the adjoining hills, however the significant environmental difference is that the creeks are likely to have held water for longer periods of time than the drainage flowing from the hills. The creek environments in the valleys are therefore likely to have been favoured by Aboriginal people as camping places when occupying the Barrier Ranges. It is predicted that in the open depression landforms and associated relatively flat slopes, artefact discard would have been relatively high as a result of greater levels of utilisation. In addition it can be expected that these locations will contain a greater variety of artefact types reflecting longer periods of habitation and a greater diversity of activities undertaken. In summary the open depressions and plains are predicted to contain higher artefact densities and a wider range of artefact types.

4.2 Overhead Transmission Line: Broken Hill to Red Cliffs

The proposed overhead transmission line extends from Broken Hill southward to Red Cliffs for a distance of approximately 300 kilometres. The topographic context of the route is shown in Figures 3, 4, 5, 6 and 7.

The route of the transmission line commences at an existing substation located on the western outskirts of Broken Hill. The route extends southward firstly passing through the southern extent of the Barrier Ranges, and then through sand plains and dunes, and after crossing the Darling River finally crosses the Murray River, east of Buronga Gol Gol.

The proposed transmission line route is located within the semi-arid zone of western New South Wales. Annual precipitation average less than 250 mm per year and evapotranspiration, in all months, exceeds precipitation. Water is available from a number of sources including those which are ephemeral such as creeks, claypans and swamps which collect surface runoff, and semi-permanent sources (the Darling and Anabranch). The Darling Anabranch is semi-permanent stream course with associated lakes and wetland areas. The Murray River provided the only permanent water source in the region (McIntyre 1988). At the time of European occupation recordings were made of large groups of Aboriginal people at such places as the confluence of the Darling and the Murray (Craib 1992), attesting to the regional importance of these water bodies.

The route traverses a wide range of different land systems, each of which possess differing hydrological systems and vegetation communities. The proposed transmission route commences on the footslopes of the Barrier Range and crosses rolling downs, lowlands land systems. The area is drained by ephemeral and shallow channels with the major drainage lines being Kellys Creek, Pine Creek and Rantyga Creek. The area is virtually treeless, except for the margins of the major creeks. The loam soils often contain a gibber surface (McIntyre 1977).

Over the majority of the remainder of route the surface geology is mostly aeolian (wind-blown) sediments; dunefields and sandplains are the main land systems. The dunefields are generally east-west trending dunes of relief less than 10 metres. The sandplains are generally slightly undulating, sometimes with aligned dunes with relief varying between 3 and 10 metres.

The Darling Anabranch measures approximately 460 km in length and is associated with lakes, playas and basins, billabongs and swamps. The stream course anabranches from the Darling River south of Menindee and enters the Murray River downstream of Wentworth. The channel is broad and sinuous, incised to 10 metres and meanders through a narrow alluvial plain. The Darling Anabranch was the course of the palaeo-Darling River during the last Ice Age (Bowler *et al*. 1978). The Darling River avulsed to occupy the present channel at around 11,000 - 7000 years ago.

The Anabranch lakes have ephemeral hydraulic connection to the main Anabranch channel. Connection occurs during Anabranch flood events, variously through Anabranch/Darling River palaeochannels or via direct connection between the lake basins and the Anabranch channel. Under natural conditions the northern lakes (Mindona, Travellers, Popio and Popiltah) trap most of the water except during exceptionally large floods such as the 1864 event (Withers 1994). Under natural conditions the Darling Anabranch flowed about two years out of three in its upper reaches, and less frequently downstream (Irish 1993); lakes such as Nearie Lake and the other lakes in the lower reaches of the Anabranch received a small fraction of the small and moderate floods (DWR 1994). It is believed that the Anabranch lakes may have flooded sequentially from north to south.

The occurrence of lake flooding under current conditions has been modified as a result of the changed hydrologic regime within the Anabranch. Additional changes have resulted from the construction of Anabranch blockbanks and the creation of artificial weir pools within the Anabranch. Lake inflow/outflow arrangements have been modified by the enlargement of some channels and construction of lake blockbanks and regulators (Jenkins 1999; Withers 1994).

The lakes are described as low-lying areas defined by a relatively sharp break in slope on the western margin representing an ancient or modern cliff line. Their eastern side is enclosed by lunettes. The basins are typically smooth and elliptical, often kidney-shaped in outline, with the long axis oriented N-S or NNW-SSE (Bowler and Magee 1978).

All of the lakes are associated with streams that supply their water, although most lakes are dry the majority of the time. Lake floor sediments generally comprise clay, which can form desiccation cracks if montmorillonite is a major component of the clay assemblage (Bowler and Magee 1978). Western lake margins commonly truncate the linear dune fields, and only rarely do the dunes extend into the lakes. Bowler and Magee (1978) infer this to mean that when the dunes were actively advancing there was water in the lakes.

The lunettes located on the eastern margins of the lakes are smooth, crescentic, transverse dunes and their size commonly is related to the size of the adjacent source area i.e. lake basin. A lake of less than 1 km diameter may have a lunette less than 5 m high. In contrast, the larger lakes have lunettes 15 or even 20 m high (Bowler and Magee 1978).

The sediments that comprise a lunette are closely related to the hydrologic condition prevailing in the adjacent source zone. Most lunettes are gypsum-rich, reflecting highly saline lake conditions during lunette accretion. In contrast, the Travellers Lake lunette on the Anabranch comprises quartz sand, suggesting that Travellers Lake itself was not hyper-saline during lunette formation (Bowler and Magee 1978).

Lunettes in the Anabranch area, and indeed throughout the Mallee Region, are relict Pleistocene features. The last phase of lunette accretion was between 19,000 and 15,000 years BP (Bowler 1976). When active, lunettes accreted sand relatively rapidly, thus providing one of the most important processes for preserving animal and human remains.

At both the Darling and Murray River crossings the route traverses alluvial floodplains. The floodplains contain meander scars, point bars, extinct channels and billabongs.

A total of 23 described vegetation communities and one undescribed vegetation community are present along the power line easement (nghenvironmental 2008). The proposed power line extends across two Bioregions within NSW, the Broken Hill Complex Bioregion in the north and the Murray Darling Depression Bioregion in the south. The Broken Hill Complex Bioregion extends approximately 80 - 90 km south of Broken Hill. Dominant vegetation communities within this area include chenopod shrublands composed of saltbush and

bluebush communities, Belah Rosewood Woodlands and Mulga (*Acacia aneura*) communities. The *Acacia loderi* Shrublands is also present.

The majority of the proposed power line is located within the Murray Darling Depression Bioregion and extends from the Broken Hill Complex Bioregion south to the Murray River. The dunefields are dominated by mallee communities with varying understorey components. The sand dunes are dominated by porcupine grass (*Triodia scariosa*) while the swales between the dunes are characterised by chenopod shrub understorey. Sandplains are characterised by Belah Rosewood Woodlands with River Red Gum (*Eucalyptus camaldulensis*) and Black Box (*Eucalyptus largiflorens*) communities occupying the floodplain areas. Slender Cypress Pine is present along sandy rises (nghenvironmental 2008).

Certain areas of the existing power line cross through cleared agricultural land and cropped agricultural land. Agricultural land varies along the route and includes:

- Semi-cleared, cropped land with scattered Black box remnants;
- Irrigated cropping for vineyards; and
- Charcoal farms consisting of cleared and regrowth mallee (nghenvironmental 2008).

Both individual land systems, and individual landform elements within those systems, can be utilised for archaeological modelling along the transmission line route; accordingly the following discussion is set out in respect of the land systems through which the route passes (shown on Figures 8, 9, 10 and 11). Further below a discussion of the archaeological sensitivity of individual landform elements within land systems is set out.

At Broken Hill the transmission route commences within the Rowling Downs and Lowlands land systems including the Nine Mile (Nm), Nuntherungie (Nn) and Katalpa (Kt) units. These units are defined as follows:

- Nine Mile (Nm) – Lower ridges, slopes and minor drainage plains of the Barrier Range, relief to 30 m with red texture-contrast soils and areas of solonized brown soils and lithosols.
- Nuntherungie (Nn) – Undulating plains, relief to 15 m. Contour bands of deep stone-free red clays alternating with bare stony red desert loams. Small areas of loose yellowish-brown calcareous loams and clay loams. Drainage tracts with deep loamy sand.
- Katalpa (Kt) – Gently undulating plains, relief to 10 m. Stony surfaces with red desert loams, bands of stone-free red clays in gilgai depressions. Less stony areas of loose, highly gypsic, yellowish-brown calcareous loams and clay loams. Drainage tracts of deep loamy alluvium.

In one area the line crosses the Barrier Range land system (Br) defined as ranges with narrow, incised drainage and relief to 80 m with lithosols and red texture-contrast soils.

As the route approaches Pine Creek the Kars (Kz) sandplains land system is crossed. The Kars land system is defined as extensive sandplain with isolated low sandy rises and drainage depressions, relief to 2 m and calcareous red earths and solonized brown soils.

At Pine Creek the route crosses the Fowlers (Fl) alluvial plains land system. The Fowlers land system is defined as narrow floodplains, moderately scalded backplains with sandy loam surfaced reddish-brown texture-contrast soils and crusty brown clays; channels with fine sand and silt.

After traversing the Pine Creek alluvial plain the route briefly crosses the Rolling Downs and Lowlands Oakvale (Ok) and Katalpa land systems before returning to the Kars sandplain. The Oakvale land system is defined as stony plains with relief to 3 m, deep red desert loams and red clays in gilgai depressions and alluvial flats with brown self-mulching cracking clays.

The following additional sandplains land systems, Trelega, Bulgamurra, Belvedere and Overnewton, as defined below, (and a dunefield: Mandleman) are crossed until a network of Playas and Basins is reached at Coombah Lake:

- Trelega (Te) – Level to slightly undulating sandplains and swales of loamy solonized brown soils; aligned low dunes and low rises of deep brownish sands and calcareous red earths; relief to 3 m.
- Bulgamurra (Bm) – Slightly undulating sandplains with areas of aligned sand dunes; relief to 7 m. Sandplains of calcareous loamy sand and sandy red and brown soils. Dunes of deep red sands. Isolated depressions of grey clays, usually fringed by black box.

- Belvedere (Be) – Undulating sandplains of solonized brown soil, broad aligned deep red earthy sand, swales of loamy solonized brown soils; relief to 7m.
- Overnewton (Ov) – Extensive slightly undulating sandplain with isolated sandy hummocks and depressions with relief to 5 m. Sandplains of calcareous loams and sandy loams.
- Mandleman (Mn) – Dunefields of parabolic and unaligned dunes merging into slightly undulating sandplains; relief to 10 m. Dunes and swales of deep sandy red earths and isolated flats of solonized brown soils.

Coombah Lake is the Popiltah (Pt) land system which is defined as small ephemeral reniform-shaped lakes to 2 km diameter with lunettes, associated feeder channels and isolated box depressions; lunette relief to 10 m, with grey cracking clays and brown texture-contrast soils in lakes, channels and swamps. Lunettes consist of deeply cemented sands and red texture-contrast soils.

After crossing Coombah Lake the route traverses a number of dunefields including Ennisvale and Scotia and sandplains including Bulgamurra:

- Scotia (Sc) – This dunefield is defined as broad to narrow swales with long aligned dunes and relief to 7 m. Earthy sands, loamy texture-contrast soils and solonized brown soils in swales; siliceous red to brownish sands on dunes with isolated flats of brown texture-contrast soils.
- Ennisvale (Ez) – This dunefield is defined as extensive gently undulating swales with aligned dunes and isolated flats with relief to 7 m. Sandy solonized brown soils and red texture-contrast soils, dunes of deep brownish sands.

In this area west of Popiltah Lake two basins are traversed: The Birdwood (Bw) land system is defined as small relict lakes and lunettes with extensive associated sandplains and isolated dunes with relief to 10 m. Basin floors are highly saline, gypseous or calcareous grey clays.

The route continues southward to the west of the Ana Branch crossing a number of sandplains including Belvedere, Overnewton, Trelega and Hatfield. Hatfield is defined as extensive slightly undulating sandplains with isolated small depressions with relief to 10 m. Sandplains of solonized brown soils and sandy red and brown texture-contrast soils. Depressions of grey clays rimmed by scalded red texture-contrast soils.

At the Ana Branch the route crosses the Ana Branch alluvial plain. This land system is defined as Ana Branch frontage and broad floodplains with associated channels, billabongs, swamps, lunettes and plains. Channels are incised to 10 m. Self mulching cracking grey clays with areas of scalded red and brown texture-contrast soils; lunettes and rises of deep sands.

After crossing the Ana Brach the route again traverses a number of different sandplains including Hatfield, Trelega, Overnewton and Menilta, and the dunefield Arumpo, before reaching the Darling River. The Menilta and Arumpo land systems are defined below:

- Menilta (Mt) – Very gently undulating partly scalded sandplains with areas of aligned dunes and isolated depressions and relief to 10 m. Sandplains of sandy loam to sandy solonized brown soils or texture-contrast soils. Dunes of deeper sand soils.
- Arumpo (Ap) – Parallel east-west trending dunes of deep red earths and relief to 10 m. Narrow swales of calcareous red earths.

The Darling River is situated within the Darling (Dl) alluvial plain defined as Darling River frontage and broad floodplain with associated billabongs, swamps, back channels, levees and sandhills. Channels incised to 15 m. Grey self mulching to silty clays, calcareous loamy sand to deep sandy red soils on levees and sandhills.

After crossing the Darling River the route traverses a series of sandplains including Menilta, Bulgamurra and Overnewton and dunefields including Mandleman and Arumpo. Shortly after crossing the Darling the route also crosses the Canally alluvial plain land system defined as scaled alluvial flats and sand dunes adjacent to the Darling River floodplain with relief to 5 m. Flats of silty or cracking grey clays. Dunes and plains of deep sandy red soils or texture-contrast soils, locally calcareous.

At the Murray River crossing the route traverses the Riverland alluvial plain defined as active floodplains of the Murray, Murrumbidgee, Edward and Wakool Rivers with associated billabongs, swamps, channels, levees

and lunettes incised to 50 m. Self-mulching and cracking grey clays with deep brownish sand, sandy solonized brown soils on lunettes and levees.

Summary

Within the different land systems individual landform elements are present which are known to be archaeologically sensitive. In many cases the broad land system itself is not expected to be archaeologically sensitive however some of the landform elements present in a broader land systems will be. The sensitivity of individual landform elements are discussed further below. The following predictions regarding sensitivity of landform elements is derived primarily from the Johnston and Witter (1996) study; other sources are listed where relevant.

- Swales – Low archaeological sensitivity (Johnston and Witter 1996);
- Sandplain flat - Low archaeological sensitivity (Johnston and Witter 1996);
- Dune – Low archaeological sensitivity (Johnston and Witter 1996);
- Lakebed - Low archaeological sensitivity (Johnston and Witter 1996);
- Colluvial slope – Moderate sensitivity; lithic scatters (Johnston and Witter 1996);
- Lake margin – Moderate archaeological sensitivity; middens, lithic scatters, hearths (Johnston and Witter 1996);
- Box swamps - High archaeological sensitivity; middens, lithic scatters, hearths (Johnston and Witter 1996; McIntyre 1977);
- Lunettes/source bordering dune – High sensitivity these landforms can contain burials, middens, hearths and lithic scatters.
- Alluvial flat - High sensitivity these landforms can contain burials, middens, hearths and lithic scatters (Johnston and Witter 1996);
- Ridge range – High archaeological sensitivity; lithic scatters (Dibden 2008; Johnston and Witter 1996);
- Water course - High archaeological sensitivity; middens, lithic scatters, hearths (Dibden 2008, Johnston and Witter 1996);
- Floodplain margin - High archaeological sensitivity; middens, hearths (Johnston and Witter 1996);
- Valley/gorge - High archaeological sensitivity; lithic scatters, hearths (Dibden 2008; Johnston and Witter 1996).

McIntyre's (1977) survey of the existing transmission line furnished other site locational information. He found the Darling River to be the most productive archaeological area along the transmission line route. McIntyre (1977) recognized that the relative absence of material adjacent to the Murray River may well have been a factor of low visibility. The old channels including their associated claypans, cane grass and box swamps along their course were found to have been focal points of settlement within the dunefields. Within the sandplains swamps were found to have been a major focal point with claypans containing minor evidence of occupation. McIntyre (1977) considered the Ana Branch to be sensitive particularly given the presence of billabongs and source bordering dunes. Within the Pine Creek area McIntyre (1977) found that sites were located both adjacent to the creeks and on the plain in areas not associated with water.

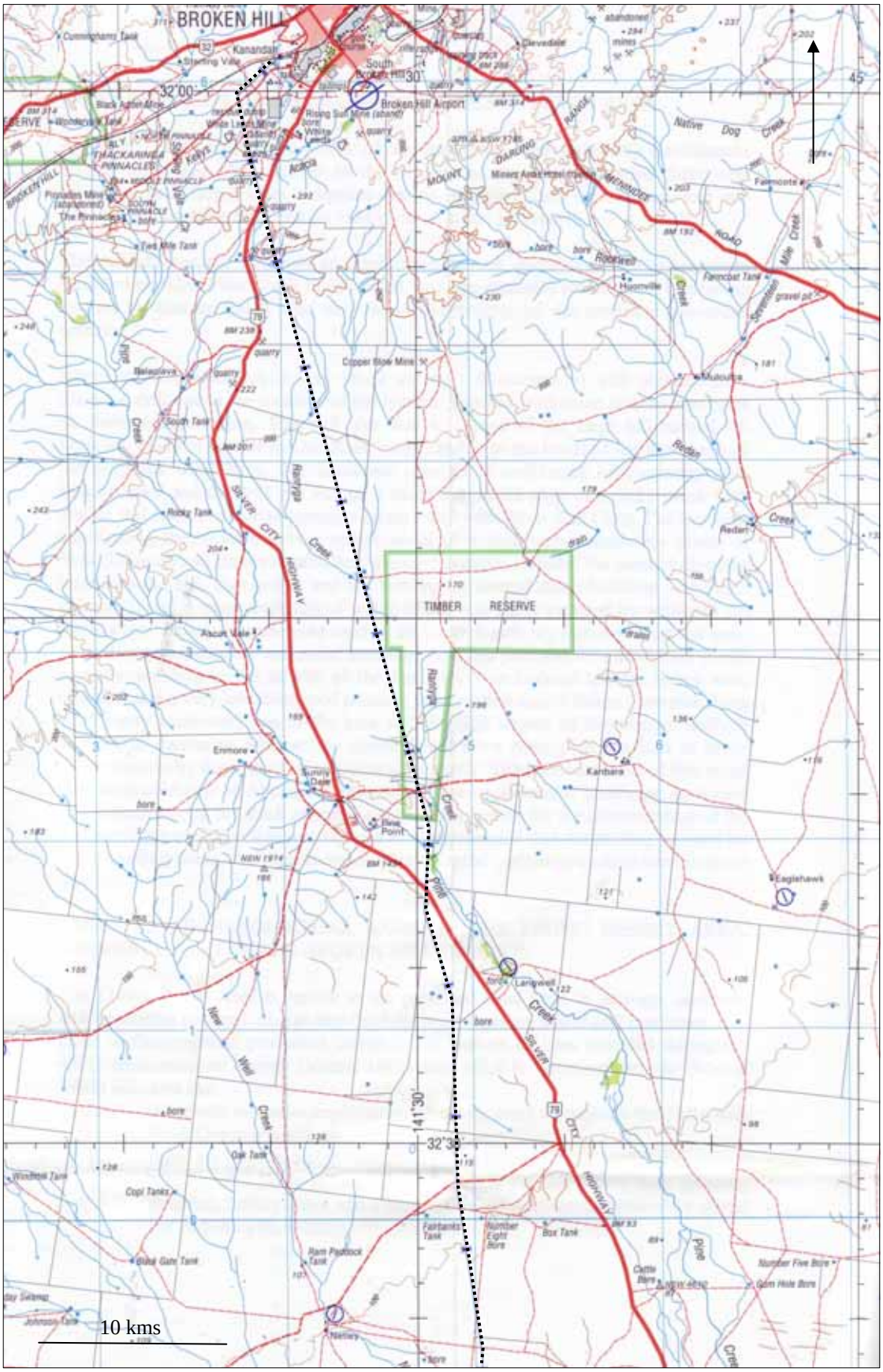

Figure 3. Route of the overhead transmission line from Broken Hill to Pine Creek (Menindee S1540-3 2nd ed. 1:250 000 topographic map).

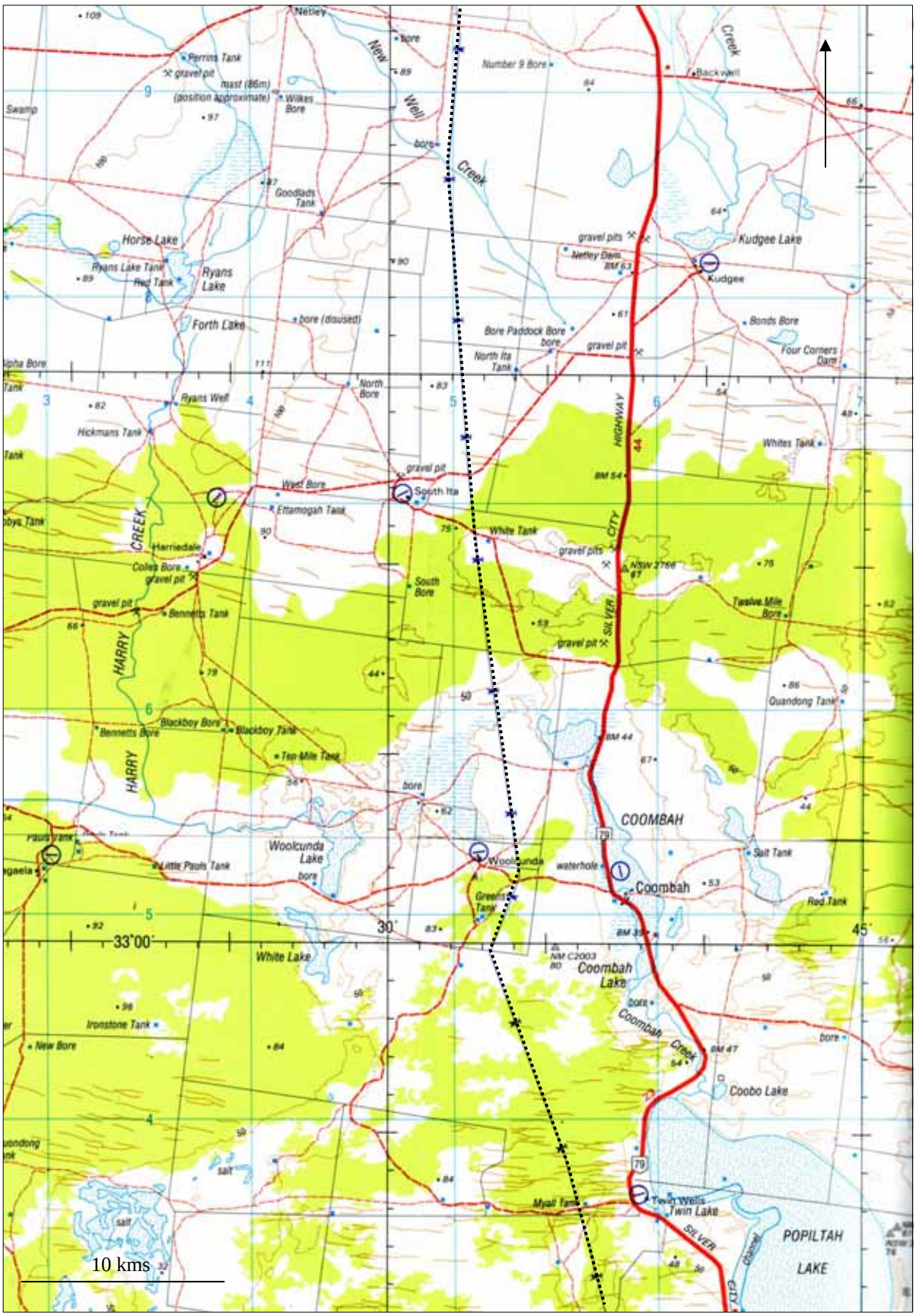

Figure 4. Route of the overhead transmission line from Pine Creek to Popiltah Lake (Menindee S1540-3 2nd ed. and Ana Branch S154-07 1:250 000 topographic maps).

Figure 5. Route of the overhead transmission line from Popiltah Lake to the Ana Branch (Ana Branch S154-07 2nd ed. 1:250 000 topographic map).

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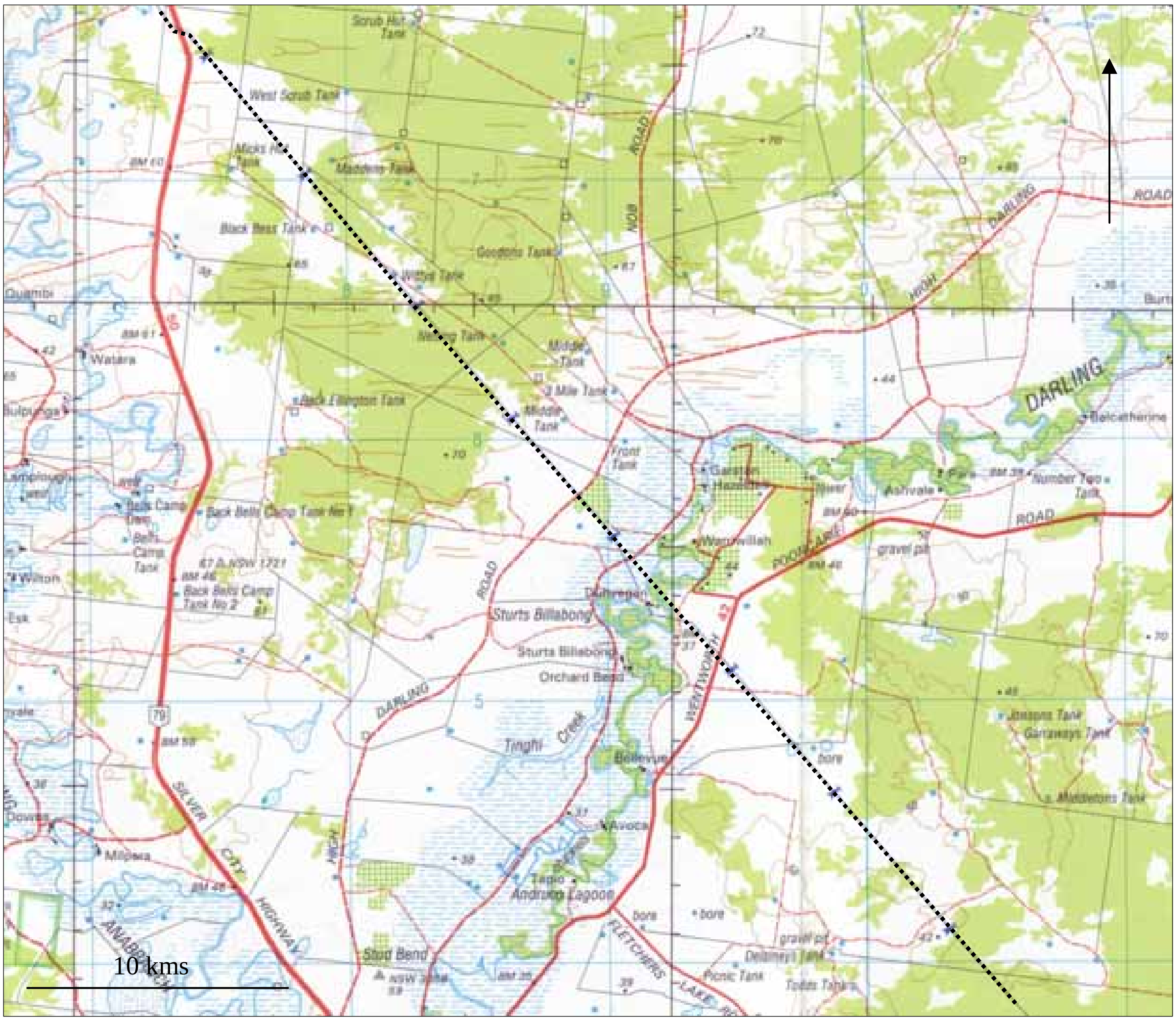

Figure 6. Route of the overhead transmission line from the Ana Branch to the Darling River (Ana Branch S154-07 2nd ed. 1:250000 topographic map).

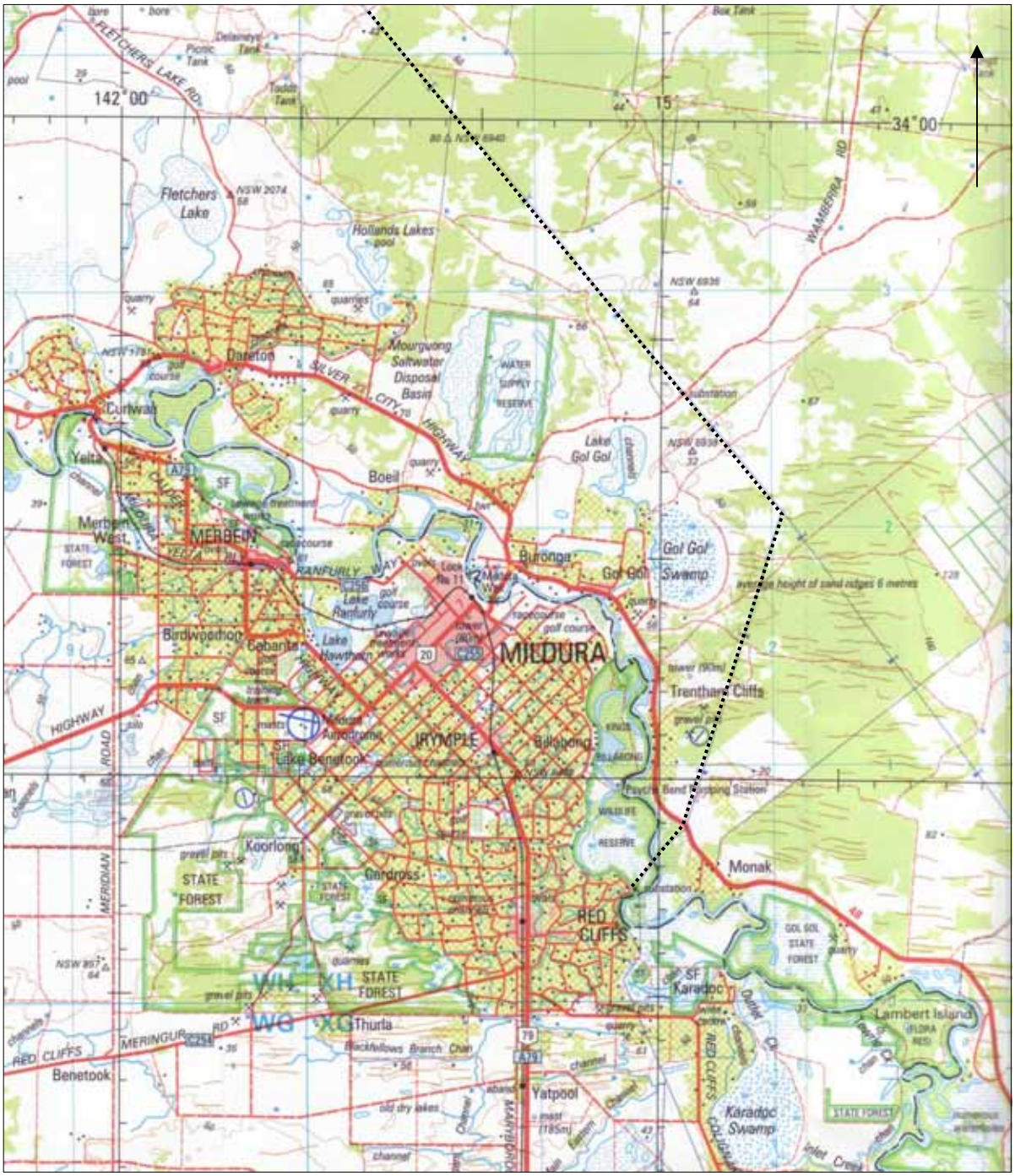

Figure 7. Route of the overhead transmission line from the Darling River to the Murray River (Mildura SI54-11 3rd ed. 1:250 000 topographic map).

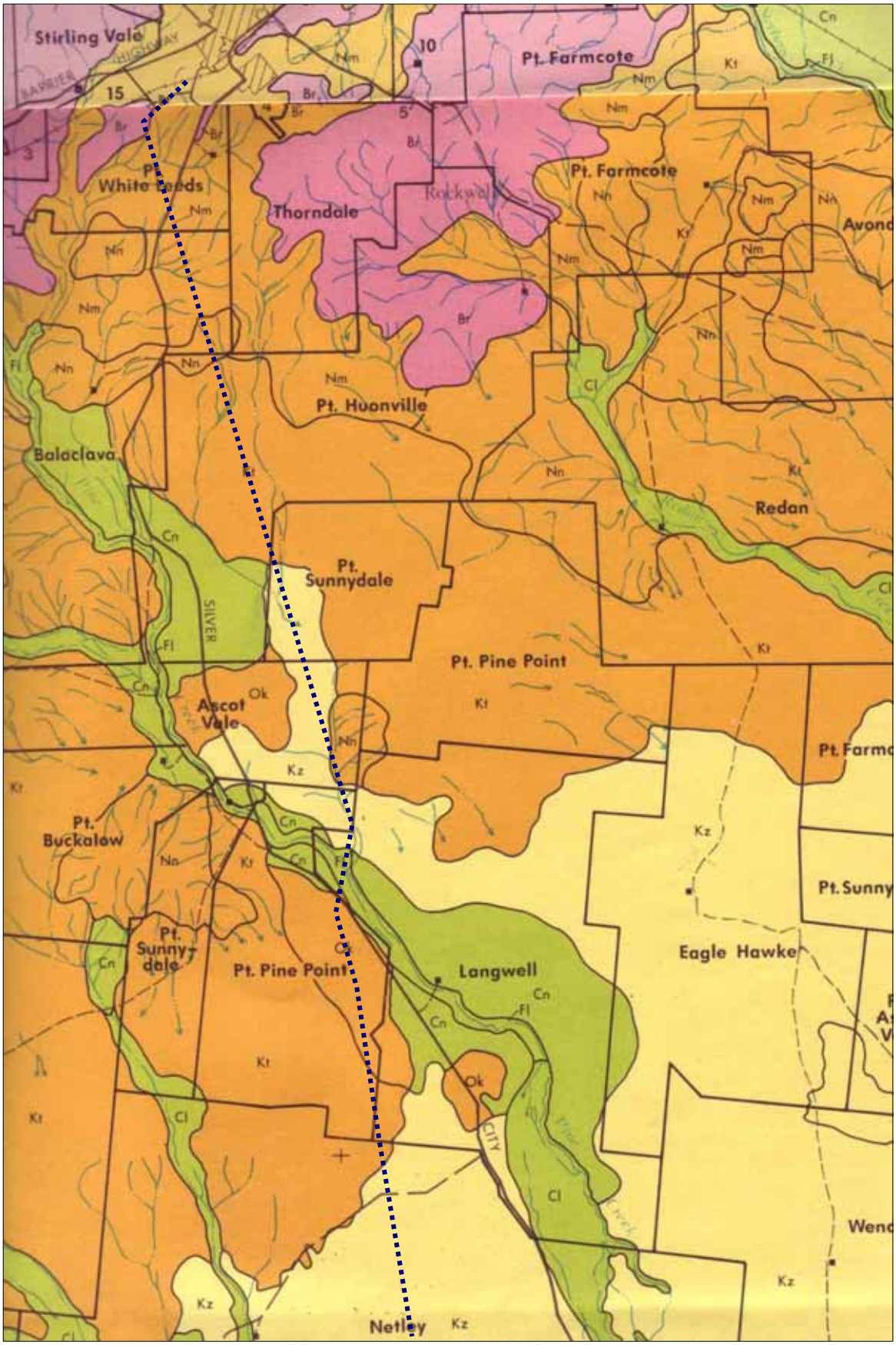

Figure 8. Location of the northern section of proposed transmission line (dotted line) in relation to defined land systems (Broken Hill Land Systems Series Sheet SH 54 – 15 and Menindee Land Systems Series Sheet SI 54 – 3).

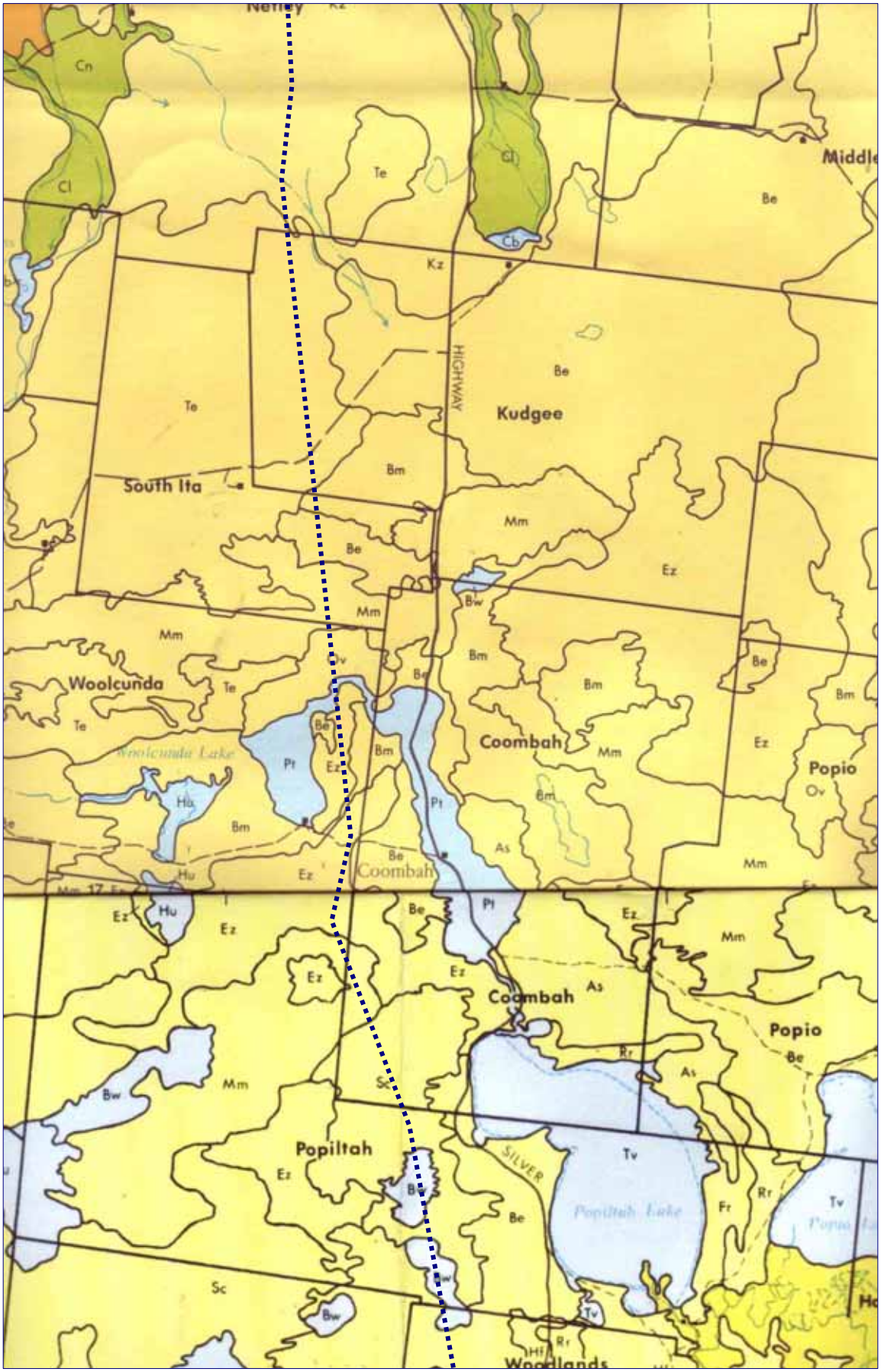

Figure 9. Location of the north/mid section of the proposed transmission line in relation to defined land systems (Menindee Land Systems Series Sheet SI 54 – 3; Ana Branch Land Systems Series Sheet SI 54 – 7).

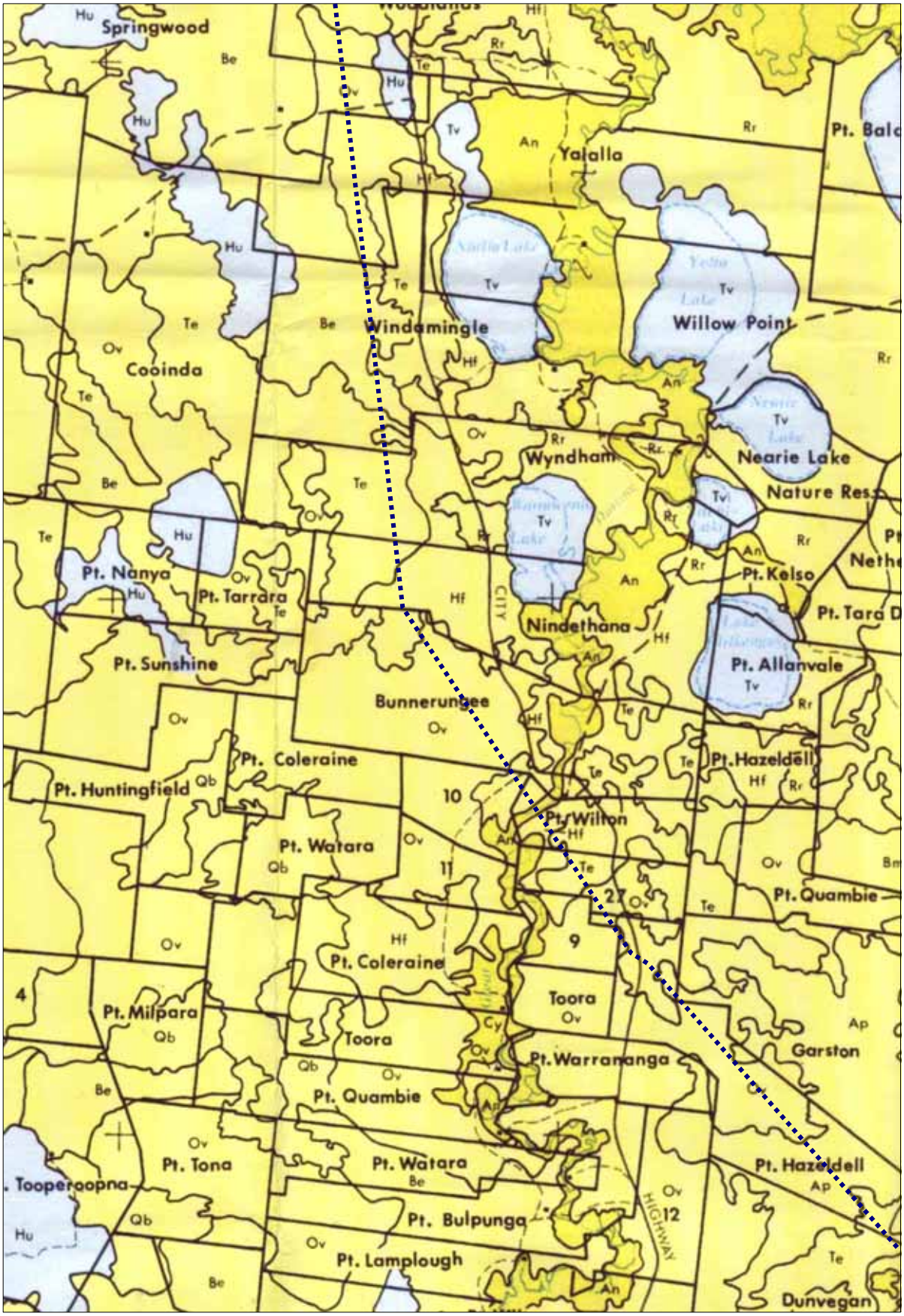

Figure 10. Location of the Ana Branch section of the proposed transmission line in relation to defined land systems (Ana Branch Land Systems Series Sheet SI 54 – 7).

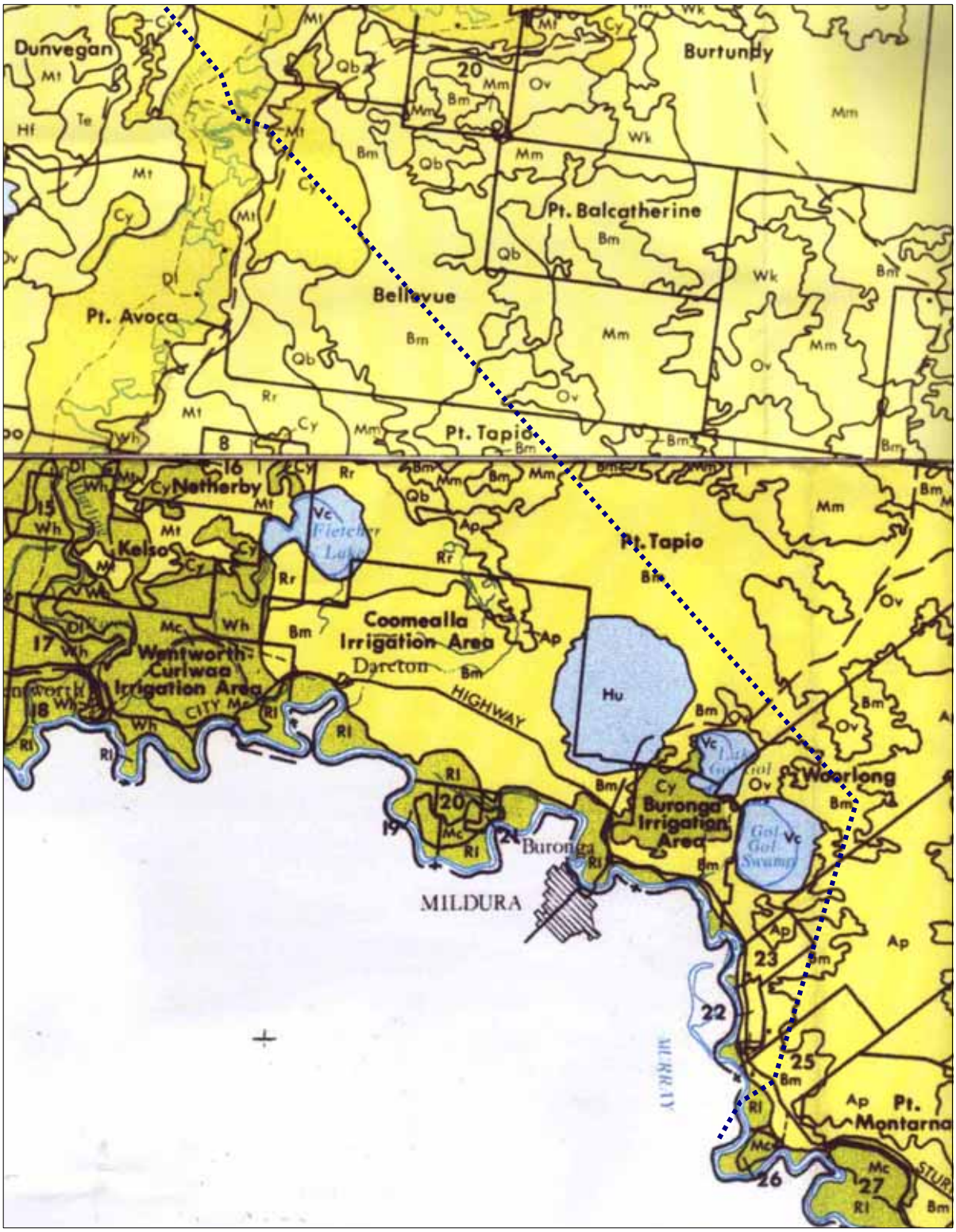

Figure 11. Location of the south end of the proposed transmission line in relation to defined land systems (Ana Branch Land Systems Series Sheet SI 54 – 7; Mildura Land Systems Series Sheet SI 54 – 11).

5. ARCHAEOLOGICAL CONTEXT - INDIGENOUS

5.1 Social geography

On the basis of archaeological research it is known that Aboriginal people have occupied Australia for at least 40,000 years and possibly as long as 60,000 years (Mulvaney and Kamminga 1999: 2). By 35,000 years before present (BP) all major environmental zones in Australia, including the arid zone, were occupied (Mulvaney and Kamminga 1999:114).

At the time of early occupation Australia experienced moderate temperatures. However, between 25,000 and 12,000 years BP (a period called the Last Glacial Maximum) dry and either intensely hot or cold temperatures prevailed over the continent (Mulvaney and Kamminga 1999: 114). At this time the mean monthly temperatures on land were 6-10ºC lower; in southern Australia coldness, drought and winds acted to change the vegetation structure from forests to grass and shrublands (Mulvaney and Kamminga 1999: 115-116).

During the Last Glacial Maximum at about 24 - 22,000 years ago, sea levels fell to about 130 metres below present levels and accordingly, the continent was correspondingly larger. With the cessation of glacial conditions, temperatures rose with a concomitant rise in sea levels. By ca. 6000 BP sea levels had more or less stabilised to their current position. With the changes in climate during the Holocene Aboriginal occupants had to deal not only with reduced landmass, but changing hydrological systems and vegetation; forests again inhabited the grass and shrublands of the Late Glacial Maximum. As Mulvaney and Kamminga (1999: 120) have remarked:

> When humans arrived on Sahul's shores and dispersed across the continent, they faced a continual series of environmental challenges that persisted throughout the Pleistocene. The adaptability and endurance in colonising Sahul is one of humankinds' inspiring epics.

Within the Western New South Wales region the very nature of the river systems, and consequently the surrounding vegetation and fauna, have all undergone considerable changes in the past 40,000 to 60,000 years. From approximately 50,000 to 25,000 years ago the region enjoyed wetter conditions with increased runoff, during which time lakes filled and contained a wide array of fish and other fauna. Then with the subsequent dryer climate from around 25,000 years ago the lakes shrank and their deposits were reworked to form the lunettes found now along their eastern margins. It was also during this period that the sand dunes became active again with their final major phase of building around 15,000 BP (Bonhomme Craib & Associates 1999: 6; Eastburn 1990: 6).

Up until 14,000 BP the Murray River was wide, shallow and reasonably straight, and possessed relatively little in the way of shellfish and other such resources. Overall the river had low habitat diversity. The modern river developed into a narrower and more sinuous channel towards the end of the Pleistocene. Since then it flows more slowly with a resulting overall increase in water temperature. During the Holocene the central to lower Murray had an even wider landscape of seasonal tributaries, relict billabongs, lakes, swamps and dunes. By time of European contact this region was one of the most highly populated parts of Aboriginal Australia, with semi sedentary communities (Mulvaney and Kamminga 1999: 302-303).

Some of the earliest evidence of human occupation of Australia comes from southwestern New South Wales (Bowler *et al.* 1970, 2003, Thorne *et al.* 1999). Stone artefacts found at Lake Mungo, to the east of the Darling River, have been dated to around 47,000 years ago. The burials of a male and female at Lake Mungo are 40,000 years old (Bowler *et al.* 2003). People were also at nearby Lake Menindee from 40,000 years ago (Cupper 2003a) and at Lake Victoria on the Murray River by around 21,000 years ago (Gill 1973). The oldest site on the Darling Anabranch is a freshwater mussel shell midden in the lunette at Lake Nitchie dating to almost 26,000 years ago (Balme and Hope 1990).

While burials are not necessarily the most common site types encountered, the Murray River corridor is known for its cemetery sites ranging from isolated burials through to those which contain thousands. Cemeteries of note are located at Kow Swamp, Coobool Creek, Roonka, Lindsay Island, Poon Boon, Robinvale, Lake Wallawalla, Snaggy Bend, Wallpolla, Swanport and Lake Victoria, the later being the largest with an estimate of some 10,000 burials (Mulvaney and Kamminga 1999: 305-306). Excavation at the Roonka Flat cemetery undertaken in the late 1960s and the 1970s, resulted in the uncovering of 216 burials in various states of preservation. A variety of dating techniques were used to determine the chronology of the site, and while the age of the earliest burials is still not agreed upon, they extend from the nineteenth century back to at least 7,000

BP. Almost 90% of all burials at this site date to the last 2000 years. This is a pattern that has also been observed at other cemeteries along the Murray (Mulvaney & Kamminga 1999: 305-306).

Colin Pardoe, who has done extensive work on the Murray River cemeteries, believes that there was an increase in Aboriginal populations on the central and lower sections during the Holocene. This is thought to be a response to the increase in riverine resources, and is evidenced primarily through the patterns of increase in cemeteries (Mulvaney and Kamminga 1999: 306). The first cemeteries date to around 10,000 to 13,000 BP at Kow Swamp and Coobool Creek. Specifically demarcated burial grounds dating from 7,000 BP have been found extending to the mouth of the river.

Aboriginal people of the Barkindji language group occupied the region at the time of first contact with Europeans (Krefft 1865). This language group comprised people who spoke the sub-dialects Barindji, Barkindji, Danggali, Maraura and Wiljakali (Allen 1974; Tindale 1974; Hardy 1976). These tribes shared similar language and kinship systems, notably the division of members into matrilineal moieties (two-part social classification) known as Mukwara (wedge-tailed eagle) and Kilpara (raven) (Blows 1995).

The Barkindji practiced a hunter-fisher-gatherer economy and appear to have had a semi-sedentary lifestyle (Krefft 1865). The explorer Gerard Krefft (1865) suggested that the Barkindji lived along the Lower Darling and Murray Rivers during the warmest months of the year, with people moving away from the rivers into the dunefields to collect food after winter rains. Communities along the Murray do not appear to have moved extensively and instead appear to have remained in the riparian corridor usually somewhat back from the river margin itself around waterholes, swamps and billabongs (Bonhomme Craib & Associates 1999: 18) where food resources were available for at least nine months of the year extending from spring through to autumn (Mulvaney and Kamminga 1999: 304).

Allen (1974), using ethnographic accounts and the archaeological record, invoked a subsistence model for the region based on the relationship between occupation of the riverine corridors and dunefields. Large populations of people congregated at the rivers during spring and summer and whenever the systems were high. Following seasonal rains smaller, mobile bands dispersed over the plains exploiting ephemeral sources (Allen 1974).

5.2 History and Ethnography

The notes and observations of early European explorers and settlers provide some information in regard to Aboriginal social and economic life. Details of Sturt's exploration down the Murray in 1829-1830 indicate that while there was a degree of nervousness on the part of the Aboriginal communities in this area there were many opportunities to observe various groups going about their day to day activities (Sturt 1989; Sturt 1999). Sturt's notes indicate that there was a population of at least 4,000 people along the Murray and Darling Rivers at that time (Sturt 1989: 61). This estimate is indicative only of the contact he had with groups right on the rivers' banks, which Sturt himself indicated was variable:

> We did not fall in with the natives in such numbers as when we passed down to the coast: still there were sufficient bodies to be troublesome. It would, however, appear that the tribes do not generally frequent the river. They must have a better country back from it, and most probably linger amongst the lagoons and creeks where food is more abundant. (Sturt 1999: 253).

These sorts of accounts provide observations about the way in which the landscape was populated and used, but the estimates of population are probably not an accurate representation of the total inhabitants in the area, especially since they do not take into consideration the population decline resulting from disease such as smallpox, which had apparently spread to the area before Sturt even arrived (Allen 1972: 21-22; Mulvaney and Kamminga 1999: 303; Sinclair 2001: 18; Smyth 1972: 255-256). It is thus likely that Sturt's estimate falls well short of the actual population that this area sustained prior to European colonisation of Australia.

The early accounts of activities such as hunting, and food collection and preparation indicate that food resources in and around the Murray River can be divided into three groups: resources within the river itself, resources on the margin of the river, and resources beyond the floodplain in the surrounding mallee. Resources within the river included yabbies, fish, mussels and water birds. Resources along the margins of the river included goannas, possums and other similar animals as well as vegetation such as nardoo and small tubers, while in the areas beyond the floodplain there were also kangaroos, bandicoot and lizards (Sinclair 2001: 18).

Observed examples of the exploitation of vegetation resources include the collection of such things as *laral* (also known as *lárp* or *lerp*), a kind of manna that was collected from eucalypts from December through to March in the Mallee (Smyth 1972: 211), and *nardoo*, a hard fruit that is a flat, oval shape about the size of a

split pea. Nardoo was crushed and winnowed to make a dough for baking (Smyth 1972: 216). Other important aspects of vegetation exploitation include the removal of bark from Red Gums and Black Box to make a variety of items ranging from bowls for food to canoes used for fishing. The use of sedge grass was used to weave a variety of items including nets that were used to catch fish and even kangaroos (Sinclair 2001: 18).

Amongst the early accounts of hunting there is also a degree of admiration on the part of the Europeans for the apparent ease with which the local Aborigines speared fish along the Murray and Darling rivers (Sturt 1999: 202; Smyth 1972: 200-201), and yet there is also a suggestion that fish was not the preferred dietary staple:

> It is certain, from their indifference to them, that the natives seldom eat fish when they can get anything else. Indeed, they seem more anxious to take the small turtle, which, sunning themselves on the trunks of logs of trees over the water, were, nevertheless, extremely on guard. A gentle splash alone indicated to us that anything had dropped into the water, but the quick eyes and ears of our guides immediately detected what had occasioned it, and they seldom failed to take the poor little animal that had so vainly trusted to its own watchfulness for security (Sturt 1999: 203).

Post contact evidence indicates that the riverine corridors were of primary subsistence importance for most of the year, and that it supported a relatively dense population (Kefous 1983: 92). The hinterland on the other hand is thought to have been the domain of small groups, and to have provided additional variety to diet, except in times of drought when it would be more heavily relied upon (Kefous 1983: 94).

In terms of the nature of contact between Europeans and Aborigines, it was not always as pleasant as some of the ethnographic accounts may imply. One famous example of the bloody confrontations that took place is the massacre that occurred at the Rufus River, where an untold number of Aborigines lost their lives (Hassell 1989). Unfortunately this was only really the beginning of confrontations. Over time the Aboriginal communities of the Murray were forced away from the river as the Europeans discovered the potential of the land for grazing.

5.3 Previously Recorded Sites

The NSW DECC AHIMS site register only includes sites which have been reported to the NSW DECC. Accordingly site searches cannot be considered to be an actual or exhaustive inventory of Aboriginal objects situated within the local area. Generally, sites are only recorded during targeted surveys undertaken in either development or research contexts. It can be expected that additional sites will be present within the local area but that to date they have not been recorded and/or reported to the NSW DECC.

It is also important to note the following additional qualification; recordings are provided from a variety of sources and therefore can be variable in their accuracy.

Silverton Wind Farm Stages 2 and 3

A search of the NSW DECC Aboriginal Heritage Management Information System has been conducted for the area encompassed by the Stages 2 and 3 wind farm (AHIMS # 21076 – 18th December 2007). The search was conducted over an area measuring 682 square kilometres and encompassed by Eastings: 517000 – 539000 and Northings: 6474000 - 6505000. There are 22 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register (Table 1). These sites are all comprised of stone artefacts. It is possible that some of these sites may be located within proposed impact areas associated with the proposed Stages 2 and 3 wind farm. Their location in respect of proposed impacts will need to be clarified during a field survey and appropriate management mitigation strategies formulated.

Site ID	Site Name	Easting	Northing	Site Features	Site Type
23-4-0033	BH1-23/25	539000	6481600	AFT	Open Camp Site
23-4-0034	BH1-22; "Nine Mile"	538318	6482251	AFT	Isolated Find
23-4-0035	BH1-21; "Nine Mile"	536111	6482471	AFT	Open Camp Site
23-4-0036	BH1-20; "Nine Mile"	535920	6482350	AFT	Open Camp Site
23-4-0037	BH1-17; "Nine Mile"	535202	6482260	AFT	Isolated Find
23-4-0038	BH1-18; "Nine Mile"	535347	6482409	AFT	Open Camp Site
23-4-0039	BH1-19; "Nine Mile"	535786	6482314	AFT	Open Camp Site
23-4-0040	BH1-14; "Nine Mile"	534256	6482097	AFT	Isolated Find
23-4-0041	BH1-15; "Nine Mile"	534341	6482097	AFT	Open Camp Site
23-4-0042	BH1-16; "Nine Mile"	534829	6482087	AFT	Open Camp Site

Site ID	Site Name	Easting	Northing	Site Features	Site Type
23-4-0043	BH1-11; "Nine Mile"	531713	6481753	AFT	Isolated Find
23-4-0044	BH1-12; "Nine Mile"	532657	6481732	AFT	Isolated Find
23-4-0045	BH1-13; "Nine Mile"	533470	6481799	AFT	Open Camp Site
23-4-0047	BH1-10; "Nine Mile"	530395	6481890	AFT	Isolated Find
23-4-0048	BH1-7; "Belmont"	528018	6480938	AFT	Open Camp Site
23-4-0049	BH1-8; "Belmont"	528474	6481907	AFT	Open Camp Site
23-4-0050	BH1-5; "Belmont"	524498	6482025	AFT	Open Camp Site
23-4-0051	BH1-6; "Belmont"	526519	6481970	AFT	Open Camp Site
23-4-0052	BH1-4; "Belmont"	522599	6482258	AFT	Open Camp Site
23-4-0053	BH1-2; "Belmont"	520586	6482055	AFT	Isolated Find
23-4-0054	BH1-3; "Belmont"	520587	6482057	AFT	Open Camp Site
23-4-0055	BH1-1	524400	6482000	AFT	Isolated Find

Table 1. Previously recorded sites listed on AHIMS Search #21076 for the Stages 2 and 3 area.

Overhead Transmission Line: Broken Hill to Red Cliffs

Four searches of the NSW DECC Aboriginal Heritage Management Information System have been conducted for the overhead transmission line route and these results are outlined below. A notable point to be made is that it appears that the majority, if not all, sites recorded by McIntyre (1997) are not listed on the AHIMS searches. This problem is further compounded by the fact that his original locational data can not be readily transposed onto current maps.

Pine Creek (AHIMS # 20888 – 3rd December 2007). The search was conducted over an area measuring 1425 square kilometres and encompassed by Eastings: 535000 – 550000 and Northings: 6370000 - 6465000. This area includes the powerline route between Broken Hill and the southern extent of the Pine Creek catchment. There are 45 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register (Table 2). 16 of these sites are artefact scatters and stone quarries located in a cluster to south west of the Broken Hill substation. Four of these sites are stone artefact scatters situated close to the transmission line at Pine Creek. The location of these sites in respect of proposed impacts will need to be clarified during a field survey and appropriate management mitigation strategies formulated.

Site ID	Site Name	Easting	Northing	Site Features	Site Type
23-4-0011	WAZ 4	543400	6463800	AFT	Open Camp Site
23-4-0014	WAZ 4	543400	6463800	AFT	Open Camp Site
23-4-0021	WAZ 6	543400	6462700	AFT	Open Camp Site
23-4-0081	**AS1**	**539110**	**6460112**	**AFT, STQ**	**None**
23-4-0082	**AS3**	**539012**	**6460300**	**ARG**	**None**
23-4-0083	**AS4**	**539106**	**6460350**	**AFT, STQ**	**None**
23-4-0084	**AS5**	**538860**	**6460460**	**AFT**	**None**
23-4-0085	**AS6**	**538930**	**6460150**	**AFT**	**None**
23-4-0086	**AS7**	**538650**	**6460280**	**AFT**	**None**
23-4-0087	**AS8**	**538610**	**6460140**	**AFT**	**None**
23-4-0088	**AS9**	**538341**	**6460729**	**AFT**	**None**
23-4-0089	**AS10**	**538433**	**6460600**	**AFT**	**None**
23-4-0090	**AS12**	**538540**	**6460660**	**AFT, STQ**	**None**
23-4-0091	**AS16**	**538220**	**6460730**	**AFT, STQ**	**None**
23-4-0092	**AS15**	**538325**	**6460180**	**AFT**	**None**
23-4-0093	**AS14**	**538213**	**6460566**	**AFT, STQ**	**None**
23-4-0107	**AS13**	**538240**	**6460510**	**STQ**	**None**
23-4-0111	**AS11**	**538500**	**6460630**	**AFT**	**None**
23-4-0112	**AS2**	**539100**	**6460160**	**STQ**	**None**
23-4-0132	South Broken Hill	546320	6462220	AFT	None
23-5-0066	BH1-54	549832	6464970	AFT	Open Camp Site
23-5-0074	PML10	550000	6460790	AFT	None
31-1-0002	PC-1; Pine Creek	542958	6421921	AFT	Open Camp Site

Site ID	Site Name	Easting	Northing	Site Features	Site Type
31-1-0004	Three Gums	541130	6454462	AFT	Open Camp Site
31-1-0005	Three Gums	541130	6454462	AFT	Open Camp Site
31-1-0006	Three Gums	541130	6454462	AFT	Open Camp Site
31-1-0008	Three Gums	541130	6454462	AFT, STQ	Open Camp Site, Quarry
31-1-0009	Three Gums	541130	6454462	AFT	Open Camp Site
31-1-0011	BH2-1	537960	6451010	AFT	Isolated Find
31-1-0012	BH2-2	538040	6450340	AFT	Open Camp Site
31-1-0013	BH2-3	538670	6446430	AFT	Isolated Find
31-1-0014	BH2-4/6	538530	6439410	AFT	Open Camp Site
31-1-0015	BH2-7	537490	6432680	AFT	Open Camp Site
31-1-0016	BH2-8/11	537430	6430690	AFT	Open Camp Site
31-1-0020	KTOKI1	542050	6417300	AFT	None
31-1-0021	KTOK2	541800	6417150	AFT	None
31-1-0022	KTOK3	542050	6416800	AFT	None
31-1-0023	**CN2**	**546800**	**6419600**	**AFT**	**None**
31-2-0013	**CN1**	**548100**	**6418200**	**AFT**	**None**
31-2-0014	**KZ1**	**547771**	**6422600**	**AFT**	**None**
31-2-0015	**KZ2**	**548418**	**6421100**	**AFT**	**None**
31-4-0014	Site 1; Menindee	540673	6390935	AFT	Open Camp Site
31-4-0015	Site 2	542501	6391301	AFT	Open Camp Site
31-4-0016	Site 1; Menindee	541130	6390935	AFT	Open Camp Site
31-4-0017	Site 2; Menindee	542044	6391392	AFT	Open Camp Site

Table 2. Previously recorded sites listed on AHIMS Search #20888 for the northern section of the overhead transmission line; *sites highlighted are very close and/or in the transmission line easement.*

- Ana Branch (AHIMS # 20889 – 3rd December 2007). The search was conducted over an area measuring 2700 square kilometres and encompassed by Eastings: 545000 – 575000 and Northings: 6280000 - 6370000. This area includes the powerline route between the southern extent of the Pine Creek catchment and where the route crosses the Ana Branch. There are 85 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register (Table 3). None of these sites are located within 1 kilometre of the proposed transmission line.

Site ID	Site Name	Easting	Northing	Site Features	Site Type
31-4-0001	10.S.6; White Lake; Buckalow;	545200	6348600	AFT	Open Camp Site
31-4-0002	10.S.7; White Lake; Buckalow;	545400	6348900	AFT	Open Camp Site
31-5-0002	Red Frank; Wentworth;	567800	6351600	AFT	Open Camp Site
31-5-0003	Red Frank 3; Wentworth;	567800	6352200	AFT	Open Camp Site
31-5-0004	Red Frank 2; Wentworth;	567400	6350500	AFT	Open Camp Site
31-5-0005	Red Frank 1; Wentworth;	568200	6350900	AFT	Open Camp Site
31-5-0006	Coombah Lake 1; Coombah Station/Lake;	556200	6356500	AFT	Open Camp Site
31-5-0007	Coombah Lake 2; Coombah Station;	556000	6356600	AFT	Open Camp Site
31-5-0008	Coombah Lake 3; Coombah Station;	556485	6356932	AFT	Open Camp Site
31-5-0009	Coombah Lake 2; Coombah Station;	556485	6356841	AFT	Open Camp Site
31-5-0010	Coombah Lake 5; Coombah Station;	556200	6356200	AFT	Open Camp Site
31-5-0011	Coombah Lake 8; Coombah Station;	555571	6355195	AFT	Open Camp Site

Site ID	Site Name	Easting	Northing	Site Features	Site Type
31-5-0012	Coombah Lake 7; Coombah Station;	555571	6355652	AFT	Open Camp Site
31-5-0013	Coombah Lake 6; Coombah Station;	555662	6355835	AFT	Open Camp Site
39-1-0021	White Lake 2; Popiltah Station;	545151	6345689	AFT	Open Camp Site
39-1-0028	Bore Hut 2; Popiltah Station;	545243	6341942	AFT	Open Camp Site
39-1-0031	Emu Bore 1; Springwood Station;	545700	6319273	AFT	Open Camp Site
39-2-0001	Woodlands Station;	574034	6319182	AFT, BUR, STA	Burial/s, Open Camp Site, Stone Arrangement
39-2-0008	Long Tank; Springwood;	551050	6326700	AFT	Open Camp Site
39-2-0009	Box Swamp 5; Springwood;	553450	6319350	AFT	Open Camp Site
39-2-0010	Box Swamp 4; Springwood;	554300	6318500	AFT	Open Camp Site
39-2-0011	Box Swamp 3; Springwood;	554250	6318250	AFT	Open Camp Site
39-2-0012	Box Swamp 2; Springwood;	554500	6318300	AFT	Open Camp Site
39-2-0013	Box Swamp 1; Springwood;	554350	6318200	AFT	Open Camp Site
39-2-0014	Wild Dog Tank; Springwood	561850	6321200	AFT	Open Camp Site
39-2-0015	Coombah Creek 5; Coombah Creek	560600	6343800	AFT	Open Camp Site
39-2-0016	Coombah Creek 4; Coombah Creek	560800	6344200	AFT	Open Camp Site
39-2-0017	Coombah Creek 3; Coombah Creek	560900	6344200	AFT	Open Camp Site
39-2-0018	Coombah Creek 2; Coombah	561500	6344700	AFT	Open Camp Site
39-2-0019	Coombah Creek 1	562000	6342600	AFT	Open Camp Site
39-2-0020	Popiltah Well 1; Coombah Station	564700	6348200	AFT	Open Camp Site
39-2-0021	Emu Bore 2; Springwood Station;	545791	6319365	AFT	Open Camp Site
39-2-0032	WI-5	574327	6318468	AFT, HTH	None
39-2-0033	WI-4	573750	6317630	AFT, HTH	None
39-2-0034	WI-3	573631	6318369	AFT, HTH	None
39-2-0035	WI-1	573469	6317534	AFT, BUR	None
39-2-0036	WI-2	573776	6317805	AFT, HTH	None
39-2-0037	Springwood-1	573775	6318847	HTH	None
39-2-0049	GS07	573970	6318460	AFT, HTH	None
39-2-0050	GS06	573850	6318550	AFT, HTH	None
39-2-0051	GS05	573840	6318750	TRE	None
39-2-0052	GS04	573760	6318760	AFT, HTH	None
39-2-0053	GS03	573640	6318570	TRE	None
39-2-0054	GS02	573530	6318780	AFT, HTH	None
39-2-0055	GS01	566990	6319980	AFT	None
39-2-0056	DA38	567083	6305342	AFT	None
39-2-0057	DA39	571448	6305606	AFT	None
39-2-0058	DA40	571353	6303898	AFT	None
39-2-0059	DA41	572424	6301533	AFT	None
39-2-0060	DA42	573065	6300489	AFT	None
39-2-0061	DA43	574608	6299532	AFT	None
39-2-0062	DA44	574785	6299831	AFT	None

Site ID	Site Name	Easting	Northing	Site Features	Site Type
39-2-0063	DA45	572114	6305621	AFT	None
39-2-0064	DA46	573838	6306114	AFT	None
39-2-0065	DA47	573840	6312950	AFT	None
39-2-0067	DA49	573560	6317411	AFT	None
39-2-0068	DA50	574721	6319418	AFT	None
39-2-0078	DA82	570246	6325830	AFT	None
39-2-0081	DA85	570355	6327051	BUR	None
39-2-0087	DA94	571728	6304555	AFT	None
39-2-0088	DA95	571443	6304580	AFT	None
39-2-0089	DA96	571234	6304628	AFT	None
39-2-0090	DA97	573298	6305327	AFT	None
39-2-0091	DA98	572200	6304427	AFT	None
39-2-0092	DA99	572301	6304645	AFT	None
39-2-0093	DA100	573465	6301087	AFT	None
39-2-0094	DA101	572751	6304319	AFT	None
39-2-0095	DA124	569490	6301712	AFT	None
39-2-0096	DA125	570622	6324349	AFT	None
39-2-0097	DA126	570603	6324533	AFT	None
39-2-0098	DA127	570570	6324817	AFT	None
39-2-0099	DA128	570570	6325051	AFT	None
39-2-0105	DA144	571795	6316124	AFT	None
39-5-0065	DA31	570204	6283586	AFT	None
39-5-0066	DA32	569802	6284211	AFT	None
39-5-0067	DA33	569566	6284264	AFT, SHL	None
39-5-0068	DA34	570907	6289134	AFT	None
39-5-0088	DA116	566550	6280163	AFT	None
39-5-0089	DA117	566714	6280490	AFT	None
39-5-0090	DA118	566695	6280654	AFT	None
39-5-0091	DA119	566854	6281392	AFT	None
39-5-0092	DA120	566823	6281671	AFT	None
39-5-0093	DA121	567140	6282350	AFT	None
39-5-0094	DA122	569498	6283069	AFT	None
39-5-0095	DA123	569466	6283034	AFT	None

Table 3. Previously recorded sites listed on AHIMS Search #20889 for the Ana Branch section of the overhead transmission line.

Darling River (AHIMS # 20890 – 3rd December 2007). The search was conducted over an area measuring 1440 square kilometres and encompassed by Eastings: 570000 – 606000 and Northings: 6240000 - 6280000. This area includes the powerline route between the Ana Branch and to the south east of where the route crosses the Darling River. There are 61 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register (Table 4). 16 of these sites are situated within close proximity of the proposed transmission line on the east side of the Darling; these sites are stone artefacts scatters, scarred trees and one hearth. The location of these sites in respect of proposed impacts will need to be clarified during a field survey and appropriate management mitigation strategies formulated.

Site ID	Site Name	Easting	Northing	Site Features	Site Type
39-5-0010	Sturts Billabong	590290	6252990	AFT, BUR, ETM, SHL, TRE	Burial/s, Midden, Open Camp Site, Scarred Tree
39-5-0011	Bellevue 7	591600	6249000	AFT	None
39-5-0012	Bellevue 9	591550	6250300	AFT	None
39-5-0013	Avoca 4	589400	6247440	TRE	None
39-5-0014	Avoca 10	582200	6250500	HTH	None
39-5-0015	BELLVUE 23	590486	6249036	ART	None

Site ID	Site Name	Easting	Northing	Site Features	Site Type
39-5-0019	AVOCA 5	587300	6249800	AFT	None
39-5-0020	MILPARA 1	578230	6249090	AFT	None
39-5-0026	AROC 3	589400	6249500	AFT	None
39-5-0029	MIPARA 2	579000	6249300	AFT	None
39-5-0035	BUNNERUNGEE 7230	583400	6249740	AFT	None
39-5-0037	AVOCA 8	590030	6248770	TRE	None
39-5-0038	BELLEVUE 8	592200	6249800	SHL	None
39-5-0039	AVOCA 1	583480	6249000	AFT	None
39-5-0040	BELLEVUE 10	591900	6249300	AFT	None
39-5-0041	Avoca 9	590300	6248300	SHL	None
39-5-0042	BVO5	591610	6242950	HTH	None
39-5-0043	BVO2	591880	6244880	AFT	None
39-5-0044	BVO1	591890	6245120	HTH	None
39-5-0045	BV10	591140	6246380	TRE	None
39-5-0046	BVO8	591120	6246370	AFT, SHL	None
39-5-0047	BVO7	591470	6242160	AFT	None
39-5-0048	BVO6	591750	6242790	HTH	None
39-5-0049	BVO4	591880	6244150	AFT, HTH	None
39-5-0050	BVO3	591920	6244320	AFT, HTH	None
39-5-0051	Bellevue 11	591040	6248700	ART	None
39-5-0064	DA30	575789	6242658	AFT	None
39-5-0079	DA103	572150	6258130	AFT	None
39-5-0080	DA104	572334	6258097	AFT	None
39-5-0081	DA105	572275	6257611	AFT	None
39-5-0082	DA106	572405	6257501	AFT	None
39-5-0086	DA114	571386	6243582	AFT	None
39-5-0087	DA115	575916	6242409	SHL	None
39-5-0098	AVOCA 6	589940	6248800	AFT, HTH	None
39-5-0111	DA 154	575499	6241477	SHL	None
39-5-0112	DA 155	575305	6242348	SHL	None
39-5-0113	Da 156	575195	6241547	SHL	None
39-5-0114	DA 157	572017	6241041	HTH	None
39-5-0115	DA 158	571716	6240910	SHL	None
39-5-0116	DA 159	575485	6241509	SHL	None
39-5-0117	DA 160	575409	6241510	SHL	None
39-6-0019	Boongala Station Ellerslie Scarred Tree 3	595594	6254833	TRE	None
39-6-0020	**Anna-Branch**	**593950**	**6250250**	**TRE**	**None**
39-6-0021	**BELLEVUE 12**	**601050**	**6243720**	**AFT**	**None**
39-6-0022	**BELLEVUE 13**	**597680**	**6247420**	**AFT, TRE**	**None**
39-6-0023	**BELLEVUE 4**	**597397**	**6247896**	**AFT**	**None**
39-6-0024	**BELLEVUE 15**	**596910**	**6248550**	**AFT**	**None**
39-6-0025	**BELLEVUE 17**	**596170**	**6249170**	**AFT**	**None**
39-6-0026	**BELLEVUE 18**	**596150**	**6249360**	**AFT**	**None**
39-6-0027	**BELLEVUE 19**	**595986**	**6249290**	**AFT**	**None**
39-6-0028	**BELLEVUE 20**	**595538**	**6249430**	**AFT**	**None**
39-6-0029	**BELLEVUE 21**	**595820**	**6249730**	**TRE**	**None**
39-6-0030	**BELLEVUE 22**	**595710**	**6249800**	**AFT**	**None**
39-6-0031	**BELLEVUE 3**	**594650**	**6250410**	**AFT**	**None**
39-6-0032	BELLEVUE 6	592730	6249900	TRE	None
39-6-0033	**BALEVUE 5**	**594700**	**6250040**	**AFT**	**None**
39-6-0034	**BELLEVUE 2**	**594640**	**6250340**	**HTH**	**None**
39-6-0035	**Bellevue 16**	**596926**	**6248550**	**AFT**	**None**

Site ID	Site Name	Easting	Northing	Site Features	Site Type
39-6-0036	**Bellevue/4**	**594570**	**6250590**	**ETM**	**None**
50-2-0030	DA 141	575647	6251720	SHL	None
50-2-0031	DA 142	575964	6255720	HTH	None

Table 4. Previously recorded sites listed on AHIMS Search #20890 for the Darling River section of the overhead transmission line; *sites highlighted are very close and/or in the transmission line easement.*

Buronga Gol Gol (AHIMS # 20891 – 3rd December 2007). The search was conducted over an area measuring 875 square kilometres and encompassed by Eastings: 600000 – 625000 and Northings: 6205000 - 6240000. This area includes the powerline route between the Darling River and Murray Rover. There are 72 previously recorded Aboriginal objects in the site search area as listed on the AHIMS register (Table 5). Three of these sites are situated within close proximity of the proposed transmission line on the Murray River alluvial floodplain at approximately 2 kilometres northeast of the Red Cliffs substation (Site #'s 46-3-0007 and 46-3-0081 are middens and Site # 46-3-008 is a scarred tree). The location of these sites in respect of proposed impacts will need to be clarified during a field survey and appropriate management mitigation strategies formulated.

Site ID	Site Name	Easting	Northing	Site Features	Site Type
46-3-0001	Merbein; River Road Buronga	603281	6221378	AFT, ETM, SHL	Midden
46-3-0002	Merbein; River Road Buronga	603281	6220464	TRE	Scarred Tree
46-3-0003	Merbein; River Road Buronga	604195	6221378	TRE	Scarred Tree
46-3-0004	Merbein; River Road Buronga	605109	6221378	AFT, BUR	Burial/s, Open Camp Site
46-3-0005	Merbein; River Road Buronga	605109	6221378	CMR	Bora/Ceremonial
46-3-0006	Gol Gol Lake	614249	6224120	TRE	Carved Tree
46-3-0007	**Redcliffs**	**614706**	**6206296**	**AFT, ETM, SHL**	**Midden**
46-3-0008	**Trymple**	**615163**	**6206753**	**TRE**	**Scarred Tree**
46-3-0010	Mildura; Mildura/Buronga Bridge	608308	6217265	TRE	Scarred Tree
46-3-0016	Lawson 1	610300	6219600	AFT	Open Camp Site
46-3-0022	Gol Gol Midden	612300	6217100	AFT, ETM, SHL	Midden
46-3-0030	Pumping Station Site	613100	6216200	AFT, ETM, SHL	Midden
46-3-0032	GGS Site 1	611130	6220600	TRE	Scarred Tree
46-3-0033	GGS Site 2	611160	6220600	TRE	Scarred Tree
46-3-0034	GGS Site 3	611000	6220170	TRE	Scarred Tree
46-3-0035	GGS Site 4	610880	6220730	AFT	Open Camp Site
46-3-0036	GGS Site 5	610830	6220730	TRE	Scarred Tree
46-3-0037	GGS Site 6	610650	6220470	TRE	Scarred Tree
46-3-0038	GGS Site 7	610960	6220570	TRE	Scarred Tree
46-3-0039	GGS Site 8	611010	6220540	AFT	Open Camp Site
46-3-0040	GGS Site 9	611040	6220600	TRE	Scarred Tree
46-3-0041	GGS Site 10	611010	6220600	TRE	Scarred Tree
46-3-0042	GGS Site 11	611050	6220510	TRE	Scarred Tree
46-3-0043	GGS Site 12	611020	6220480	TRE	Scarred Tree
46-3-0044	GGS Site 13	611030	6220490	TRE	Scarred Tree
46-3-0045	GGS Site 14	611080	6220450	TRE	Scarred Tree
46-3-0046	GGS Site 15	611080	6220450	TRE	Scarred Tree
46-3-0047	GGS Site 16	610980	6220690	AFT	Open Camp Site
46-3-0048	GGS Site 17	611030	6220660	AFT	Open Camp Site

Site ID	Site Name	Easting	Northing	Site Features	Site Type
46-3-0049	GGS Site 18	611110	6220480	TRE	Scarred Tree
46-3-0050	GGS Site 19	611080	6220480	TRE	Scarred Tree
46-3-0051	GGS Site 20	611077	6219773	TRE	Scarred Tree
46-3-0052	GGS Site 21	611110	6220419	TRE	Scarred Tree
46-3-0053	GGS Site 22	611181	6220388	TRE	Scarred Tree
46-3-0054	GGS Site 23	611159	6220172	TRE	Scarred Tree
46-3-0055	GGS Site 24	611108	6220204	TRE	Scarred Tree
46-3-0056	GGS Site 25	611005	6220174	TRE	Scarred Tree
46-3-0057	GGS Site 26	611031	6220174	TRE	Scarred Tree
46-3-0058	GGS Site 27	610928	6220144	AFT	Open Camp Site
46-3-0059	GGS Site 28	610589	6219655	TRE	Scarred Tree
46-3-0060	GGS Site 29	610821	6219776	TRE	Scarred Tree
46-3-0061	GGS Site 30	610820	6219776	TRE	Scarred Tree
46-3-0062	GGS Site 31	611155	6219864	TRE	Scarred Tree
46-3-0063	GGS Site 32	611155	6219864	TRE	Scarred Tree
46-3-0064	GGS Site 33	611103	6219772	TRE	Scarred Tree
46-3-0065	GGS Site 34	610562	6219532	TRE	Scarred Tree
46-3-0066	GGS Site 35	611254	6219586	TRE	Scarred Tree
46-3-0067	GGS Site 36	611126	6219556	TRE	Scarred Tree
46-3-0068	GGS Site 37	611334	6219831	TRE	Scarred Tree
46-3-0069	GGS Site 38	611259	6220017	TRE	Scarred Tree
46-3-0070	GGS Site 39	611233	6219986	TRE	Scarred Tree
46-3-0071	GGS Site 41	610847	6219837	TRE	Scarred Tree
46-3-0072	GGS Site 43	610975	6219805	TRE	Scarred Tree
46-3-0073	GGS Site 44	611027	6219835	TRE	Scarred Tree
46-3-0074	GGS Site 45	611051	6219773	TRE	Scarred Tree
46-3-0075	GGS Site 46	611077	6219773	TRE	Scarred Tree
46-3-0076	GGS Site 40	610820	6219740	TRE	Scarred Tree
46-3-0077	GGS Site 42	610920	6219710	TRE	Scarred Tree
46-3-0079	Gol Gol Lake Midden	613350	6222950	BUR	Burial/s
46-3-0080	Gol Gol Swamp	613350	6222950	BUR	Burial/s
46-3-0081	**Bowen Park 1**	**616300**	**6206750**	**AFT, ETM, SHL**	**Midden, Open Camp Site**
46-3-0086	TAPIO 1	610680	6232110	AFT	None
46-3-0092	Buronga Loam Pit 1	611120	6223910	AFT	None
46-3-0093	Buronga Loam Pit 2	611900	6223670	AFT	None
46-3-0095	KB 1	606718	6223935	AFT	None
46-3-0096	KB 4	602139	6222531	HTH	None
46-3-0097	KB 5	601168	6222667	AFT	None
46-3-0098	KB 6	601859	6222959	HTH	None
46-3-0099	KB 7	602635	6222271	AFT	None
46-3-0100	KB 8	602658	6222297	AFT	None
46-3-0107	KB 2	603522	6231829	AFT	None
46-3-0108	River Drive 1 (RD1)	608366	6217214	AFT	None

Table 5. Previously recorded sites listed ion AHIMS Search #20891 for the Buronga Gol Gol section of the overhead transmission line; *sites highlighted are very close and/or in the transmission line easement.*

The following discussion in Section 7.3 will present a review of previous archaeological work in the region for the purposes of producing a predictive model of site type and location relevant to the study area.

5.4 Archaeology – Regional Context

Western New South Wales, and more specifically the central section of the Murray Darling Basin, has been the subject of archaeological research since the early twentieth century. The first archaeological study in the region

was undertaken by Tindale as part of a mapping project done with Birdsell in 1939 at the then dry Lake Menindee. Fossils of extinct animals, Aboriginal artefacts and human burials were recorded and further investigated by Tindale, Tedford and Stirton in 1953. Work continued at Lake Menindee into the 1960s providing information regarding the antiquity of human occupation in Australia as well as the possible links between humans and the extinction of megafauna (Hope 1981: 2).

Work in the 1960s concentrated on Lake Tandou, the southernmost of the Menindee Lakes (Hope 1981: 4), however, an extensive program of archaeological work along the Murray between Mildura and Renmark was also initiated during the late 1960s by the National Museum of Victoria (Buchan 1984: 33).

One of the most significant contributions to the archaeology of the region came in 1972 when Harry Allen submitted his PhD thesis on the Aboriginal people of the Darling Basin. Allen (1972; 1974) documented the available food sources and the manner in which they were exploited (see above).

In 1977 a series of surveys were initiated within the Willandra Lakes (Hope 1981: 4). This led on to the Darling Project, which aimed to provide a more detailed and systematic set of archaeological data for the region through a focus on the lunette systems and the major river channels; that is, on sites directly associated with primary water sources, particularly sites displaying faunal remains (Hope 1981; Hope *et al.* 1983).

It was also around the time that the Darling Project took shape that development driven heritage assessments began to take place in the region. One of the first of these was a survey for assessment of impacts to sites by the Mildura-Broken Hill electricity line in 1977 (McIntyre 1977; 1981). This survey located 132 sites comprising 106 open camp sites, five shell middens, ten PADs, seven burial sites and four isolated finds (McIntyre 1981: 9). The survey corridor measured 285 kilometres long and three to seven kilometres wide however the actual survey was concentrated within a few hundred metres of the central pegged line (McIntyre 1981: 10). The survey was thus targeted, and the coverage could not be considered comprehensive within the defined corridor. Information regarding ground surface visibility is unavailable except for a general comment that it was poor in the Murray River sections. It is unlikely that the results of this survey are a complete and accurate reflection of the patterning of archaeological sites. Nonetheless this survey provided a significant contribution to our understanding of site location within the region.

In attempting to resolve questions relating to the chronology of Aboriginal occupation in the arid margins of southeastern Australia in the area north of Broken Hill, and well away from major rivers and lakes, Holdaway *et al.* (2002) dated charcoal deposits found in 28 heat retainer hearths in the Sturt National Park. The soil profiles into which the hearths were dug were found to be no older than 4-5,000 years, and perhaps as recent as 2000 years, due to prior erosion. The findings of the investigation demonstrated hearth construction in the area for at least the last 1700 years, but with a gap of 200 - 400 years between 820 ± 50 and 1170 ± 130 years BP. This finding was interpreted as demonstrating a hiatus in occupation of the area. However, while Holdaway *et al.* (2002) suggest the possibility that paleoenvironmental fluctuations resulted in this discontinuity of occupation, they nevertheless advised caution in postulating causes until further research had been conducted.

Shiner (2006) similarly found a discontinuity in landscape occupation over the last 2000 years when dating 16 hearths in conjunction with an analysis of the surface stone artefact assemblage from Pine Point and Langwell Stations, located just to the south of the foothills of the Barrier Range. Shiner (2006) found that the different artefact assemblages he examined represented unique occupational histories, but that these were punctuated by long periods with scant evidence of Aboriginal presence or activity.

A project aimed at developing a predictive model for site location for western New South Wales was conducted by Johnston and Witter (1996). The approach adopted employed expert system forecasts, and archaeographic modelling based on groups of land systems and their margins. Field testing was then conducted in order to assess the reliability and usefulness of this method in formulating site location rules so as to better understand the distribution of Aboriginal archaeological material across the landscape. Extrapolating from the findings of this project Johnston and Witter (1996) formulated more explicit rules for the site location model. They concluded that:

- Occupation can be expected near to water. The abundance of archaeological evidence should be proportional to the quality of the water source, considering factors such as reliability, salinity and production of vegetation.
- Occupation can be expected to focus on ecotonal boundary areas.
- People prefer to occupy certain environmental types which need to be ranked with regard to factors such as the presence of ephemeral water, food resource abundance and food resource diversity.

- Varying effective visibility should be taken into account for each environmental type so that potential biases can be avoided. Then the information derived would relate to the archaeology and Aboriginal heritage present in an area, rather than only that which can be detected.
- Where stone sources are known to exist artefacts can be expected in extreme abundance within a radius of two kilometres and in increased numbers within a radius of twenty kilometres.
- Other factors such as areas of known population focus, zones of exceptional productivity and food abundance could have been such a centre of activity in the landscape that a halo effect may have resulted. And that within localised study areas more small scale influencing factors that are difficult to consider within a regional model may be of use.

5.5 Archaeology – Local contexts

Archaeological work within the local region has been underway since at least the 1970s. A summary of local studies is provided below.

Broken Hill – Barrier Ranges

The Barrier Ranges archaeological region has been defined by Witter (2004). This region has been subject to very few previous archaeological investigations and accordingly is not well understood. Given that the environmental context is semi-arid, and far from rivers or lakes, the region would seem to be unfavourable for Aboriginal occupation. Nevertheless Witter indicates that open camp sites are abundant and present on all landscapes. Witter (2004) suggests that occupation of the region may have been highly dynamic with occupation fluctuating in accordance with seasonal variability, and perhaps longer term climate changes. The site types found in the Barrier Ranges include camp sites comprised of stone artefacts and heat retainer hearths located along streams and around clay pans, and at water holes in the ranges, quarries and rock art. Artefact types found in the region include ground stone artefacts, including milling slabs, often made of the local schist, flaked stone mostly of quartz, and occasional retouched artefacts including Pirri points, geometric backed blades, Bondi points and Tulas.

During his original survey of the existing Broken Hill to Red Cliffs transmission line McIntyre (1977) recorded a number of sites in the Barrier Ranges area between Pine creek and Broken Hill. An unexpected and notable finding during the survey was that sites were recorded in locales situated on the plains away from creeks. McIntyre also remarked about a complex of sites situated on a series of ephemeral channels on Three Gums Station and one north of Kellys Creek.

The Living Desert Area, situated immediately to the north of the Broken Hill township, is similar to the proposed wind farm in geology, landform and vegetation patterns, except that the hills and ridges are lower and less steep. The pattern of sites recorded during the 4WD archaeological survey (Martin 1995) and Wildlife Sanctuary Survey (Martin 1998) indicates that:

- there was intensive exploitation of quartz reefs throughout the Hills with Rock Outcrop landform;
- there are large complex campsites in the Upper Creeks with Terraces and Valleys with Wide Alluvial Flats with heat retainer ovens, seed grinding material, flaking areas, and a range of flaked artefacts dominated by quartz but including on average <5% silcrete/chert;
- there is less abundant, less varied archaeological material on Low Ridges and the Undulating Uplands landforms; and
- there are rare but well-delineated quartz blade workshops and artefact scatters on some ridges, perhaps indicating areas that were used as day camps and ‘lookouts’ overlooking valleys or waterholes.

Martin (1995) recorded five quartz reef stone procurement areas on the rocky hills; two quartz artefact scatters on low rocky ridges; one artefact scatter on a low undulating upland; one large site with artefacts, flaking areas and ovens on an alluvial/colluvial terrace, and two very large sites on wide valley floors with artefacts, flaking areas and heat retainer ovens. Martin (1998b) recorded eight quartz reefs with evidence of stone procurement including bedrock anvils with Hertzian cones and battering marks as well as trimming debris and evidence of flaking activities. An extensive flaking area on a ridgetop was interpreted as a daytime camp for flaking, wood-working and a ‘looking out’ to watch for game etc. The upper valleys had three open sites with quartz artefacts and heat retainer ovens, and the large lower valleys had three extensive sites with heat retainer ovens, seed grinding material, and dominated by quartz artefacts but with 0%, 1%, and 6% silcrete artefacts in three random sample areas.

In addition some more unusual sites were recorded in the Living Desert Area. A rock engraving site is located adjacent to Ngatji Nguku Mingka (Rainbow Serpent Waterhole) semi-permanent rockhole. The rock engraving site has been recorded in detail by Dr Dan Witter and the Broken Hill Aboriginal Land Council and principally consists of engraved circles and animal tracks, and also a panel of small cupules. Local Aboriginal elder Alice Bugmy (now deceased) has described how her family camped some distance away from this site and only her father was able to approach the site and take water indicating the significance of the waterhole and the rock engravings (Martin 1998b). This is the only known engraving site in the area immediately surrounding Broken Hill, although engravings are known further to the west and north.

Gnamma holes (rockholes) with stone lids were located on a sloping rock platforms on the edge of a hill in the Living Desert Area (Martin 1998b). One rockhole is 1.52 metres long, 0.4 metres wide and 0.96 metres deep. This rockhole has four large flat rocks beside it and one fallen into one end of the hole, obviously used in the past to cover the hole over to prevent evaporation of water and use by animals. This site is situated on a gently sloping outcrop of granite-like gneiss that acts as a catchment for the rockhole. The edges of the rockhole are polished with use.

Appleton (1996) recorded a series of stone artefact sites (these are listed on the AHIMS search) on Belmont Station and Nine Mile Station in the vicinity of the proposed wind farm near Silverton. These recordings all consist of stone artefact sites including both open camp sites or isolated finds.

Appleton (1999) surveyed a section of the Living Desert Area that overlapped with Martin (1998b). He recorded 20 sites including seven artefact scatters, two heat retainer ovens and one oven complex, three isolated artefacts, and seven quartz reef quarries and associated artefacts. Appleton found that some of the quartz reefs in the hills had been extensively exploited for suitable material for flaking, and that flaked material in the area was dominated by quartz, with some quartzite and silcrete artefacts.

Martin (2000) undertook a very small survey on a diamond drill site at the location of the historic Terrible Dick mine and smelter ruins on Purnamoota Station. The drill site was at a base of the large hill named Mt Lookout which is part of the Mt Robe range, and is located within the broader area encompassed by the Stages 2 and 3 wind farm area. The landscape consists of undulating hilly country with small creeks, and the drill site was on a small flat on the edge of a rocky creek. Historic material recorded included the smelter chimney built into the hill, slag heaps, the remains of several stone buildings and stone chimneys, and a mine shaft full of water which was being pumped by windmill for stock water. Heavy ceramic pots used to set silver ingots lay scattered over the area, as well as glass, ceramic and metal artefacts. A mulga post and wire stockyard is still partially standing in the middle of the flat area. Five isolated silcrete flakes were recorded and a very low density of possible unretouched quartz flakes. However, long term heavy machinery use in the area and the high degree of disturbance made it difficult to determine whether the quartz flakes were Aboriginal artefacts or made more recently by the impact of machinery on quartz. The successive use of this small area with evidence of Aboriginal use, mine, smelter, domestic buildings, stockyard and watering point for stock makes it a significant feature for the interpretation of the history of the Mt Robe Ranges.

Gay (2001) conducted an assessment of the then proposed Bemax mineral separation plant located southwest of the Broken Hill substation. The existing Broken Hill to Mildura transmission line traverses the property. Gay (2001) recorded 16 sites including open camp sites and quartz quarries. Camp sites appeared to be associated with ephemeral water courses and occasionally were found to contain heat retainer ovens. Quarry sites comprised low density artefact scatters associated with bedrock quartz outcrops.

The Western NSW Archaeology Program, research headed by Simon Holdaway and Trish Fanning, has entailed some artefact analysis at Poolamacca, immediately to the north of the proposed wind farm. Parts of Poolamacca have similar geology, vegetation and landform to the Stage 2 and 3 areas, although the central area of Poolamacca consists of younger Adelaidean geology that includes conglomerates with quartz and quartzite pebbles and cobbles. This different geology may affect the technology and materials used for flaking on parts of Poolamacca. Holdaway *et al*. (2005) reports that 3 types of quartz were identified on the basis of the degree to which it transmits natural light; crystal quartz, milky quartz and opaque quartz. Angular fragments without conchoidal fracture are common, but complete flakes with a full suite of attributes relating to conchoidal fracture outnumber them. A large sample recorded gives frequencies for flakes, flake fragments and tools recorded at Poolamacca. Crystal quartz includes 6 angular fragments, 9 complete flakes, 1 core and 1 distal flake. Milky quartz includes 476 angular fragments, 20 angular fragment tools, 2 complete bipolar flakes, 532 complete flakes, 24 complete split flakes, 3 spilt flake tools, 12 complete flake tools, 118 cores, 116 distal flakes, 1 distal flake tool, 34 medial flakes, 45 proximal flakes, 1 proximal flake tool. Opaque quartz includes 163 angular fragments, 2 angular fragment tools, 2 complete bipolar flakes, 266 complete flakes, 9 spilt flakes, 7 complete flake tools, 24 cores, 60 distal flakes, 2 distal flake tools, 13 medial flakes, and 12 proximal flakes. Another table gives frequencies of quartz tool types, including 1 backed blade, 7 denticulates, 4 notched tools,

1 pirri point, 11 angular fragment scrapers, 12 complete flake scrapers, and 9 utilised flakes. It is concluded that quartz artefacts are abundant at Poolamacca and occur in a range of forms (he does not give the numbers on other materials as this note was specifically about quartz).

Detailed recording of a terrace on a valley floor next to Campbell's Creek, Poolamacca Station, resulted in the recording of 223 hearths and a sample of 2129 stone artefacts. Of the 2129 recorded artefacts, the majority were made from quartz, plus 110 silcrete artefacts, 55 quartzite artefacts, and 2 pieces of ochre. Only artefacts with a maximum dimension greater than 20 mm were recorded. Calculated by Minimum Flake Number, the percentages of the different raw materials of artefacts at Poolamacca is; amorphous silcrete 1.2%, clast silcrete 4%, coarse silcrete 0.3%, matrix dominated silcrete 0.3%, milky quartz 61%, opaque quartz 29%, crystal quartz 0.9%, quartzite 3.1% (Holdaway *et al.* 2005).

Quartz outcrops are located close to the study area and at least one outcrop has been quarried and it is surrounded by worked flakes and cores. No systematic survey for quarries was undertaken but it is considered likely that many quartz outcrops at Poolamacca were quarried (Holdaway *et al.* 2005).

Of the 223 hearths, 15 were classified as partially exposed, 38 as intact, 3 as disturbed, 116 as scattered, and 20 as remnant. Twenty of the more intact hearths were excavated and 18 contained enough charcoal for dating. Most date to within the last 1000 years, but two older dates of 1500 BP and 6000 BP were obtained. The use of OSL dating was trialed by comparing OSL dates from hearth stones with the charcoal dates, results indicated that for 68% of the stones dated the OSL dates agreed closely with the charcoal dates. Charcoal in hearths was analysed and found contain either a single species or a mixture of species including Acacia type A (including mulga and dead finish), Acacia type B (prickly wattle), river red gum. One hearth had Buddha or *Eremophila* mitchelli, and one had water bush (*Myoporum montanum*). There were 2 undetermined species present (Holdaway *et al.* 2005).

'The Pinnacles' are three distinctive pointy hills to the south-west of Broken Hill, an area of similar geology and vegetation to the wind farm, but lower topography. In 1992 Lance undertook an archaeological survey of the Hungary Hill area adjacent to the Middle Pinnacle where he surveyed a proposed amphibolite quarry in detail. The area surveyed was 900 x 550 metres and Lance recorded one artefact scatter on the top of Hungary Hill and a very low background density over the slopes of Hungary Hill and the bottom of the Middle Pinnacle. The artefact scatter on top of Hungary Hill consists of 31 quartz artefacts including 1 backed blade, 12 flakes, 1 core, 16 flaked pieces and 1 retouched piece. Lance noted that the quartz found in this site was similar to that found in the large quartz quarry to the north (recorded as Site 36 in Martin 1998a), and that precision flaking techniques were being used. He suggested that fine wood-working tasks were being carried out at this site as well as the maintenance of spears with quartz barbs (Lance 1992).

The anthropologist Dr Lindy Warrell (1995) was employed in August 1994 by NSW NPWS to undertake an anthropological assessment of the Pinnacles. A process was set in place for all the stakeholders to comment on the Warrell report and its recommendations and The Pinnacles were finally declared an Aboriginal Place on the 5th July 1996. The boundaries of the Aboriginal place were however markedly smaller than the boundaries recommended in the Warrell report and recommended by the Aboriginal elders at a 1995 workshop. The boundary declaration process did not address the questions of adequate buffer zones or whether there was additional cultural material that should also be protected.

As a result of the small area declared around the Pinnacles it was decided by NPWS (now DECC) that an archaeological survey was needed to document the range and distribution of archaeological material in the wider area and to determine whether other significant areas occur that need to be protected. A series of sample areas along Stirling Vale Creek, Pine Creek, and around the three Pinnacles was surveyed in 1997 (Martin 1998a). The results of this sample survey are summarised below:

Distribution of archaeological material at The Pinnacles

The survey showed a distinctive patterning of archaeological material around the Pinnacles. Campsite material is concentrated in two areas along Pine Creek and in one area on Stirling Vale Creek. By far the most concentrated area is the area near the South Pinnacle on both sides of Pine Creek (Sites 8, 9, 10, 11, 12, 13, 14, 15) and in particular on the north side of the creek (Sites 11, 8, 9). The second biggest concentration of material is on Stirling Vale Creek around Site 30. Site 37 on the northern branch of Pine Creek also has a relatively high concentration of artefacts. These three areas all have a density of ovens and food processing equipment including grinding dishes and mortar/pestle type proportional to the artefact density.

Apart from these three areas there is a consistent low to medium density scatter of material along both creeks with only occasional ovens and rare grinding equipment. It was found that the lower the density of material the lower the range of artefact types.

The Rolling Lowlands Zone contains significant campsite material where it is adjacent to the main creeks and low and smooth enough to be utilised in the same way as the alluvial flats along the creeks (Sites 10, 17, 18, 23 and 33). Small artefact scatters were also found on top of the Knob between Sites 11 and 12, and along a small tributary gully draining from the North Pinnacle. Quarries 15, 20, 21, 22, 35 and 36 were also located in the Rolling Downs Zone.

The actual conical peaks of the South, Middle and North Pinnacles had no archaeological material except a very low density background scatter on the lower colluvial slope units. However other archaeological material was found to be associated with these Zones. Hummock Hill has a small artefact scatter on top recorded by Lance 1992. Quarry 14 is located on the gibber surface unit at the base of the South Pinnacle and Quarry 40 and 41 located on the slopes of a ridge adjacent to the North Pinnacle. Artefact scatters were also found on the gibber surface below the North Pinnacle and beside a tributary gully on the western side of the North Pinnacle zone.

Quarrying and Associated Activities.

The quartz quarries recorded during the survey are typical of the Broken Hill area and represent intensive exploitation of the good quality quartz and less intensive exploitation of poorer quality quartz material. The quartz reefs represented an invaluable material to the Aboriginal people of the area who otherwise did not have any suitable material for making artefacts. The reefs with the better quality milky and translucent quartz have been heavily utilised, sometimes leaving only rounded bedrock from which it was impossible to detach any more suitable pieces. The bedrock displays Hertzian cones or ring cracks from the impact of rocks being thrown against the bedrock anvils in order to smash rocks up into suitable size for further working. The bedrock also displays areas of pounding and negative flake scars where rocks have been hit against the bedrock to dislodge large flakes or blocks. The quarries are surrounded by a ring of quartz trimming debris and in places workshops can be delineated where artefacts were manufactured.

Quartz Technology

Quartz is worked in a number of ways in the Broken Hill area (Martin & Witter 1997, Martin & Witter in prep);

1. fracture line or fracture plane propagation for core preparation and production of block tools;

2. production of flakes detached from a hand-held core by a hammerstone;

3. blade technology manufacture of microblades by a wooden baton;

4. bipolar or semi-bipolar manufacture of microblades; and

5. nuclear tools including naturally weathered or fractured blocks and quartz crystals.

The quartz blade workshops found at The Pinnacles are typical of the Broken Hill area. The Broken Hill type blades (blades defined as thin flakes with parallel or symmetrically tapering margins and straight dorsal scars) have been experimentally replicated by Dr Dan Witter using a hard Acacia (Gitji or Mulga) baton to detach blades from a quartz core (Martin & Witter 1997). The baton detached blades with precision and offered a much more controlled situation than a hammerstone. Bending type fractures were common but it was possible to make long straight-sided blades like the ones seen in the Broken Hill sites. Dan has also used a smaller wooden baton for retouching quartz artefacts with success, although finer retouch such as the backing and invasive flaking on the backed blades, pirri points and small notched blade tools probably resulted from pressure flaking with a bone point. However, many of the blades may have been used without retouch, as Witter has suggested that many of the thin quartz blades found in abundance on most of the sites recorded during this survey were used for the manufacture of "jagged" spears which are normally associated with group hunting of larger animals. The blades would be snapped to the right size and shape for hafting in spears rather than backed (Martin & Witter 1997). The use of wooden batons for manufacture of the blades is also suggested by the scarcity or absence of hammerstones or fragments of hammerstones in many of the sites, including quartz workshop areas (Martin 1995, 1998a).

Retouched Artefacts.

The majority of retouched tools on the sites are small to medium sized general purpose wood working tools with single or multiple working edges. Edges showing only usewear are more common than retouch, but retouched tools may have scalar, step or cuspate retouched edges, or notched or snapped edges. A number of sites including Site 8 and 37 contain a number of larger tools including core tools and tools made on large blocks and flakes which would have been used for heavy duty woodworking. Specialised tools include crescentic backed blades, pirri points and micro round edged tools (thumbnails).

Stone Material Type

The stone material found in the sites is predominantly local quartz from the quarried quartz outcrops. Quarrying of good quality and medium quality quartz is the dominant stone used in all the sites, the best quality being the translucent reef quartz such as that found at Site 36. The exact source of the crystal quartz also found in sites is not known, but is probably the local pegmatite. Crystals are difficult to work because of small size, and may have been used for ceremonial purposes. Silcrete and chert is found in sites, but only makes up between 1% - 5% of artefacts and has been brought in from probably over 100 km. Coarse brown silcrete that outcrops 30-50 km south of the Pinnacles is not found at the Pinnacles, but is found in sites close to the outcrops.

Local gneiss has been used for grinding dishes, but the extent of this is difficult to judge as many of the flat gneiss rocks found in sites (manuports) have been weathered and it not possible to say if they have been used as grinding dishes. However, there are enough examples with non-weathered ground surfaces to indicate that the use of local gneiss was common. A range of different non-local quartzites has been used for grinding dishes and in rare cases for hammerstones.

Heat Retainer Oven Use.

Evidence of heat retainer ovens was noted in the larger campsites along Pine Creek and Stirling Vale Creek. The ovens range in diameter from 50 to 180 cm and are composed of local stone (mainly gneiss with some quartz) heat retainer with rare pieces of burnt termite mound heat retainer. Some ovens are still *in situ* and just exposed while others have been affected by erosion and are either on pedestals or are left "floating" on the eroded surface. Charcoal and charcoal staining can be seen in some ovens.

Water Resources.

The larger campsites are located in specific areas along the main creeks and this patterning may relate to the presence of springs. Both the mythology and oral history describe the presence of water at the Pinnacles, and the oral history describes this water as a “spring” in Pine Creek.

More recently a number of studies have been carried out at the Pinnacles in response to the NSW DECC bringing court action against the Pinnacles Mine owners for damaging the Pinnacles Aboriginal Place and recorded archaeological material in adjacent areas. Macintyre-Tamwoy, employed by the defendant, looked at partially overlapping areas to Martin (1998a) and agreed with some of her conclusions, but strongly disagreed with others. Macintyre-Tamwoy re-recorded the large open sites on both sides of Pine Creek near the South Pinnacle and found another area with a high density of artefacts to the west of the Middle Pinnacle in an area not surveyed by Martin (1998a). However, Macintyre-Tamwoy concludes that none of the quartz outcrops at the Pinnacles have been exploited for raw material and that the quarries recorded by Martin (1998a) do not show any evidence of exploitation by Aboriginal people. In an appendix to her report Wright supports this conclusion after examining several quartz outcrops both at the Pinnacles and at the Railway Siding also damaged by the defendant and near the Pinnacles. However, it must be stated here that Wright examined at the Railway siding a different feature to that photographed and recorded by Martin and NSW DECC investigators, and the area at the Pinnacles where he purportedly examined two other quarries recorded by Martin (1998a) was so badly damaged by large costeans that Martin and the NSW DECC investigators were unable to relocate the original features and concluded that they had been destroyed. Martin’s (1998a) Quarry 14 at the South Pinnacle was determined by Macintyre-Tamwoy not to be a site, despite the exceptionally good bedrock anvil features such as Hertzian cones, ringcracks, battering marks, and surrounding flaked material recorded by Martin. Macintyre-Tamwoy did not examine the very large and exceptionally good quality reef of distinctive banded milky/translucent quartz recorded by Lance (1992) and as Quarry 36 by Martin (1998a), despite the fact that it is visible from, and very close to areas she surveyed. Wright also examined Martin’s (1998a) Site 38 and found that it had a very low density of artefacts, so low that he calculates it was being of background density found all over Australia, and that most of the quartz material was naturally occurring ‘lag’ quartz. Martin (1998a) however, specifically mentions in addition to a consistent density of between 0.6/m2 to 2.2/m2 of flakes, blades and blocks or angular fragments (estimated by flipping a rigid metre square across exposures and tallying density in each square), a large unifacial core, 3 bipolar split cores, a crystal micro block tool, a flake tool with scalar retouch, a grey crystal flake tool with scalar retouch, a block tool with scalar retouch, a crystal blade core and a nosed flake tool, as well as one *in situ* heat retainer oven. The disparate findings of Martin (1998a), Martin & Witter (1997) and Lance (1992) compared to Macintyre-Tamwoy (2006) and Wright (2006) clearly need explanation.

At the junction of the Barrier Range foothills and the sand plain, approximately 60 km to the south of Broken Hill Shiner found that quartz, silcrete and minor quartzite were the main raw materials (2004:182). In this detailed study he found that quartz gibber nodules varied from milky to partially translucent, and included significantly smaller amounts of quartz crystal gibber. He found that both the milky and partially translucent quartz could occur in the same small fist sized nodule, and that it is the internal flaws in the structure of the

material that affected knapping quality rather than the degree of translucency. Reef quartz is extremely rare in this area and the two minor occurrences noted exhibited numerous internal flaws reducing its utility for knapping. Quartzite occurs rarely as isolated nodules within the quartz gibber pavements (Shiner 2004:184-185). Silcrete occurs in this area as two small areas of outcrop on Tertiary deposits and as a remnant of Tertiary outcrop now eroded to gibber pavement covering low rises. This silcrete is defined as clast silcrete with light brown 'abrasive' cortex on the outcrop and smooth rounded cortex on the gibber nodules. Shiner shows that the non-clast silcrete found in small quantities in the artefact samples in his study area is not from the study area (Shiner 2004:188,192, 259). He defines clast silcrete as that having fine to coarse clasts or grains, and non-clast silcrete as dominated by microcrystalline matrix with no clasts or scattered angular clasts (Shiner 2004:187-189). The assemblage samples displayed different proportions of raw material but all were heavily dominated by quartz. The minimum number of flakes and total number of pieces counts are more dominated by quartz than the volume, where the proportion of other materials increased relative to quartz. In the 2 CN assemblages quart accounts for about 80% of the number of pieces, with silcrete accounting for about 20%, of that between 3-4% is non-clast, ie. non-local silcrete. At the KZ assemblages quartz accounts for 60% of pieces, and silcrete accounts for about 38%, with non-clast silcrete comprising between 4-7%. Quartz crystal and quartzite comprise a tiny proportion of pieces, which together with chert, hornfels, ironstone, sandstone, and schist, comprise only between 0-2% (Shiner 2004:193-200). Shiner shows that silcrete has a much higher tendency than quartz to have been partially decortified before reaching the dominant occupation assemblages, and that silcrete is mainly obtained from the outcrops rather than the gibber, while quartz is mainly obtained from the gibber and creek gravels. Assemblages closer to the silcrete outcrops have a higher proportion of silcrete, and silcrete nodules coming from the quarries were larger than both quartz and non-clast silcrete original pre-flaking pieces (Shiner 2004:200-206). Thus the assemblages are dominated by the most easily obtained material, gibber and gravel quartz, and then by the local clast silcrete which was mainly obtained from outcrops between 3-7 kilometres away. The proportion of silcrete increases in the assemblages closest to the silcrete outcrops. Shiner demonstrates that larger proportions of non-clast flakes are retouched into tools than either quartz or clast silcrete flakes, and these tools tend to be more formal tool forms. The quartz section of the assemblages has a low proportion of tools, except at one assemblage where it has the highest proportion, which is consistent with non-intensive utilisation of a local raw material source (Shiner 2004:258). Specialised core forms are rare and core rotation is uncommon, unifacial cores making up the largest proportion. Non-clast cores tend to be the most reduced, followed by clast silcrete, then quartz. Core platform preparation is rare and largely confined to non-clast silcrete. Non-clast silcrete is most intensively worked and selected for certain tool forms, showing conservation of this material that was brought for a greater distance (Shiner 2004:258-260). Shiner compared areas at Fowlers Gap and Burkes Cave in different landforms and at a distance and found that some of the patterns found at Pine Point were consistent. This includes that trend for quartz, despite the fact that it is contributes the highest numbers of artefacts to all assemblages except Burkes Cave, to be the least intensively worked raw material as measured by core reduction, proportion of tools and degree tool resharpening. Another trend is that raw material availability was an important factor in influencing assemblages (Shiner 2004:283).

Indigenous sites were found to be widespread across the Silverton Wind Farm Stage 1 proposal area (Dibden 2008). A total of 262 Aboriginal object locales were recorded during the field survey. The majority (N=166; 63.4%) of locales are distributions of predominantly quartz stone artefacts across individual survey units. A total of 78 (approximately 30%) quartz outcrops with evidence of exploitation – Stone Procurement Areas, were recorded. Fourteen locales are stone artefacts with heat retaining hearths (5.34%). In addition three isolated artefacts and a complex of two small circular stone arrangements were recorded (Dibden 2008).

Given the comprehensive nature of the archaeological survey in the Stage 1 area patterning in artefact type and distribution across the landscape which indicates a variable use by Aboriginal people of the different landforms has been identified. The ridge crests and slopes possess primarily quartz artefacts in a widespread but generally low density distribution. The majority of quartz outcrops, including very small and insignificant exposures, possess evidence of their use as stone procurement sites. A greater abundance of quartz artefacts are found in areas in which quartz outcrops are present. The majority of stone artefacts are unretouched flakes and cores however a number of retouched tools were also recorded. The artefact types recorded indicates that the ridges were utilised by both men and women for hunting and gathering activities (Dibden 2008).

Drainage depression landforms and flats associated with creek lines possess a relatively higher artefact density and diversity of artefacts types; a higher percentage of foreign stone is present in the artefact assemblages and stone heat retainer ovens/hearths are common in these lower landforms (Dibden 2008).

The Ana Branch and Darling River

Similarly to the Broken Hill area the Anabranch and Darling River areas have been subject to very little prior research. Furthermore the majority of work that has been conducted has been linear surveys associated with pipelines and electricity easements.

McIntyre (1977) found the Darling River to contain a high number of sites. Reference to his site mapping indicates that sites were clustered on both sides of the Darling. One of McIntyre's (1977) sites at Sturts Billabong, along the Darling River, has been the subject of further research (Littleton and Blair 1993). The site at Sturts Billabong consists of a large sand dune measuring approximately 500 m x 150 m. It is possible that the site is located in the general vicinity of Sturt's first camp on the Darling River when he journeyed there between 1844-1846. The centre of this dune has eroded to reveal 36 human burials, numerous burnt clay heat retainers from old fireplaces or hearths, and about 22 small campsites or stone artefact scatters. There are also sparse remains of freshwater mussel, fish and yabby.

Balme and Hope (1990) and Balme (1995) conducted research on Aboriginal exploitation of aquatic resources on the Lower Darling River and its lakes and anabranching channels. The region between Wilcannia and Menindee was the focus of the study, although areas around several relict lakes of the Darling Anabranch (Travellers Lake and Lake Milkengay) were also examined. Most of the shell middens they examined were located in lunette or source-bordering dune sediments. Few sites were located in the dunefields and sandplains or on the floodplains. This distribution may have been an artefact of erodability, with lunette and source-bordering dune sediments more likely to be exposed. The middens were found to be usually thin and localized (Balme and Hope 1990, Balme 1995).

Clarke (1983) conducted a survey of a seismic line along the Lower Darling. He recorded 15 sites most of which were near low landform features that retain water from localised runoff after rain. Eight of the sites consisted of open camp sites represented by stone artefact scatters, hearths and heat retaining stones. Stone artefact assemblages were of flaked silcrete. Retouched stone tools comprised scrapers and adzes and there were numerous cores, hammerstones and grinding implements. The remaining seven sites comprised heat retaining stones (Clark 1983).

Martin (1985) also conducted a survey of seismic exploration lines in the Darling Anabranch. Martin recorded 58 open camp sites most of which were located near lakes or palaeochannels.

Edmonds (1999b) conducted a survey on Avoca Station west of Darling River. Twelve sites were located including over 20 scarred trees, eight shell middens, two open campsites and a complex of hearths. Middens were mostly shallow accumulations of individual shell heaps comprising freshwater mussel shell (*Alathyria jacksoni*) and occasionally freshwater snail (*Vivipara* spp. probably *sublineata*). Middens usually included burnt clay heat retainers in a dark, grey ashy matrix. Most of sites appeared to be stratified. These middens were located along the high riverbank and usually extended inland for between 10 - 30 m. Open campsites were rare and comprised a sparse but extensive scatter of flaked stone (silcrete), and scattered and *in situ* burnt clay heat retainers (hearths). Campsites were located around scalds (ephemeral water source) or on a low sandsheet overlooking the interior floodplain

Witter (2001) and Cupper (2003b) surveyed a proposed mineral sands mine site and ancillary infrastructure routes to the east of the Anabranch. Witter (2001) originally identified 94 sites, most of which were isolated finds of stone artefacts or heat retainers from hearths; 31 open camp sites including stone artefact scatters and/or hearths. Witter (2001) also recorded six scarred trees, a burial site and a shell midden.

Cupper (2003b) located 21 Aboriginal archaeological sites and 12 isolated finds of stone artefacts. Of the sites, five were hearth sites, five were open camp sites represented by scatters of stone artefacts, two were quarry sites, three were scarred trees, three were open camp site/freshwater mussel shell midden site complexes, two were open camp site/quarry site complexes and one was a freshwater mussel shell midden. Most of the sites were found close to (within several kilometres) the Darling River and Darling Anabranch floodplain (Witter 2001, Cupper 2003b). The scarred trees, burial and shell midden were located near either of the two main watercourses. Open camp sites, hearths and isolated finds were found at a much lower density in the dunefields and sandplains, most noticeably around small depressions (Witter 2001, Cupper 2003b). However Witter (2001) concluded that the prevalence of sites around these natural depressions such as ephemeral swamps and claypans indicated quite an extensive Aboriginal exploitation of the dunefields and sandplains away from the river.

Cupper (2004) conducted a survey of a proposed stock and domestic water pipeline along the Anabranch. The study area comprised approximately 315 km of pipeline and an additional 100 km of spur lines. Cupper recorded 120 Aboriginal sites and 9 isolated finds of stone artefacts. Of the sites, 91 were open camp sites represented by scatters of stone artefacts, 13 were freshwater mussel shell midden sites, 6 were scarred trees, 6 were burial/open camp site complexes and 4 were hearth sites.

Open camp sites were found to consist of a few to large numbers of artefacts. Stone artefact assemblages predominantly included unmodified flakes and flaked pieces, blades, cores and nuclear tools and amorphous material. Formal implements including retouched flake tools such as adzes and scrapers, an edge ground waisted axe, hammerstones, mortars, pestles, mullers, grindstone fragments and anvil stones are also represented at much lower abundances in the assemblages. Lithic materials used for the manufacture of the artefacts include silcrete, chert, quartz, quartzite and sandstone. Organic material and the remains of hearths are also associated with the stone artefacts (Cupper 2004).

Cupper (2004) concluded that the site distribution reflects a semi-sedentary settlement patterns consistent to that recorded in local ethnographies. Sites were found in relatively high density near the main watercourse Darling Anabranch, and its associated lakes. Sites close to water are often quite large and contain the greatest diversity of artefact types. Cupper (2004) suggests that the open camp sites, burial/open camp site complexes, middens, scarred trees and hearths located near the riverine corridor probably represent residential base camps that were occupied for substantial periods.

By contrast, in the dunefield and sandplain hinterland Cupper (2004) found that sites were markedly smaller and sparser. Cupper (2004) argued that these sites probably represent the temporary field camps of small bands of people who used this region during moister intervals.

The Murray River Area

McIntyre recorded numerous sites in the area north of the Murray during his original survey of the existing overhead transmission line and these are discussed below. Subsequent investigations have been conducted in two sections of the original transmission route; Bowan Park, Monak has been subject to survey and subsurface testing resulting the additional sites in the vicinity of the transmission line (Dowling 1990 and Edmonds 1995; 1997b) and a part of the route from north of Gol Gol Swamp west to the Darling has been surveyed by Edmonds (2002).

Buchan 1974, 1984 conducted field work over a two years period during 1973 and 1976 along the northern bank of the Murray River between Albury and Mildura. The fieldwork involved targeted survey during the first year with work concentrating on accessible sites identified via information from a publicity program. As a result of that first season a series of survey areas were chosen for the subsequent field season. Each of these zones measured approximately 300 square miles in area and was surveyed by vehicle and on foot (Buchan 1984: 36). A total of 198 sites were recorded, including 25 within the Wentworth region; these comprised 19 scarred trees, three shell middens, one surface camp, one burial and one ceremonial site (Buchan 1984: 39).

The scarred trees were mainly located around Lake Gol Gol, two of which were located adjacent a complex of sites (ceremonial ground, burial, campsite and midden). The other two midden sites are situated on the banks of the Murray at Gol Gol. Site #46-3-0022 is located immediately south of the village of Gol Gol and extends for hundreds of metres along the river bank with midden deposits measuring up to 80 cm in thickness. Site #46-3-0030 is located approximately one kilometre southeast of site #46-3-0022; it extends for at least 100 m along the bank. Both sites have been disturbed by European activity and are subject to erosion.

McIntyre (1977) recorded middens comprised of freshwater mussels on the lunettes of Gol Gol Lake and Gol Gol Swamp. McIntyre 1981: 32 noted that the stratigraphy of sites at Gol Gol suggest that lacustrine resources were possibly exploited as long ago as the Pleistocene.

The Wentworth Heritage Study was undertaken by Hassell Planning Consultants (Hassell 1989) with a specialist contribution by Colin Pardoe. This study aimed to provide Wentworth Shire Council with the identification and assessment of items of heritage significance, including both European and Aboriginal sites, and to provide a schedule of sites for inclusion on the Local Environmental Plan. In terms of the Aboriginal component of the assessment, no fieldwork was undertaken; however a relatively comprehensive review of site types and location was compiled (Hassell 1989: Appendix 3).

In 1990 Dowling conducted a survey of two areas proposed for sand extraction: one at Dareton and one at Bowan Park near Monak. The Bowan Park site is situated immediately to the north of the Murray and adjacent

to the existing and proposed overhead transmission line. The survey areas both comprised alluvial flood plains, and both were surveyed on foot. Poor visibility was encountered in both instances, and no surface evidence of Aboriginal occupation was identified (Dowling 1990: 5-6). It was concluded that despite the results there remained a high potential for subsurface sites, particularly at Bowan Park, and accordingly a program of subsurface testing was recommended (ibid: 7-8). Following on from this study further investigations were completed in 1995 (Edmonds 1995) and salvage of a midden site undertaken in 1997 (Edmonds 1997b). Edmonds (1997b) obtained two radiocarbon dates from the Monak midden: 19,670±1030/-910 and 20,420±1130/-990.

A survey of the Silver City Highway between Curlwaa and Dareton was undertaken by NPWS officers in 1987; no visible indications of sites were identified. Subsequently, the Regional Archaeologist for NPWS, Harvey Johnston, identified a shell midden in a roadside cutting at Dareton (Johnston 1990). The route of the road was modified to avoid this site, but when another area of midden was identified 500 m to the east it was necessary to apply for 'Consent with Salvage'. The Dareton midden was then surveyed and excavated by Johnston in 1990 with the aim of establishing the size, age, contents and significance of the site (Johnston 1990). A 10 cm auger was used to test those areas of the site not visible at surface level. Cores were taken at 20 m intervals, and three radiocarbon samples were obtained. Results of the survey and testing indicated that the site extended for some three kilometres, with the majority of the site consisting of a lens one to two centimetres thick located at a depth of around 50 cm below the surface. The radiocarbon dates returned two age determination of ca. 12,000 BP and ca. 18,000 BP, with the 12,000 BP date generally accepted as the best indication of the period of occupation (Johnston 1990: 14). A portion of the site was eventually conserved despite the consent issued for the road works. The conserved portion was in an area of horticultural use, however, it should be noted that the zone of horticultural impact was above that of the midden (Johnston 1990: 19).

Survey for the Mildura – Wentworth optical fibre cable route was undertaken by Gaffey in 1991. This survey involved the survey of a corridor (four metres wide) adjacent the Silver City Highway into Buronga, although the areas within the towns themselves were not surveyed (Gaffey 1991). Visibility encountered between Buronga and Dareton was in the range of 60% to 100%. From Dareton to Wentworth visibility varied between 95% and 100%, while it was only around 20% along the Murray at Wentworth (Gaffey 1991: 16). One isolated broken silcrete flake was located six metres off the proposed route 500 m west of Buronga. Areas of midden and associated hearths, including the previously recorded Dareton midden (*cf* Johnston 1990) were identified between Dareton and Wentworth, but no sites were visible in the section along the Murray (Gaffey 1991).

A survey of some 625 ha, undertaken by Craib (1992) in the Wentworth Gol Gol region. The goal of the project was to focus on the relationship between cultural and natural resources in order to facilitate landuse planning. The northern most point of the study area was located slightly north of Ashvale station on the Darling River at the point where the existing Broken Hill/Red Cliffs overhead transmission line crosses the Darling; most of the eastern boundary of the study area was contiguous with this transmission line. The survey incorporated riparian, lacustrine, box plain, open and sand hill environments

Craib's (1992) results revealed that the whole study area could be considered to be one spatially continuous site with considerable variation both in terms of density and type of artefacts and features, but with relatively few distinct clusters other than a tendency for concentrations of material around watercourse junctions. Middens along the river margin were found to be in the order of 300 to 500 metres long and five to ten metres wide, and most possessed no stone artefacts. Low density lithic scatters (1 item/10m<) were however found along the margins of runners leading into the river. In total 87 sites were recorded, with scarred trees as the predominant site type (Craib 1992). While this study was instrumental in demonstrating the potentially high archaeological sensitivity of the region, it also highlights the possibility that the high numbers of scarred trees may be a reflection of different visibility levels, that is, identification of burials, campsites, isolated finds and middens is heavily dependant upon surface visibility, and as such they are likely to be under represented in surveys.

Bonhomme (1993) conducted a survey of approximately 46 ha at Lake Victoria and 97 ha at Koondrook State Forests west of Wentworth. Landforms encountered included river and lagoon margins, point bar deposits, source bordering dunes, ephemeral creek lines/runners, and floodplains. A total of 53 sites including scarred trees, shell scatters, burials and isolated finds were found in Lake Victoria State Forest, while 89 sites including mounds, burials and scarred trees were found in Koondrook State Forest (Bonhomme 1993: 5-6). It was indicated by Bonhomme that these site numbers could only be considered a minimum, and that the actual number was likely to be considerably higher (Bonhomme 1993: 6). At Lake Victoria State Forest shell scatters and middens were identified to have a strong association with hydrological features, with shell scatters occurring randomly along margins of the Murray River and ephemeral creeks and lagoons. Middens however often occurred at the junction of water bodies, with large middens occurring on the Murray where runners join the main channel; these were usually on higher ground, often indicated by the presence of Box trees

(Bonhomme 1993: 7). Stone scatters were relatively scarce in this survey, although this result was thought to be a factor of problems with visibility. Where encountered artefact scatters were usually present along the margins of water, often in association with middens (Bonhomme 1993: 8). Scarred trees were identified on Box trees and Red Gums throughout the study area, but were concentrated along water courses, while burials were found most often in sand dunes, sometimes with high numbers of associated scarred trees (Bonhomme 1993: 7).

In 1993 Lance undertook a survey for the proposed Buronga Gol Gol Sewerage Works on approximately 100 ha of alluvial plain and lunettes. During the course of that survey 46 sites (DEC #46-3-0032 through to #46-3-0077), including scarred trees, a stone artefact scatter and a number of hearths were identified (Lance 1993a). The survey was conducted entirely on foot with the most intensive work focused around an ancient lake bed (ibid: 4). Disturbance by rabbits, vehicles and erosion was noted in the lunettes, and as a result particular attention was paid to these features. The majority of sites recorded were scars on black box trees, which ranged from definite Aboriginal scars through to scars of possible/probable Aboriginal origin. It was also noted that a number of scarred trees had probably been lost due to clearance (ibid: 14). The sites were assessed to be significant on their own and as a suite, and as such development plans were revised so that only a quarter of the original area was to be used and only two of the trees threatened (#46-3-0076 & #46-3-0077). In terms of sites other than scarred trees, the general survey coverage information shows that sites were only recorded in areas with good to excellent visibility. Accordingly it is likely that the results do not indicate the full extent of artefact scatters, isolated finds and hearths sites. Similarly it is possible that there are as yet unidentified and/or undisturbed burial sites within the lunette land forms.

Lance (1993b) also undertook an investigation of sites threatened by the Dareton Buronga Gol Gol water supply scheme. This project involved field survey and subsurface testing of two middens previously recorded by Buchan (1984) that are now referred to as the Pumping Station Site (#46-3-0022), and the Gol Gol Midden (#46-3-0030), both of which are located on the high cliffed banks of the Murray. The Pumping Station Site is situated 17.5 m above the river and had previously been disturbed by grape cultivation, ploughing, and vehicular tracks. The Gol Gol site is situated about 10 m above the river and consists of a midden lens that is up to 20 m wide and 80 cm thick and contains shell, bone, ash, clay balls and hearth stones (Lance 1993b: 5-7). Faunal remains from the middens were dominated by freshwater mussel but also included yabbies, and small mammals. 41 stone artefacts were recovered from the two sites, the majority of which were flaked pieces made of silcrete. Radiocarbon dates from the Pumping Station Site indicated that the site has been occupied since ca. 17,000 BP (Lance 1994b: 27).

Archaeological material at the Gol Gol Midden (#46-3-0030) was later disturbed during construction work for viewing platforms in James King Park in 1994. The stratigraphy of these pits was subsequently recorded and samples taken for dating (Lance 1994b). While the results of radiocarbon dating were not available at the time of the report by Lance it was estimated that the site was of more recent antiquity than the nearby Pumping Station Site (Lance 1994b: 30).

During assessment of the Dareton Pumpout Station site was undertaken by Lance in 1994, an extensive midden was recorded along a low bank of the Murray River (Lance 1994a). The site was subsequently salvaged by Edmonds (1998). The work undertaken by Lance involved 'd-probe' samples taken along the river bank, the results of which indicated a relatively sparse and intermittent distribution of midden material. Samples taken 30 m to 40 m in from the river bank did not produce any shell material (Lance 1994a). The subsequent project conducted by Edmonds was restricted to within 20 m of the river bank and involved mechanical excavation of part of the original rising mains trench, with shell samples taken from *in situ* lenses within the exposed sections. The results of that project generally confirmed Lance's work and indicated that midden material only extended 5.5 m back from the river bank. The midden was assessed on the basis of radiocarbon samples to date from 2,000 years BP through to the contact period (Edmonds 1998: 16-17).

One of the most comprehensive and recent studies within the Murray River area was that undertaken by Bonhomme Craib and Associates (1999) for the *Murray Darling Water Management Action Plan* (MDWMAP). The heritage study submitted for the MDWMAP was a largely desktop review for an area of some 900,000 ha, extending five kilometres either side of the Darling River from Menindee Lakes to Wentworth, and a 10km band along the northern side of the Murray River from Wentworth to the Murrumbidgee confluence in the east (Bonhomme Craib & Associates 1999: i). While limited survey work was undertaken as part of that study, the most useful contribution to this project was the formulation of predictive models of site location (Bonhomme Craib & Associates 1999: 44-72). This aspect of the report will be discussed in more detail below in section 7.5. Some of the key recommendations made by Bonhomme Craib & Associates (1999: 87) were that developers should be advised to avoid: source-bordering dunes (highly likely to contain Aboriginal burials); margins of all hydrological features in the MDWMAP study area; and intersections of major rivers or creeks with runners.

Edmonds (2002) conducted a survey of a part of the existing Broken Hill – Red Cliffs transmission line from north of Gol Gol Swamp, west to the Darling in respect of a proposed South Australia – New South Wales Interconnection (SNI) from the Buronga Substation in western NSW through to Robertstown in SA. A total of 63 indigenous archaeological sites were recorded. Some sites contained multiple features, the breakdown of which is as follows; 17 scarred trees, 17 campsites: - four with a midden component, 11 shell middens, seven isolated hearths and 5 hearth complexes and 10 isolated stone artefacts. Edmonds believed that some of these recordings were likely to include some previously recorded by McIntyre.

Based on the above review and a consideration of the elevation, geology, hydrology and topography of the study area the type of sites known to occur in the region and the potential for their presence within the study area are listed as follows.

5.6 Predictive Model of Site Type and Location

Much of what is known regarding the current site patterning or clustering within western NSW is a reflection of the varying degrees of research and survey conducted; that is, sites are clustered where work has been concentrated. Furthermore, the focus of attention has often been on lakes, rivers and creeks. Our understanding of Aboriginal occupation of areas beyond the floodplains and lakes is limited. The potential for 'significant data' is recognised, and already demonstrated in the range of sites previously recorded (Bonhomme Craib & Associates 1999: 39-40).

The type of sites known to occur in the region and the potential for their presence within the study area are listed as follows:

Stone Artefacts

Stone artefacts are located either on the ground surface and/or in subsurface contexts. Typically stone artefacts recorded in open sites are representative of debris which results from flaking stone and will include unmodified flakes, cores and flaked pieces. Actual stone tools such as deliberately formed artefacts (such as scrapers, backed blades or adzes) or pieces which possess evidence of use are generally present in low frequencies.

Stone artefacts are likely to be present in most landforms within the Stages 2 and 3 area and along the proposed transmission line route.

Middens

In the region middens will be dominated by freshwater mussels, but are also likely to contain animal bones, stone artefacts, ash, charcoal and other remnants of hearths such as heat retainer stones. Middens tend to occur near (within 600 m) the intersection of a stream or lagoon and the river. They are found in Red Gum forest along the margin of the Murray and at the interface with the higher ground where the Black Box grow (Bonhomme Craib & Associates 1999: 47-49). Middens will be found adjacent to current and prior watercourse and lagoon channels, high cliffs and escarpments overlooking the Murray floodplain, sand deposits adjacent to the floodplain and in lunettes around swamps or lakes.

River mussel (*Alathyria jacksoni*) is predominant in middens along the Murray River and major creeks, while freshwater mussel (*Velesunio ambiguus*) is common in sites adjacent to lakes, swamps and minor watercourses. Other species of shell fish include the freshwater snail (*Vivipara notopala hamelyi*).

Middens are likely to be present in many locations along the proposed transmission line route.

Burials

Aboriginal burial sites are a relatively rare recording type within the Murray corridor, however it is likely that there are a significant number of these sites as yet unidentified. Burials for the region are known to have occurred both in the ground and in trees, usually Box Trees. A variety of burial practices occur throughout time and include flexed, extended and cremated inhumations with the most common being extended inhumations. Bundle burials appear to be restricted to the late Holocene (Pardoe 1995: 704). Burials have been dated anywhere from 25,000 years BP through to the time of early European settlement.

There is high potential for burials to be present along the proposed transmission line in lunettes, source bordering dunes, point bar deposits and sandy riverbanks/escarpments.

Scarred and Carved Trees

These sites result from the removal of bark from trees by Aboriginal people for either domestic or ceremonial purposes. These site types can occur anywhere that trees of sufficient age are present, however, in an Aboriginal land use context would most likely have been situated on flat or low gradient landform units in areas suitable for either habitation and/or ceremonial purposes.

Bark removal by European people through the entire historic period and by natural processes such as fire blistering and branch fall, make the identification of scarring from a causal point of view very difficult. Accordingly, given the propensity for trees to bear scarring from natural causes their positive identification is impossible unless culturally specific variables such as stone hatchet cut marks or incised designs are evident and rigorous criteria in regard to tree species/age/size and it specific characteristics in regard to regrowth is adopted.

Within the local region Box Trees (*E. largiflorens*) and River Red Gum (*E. camaludlensis*) are the most common species for scars. Areas with high potential are alluvial flood plains with old growth stands of these trees (Bonhomme Craib & Associates 1999: 27, 67).

There is a high potential for scarred trees to be present along the proposed transmission line route.

Stone Quarry and Procurement Sites

Throughout Australia various stone and mineral substances were collected and sometimes quarried to make stone implements and pigments of various kinds (Hiscock and Mitchell 1993; Mulvaney and Kamminga 1999:27-31). Sandstone also was quarried in large slabs for use as grindstones in milling seeds for flour. Pebble beds in watercourses were often ideal places to collect suitable stone, because there was usually a choice of different stone types, pebbles and cobbles were often a convenient size and shape, and water transport had tested the stones for toughness. In areas where pebbles were collected there often occur rejected pieces of flaked stone and other flaking debris from roughly shaping pieces of stone before these were taken away for final knapping. Where particularly desirable stone was available, the discarded knapping debris may be thousand of items per square metre. Some larger stone collecting localities in the arid zone were extensive rock formations, where knapping debris is scattered over the ground for kilometres. Some collecting sites have quarry pits and shafts following a seam of high quality stone or ochre. Around these pits are knapping floors or 'stone reduction sites', where the early stages of tool manufacture occurred. Often at probable stone procurement places such as small pebble beds in creeks, there is little or no archaeological evidence, in the form of extraction pits or concentrations of preliminary knapping debris, that stone had been selected and knapped in the past.

Certain Aboriginal quarries and mines possessed significance that transcended material needs. People did not always prefer the closest source, but exchanged valuable goods or travelled through arid country to a more distant source for stone they believed was imbued with spiritual power.

Quartz quarries are often recorded during surveys in the Broken Hill area and represent intensive exploitation of the good quality quartz and less intensive exploitation of poorer quality quartz material. The quartz reefs represented an invaluable material to the Aboriginal people of the area who otherwise did not have any suitable material for making artefacts. The reefs with the better quality milky and translucent quartz have often been heavily utilised, sometimes leaving only rounded bedrock from which it was impossible to detach any more suitable pieces. The bedrock displays Hertzian cones or ring cracks from the impact of rocks being thrown against the bedrock anvils in order to smash rocks up into suitable size for further working. The bedrock also displays areas of pounding and negative flake scars where rocks have been hit against the bedrock to dislodge large flakes or blocks. These stone procurement areas are often surrounded by a ring of quartz trimming debris.

Providing stone outcrops in the proposal area this site type is likely to be present.

Heat Retainer Hearths/Ovens

Heat retainer ovens range in diameter from 50 to 180 cm. In the Broken Hill area heat retainer hearths are generally composed of local stone (mainly gneiss with some quartz) heat retainer and occasionally with rare

pieces of burnt termite mound heat retainer. This type of fireplace is described in the diary of the explorer Daniel George Brock (Peake-Jones 1988). The feature consists of a shallow pit excavated into the ground surface in which a fire was lit on top of a layer of stones. It is believed that when the stones were hot, food was on the stones, and then covered by the excavated dirt (and also possibly vegetation: Martin 2007 pers comm.). South of Broken Hill heat retainer hearths are comprised of termite nest or lumps of burnt/baked clay or calcrete, sometimes in an ash and charcoal matrix.

Holdaway *et al*. (2002) report that excavation of hearths reveals a layer of heat cracked stone mixed with soil and in some cases flecks of charcoal. Some hearths have a dense layer of charcoal underneath the stones. Generally however hearths are so eroded that all traces of charcoal have been removed. Excavation of hearths has also shown that most were excavated a few centimetres into the top of the massive, bleached A^2 horizon, which provided a firm base for the arrangement (Reaves 1997).

Some ovens are found *in situ* and just exposed while others have been affected by erosion and are either on pedestals or are left "floating" on the eroded surface. Charcoal and charcoal staining can be seen in some ovens. Ovens are commonly recorded along valley floors (Holdaway *et al*. 2002) and in upper valley/basin contexts.

There is high potential for this site type to be recorded in proposal area.

Rock Art

Rock art is found across the continent as paintings, drawings, and pecked or abraded imagery and mechanically produced motifs such as stencils. In the Australian semi-arid zone art is found both within rock shelters on walls, ceilings and other stone features and also in open contexts as pecked or abraded art. In Australia rock art has been produced since the Pleistocene through to the present.

Much of the rock art in the semi-arid zone belongs to the so called Panaramitee style or track and circle style. This imagery typically includes animal track motifs. Classic Panaramitee rock art sites are present at Sturts Meadow and Mt Poole both of which are located north of the Barrier Ranges. In the region this site type is often found on large expanses of rock close to water holes and springs.

Providing suitable rock surfaces are present in the proposal area there is potential for this site type to be present.

6. ARCHAEOLOGICAL AND HERITAGE CONTEXT – NON-INDIGENOUS

6.1 Regional Overview

Exploration, pastoralism and the development of agriculture

The first phase of European history in this region relates to the early exploration expeditions of the nineteenth century. In 1817 John Oxley discovered two rivers flowing westward across the country that he believed flowed into an inland sea (Christopher 2000: 8). In an attempt to discover the alleged sea expeditions were led by Captain Charles Sturt along the Darling, Murrumbidgee and eventually the Murray in the years 1829 and 1830 (Sturt 1989, 1999). Sturt named the Murray on the 23rd January 1830 in honour of Sir George Murray, who was the Secretary of State of the Colonies at that time (Sinclair 2001: 17).

The northern section of the Darling was discovered by Europeans in 1829 during exploration undertaken by Sturt, who named the river after the Governor of New South Wales, Sir Ralph Darling. Following this Major Thomas Livingston Mitchell explored further to the south in 1835 and discovered a series of lakes he named *Laidley's Ponds*, which are now known as Menindee Lakes. During that expedition Mitchell noted a range of mountains to the west of the river; this same range was also later noted from the western side by Captain Frome, Surveyor General of South Australia, who described them as 'a succession of apparently barren ranges running north and south' (Kearns 1973: 7). The first Europeans to explore these mountains were the members of Captain Charles Sturt's 1844 Central Australian Expedition. Sturt undertook the expedition in an attempt to settle the debate as to whether there was an inland sea in central Australia. In August 1844 he and a party of 15 men, 200 sheep, six drays and a boat set out to explore north-western New South Wales and then to advance into central Australia. They traveled along the Murray and Darling Rivers before then heading to the Great Dividing Range (AUCTA 2007).

In their travels from the Darling to the north-west they moved through the site of present day Broken Hill, with Sturt making mention of this "broken hill" in his diary (DECC 2007). At the time Sturt collected mineral specimens, which later, upon his return, were not properly examined or assayed (AUCTA 2007). Sturt and his party then made several scouting expeditions into and beyond the Barrier Range. Sturt named this feature Stanley's Barrier Range due to the difficulties it presented to his progress. He described the land in this area as some of the most barren and desolate he had seen.

To negotiate the range "the party found a route by following Stephen Creek to the junction of Nine-Mile Creek, then along its northward course into the hills, passing Parnell Creek, the seven-mile well, past Lewis Hill (which they climbed) on to the watershed between Stephen, Yancowinna and Purnamoota Creeks. Crossing this watershed they reached the headwaters of Purnamoota Creek and followed this down till they found a pool. Below this pool the bed of the Purnamoota Creek became impassable owing to large boulders, so they turned up a spur which led them westerly on to the plains of Mundi Mundi close to the present Soapstone Creek. From here they travelled northwards along the base of the scarp till they found good water at the "Gorge of the Glen," where Campbell Creek issues from the ranges on the plains" (Cumpston 1951).

Thereafter, as the party progressed further into the arid regions they became stranded for months by the extreme summer conditions near the present site of Milparinka. The men and their equipment suffered terribly from the heat and Sturt's second-in-command, James Poole, died of scurvy. When rains eventually came Sturt pressed on into central Australia until they discovered the Simpson Desert, at which point they were unable to go further and turned back to Adelaide (Cumpston 1951).

Another important phase in European settlement of western New South Wales begun when Joseph Hawdon and Charles Bonney drove cattle across to Adelaide in 1838. This journey was the beginning of the establishment of an overland stock route and a new class of settlers, known as overlanders, who continued to use the route for many years. On their initial journey in 1838 Hawdon and Bonney set up a camp at the Murray/Darling junction; this became a regular camp spot for overlanders and was initially known as Hawdon's Ford (Hassell 1989). During these early years of European settlement of Australia occupation of land beyond Yass was illegal; however the establishment of the overland stock route was encouraging a certain degree of stock grazing as well as the growth of intermittent service points. The area was otherwise largely untouched by Europeans, but clashes with the Aboriginal population were already beginning.

One of the most famous clashes in the region was that at Rufus River, which began with an initial confrontation between overlanders and Aborigines in 1839, and was followed by a more serious incident in 1841 when Henry Inman and Henry Field were ambushed by Aborigines and forced to abandon all of their stock, drays and provisions. The brother of Henry Field, Lieutenant Field RN, who was also a part owner of the sheep, organised a private group to try to rectify matters. However the group was outnumbered and defeated by the Aborigines. The government then prepared an official group that arrived at Rufus River only to find the sheep from Inman and Field's group dead, and that the Aborigines had overrun another group of overlanders, who had abandoned their bullocks. As a result of this sequence of events a group of overlanders and police headed out either side of the river, and when they arrived at Rufus River they massacred an unknown number of Aborigines (Sinclair 2001: 49-50).

When squatting began in the 1840s there was yet to be an official survey of much of the lands and so there were no administrative controls over squatting. Then in 1851 a grazing license could be obtained that entitled the squatter to however many runs were necessary to run 4,000 sheep. Just a few years later in 1854 the southern surveys were completed, thus enabling squatters to tender for their runs and attain a degree of security in their tenure (Hassell 1989). Around this time pastoralists began to move west in order to take up land along the Darling River. Between 1847 and 1857 sheep runs such as Tapio, Para, Cawndilla, Weinteriga, Netallie, Moorabin, Culpaulin, Toorale, Pamamaroo, Tintinallogy, Cuthero, Willotia, Annalara, Nelia Gaari, Netley and Mount Murchison were taken up along the river frontage (Kearns 1973). However, when the lands along the river were fully occupied pastoralists were then forced to look further to the west. This situation was exacerbated in 1864 following a severe drought in the district (Fairfax 2007).

While the first phase of mainly pastoral settlement was relatively slow, it was aided greatly by the beginning of river transport in the 1850s (Sinclair 2001: 18-19). The precursor to river trade on the Murray came in 1840 when Captain W. J. Pullen successfully sailed a sloop from the sea into the Murray and up to the township of Blanchetown, some 160 miles upstream. Then in 1850 the South Australian Government offered £2,000 to each of the first two iron vessels to make it to the Murray Darling junction. This challenge was taken up by William Randell in the Mary Ann and Francis Cadell in the Lady Augusta who raced their way to the junction (Colwell 1972: 65-69). The Lady Augusta and the Mary Ann arrived within hours of one another at Swan Hill, with the Lady Augusta taking line honours (Christopher 2000: 22).

In 1859 the Darling River was navigated from Wentworth to Brewarrina, Captain Cadell, who had made the journey up to Mount Murchison sheep station in the paddle steamer *Albury*, established a stores depot on the west bank of the river at the site of what is now Menindee. As riverboats became more common along the Darling, thus providing new transport routes for supplies, pastoralism also grew. During the 1860s a series of properties further to the west in the Barrier Ranges were taken up, including Corona, Alberta, Poolamacca, Mundi Mundi, Mount Arrowsmith, Tarella and Torowoto (Kearns 1973).

The development of river trade resulted in a growth in settlement with an ensuing increase in land degradation. By 1861 there were 200 European settlers recorded at Wentworth alone (Hassell 1989); the western lands were officially opened for settlement from 1881 onwards, and as a result the squatters lands were reduced. This, together with the problems of drought, rabbits and overstocking increased land degradation, lead to a decline in pastoralism that was replaced by interest in irrigation and cultivation of various fruits (Bonhomme, Craib & Associates 1999: 13).

Running alongside the evolution of squatting was the establishment, growth, and eventual recognition of non-government settlements, an excellent example being the one at the junction of the Murray and the Darling, which by the late 1840s was known as McLeods Crossing. The settlement was named after Bates and McLeod who were the first European residents, McLeod being the owner of the Junction Inn that was opened in 1847. At this stage the government administration centre was located west of the junction at Moorna, where there was a Commissioner of Lands, police station and post office. However, in 1857 it was decided that a proper township should be established at the Murray Darling junction, and in 1859 the site was approved and the first allotments sold with the town officially proclaimed the following year as Wentworth. In addition to such formal settlements the surrounding stations continued to act more or less as small towns with a degree of self sufficiency. Early pastoral stations in the region included Lake Victoria, Polia, Para, Tarcoola, Mallara, Moorara, Tapio, Moorna and Mallee Cliffs (Hassell 1989).

There was pressure on the governments in the 1880s to provide the necessary infrastructure for irrigation. The governments of South Australia and Victoria thus entered into agreement with Messer's Chaffey Brothers, who had already worked on irrigation schemes in Southern California, to develop 500,000 acres of land on the banks of the Murray for settlement based on irrigation. The scheme was to be aimed at small through to large

scale investors and settlers (Vincent 1888: 3), with land around Mildura and Renmark at £15 per acre for agriculture and £20 per acre for fruit (ibid: 5, 21). Mildura irrigation settlement consisted of 250,000 acres, of which 50,000 acres, including the town itself, were developed and irrigated in the first phase (ibid: 7), olives, oranges, pears and gapes were all pushed as potential crops at this stage. The Wentworth Irrigation Trust was established in 1890, and from 1896 to 1900 the first channel of the Wentworth Irrigation Area was built on the west bank of the Horseshoe Billabong, thus the first parts of irrigated lands were opened in NSW (Bonhomme Craib & Associates 1999: 16).

By 1915, due to the fluctuating flow of the Murray, there were so many disputes over water between NSW, SA and Victoria that it was decided to lock and dam the river. A series of locks, weirs and dams were thus completed by 1939 (Sinclair 2001: 19). While river regulation assisted in navigation of the river, the development of road and rail links and the introduction of automobiles meant there was a downturn in riverboats. It is also during the twentieth century that Mildura's continued growth has resulted in centres such as Wentworth not developing as they could have (Bonhomme, Craib & Associates 1999: 13).

Mining and other developments

The search for minerals in Australia began soon after the arrival of the First Fleet. Initial reports of gold were however suppressed due to fears of effects the news might have on the convicts (Kearns 1980). The first official report of gold in New South Wales was at Fish River between Rydal and Bathurst in 1823 by James McBrien, a Land Department Surveyor. At that time mining was still not a priority for the colony, however following the emigration of settlers to the gold rush in California in 1849 the government realised the need to identify substantial gold deposits at home to reverse the migration. A reward was offered for the discovery of payable gold and in April 1851, John Lister and William Tom made the first report of payable gold at the junction of Lewis Ponds and Summer Hill Creeks, Ophir near Bathurst. Thus began the Australian gold rush which provided the first impetus for substantial growth in the country. Within the next ten years population grew in New South Wales from 197,265 to 350,860. The gold rush also affected demography with a substantial increase in non-Anglo immigrants such as those from Germany, France, America, and China. Initial finds were alluvial deposits, although with time reef gold was also identified and mined. From 1851 to 1948 New South Wales contributed 8.5% of Australia's gold production (Department of Mineral Resources 1994: 3-4).

Although Sturt had collected mineral samples from the Barrier Ranges during his Central Australian Expedition the specimens had not been adequately examined. It was not until December 1858 that a serious prospecting party set out from Adelaide to search for gold in the Barrier Ranges; nonetheless, even this exploration did not result in gold or other mineral finds. Soon after pastoralists settled in the Barrier Ranges reports went back to South Australia of quartz outcrops similar to those in the Bendigo goldfields. In 1867 there was a so-called gold rush at Poolamacca Station that turned out to be a hoax. A station employee had borrowed a horse to allegedly ride to Wilcannia to register a claim, however he was never seen again. While some reports suggest that gold was discovered in the Barrier Ranges in the 1860s, it was not until after 1875 that major exploration for gold, silver and tin took place. (HO & DUAP 1996). The impetus for this renewed exploration was the news of silver-lead ore discovered at Thackaringa.

Thackaringa (20 km southwest of Silverton) was originally a stop over point for those travelling through the region; it was located at the junction of tracks that linked South Australia with Menindee, Milparinka and Wilcannia (Kearns 1980). In 1875 silver-lead ore was discovered by Julius Charles Nickel and his companion McLean while sinking a well on Thackaringa Station. The ore was then identified by local hotel keeper John Stockie, who showed the ore to Patrick Green, a storekeeper from Menindee, Green in turn pegged out a claim in 1876 known as the Pioneer Mine, which was the first in the Barrier Ranges (Kearns 1973, 1980). The Pioneer Mine was worked on and off by Patrick and his brother Richard. Following Patrick's death in 1877 his brother Richard continued work at the mine with partner A. L. Garot. It was not until 1878 (1880?) however that a shipment of ore successfully reached England and was assayed to contain 65% lead and an assayed 35 ounces of silver per ton. Previous shipments had been lost *en-route*, thought to have most likely been dumped overboard into the Darling when a paddle steamer ran aground (Kearns 1973).

The discovery of a rich silver-lead ore started a flurry of prospecting in the district with miners arriving in numbers, especially from the declining copper fields of South Australia and the early 1880s saw many encouraging finds of silver in the district. In 1881 John Stokie founded the Umberumberka Mine to the west of the modern settlement of Silverton (DLWC 1995). The following years saw numerous other mines established, including the Day Dream and Apollyon mines 15 km to the northeast of Silverton. A settlement of 400 to 500 people soon grew around that location and the first smelters in the district were established there in 1885. At the same time the mine at Purnamoota was flourishing, to the extent that in 1884 the township there was

considered to have such prospects as to warrant the installation of an electric power station and tram services (AUCTA 2007).

As mining increased in the region so did the population. In 1879 a hotel and store were established adjacent the workings of Stockie's Umberumberka Mine (DLWC 1995), about two kilometres south-west of the present township of Silverton. In addition to the hotel and store there were two boarding houses that helped cater for a population of 150. However, many settlers preferred to establish themselves closer to the water supply and so set up camp by Umberumberka Creek. This offshoot of Umberumberka gradually became the centre of settlement and following a meeting at John Stokie's hotel in 1883 a request was made to the Postmaster General for a post office at this settlement, which was to be known as Silverton (Kearns 1980). Rough huts of iron and canvas began to proliferate.

> On foot or in the saddle, by coach or by team, the diggers reached Silverton at last… Silverton lay before us as a mass of canvas stretching in all directions. Iron shanties, looking like big sardine tins, dotted the whole valley. (*Barrier Silver and Tin Fields in 1888* 1970: 23).

The town itself was essentially ill equipped for the ensuing population increase, prices were inflated and housing was at a premium. Most lived in tents, with some unable to even secure this level of comfort. Shops were largely built of weatherboard with stone chimneys, while a few of the public buildings such as the Bank of Australasia were constructed of bluestone (Cox & Stacey 1973).

> This was Silverton, the capital of the Barrier in those days. Afterwards men settled down a little. The prospectors spread out over the country, and the business people built themselves habitations, and hotels sprang up like magic, Chapels followed. (*Barrier Silver and Tin Fields in 1888* 1970: 23)

The population increased from 250 in September 1883 to 500 by December and peaked at 2,000-3,000 in 1885-86. In 1884 alone 1222 mineral leases, 937 business permits and 114 miners' rights were issued. That same year 6000 tonnes of ore were extracted, three-quarters of which was sent to South Australia for processing (Fairfax 2007). 1884 saw the formation of the Barrier Ranges Miners' Association in Silverton, which was a forerunner to the trade union movement in Broken Hill (Kearns 1973). In the same year the first hospital and school opened, while 1885 saw the opening of a customs house, Bank of Australasia, "Lion" brewery (Emil Resch) and commencement of the Silverton Tramway that linked the district with Cockburn in South Australia (Camilleri 1997; DLWC 1995) Further developments included establishment of telegraph communications with Adelaide in 1885, proclamation as a municipality in 1886, construction of a Masonic temple in the same year followed by a police station and gaol in 1888 and 1889 respectively; 1888 also saw the opening of the Silverton Tramway (Alpin et al 1987; Camilleri 1997; DLWC 1995). The end result of this tramway was that the region was linked with Adelaide as opposed to Sydney and Melbourne, and a bulk transport system was already in place when Broken Hill developed (HO & DUAP 1996).

The early to mid 1880s were the heyday of Silverton, located as it was central to the surrounding mines and on reasonably flat ground with a form of water supply nearby, Silverton naturally became a district centre that served mines such as The Day Dream, Umberumberka, Purnamoota, Pinnacles and Pilgrim Mine (Cox & Stacey 1973). Prior to 1880 all mining in the Barrier Ranges was under the jurisdiction of the Albert District. This meant that all mining applications had to be made through Milparinka or Wilcannia. This was then locally centralised through the appointment of Richard O'Conell as Police Officer, Acting Clerk of Petty Sessions, Mining Registrar, and Wardens Clerk. O'Connell was initially based just north of Mount Gipps Station homestead and then later based himself at Silverton in 1883 (Kearns 1980). Other significant changes during the 1880s included the diversification of the transport network with goods now carried by tram, steamboat, bullock wagon and camel train; coaching services were established and Afghan and Indian hawkers began trading throughout the region (Kearns 1973).

However by the late 1880s Silverton's better ore had been exhausted and with the opening up of the far richer lodes at Broken Hill, Silverton started to decline. The Day Dream Mine smelter had already closed down in 1886, one year after it commenced operation, and the mine was abandoned in the 1890s. The Umberumberka mine closed in 1892, the Thackaringa mine closed in 1897 and by 1890 Purnamoota had ceased to exist as a township. In 1888 Broken Hill boasted a population of some 11,000 (Drew 1991) while the population of Silverton was 1,700 and by 1901 it had dropped to 286. By this time many of Silverton's houses had been carted off to Broken Hill by their owners and the area was becoming a recreation centre for Broken Hill residents. Silverton ceased to be a municipality on 25 September 1907. Today about 50 people remain in Silverton and most of those cater to tourism (Australian Heritage Database 2007).

Mt Gipps Station was taken up in 1863 by the Barrier Range Co. The richest silver, lead and zinc deposit yet discovered in the world was found on the station by a German born boundary rider, Charles Rasp, in 1883.

Rasp pegged out 40 acres on Mt Gipps Station that he thought to be rich in tin (Block 10). Together with the Station Manager, George McCulloch, and five other workers they pegged out another 6 blocks (Blocks 11-16). In January 1885 a young jackaroo by the name of Philip Charley discovered silver chlorides in the ore from Rasp's shaft; it was assayed to contain thousands of ounces per ton (Kearns 1973). Broken Hill Proprietary Company Ltd (BHP) was formed in August 1885 comprising Blocks 10-16. The first dividend was returned in 1886; it was also in this year that Broken Hill took off as a settlement. Rasp and company initially smelted their ore at Day Dream, they then built their own Nevada furnaces in 1886, which continued in operation until 1898 when smelting operations were moved to Port Pirie. Local vegetation was harvested across the region to fuel the furnaces; this resulted in a denuding of the landscape that led to enormous dust storms as a common occurrence (Drew 1991). 1886 also saw the Barrier Ranges Miners' Association move from Silverton to Broken Hill (Alpin et al 1987). Over the years zinc residues from the Broken Hill mines were stockpiled awaiting suitable extraction methods. Herbert Hoover (later to become the US President) bought the tailings and formed Zinc Corporation in 1905 and started his own mine (Alpin et al 1987).

Broken Hill township reserve was proclaimed in 1885 and the town of "Willyama" was laid out in 1886 on the saltbush plain to the northwest of the ore body with the streets aligned parallel to the mining leases. The name Willyama however proved unpopular and so the settlement continued to be known as Broken Hill. Its population was in the hundreds in 1885, and by 1886 there were some 3000 people living largely in tents in a shantytown. By 1891 there were over 21,000 and by 1901, 31,000. Population then fluctuated during the two World Wars and peaked again in the 1950s/60s before declining to around 20,000-24,000 (Drew 1991).

Broken Hill South opened in 1885. The Silverton Tramway was then extended to Broken Hill in 1888 (HO & DUAP 1996), securing an ongoing connection between the old and new centres of the Barrier Ranges. Another rail link was established a few years later with the opening of the Broken Hill railway to Tarrawingee, this line operated from 1891 to 1932 and was initially established to transport limestone flux to the smelters in Broken Hill. The Broken Hill railway station was built in 1895, the courthouse in 1889, post office and mosque in 1889 and the town hall in 1890 (Alpin et al 1987). The first miners' strikes were in 1889, 1890 and 1892 (Alpin et al 1987); these events helped shape the union movement in Australia. Furthermore, the *Barrier Truth* newspaper that was founded in 1898 became the first union owned paper in Australia in 1908 (Alpin et al 1987). Essentially, Broken Hill has played an important role in Australian history both in terms of mining and industrial relations.

Broken Hill also has an important place in the history of Australia's cameleers. As a railhead and major mining centre there were numerous camel trains and hawkers that used the town as a base. There were two "Ghantown" camps at Broken Hill and while the modern settlement has engulfed these sites the Muslim section of the cemetery and the Mosques on William Street provide a tangible physical link with this often overlooked aspect of the region's past; the mosques themselves being among the oldest examples still standing in the country (Cigler 1986; Hardy 1969; Parkes 1997). Another facet of the relationship between Broken Hill and Australia's Muslim community was displayed in the infamous Turkish attack on the railway during World War I. This incident, which has been depicted in varying ways over the years, led to the Attorney General's decision to inter all enemy nationals in Australia (Alpin et al 1987).

Over the years Broken Hill has seen numerous changes, although many of the early buildings are still standing. There is an echo of the 1880s town that mainly comprised timber and corrugated iron structures and included 35 hotels and numerous churches. Although, it is more than the architecture that has lived on, anyone who has spent much time in Broken Hill would see the similarities between the modern settlement and the early descriptions of life and atmosphere.

> The visitor to Broken Hill should not, if he can help it, miss Saturday night in the streets… The principal street of the town, Argent-street, is the centre of traffic, and it is crowded with energetic good-humoured people, mostly men and boys, moving up and down where the numerous tradesmen display their wares in shops large and small…
>
> (*Barrier Silver and Tin Fields in 1888* 1970: 7)

Broken Hill is Australia's longest living mining city and the world's largest silver-lead-zinc mineral deposit (Drew 1991). BHP's expansion and success has meant that Broken Hill and the mines there have a special place in Australian history (HO & DUAP 1996), which in turn has resulted in the history of mining and the union movement having a continued importance within the local community today.

6.2 Historical Register searches

Searches have been conducted for previous heritage listings in and around the Stage 2 and 3 wind farm and overhead transmission line proposal areas; these searches have included all of the relevant heritage registers for items of local through to world significance. Details of these searches are provided below.

Australian Heritage Database

This database contains information about more than 20 000 natural, historic and Indigenous places.
The database includes places in:

- the World Heritage List
- the National Heritage List
- the Commonwealth Heritage list
- the Register of the National Estate

and places under consideration for any one of these lists. A search of this database revealed that there are no items on any of these lists that are within the proposal areas for Stages 2 and 3 and the overhead transmission line.

State Heritage Inventory

The *NSW heritage databases* contain over 20,000 statutorily-listed heritage items in New South Wales. This includes items protected by heritage schedules to local environmental plans (LEPs), regional environmental plans (REPs) or by the State Heritage Register.

The information is supplied by local councils and State agencies and includes basic identification details and listing information. Consequently listings should be confirmed with the responsible agency.

A search of this database revealed that there is one item located immediately adjacent the proposal area (Table 6); there are no items listed within areas of direct impacts. The abovementioned item is the Day Dream Smelter, which is listed under the Heritage Act as an item of state significance.

Item Name	**Address**	**Suburb**	**LGA**	**Significance**
Day Dream Smelter	Por. PML 2	Broken Hill	Unincorporated	State

Table 6. State Heritage Inventory search results.

Broken Hill Local Environment Plan

There are no heritage items in the proposal area listed on the Broken Hill heritage schedule.

Wentworth Local Environment Plan

There are no heritage items in the proposal area listed on the Wentworth heritage schedule.

National Trust of Australia (NSW) Register

The National Trust of Australia (NSW) is a non-government Community Organisation which promotes the conservation of both the built and natural heritage (for example, buildings, bushland, cemeteries, scenic landscapes, rare and endangered flora and fauna, and steam engines may all have heritage value). The Trust has approximately 30,000 members in New South Wales.

Following its survey and assessment of the natural and cultural environment, the Trust maintains a Register of landscapes, townscapes, buildings, industrial sites, cemeteries and other items or places which the Trust determines to have heritage significance and are worthy of conservation. Currently there are some 11,000 items listed on the Trust's Register. They are said to be 'Classified'.

The Trust's Register is intended to perform an advisory and educational role. The listing in the Register has no legal force. However, it is widely recognised as an authoritative statement of the heritage significance of a place. The Trust does not have any control over the development or demolition of the Classified Places or Items in its Register.

While the National Trust Register does not provide any statutory obligations for protection of a site as such, the acknowledgment of a place being listed on the Register as a significant site lends weight to its heritage value. Also, the fact that the actual data for sites may be minimal does not diminish the significance of a place. In fact, many sites were listed with only basic data added, especially in the early developmental stages of the Register.

The Trust, over the last few years has been upgrading the information for places listed, with criteria for assessment for listing based on the Australian Heritage Commission Criteria of assessment for entry to the Register of the National Estate.

A search of the National Trust of Australia (NSW) Register revealed that there is one item adjacent the current proposal area (Table 7). The item in question is the DayDream Smelter, which is also listed on the State Heritage Inventory.

Item name	**Address**
DayDream Smelter Ruins	DayDream Road, 15km north-west (sic) of Silverton, 13km due east of the Umberumberka Reservoir, 19km north-west of Broken Hill

Table 7. National Trust of Australia (NSW) Register search results.

Other Identified Heritage Items

While there are no items currently listed within areas of direct impacts associated with Stages 2 and 3 and the overhead transmission line, this should not be treated as an accurate reflection of the presence of absence of heritage items. As Hope (2006) pointed out in her recent heritage study for the Unincorporated Area, the history and heritage of the region is deserving of more comprehensive analysis and many of the heritage items known to occur are not as yet listed on the abovementioned heritage databases. Below are details of heritage items discussed in that report that are located in areas of direct impacts associated with Stages 2 and 3 and the overhead transmission line.

Day Dream Mine and Settlement
Located at the Day Dream Mine tourist site and in association with the State Heritage listed Day Dream Smelter are the remains of the underlay mine and the settlement that developed alongside the mine. There are many mining feature visible at this site including openings to underlay declines, vertical shafts, building ruins, mining equipment and mullock heaps. This site is unusual in that it is accessible to tourists and has a considerable amount of original fabric. In addition to this there are remains of the substantial settlement that developed at this site, which extends across the plain from the Day Dream Road. Features present include chimney mounds, building footings, earth works and artefact scatters. As a site complex including the smelter and mine this has been identified as one of the most complete and accessible early mining landscapes in the Barrier Ranges (Hope 2006). While much of this complex, inclusive of the state listed Day Dream Smelter, is outside the proposal area it is likely that elements to the west of the Day Dream Mine Road, such as the settlement ruins, might coincide with the broader envelope for turbines and associated infrastructure.

Umberumberka Reservoir and Infrastructure

> The dam at Umberumberka is of concrete with a crest of 680 feet long, 85 feet above the creek bed and 135 feet above the rock foundation, with a spillway 263 feet wide. There is a rising main (1.9miles) to a service reservoir on top of Blue Anchor Hill, then 16.8 miles of gravitation mine to Broken Hill. Originally 18 inch woodstave piping was used on the sections of the gravitation main where the pressure was lower, with steel pipes for the lower part of the gravitation main and the rising main (Hope 2006: 324).

There are a wide variety of extant heritage items associated with the Umberumberka Reservoir. These include the dam itself, pumphouses and engines, steam boilers and bins, concrete mixers, barrel hoops, wooden pipes, Blue Anchor Tank, and remains of the settlement that developed as a result of the reservoir construction. The complex as a whole has been assessed by Hope (2006) to be of state significance.

While the reservoir itself is outside areas of direct impact associated with Stages 2 and 3, part of the pipeline to Broken Hill is within the proposal area and there is the potential for other features associated with the dam.

Lakes Grave

The grave of William Henry Lake is a local landmark that was recorded as part of Stage 1 fieldwork; it is located within the broader turbine envelope for Stage 2. A late 19th century description of this site and its history is provided below.

> The road from Silverton to Tower Hill has several interesting features. It passes through picturesque and undulating country in sight of rugged ranges. Its name has a tragic association – Lake's Grave-road, and about 5 miles out, the grave is found on the road enclosed by a picket fence, while close by, at the turn of a deep gorge to the right, is the unfinished stone house of the deceased, fast falling to ruins. Mr. Lake, a station owner, some years ago was returning from Umberumberka, and fell off his horse. Twice he was assisted into the saddle again, but his third fall found him dead on the ground, and there he was buried. A little further on to the left is a conical shaped peak, slightly bent at the summit, standing severely isolated in the cloudless sky as if it were some Titanic fortress. It was called Lake's Knob, but now more appropriately Tower Hill. (*Barrier Silver and Tin Fields in 1888* 1970: 54).

Lakes Camp - Nevada

Lakes Camp, also known as Apollyon, was a mining settlement on Lakes Creek northeast of Silverton. The location of this settlement is also marked on the Yancowinna County Map as the village of Nevada. The history of this item is briefly covered by Hope (2006), although no description of the site is provided.

Mundi Mundi Ruins

The ruins of the Mundi Mundi homestead are located approximately one and a half kilometres north of the Stage 1 study area. These ruins are a site complex that date to the nineteenth century and include homestead remains, a water tank and well and a series of burials; they are located on Eldee Station and correspond to proposed Stages 2 and 3 impact areas. Research indicates that the Mundi Mundi Ruins are almost definitely of local significance and have the potential to be of state significance (Dibden 2008).

6.3 Historical Themes

An historical theme is a way of describing a major historical event or process that has contributed to the history of NSW. Historical themes provide the background context within which the heritage significance of an item can be understood. Themes have been developed at National and State levels, but corresponding regional and local themes can also be developed to reflect a more relevant historical context for particular areas or items.

Below is a summary of themes (Table 8) that are applicable to the areas in and around Stages 2 and 3 and the overhead transmission line for Silverton Wind Farm.

Australian Theme	**NSW Theme**	**Local Theme**
Tracing the natural evolution of Australia	Environment – naturally evolved	Barrier Ranges
		Mundi Mundi Plain
		Stone and mineral resources
		Wind resources
Peopling Australia	Aboriginal cultures and interactions with other cultures	Day-to-day life
		Mythological and ceremonial
		Natural resources
		Contact period
	Ethnic influences	'Afghans'/cameleers
		Chinese
Developing local, regional and national economies	Agriculture	Fencing
		Sheds
		Pasture
		Water provision

Australian Theme	**NSW Theme**	**Local Theme**
		Farmsteads
		Machinery
		Mulga cutting
	Commerce	Banking
		Trade routes
		Shops
		Inns
	Communication	Postal services
		Telephone and telegraph services
		Newspapers
		Transport networks
	Events	Picnic Train Attack
		Lake's Grave
		Miners' strikes
	Exploration	Camp sites
		Exploration routes
		Water sources
	Health	Hospitals
		Pharmacies
	Industry	Blacksmithing
		Kilns
		Smelters
		Workshops
		Breweries
		Private rail lines
	Mining	Prospecting
		Mine claims
		Extraction of ores
		Processing plants
		Transport of supplies and ore
		Mining settlements
		Mining equipment/machinery
		Mining landscapes
		Aboriginal stone procurement
	Pastoralism	Pastoral stations
		Sheds and yards
		Travelling stock reserves
		Fencing

Australian Theme	**NSW Theme**	**Local Theme**
		Pastoral workers' camps
		Water sources
	Technology	Communication networks
		Processing of ores
		Aboriginal technologies
	Transport	Stock routes
		Highways
		Railways
		Coaches
		River transport
		Camel trains
Building settlements, towns and cities	Towns, suburbs and villages	Existing towns
		Abandoned settlements
		Relocated centres
		Streetscapes
		Neighbourhoods
		Ethnic quarters
	Land tenure	Fencing and other boundary markers
		Mining lease markers
		Trig stations
	Utilities	Water distribution
		Garbage disposal
		Sewage/septic systems
		Provision of electricity
		Bridges
		Culverts
	Accommodation	Inns and hostels
		Domestic residences
		Temporary encampments
		Homesteads
		Humpies
Working	Labour	Trade unions
		Miners' strikes
		Workers' quarters
		Work kitchens
		Brothels
Education	Education	Technical institutes
		Schools

Australian Theme	**NSW Theme**	**Local Theme**
		Playgrounds
Governing	Defence	Training grounds
		National security – Picnic Train Attack
	Government and administration	Municipal chambers
		Mining registrar
	Law and order	Judicial system
		Policing
		Detainment of suspects and criminals
	Welfare	Trade training institutions
Developing Australia's cultural life	Domestic life	Domestic artefact scatters
		Residences
		Food preparation
		Gardens
		Domesticated animals
	Creative endeavour	Sculptures
		Rock art
		Film industry
	Leisure	Picnic/camping areas
		Showgrounds
		Scenic lookouts
		Dance halls
		Tourism
	Religion	Churches
		Mosques
		Graveyards
		Religious schools
		Religious residences
	Social institutions	Masonic hall
		Public hall
		Public library
		Social groups/associations
		Museums
	Sport	Sports grounds
		Sports teams
Marking the phases of life	Birth and death	Hospitals and other places of birth
		Mortuary practices

Australian Theme	NSW Theme	Local Theme
		Cemeteries
	Persons	Individual monuments
		Significant individuals/families
		Place names

Table 8. National, state and local historical themes that are applicable to the study area and surrounds.

As the above table indicates there is an enormous array of themes and hence potential site types that might occur in and around the study area. It is however likely that the majority of potential heritage items will be associated with mining and pastoral activities and potentially exploration, transport and communication. Similarly, there is the potential for features associated with particular individuals; examples might include place names and burials.

With regard to potential heritage items that might occur in areas adjacent the proposal area, that is, within view of the wind farm, there is a potential for a much wider array of themes to be evidenced. This is particularly true at areas in and around Silverton, and Broken Hill.

6.4 Predictive Model

For the purposes of providing predictive statements regarding the potential existence of additional items of Non Indigenous heritage a series of broad themes have been developed from Table 8. These themes aim to provide a convenient classificatory system for sites in term of which phase of occupation they relate to. It should be noted that there will be a degree of chronological overlap in these themes, and that any given site may relate to more than one theme.

Historical themes for the Stages 2 and 3 area include:

- Exploration
- Squatters and pastoral stations
- Townships
- Mining
- Road transport and trade

Historical themes for the area encompassed for the overhead transmission line area include:

- Exploration
- Overland route
- Squatters and pastoral stations
- Townships
- River transport and trade
- Road transport and trade
- Irrigation and horticulture
- Locking of the river

The following section provides predictive statements for each of these historical themes. The predictive statements are based on the preceding reviews of primary and secondary documentary sources and the regional databases of known historical sites. It should be noted that the potential for sites to exist is not a reflection of their potential significance. That is, a high potential does not necessarily imply high significance.

Exploration
Exploration of the area began in 1829 with the expedition of Captain Charles Sturt. Between then and 1838 when the overland route began to be established European activity in the area would have been negligible. Furthermore, archaeological evidence of such exploration activities would in most cases be very ephemeral. As such the potential in the study area for sites related to this theme is predicted to be low to moderate. Areas of greatest potential would be where the proposed transmission line intersects with rivers and other major water sources where camps might have been made.

Overland route
The overland route was established from the late 1830s onwards. European activity would initially have been quite minimal, consisting of a series of regular or semi-regular camp spots such as the one that developed at the Murray Darling junction. Other activities and events associated with this theme are the grazing of cattle and violent confrontations with Aborigines. Due to the nature of sites associated with such events and activities and the extent of subsequent development in the area, evidence relating to this theme is unlikely to survive. The potential for such sites is thus predicted to be low, although there is a limited potential for locations associated with this theme to still be remembered via oral history.

Squatters and pastoral stations
From the 1840s onwards squatters established homesteads with associated workers residences, stockyards, woolsheds and the like. As the earlier stations were subdivided the number of homesteads and associated infrastructure multiplied. In some cases the original homesteads continued in use, and in others they were abandoned in favour of new locations, as was the case for Mundi Mundi Station where substantial ruins of the original settlement can still be found. The potential for sites associated with the various phases of pastoral settlement is high and potential heritage items that might be present include tree stumps from clearing, remains of fencing, relict field systems, plantings of introduced tree species, roads, buildings, graves, and building platforms or footings.

Townships
Unofficial and government settlements began to appear in the wider region from the mid 1840s onwards. The establishment of urban settlement usually results in some of the most enduring forms of archaeological evidence. This evidence can include original buildings; structures that have been heavily modified, perhaps masking the existence of original elements; locations that have maintained the same function over time despite any changes to the fabric of buildings; street layouts; cemeteries; elements of services such as water and electricity; parks or commons, including any associated fencing or tree plantings; tree stumps from clearing; middens of glass and other refuse; discarded machinery; and quarries where stone, clay or sand have been exploited. While this list is not exhaustive, it does demonstrate the wide range of forms of archaeological evidence relating to towns and villages. The potential for archaeological evidence such as those listed above is predicted to be high to very high, particularly around current urban centres and in areas adjacent the larger mines such as Day Dream and Apollyon.

Mining

The Barrier Ranges have witnessed both past and current intensive mining activity and traces of these mines are likely to be still evidenced in the form of costeans, prospecting pits, mine shafts, adits, drives, quarries, mullock and tailing mounds, and pieces of machinery. There is also the potential for a range of other historical features to exist that are associated with mining. Examples include old roadways, miners' camps, and graves. During the survey of impact areas associated with the Silverton Wind Farm Stage 1 a total of 24 historical features were recorded. These recordings largely include sites that relate to mining activities. Based on information contained on the various geological maps available for the region there are hundreds of former mine leases within the proposal area varying in scale from prospecting pits where no mineralisation was recorded through to larger mines such as Terrible Dick and Apollyon where more substantial remains are likely to exist. The potential for archaeological evidence of mining is very high, particularly in the proposed turbine envelopes.

River transport and trade
From the 1850s to the 1920s trade was largely reliant on the Murray and Darling Rivers. Vessels used on the river ranged from punts and barges through to paddle steamers. Buildings and activities associated with this theme include stores, warehouses, wharfs, timber felling and woodcutter camps. Archaeological evidence for this theme could range from tree stumps through to building footings, partial or complete structures, and partial or complete remains of the river vessels themselves. The existence of sites relating to this theme to be present in the proposed transmission route is moderate. While standing structures associated with river transport and trade have not previously been identified, the potential for the remains of such buildings, either on the surface or at a subsurface level is predicted to be moderate, particularly in areas immediately adjacent the river banks. Furthermore, the potential for more indirect evidence such as tree stumps or discarded tools or machinery is predicted to be low to moderate along the transmission route as a whole, and tending to increasing towards the river banks.

Road transport and trade
From the very beginnings of the overland route roads have been of great importance to European settlement in the area. This was further increased when coach travel developed in the 1870s. The importance of road based trade has only continued to grow since then with the installation of bridges and upgrading and expansion of the

road network. Possible elements of heritage associated with this theme include the roads and bridges themselves; stores and shops; warehouses; hotels and inns; cameleer encampments; abandoned vehicles; and commons and stables for housing horses. The potential for such items to occur within the study area is variable although it would be highest along old travel routes (e.g. creeklines and traveling stock routes) in the turbine envelopes and in areas where the transmission line intersects old roads. Overall potential for sites associated with this theme is assessed to be moderate to high.

Irrigation and horticulture

The success of the region around the Murray River has stemmed greatly from the successes in irrigation and horticulture that were pioneered during the late nineteenth and early twentieth centuries. Early evidence of settlement associated with this theme usually takes the form of small timber buildings with a lean to kitchen and a front porch/verandah, found amongst orchards, and often marked by the presence of a palm tree. However, some larger homes that relate to the very earliest phases when large amounts of money were invested in horticulture also exist (Bonhomme Craib & Associates 1999: 16). In addition to the residences associated with horticulture, archaeological evidence associated with this theme can take the form of irrigation canals, field systems, machinery and tools, and even trees in the case of old orchards. While continuance and expansion of the settlements and the associated horticulture may have resulted in the destruction of many of the early elements of agriculture, it is still predicted that the potential for heritage items associated with this theme is moderate to high along the southern sections of the transmission line route, particularly outside the urban centres.

Locking of the river

Locking of the Murray was completed in 1929. Locks 7 through 11 are in Wentworth Shire. The locks and weirs are the primary forms of archaeological evidence within this theme. There is a low potential in the proposal area for archaeological material relating to the locking of the river.

7. STATUTORY CONTEXT

The Environmental Planning and Assessment Act 1979

The Environmental Planning and Assessment Act 1979 (EP&A Act), its regulations, schedules and guidelines provides the context for the requirement for environmental impact assessments to be undertaken during land use planning (NPWS 1997).

Part 3A of the Environmental Planning and Assessment Act 1979

On 9 June 2005 the NSW Parliament passed the Environmental Planning and Assessment Amendment (Infrastructure and Other Planning Reform) Bill. The Act was assented to on 16 June 2005 and commenced on 1 August 2005. This amendment contains key elements of the NSW Government's planning system reforms and makes major changes to both plan-making and major development assessment.

Fully operational in August 2005, the major projects assessment system includes:

- a new part of the *Environmental Planning and Assessment Act 1979* (EP&A Act) — known as Part 3A — which defines the way a project should be assessed.
- State Environmental Planning Policy (Major Projects) 2005 — which defines what projects are subject to Part 3A and require ministerial approval.

The Silverton Wind Farm has been declared a major project under Part 3A of the Act and furthermore has been declared to be 'critical infrastructure'. The environmental assessment process for critical infrastructure is the same as for any other major project, that is, the Director-General of the Department of Planning establishes requirements which outline the key issues that a proponent must address in its environmental assessment of the project. Relevant government agencies such as the Department of Environment and Climate Change and the Heritage Council of NSW are consulted in developing these requirements.

Under the terms of Part 3A of the Environmental Planning and Assessment Act 1979 the following authorizations are not required for an approved project (and accordingly the provisions of an Act that prohibit an activity without such an authority do not apply):

- a permit under section 87 or a consent under section 90 of the National Parks and Wildlife Act 1974
- an approval under Part 4, or an excavation permit under section 139, of the *Heritage Act 1977*.

8. CONCLUSIONS AND RECOMMENDATIONS

Background research has revealed that there are many previously recorded sites and heritage items known to exist across the region and within the local area in which impacts are proposed. A predictive model based on prior local and regional archaeological work has resulted in an assessment that there is a high potential for Indigenous sites to be present in majority of the proposed impact areas. Indigenous heritage is likely to include stone artefacts, stone procurement areas, scarred trees, heat retaining hearths, middens, ceremonial sites and burials.

There is a similarly high potential for historical features associated with mining, transport and pastoral activities to be present within the Stages 2 and 3 areas. Along the proposed overhead transmission line route the potential for heritage items is more variable and encompasses a wider array of possible items including those associated with river trade; the areas of highest potential are in and around areas where the transmission line route intersects water sources and old roadways.

It is concluded that while Indigenous objects and Non Indigenous heritage items can be expected to be present within impact areas there is low probability that they will pose a constraint to the proposal. The scientific and cultural significance of Indigenous and Non Indigenous heritage is predicted to range for low to high. Accordingly a range of management strategies will need to be formulated taking into consideration significance values and the nature of impacts. It is proposed that appropriate management strategies are likely to include:

- Unmitigated impacts – unmitigated impacts are appropriate when sites are assessed to be of low heritage significance;
- Mitigated impacts – mitigated impacts are appropriate when avoidance of impacts is not feasible and when sites are assessed to possess higher significance values. Mitigated impacts can take the form of partial site conservation and/or salvage excavation;
- Conservation – avoidance of site impacts is appropriate when a site is assessed to be of high scientific or cultural significance.

8.1 Recommendations

- As a result of the review undertaken during this study it is recommended that providing appropriate impact mitigation strategies are implemented prior to construction there is unlikely to be any overall constraints relating to the proposal.
- The proposed impact areas should be subject to an appropriate level of field survey and assessment for the purposes of identifying Indigenous and historic heritage sites.
- The field assessment should be undertaken in partnership with the local Aboriginal community.
- Any Indigenous and Non Indigenous heritage sites located in the proposed impact areas should be subject to a site significance assessment in order to form the basis for the development of appropriate mitigation and management strategies.
- Following a comprehensive field survey and significance assessment the proponent should develop a Cultural Heritage Management Protocol prior to the commencement of construction, which documents the procedures to be followed for impact avoidance or mitigation. Personnel involved in the construction and management phases of the project should be trained in procedures to recognise and avoid disturbance to cultural heritage places and items.

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