
AUSTRALIAN NATIONAL PERIODIC REPORT

SECTION II

**Report on the State of Conservation of the
Willandra Lakes Region**

II.1. INTRODUCTION

a. State Party

Australia.

b. Name of World Heritage property

Willandra Lakes Region World Heritage Property

c. Geographical coordinates to the nearest second

142⁰ 46' 44" East, 34⁰ 18' 54" South to 143⁰ 34' 40" East to 33⁰ 8' 54" South.

Located in the Murray Darling Basin in south western New South Wales. The area is divided diagonally in a south western to north eastern direction by the boundary of the Balranald and Wentworth Shires.

d. Date of inscription on the World Heritage List

1981

e. Organization(s) or entity(ies) responsible for the preparation of the report

Environment Australia, in conjunction with NSW National Parks and Wildlife Service.

II.2. STATEMENT OF SIGNIFICANCE

Criteria

The region was inscribed on the World Heritage List for both outstanding cultural and natural universal values:

Natural Criterion (i)

- as an outstanding example representing the major stages in the earth's evolutionary history; and
- as an outstanding example representing significant ongoing geological processes.

Cultural Criterion (iii)

- bearing an exceptional testimony to a past civilisation.

Located in far south western New South Wales, the Willandra Lakes Region covers 240 000 hectares of a semi-arid landscape comprising a system of Pleistocene lakes, formed over the last two million years. Most are fringed on the eastern shore by a dune or lunette formed by the prevailing winds. Today, the lake beds are flat plains vegetated by salt tolerant low bushes and grasses.

There are five large, interconnected, dry lake basins and fourteen smaller basins varying from 600 to 35 000 hectares in area. The original source for the lakes was a creek

flowing from the Eastern Highlands to the Murray River. When the Willandra Billabong Creek ceased to replenish the lakes, they dried in series from south to north over a period of several thousand years, each becoming progressively more saline. The ancient shorelines are stratified into layers of sediments that were deposited at different stages in the lakes' history.

The earliest sediments are more than 130 000 years old and are orange-red in colour. Above are clays, clean quartz sand and soil that were deposited along the lakes' edges when the lakes were full of deep, relatively fresh water, between 60 000 and 19 000 years ago. The top layer is composed largely of wind-blown clay particles heaped up on the lunettes during periods of fluctuating water levels, before the lakes finally dried up.

Aborigines lived on the shores of the Willandra Lakes from at least 50 000 to 40 000 years ago. Excavations in 1968 uncovered a cremated woman (Mungo I, or WLH-1) in the dunes of Lake Mungo. This is the world's oldest known example of the rite of cremation. In 1974, the ochred burial of a male (Mungo III, or WLH-3) was found nearby and radio carbon dating at the time placed the burial at around 28,000 years old (it is now regarded as being in the vicinity of 45,000 years old).

The use of ochres for burial in Australia at 30,000BP paralleled their use in France at around the same time. A combination of dating techniques, most recently a series of OSL dates, has established that these remains were some of the earliest evidence of modern humans in the world.

During the last Ice Age, when the lakes were full, the Mungo people camped along the lake shore taking advantage of a wide range of food, including freshwater mussels and yabbies, golden perch and Murray cod, large emus and a variety of marsupials, including some species now extinct. They also exploited plant resources, particularly when the lakes began to dry and food was less abundant.

The human history of the region is not restricted to an ancient episode. Evidence so far points to an extraordinary continuity of occupation over long periods of time. In the top layers of sediments there is abundant evidence of occupation over the last 10,000 years.

The vegetation in the region, sparse though it is, is typical of the semi-arid zone. It plays an important role in stabilising the landscape and hence maintaining its sediment strata and many species of native fauna.

On the dunes are found the small scrubby multi-stemmed mallee eucalypts with an understorey of herbs and grasses. Rose wood-belah woodland is common on the sand plains. In the lake beds, several species of salt bushes are able to thrive in the saline conditions.

The remains of a large number of animals have been found in Willandra. More than 55 species have been identified, 40 of which are no longer found in the region, and 11 are totally extinct. Twenty-two species of mammals are currently recorded at Willandra, of which bats are the most diverse group. There are some 40 species of reptiles and amphibians. The bird life of the Willandra region is similar to that in many other semi-arid areas of Australia. Parrots, cockatoos and finches are the most conspicuous of the 137 recorded species.

Justification for listing

The original justification for the listing of the Willandra Lakes is as follows:

a) Cultural Property

As a cultural property the region is of outstanding universal value because:

- The remains of *Homo sapiens* in the Lake Mungo lunette establish that modern man had dispersed as far as south eastern Australia before 30,000 years ago.
- Complex ritual and symbolic systems are indicated by the 30,000 years old ochred burial and by the 26,000 year old cremation (the oldest cremation site in the world)
- These skeletal remains provide amongst the earliest evidence of *Homo sapiens* anywhere in the world and establish the great antiquity of Australian Aborigines.
- Some of the world's earliest substantial evidence for the exploitation of freshwater resources occurs here in quantity.
- The evidence enables a reconstruction of the economic life of *Homo sapiens* showing a remarkable adaptation to local resources and the interaction between culture and the changing natural environment.
- Grindstones to produce flour from wild grass seeds were used here in the late Pleistocene, at much the same time as their use in the Middle East.
- Pigments were transported to these lake shores before 32,000BP
- The typology of early Australian stone tools was defined as a result of research in this region.

An aesthetic sense, ritual and concern for deceased are surely the hallmarks of mankind. The Willandra discoveries have established the great antiquity and richness of Aboriginal culture and have caused a significant reassessment of Aboriginal prehistory and its place in the history of modern man. The discoveries have linked the origins of modern society in the old world with one across Wallace's line in Australia.

b) Natural Property

In terms of its natural heritage the Willandra Lakes Region is of outstanding universal value because it:

- Represents a regional Quaternary environment, a fossil landscape largely unmodified since the end of the Pleistocene ice age.
- Provides a resource of palaeoclimatic research into how non-glaciated inland regions were affected by major climatic fluctuations in ice sheets.
- Offers detailed stratigraphic, geochemical and pedological evidence for climatic and related environmental changes over the last 100,000 years.
- Contains evidence relating to semi arid environments which has global applications to Pleistocene research.
- Possesses in the Chibnalwood lunette an unusually large clay dune, one of the largest in the world.
- Is the focus of important innovative research on late Pleistocene palaeo-magnetism.

The area also meets the condition of integrity. It includes the entire lake and river system from Lake Mulurulu, the latest to hold water, to the Prungle Lakes, dry for more than 15,000 years.

Additional information since listing

Recent research has confirmed the great antiquity of the human remains found in the Willandra Lakes region. This research has provided results indicating that the Mungo III (WLH-3) burial is around 45,000 years old, and that the Mungo I (WLH-1) cremation is also significantly older than originally estimated.

This information confirms the validity of the original listing. Since the inscription of the Willandra Lakes Region on the World Heritage List a new category of listing has been established – that of Cultural Landscapes. Consideration may be given at some future time to renomination of the area as a Cultural Landscape.

Indicative Values Table

The *Environment Protection and Biodiversity Conservation Act 1999* prohibits actions that have "a significant impact on the World Heritage values of a declared World Heritage property" unless the action is approved or in accordance with an accredited management plan. The World Heritage values of a property are the natural heritage and cultural heritage contained in the property, which have the same meaning given by the World Heritage Convention.

The following indicative World Heritage values table includes examples of the World Heritage values for which Willandra was listed for each World Heritage List criterion. These are, in the Commonwealth's view, the statements of the outstanding universal values of each World Heritage property. While these examples are illustrative of the World Heritage values of the property, they do not necessarily constitute a comprehensive list.

| | |
|---|--|
| <p>Natural and cultural criteria against which the Willandra Lakes Region was inscribed on the World Heritage List in 1981.</p> | <p>Examples of World Heritage values of the Willandra Lakes Region for which the property was inscribed on the World Heritage List in 1981.</p> |
| <p>Natural Criterion (i) an outstanding example representing a major stage of the earth's evolutionary history.</p> | <p>The Willandra Lakes Region represents major stages of the earth's geological history, particularly associated with the response to major glacial-interglacial fluctuations. The World Heritage values include:</p> <ul style="list-style-type: none"> • non-glaciated, low-latitude lacustrine landscape lake basins which include: • lunettes; • inter-lake areas between major lake basins; • connecting channels adjacent to the lake system; • connecting dunefields adjacent to the lake system; • unusually large clay dunes; and • complex downstream variability in the character of the lacustrine system; • fossil dunes and lake sediments including those which show: • evidence of Pleistocene climatic changes and landscape history for the geomorphological record spanning well over 100,000 years; • detailed stratigraphic, geochemical and pedological evidence for climatic and related environmental changes; • how non-glaciated inland regions were affected by the major climatic fluctuations associated with oscillations in ice sheets; • the influence of the westerly winds that prevailed throughout the period of dune formation, a period extending from at least 100,000 years to about 15,000 years ago; and • evidence of giant extinct marsupial species. • extensive flat plains of lake floors and sedimentary carbonates which show: • evidence of past salinity fluctuations and the stability of the landscape in this region; and • evidence of the area's response to major climate change. • stunted blue bush (<i>Maireana sedifolia</i>, <i>M. pyramidata</i>) and saltbush (<i>Atriplex stipulata</i>) on the lake floor showing evidence of final saline phases of lakes. |

| | |
|---|---|
| <p>Natural and cultural criteria against which the Willandra Lakes Region was inscribed on the World Heritage List in 1981.</p> | <p>Examples of World Heritage values of the Willandra Lakes Region for which the property was inscribed on the World Heritage List in 1981.</p> |
| <p>Cultural Criterion (iii) unique, extremely rare, or of great antiquity.</p> | <p>The Willandra Lakes Region demonstrates an exceptional sequence of Aboriginal cultural occupation extending over tens of thousands of years, including an outstanding record of human responses to major changes over time in climate and environments (e.g. due to increasing aridity). The World Heritage values include:</p> <ul style="list-style-type: none"> • landforms and locations which greatly extend our understanding of Australia's environmental and Aboriginal cultural history, including: • exposures of sedimentary sequences which reveal Pleistocene sedimentary profiles and associated archaeological and palaeontological materials; • extensive intact lakeshore landforms that may contain extensive archaeological and palaeontological materials; and • the remains of hearths, including those with considerable antiquity, which have provided an ideal source for palaeomagnetic measurements; • archaeological sites which occur within stratified sedimentary sequences and provide evidence for the antiquity and continuing presence of human occupation; • archaeological sites which contain evidence of utilisation of lacustrine resources during lake full phases, and rangeland resources during arid phases; • archaeological sites which demonstrate continuity of human occupation for the region through fluctuations in lake levels drying of the system about 15,000 years ago through the Holocene period and up to historic times; • archaeological sites which provide outstanding examples of hunting and gathering, a way of life that has dominated the Australian continent up to modern times, including: • evidence of human occupation of, and interaction with, the landscape of lakes, lunettes and sand dunes over time in the form of campsites, middens, fireplaces, quarries, knapping floors and burials; and • campsites and fireplaces that reflect people's hunting, gathering and fishing diet; • burial sites which are of global significance for the antiquity of burial practices represented and also for the information they provide on the development of human societies, including Pleistocene and Holocene burial sites; and • burial sites with associated mortuary goods and evidence of ritual burials which demonstrate the antiquity of particular burial practices and the development of religious beliefs and systems over time. |

II.3. STATEMENT OF AUTHENTICITY/INTEGRITY

Authenticity / Integrity

At the time of listing the authenticity and integrity of the Willandra Lakes Region was unquestionably high. The defined region contained the creek and lake system almost in its entirety. Despite ecological changes effected by the pastoral industry, the region was regarded as being predominantly in its natural state.

With regard to the integrity of the region, it is an irony of the Willandra Lakes that continued erosion of key geomorphological features results in the exposure of cultural sites that further reinforce the reason for the listing. At the time of the nomination around 8% of the lunette features were considered to be extensively eroded, and 72% was regarded as stable and uneroded.

Maintenance of values

As overall, or general measures of condition, the authenticity and integrity of the Willandra Lakes Region remain intact. Although there has been ongoing erosion in some areas where the scale of denudation in conjunction with the semi arid climate make it impractical for any intensive re-vegetation to succeed, the implementation of management procedures and pastoral property restructure has been conducive to removing stock pressure from sensitive areas. Although there has been no quantification of areas of eroded lunette compared to stable lunette, a broad estimate from an aerial view would suggest that the percentages of 8% extensively eroded and 72% stable and uneroded would remain valid. The only change has been continued deflation and erosion of that which was already eroded at the time of listing.

Boundaries and buffer zones

At the time of listing the boundary of the Willandra Lakes Region was defined by cadastral boundaries which included pastoral leases and crown reserves. The cadastral boundaries provided a convenient reference at the time of nomination. In the context of present day mapping capabilities the cadastral boundaries do not accurately reflect the location of the landscape elements containing World Heritage values.

In 1995 Australia advised the World Heritage Committee of its intention to amend the boundary to reflect the location of the landscape elements, based on recommendations presented by the Willandra Lakes Region World Heritage Technical and Scientific Advisory Committee.

Also in 1995 the World Heritage Committee endorsed the revised boundary, and as a consequence the property was reduced to just under 240,000 hectares in area. The new boundary reduced the number of pastoral properties within the Willandra, and also added a number of small but previously excluded areas containing World Heritage Values. The revised boundary is supported by State and Federal Governments, scientists, landholders and the three traditionally affiliated tribal groups. It also provides an improved basis for the management of the site.

As part of the process of developing a plan of management for the Willandra Lakes Region several pastoral leases with land inside the World Heritage Area were purchased with a view to adding them to the existing conservation estate (Mungo National Park). This transfer was effected in October 2002. Where conservation estate comprised 10% of the World Heritage Area in 1981, with extensions to the National Park, and reduction in size of the World Heritage Area, conservation estate now comprises approximately 25% of the World Heritage Property. Extensions to Mungo National Park cover significant areas of lunette and interlake zones.

The balance is predominantly pastoral grazing leases. The alteration of two leases has recently removed another two pastoral leases completely from the World Heritage Area

(the boundaries of the leases changed, the boundary of the World Heritage Area did not).

There are no formal buffer zones established outside the existing boundary of the World Heritage Area. However, any proposed development in the vicinity of the boundary is formally assessed under relevant New South Wales and Commonwealth legislation, and is scrutinised by the Willandra Lakes Region World Heritage management committees. The ability to assess and control peripheral actions which might have a detrimental effect on World Heritage values has been recently reinforced through the enactment of new Commonwealth legislation (the *Environment Protection and Biodiversity Conservation Act 1999*).

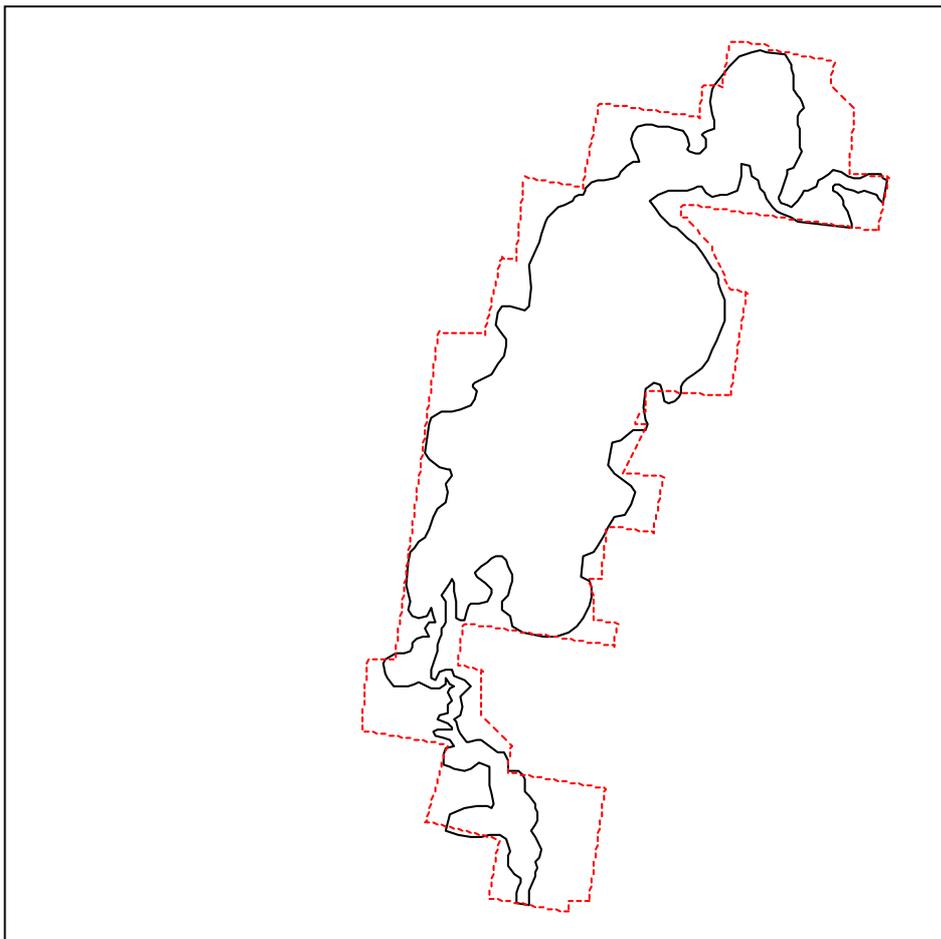


Figure above shows original boundary (broken line), and the revised boundary (solid line)

II.4. MANAGEMENT

International Obligations and Commitments

There are no other international conventions, programs or protocols that are applied specifically to the Willandra Lakes Region.

National Legislation and Controls

The *Environment Protection and Biodiversity Conservation Act* 1999 (EPBC Act) is the main Commonwealth (federal) legislation that protects World Heritage Properties. To date since its enactment there have been few proposed actions relating to the Willandra Lakes Region referred for consideration under the Act. This is by virtue of the Willandra Lakes Region being in a remote area and not subject to high development pressure. Referrals to date have been related to proposed sand mining projects located outside the boundary of the World Heritage Area, and which will not impact on World Heritage values.

At a national administrative level Environment Australia, through the Heritage Management Branch, has been a proactive and effective manager of World Heritage properties.

State Legislation and Controls

At a state level the Willandra Lakes Region World Heritage Area is afforded protection through a number of legislative controls. The Willandra Lakes Region has its own gazetted Regional Environmental Plan which identifies the Community Management Council, Technical and Scientific Advisory Committee and three Traditional Tribal Groups Elders Council as having decision making responsibilities with regard to any development in the World Heritage Area. This Plan is given statutory force under the *Environmental Planning and Assessment Act* (NSW) 1979. This Act is administered by Planning NSW.

That portion of the World Heritage Area that is included in Mungo National Park is afforded protection by the *National Parks and Wildlife Act* (NSW) 1974. Management of the National Park must be consistent with the provisions in that Act. The Act is administered by the NSW National Parks & Wildlife Service, which is the lead agency for management of World Heritage in NSW.

That portion of the World Heritage Area not inside Mungo National Park is comprised of lease hold land for the purpose of grazing. The leases are granted under provisions of the *Western Lands Act* 1901. This Act is administered by the NSW Department of Land and Water Conservation. This department is responsible for granting approvals for activities on western lands leases, and also conducts rangeland monitoring to ensure areas are not overstocked or over grazed. This monitoring is not specifically targeted towards World Heritage values, but rather to general landscape conservation. The value of this legislation is that it enables the Department to monitor the effect of stock on the landscape, and provides the authority for it to direct lessees on stocking rates.

Local government and Regional statutory controls

Local government planning schemes do not play a significant role in conservation and management of World Heritage values. However local government does make a contribution to these objectives through representation on management committees and contributions in kind to selected projects.

Management Arrangements

Management of the Willandra Lakes Region is supported by a group of committees, each with a specific role. These committees are:

The Willandra Lakes Region WHA Three Traditional Tribal Groups Elders Council (Elders Council)

The Elders Council is comprised of members of the Paakantji, Mutthi Mutthi and Ngiyampaa tribal groups – each of whom have traditional country within the boundary of the WHA. This group considers management issues from the perspective of Traditional Owners and provides advice to WHA management bodies, and other bodies and individuals, as required. The Elders Council is responsible for overseeing specific actions identified in the Plan of Management, and is currently preparing a range of planning projects that will improve the involvement of the three traditional tribes in the management of the WHA.

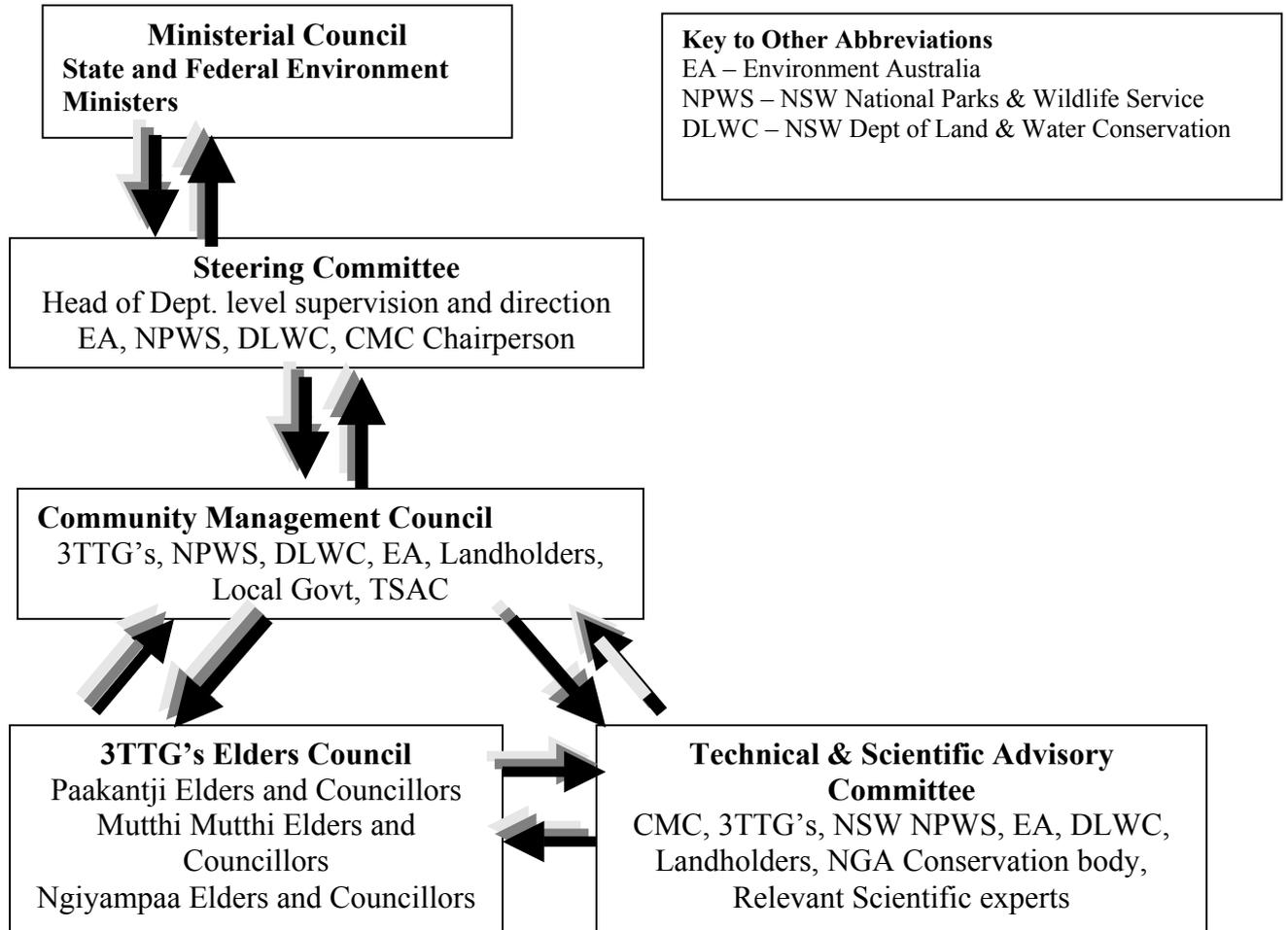
The Willandra Lakes Region WHA Community Management Council (CMC)

CMC is the peak ‘local’ stakeholder advisory committee for the Willandra Lakes Region WHA. The CMC advises the Ministerial Council on matters relating to the protection, conservation, presentation and management of the Willandra Lakes Region from the viewpoint of landholders and the community. The CMC is charged with oversight of the implementation of the Plan of Management, and is named as a body requiring notification in the Willandra Lakes Region Regional Environmental Plan – therefore having statutory recognition in NSW planning arrangements. There is cross representation of membership of the CMC, TSAC and the Steering Committee (Figure 1).

The Willandra Lakes Region WHA Technical & Scientific Advisory Committee (TSAC).

TSAC provides advice of a technical and scientific nature where required to the Ministerial Council and the CMC on the protection, conservation, presentation and management of the Willandra Lakes Region. There is cross representation of membership of the CMC, TSAC and the Steering Committee (Figure 1).

Figure 1. Summary of Management Structure



The Willandra Lakes Region WHA Steering Committee

Steering Committee is a small group of executive level officers from relevant New South Wales and Commonwealth departments. They coordinate interdepartmental policy on the management of the World Heritage Area, and provide high-level decisions on management directions and contributions of their various departments to World Heritage management projects and issues.

Ministerial Council

The New South Wales World Heritage Properties Ministerial Council coordinates policy between the Commonwealth and New South Wales governments on all matters concerning World Heritage properties in New South Wales. It provides the vehicle whereby relevant Commonwealth and State Ministers can meet and discuss issues requiring action at a Ministerial level.

Other Management Arrangements

The NSW NPWS is the lead State agency for World Heritage management in NSW. It auspices funding for World Heritage management projects, and hosts administrative positions. For the Willandra Lakes WHA the main administrative position is that of the Executive Officer – based in the Lower Darling Area of the NSW NPWS. This position services TSAC, CMC and the Elders Council, as well as providing a local contact point

for World Heritage management.

Strategic Planning

As noted above the Willandra Lakes Region WHA has its own Regional Environmental Plan, gazetted in 2001. This plan places the Willandra Lakes Region WHA Advisory Committees in an assessment role for any development proposed within the boundaries of the WHA.

The Willandra Lakes Region WHA is also included in the Lower Murray Darling Catchment Management Blueprint. This document is a New South Wales government regional strategic plan which will be used to prioritise projects aimed at improving the natural and social environment of the region. It is also proposed that the priorities and projects identified in this plan be used in the future to guide the delivery of funds to the region from the Commonwealth's Natural Heritage Trust program.

Administrative and Contractual Arrangements

The Willandra Lakes Region WHA management committees are serviced by an Executive Officer. This position is funded by the Commonwealth, but is located in the NSW NPWS for administrative convenience. The NSW NPWS provides in kind support for the position. The officer is responsible for all administrative duties relating to the committees, and management of projects commenced by the same.

Decisions by the advisory committees noted above are communicated to management agencies through their representatives on the advisory committees. This arrangement is generally effective. The major administrative contractual arrangements are between NSW NPWS and Environment Australia, where the former is contracted to auspice funding and administration of World Heritage management projects

Contact Details

NSW National Parks and Wildlife Service

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Willandra Lakes Region WHA
C/- NSW NPWS
Lower Darling Area
PO Box 318
BURONGA NSW 2739

Environment Australia

Heritage Management Branch
Heritage Division
Environment Australia
GPO Box 787
Canberra ACT 2601

Joint Management measures (Traditional Protective measures)

That part of the Willandra Lakes Region WHA that is part of Mungo National Park is jointly managed by the NSW NPWS and the Willandra Lakes Region 3 Traditional Tribal Groups. This management body is known as the Mungo National Park Joint Management Advisory Committee, and is governed by the Mungo National Park Joint Management Agreement. This Advisory committee has received interim approval to the end of June 2003, and submissions are being prepared to recommend it be made a permanent arrangement.

Under this agreement members of the 3 Traditional Tribal Groups have a majority on the Joint Management Advisory Committee. This Traditional Owner membership is drawn from people nominated by the WHA 3 Traditional Tribal Groups Elders Council, thus securing the management and conservation of World Heritage values as a cornerstone of the Joint Management Advisory committee's operations.

As summarised above, the one of the management committees of the Willandra Lakes Region WHA is the 3 Traditional Tribal Groups' Elders Council. This advisory committee is funded by the Commonwealth, and is an integral part of the management of the WHA.

Both the mechanisms described above are effective in formally involving traditional owners in the decision making process in a meaningful manner. It provides traditional owners with a recognised body through which to formulate advice and policy, but also bodies which are efficient mechanisms by which traditional owners can be approached.

In order to provide better strategic directions for traditional owners in the Willandra Lakes Region WHA a 3 Traditional Tribal Groups' Plan of Management has been commissioned. This is being prepared in conjunction with an Employment Strategy and a Feasibility Study for a Keeping Place, Research and Education Centre.

Management Planning

The Willandra Lakes Region WHA is managed under the direction provided by *Sustaining the Willandra: The Willandra Lakes Region World Heritage Property Plan of Management*. Completed in 1996, this plan of management has been used as a model for several other World Heritage Property plans of management. At the time of this report it is approximately 6.5 years old, and overdue for review. However, the directions and visions described in the document remain broadly relevant.

Sustaining the Willandra is not a legally binding document, however the unambiguous commitments documented therein provide strong grounding for the progress of issues and projects. It has to date been an invaluable tool for the management of the Willandra Lakes Region WHA since 1996.

The NSW NPWS is at present preparing a new Plan of Management for Mungo NP. This plan will work from the viewpoint of conservation of World Heritage Values, as well as other conservation aims. Willandra Lakes Region WHA advisory committees have had the opportunity to input advice from a World Heritage Management perspective, and will have further opportunity to review the document in due course.

Each grazing property with area inside the World Heritage Property boundary has had an individual property plan prepared. These plans document a number of projects designed to modify property infrastructure to mitigate the impact of pastoral activities on World Heritage Values. These documents not only identify projects to be completed, but also the body responsible for funding. The implementation of Individual Property Plans (IPP's) is progressing, with many IPP's being fully complete. At this point there has been no monitoring of the effectiveness of the IPP's.

At the time of writing (as noted above) a Plan of Management for the Willandra Lakes Region WHA 3 Traditional Tribal Groups 's is being prepared. Also in preparation is an Employment Strategy and a Feasibility Study for a Keeping Place, Education and Research Centre.

Changes in ownership and/or legal status

Since the time of nomination there have been several changes to ownership and legal status of different parts of the WHA. The main changes to date have been:

1984: Purchase of 'Zanci' by NPWS from neighbouring land holder, and added to Mungo NP. This effectively doubled the size of Mungo NP to c.32,000ha.

1995: Reduction of boundary of Willandra Lakes Region WHA to current location.

1997-1998: Government purchase of Spring Hill, Pan Ban/Balmoral, Garnpang, Leaghur and Joulni properties, on the basis that a significant proportion of their area contained World Heritage Values. These purchases totalled approximately 190,200 hectares. All except the Joulni property were purchased with the view to adding those areas with the greatest concentration of World Heritage Values into Mungo National Park, with the balance to be subdivided and re-sold to neighbouring World Heritage landholders.

2002a: The *Wilson v. Anderson* decision in the High Court of Australia (HCA29 8 August 2002) determined that Native Title had been extinguished on NSW Western Lands Leases granted in perpetuity. This applies to the land within and surrounding the Willandra Lakes Region WHA, apart from small isolated freehold parcels where Native Title had previously been determined to have been extinguished.

2002b: Gazettal of 61,845 hectares as additions to Mungo NP, and proposed creation of a State Conservation Area (SCA) of 17,850 hectares (that being the majority of the Balmoral property). Mungo National Park is now 90,042.5 hectares in area. Of this 59,223 hectares is also inside the World Heritage Area, meaning that nearly 25% of the World Heritage Property is gazetted as national park.

Staffing, Financial and Training Resources

As indicated above the Willandra Lakes WHA has one dedicated staff member (the Executive Officer) located in the region. This officer is funded by the Commonwealth and supported by the staff and administration of the NSW NPWS. Training is provided by the NSW NPWS on an as needs basis. The Executive Officer is also supported by staff in Environment Australia. Computer resources are adequate, provided by the NSW NPWS. They run on an IBM compatible network (Windows NT) and are

supported by a NPWS Intranet. E-mail is used extensively for general messaging and communications, and also for administrative purposes.

Funding for World Heritage management projects has been primarily Commonwealth grants since 1996, through the Natural Heritage Trust. This has entailed the submission of annual funding bids to the Commonwealth through Environment Australia. Matching contributions, or contributions in kind from the State have been from the NSW NPWS. Matching contributions have in the main been where existing NPWS management activities can be seen to be complementary to objectives being pursued by the Willandra Lakes WHA Advisory Committees.

Grant funds from the Commonwealth Natural Heritage Trust are used for the whole range of management activities in the WHA. They include:

- Executive Officer Support
- Advisory Committee Support
- Implementation of Individual Property Plans
- Improved Signage
- Communications and Marketing
- Research and Dating
- Site Management & Monitoring (Cultural Sites)
- Pest Control
- Preparation of Management Plans

The financial and structural readjustment package that led to the purchase of the properties noted above and additions to Mungo National Park were delivered as a joint State and Commonwealth funding venture specific to the Willandra Lakes Region WHA.

To date funding has been adequate for the requirements of the management of the WHA. Future funding for World Heritage Management is proposed to continue to come from the Natural Heritage Trust.

Pending finalisation of the new arrangements for the Natural Heritage Trust, concerns have been raised by management committees and other stakeholders that the proposed method of delivery of this funding should not compromise the effectiveness of World Heritage management, and lead to a reduction in World Heritage funding. This concern is being considered by the Commonwealth.

Scientific and technical studies

A complete list of relevant scientific and community papers, reports and publications is provided in Appendix 1.

Visitation

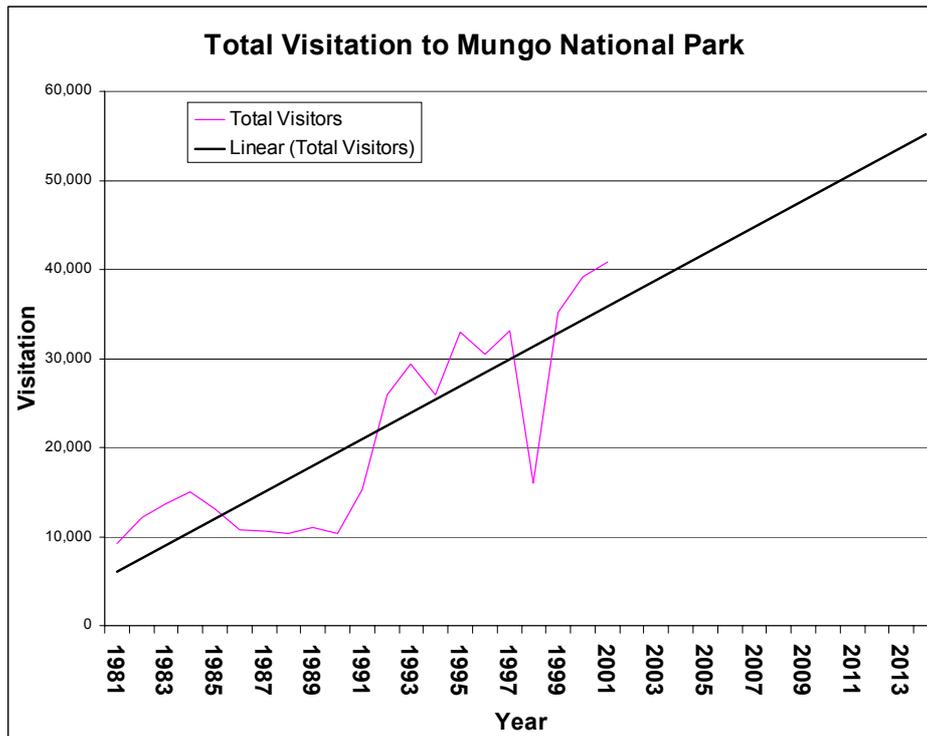
Public visitation to the Willandra Lakes Region is directed towards Mungo National Park. NPWS have collated data on visitor numbers since 1981 through road counters, pedestrian counters, vehicle surveys and analysis of visitor book signatures. An average of 3.3 passengers per vehicle is used for calculating 'passengers per vehicle', a figure calculated from various surveys conducted in the past. A new 'Commercial Tour

Operator's Monthly Return' (not shown here) will enable more accurate visitation numbers to be assessed for larger vehicles.

In 2001 NPWS estimates that some 40,000 people visited Mungo National Park, with significant peaks in visitation during school holiday periods and the winter months.

| 2001 | Vehicles to Walls of China | Vehicles on Drive Tour | Visitors to Walls of China | Visitors on Drive Tour |
|--------------|-----------------------------------|-------------------------------|-----------------------------------|-------------------------------|
| 01-Jan | 471 | 434 | 1,804 | 1,432 |
| 01-Feb | 290 | 302 | 1,061 | 997 |
| 01-Mar | 550 | 288 | 2,337 | 950 |
| 01-Apr | 1344 | 715 | 5,142 | 2,360 |
| 01-May | 2028 | 1061 | 7,492 | 3,501 |
| 01-Jun | 601 | 334 | 2,464 | 1,102 |
| 01-Jul | 1017 | 524 | 3,806 | 1,729 |
| 01-Aug | 782 | 374 | 3,052 | 1,234 |
| 01-Sep | 525 | 182 | 2,388 | 601 |
| 01-Oct | 1649 | 611 | 5,906 | 2,016 |
| 01-Nov | 766 | 413 | 2,986 | 1,363 |
| 01-Dec | 683 | 358 | 2,370 | 1,181 |
| TOTAL | 10,706 | 5,596 | 40,807 | 18,467 |

Detailed Visitation data to Mungo National Park January – December 2001. Walls of China refers to the main visitation area on the Mungo lunette. The drive tour is the loop road that circumnavigates the park.



General trend of visitor numbers to Mungo National Park, 1981 to 2001. The data presented is based on road counters and estimates of passengers per vehicle. A significant variation away from the general trend of the data in 1998 is probably due to faults in the road counter operations rather than an actual decline in visitor numbers.

Education, Interpretation and Awareness Raising

At present interpretation material for the Willandra Lakes Region WHA is limited, but steps are being taken to rectify this situation. A detailed study of visitor attitudes and experiences (Archer & Griffin 2002) has shown that there is a low level of understanding of the WH Values of the region.

Existing interpretive facilities include:

- A self guided visitor centre at Mungo National Park, with audio supplements. This centre interprets, in a very summarised fashion, some aspects of 3 Traditional Tribal Groups culture, the archaeology, the natural history, and the pastoral history of the area.
- New signage at the World Heritage Area boundaries, and at the entrances to Mungo NP. In an effort to raise the awareness of the World Heritage status of the Willandra Lakes signs were placed on the entrances to the World Heritage Area. These signs acknowledge the traditional owners of the region, and the fact that the visitor is entering a World Heritage Area. Likewise, new signage at the entry to Mungo NP focuses on the values which are the basis for the Willandra Lakes' inscription.
- A small section on World Heritage in the current Mungo NP Guidebook (Fox 1992). The guidebook itself is a useful summary for Mungo NP, as per the post 1984 boundaries, but is now somewhat out of date, especially given the recent extensions noted above.
- Summaries included on the Environment Australia web page, also available as printed brochures.
- Lake Mungo: Window to Australia's Past (Bowler 2002). This is an interactive CD-

ROM produced by Dr Jim Bowler, containing an impressive interpretation of the Willandra Lakes Region with a focus on Lake Mungo. This is a private publication, but is for sale at Mungo NP.

Projects to improve delivery of interpretive material include:

- A Communications & Marketing project, which will be complete by June 2003. This project will prepare an interpretive brochure and map of the World Heritage Area, and is proposed for sale to visitors. The material prepared will also be used to establish a web page for the Willandra Lakes Region WHA.
- Upgrade of Mungo NP Audio visual room. The existing AV room at the Mungo visitors centre will be refurbished, and furnished with touch screen computer terminals and projection facilities. It is envisaged that, in the first instance, the Bowler CD-ROM will be the primary interface used by visitors at these terminals.

Interpretation of the culture of the 3 Traditional Tribal Groups is one area where significant improvement is required, although there have been recent advances. The 3 Traditional Tribal Groups planning projects noted above (Plan of Management, Employment Strategy and Feasibility Study for Keeping Place, Research and Education Centre) will provide direction on the desired means to achieve this improvement.

Identification of gaps and management needs

Traditional Owners

Despite the Willandra Lakes Region having been inscribed on the World Heritage List since 1981, the Traditional Owners of the region are only now beginning to achieve a meaningful role in the management of the World Heritage Area. An identified and recognisable base for the 3 Traditional Tribal Groups to work from is an important requirement. This issue will be a priority of the Plan of Management that is currently being prepared. Implementation of the actions identified in the planning documents being prepared will be a major management priority from 2003 onwards.

Funding

Although funding for the Willandra Lakes Region WHA has been adequate, there are some concerns over its delivery which could have an adverse impact on the management of the WHA. These include:

- The fact that funding for WHA projects and management is project based and annual, as opposed to recurrent. This makes the initiation of management projects that would ideally have ongoing or continuous components (ie, site monitoring, site rehabilitation, staffing, administrative/advisory arrangements) problematic.
- The State of NSW has no specific budget for World Heritage management. State contributions are received, but are generally at the discretion and budget situation of the host agency. A State budget identified for World Heritage Management projects would be of great assistance in preparing joint Commonwealth/State funding submissions. This is particularly the case for NSW which now has management responsibility for 4 World Heritage Areas (Willandra Lakes, Lord Howe Island, Central Eastern Rainforest Reserves (shared with Queensland) and Greater Blue Mountains.
- An ongoing/recurrent budget for Site Monitoring and Management is a major requirement.

Management

- A comprehensive review of the existing Plan of Management is urgently required.
- The absence of an ongoing Site Monitoring and Management project is a major gap in the management of the WHA. Its establishment is a management need, but is dependant upon receiving a recurrent budget.

II.5. FACTORS AFFECTING THE PROPERTY

Development pressures

A small tourist resort, Mungo Lodge, was established just outside the western boundary of Mungo National Park in the late 1980's. Low and sustainable tourist numbers have resulted from this development.

Lakebed cropping was undertaken on the Garnpang lakebed in the 1980's but this proved to be unviable due to low and unreliable rainfall. Cropping has largely been limited to small areas of the southern, wetter parts of the WHA, and on the mallee sandplain areas now outside the boundaries of the WHA. No licences for land clearing have been issued for the WHA since it was inscribed. Clearing has been limited to small areas associated with woody weed control and along new fenceline and pipeline alignments.

Mining for mineral sands is a developing industry in the Murray Basin and exploration has occurred throughout the region. Mineral sand deposits have been located at a number of locations on areas just outside the WHA and especially on Garnpang Station, to the west of the WHA, and at Prungle Station, to the southeast of the WHA. Detailed environmental assessment of these locations are in progress. The mineral sands at Garnpang Station will require large volumes of water that are not available from within the mine lease and the developers have sought access to the WHA to investigate the potential for ground water extraction. The TSAC and CMC Committees have recommended that the establishment of a borefield for mining purposes is not consistent with the WH Values for the area and have recently drafted a statement to that effect.

The presence of mineral sands within Balmoral Station was noted during the recent extensions to Mungo National Park and the station was not been added to the park. It is proposed that this station will be declared a State Conservation Area until the extent, nature and viability of these mineral sands has been resolved.

Maintenance and upgrading of existing roads and telecommunication facilities has taken place, usually along existing alignments, and is expected to be on-going, however these works have been of a minor nature and have not proven to be a threat to WH Values.

Environmental pressures

The combined grazing pressure of domestic, feral and native grazers on the semi-arid rangelands of the Willandra have created an eroded and scalded landscape. Some areas such as the Walls of China and limited areas on other lake margins, creek lines and shorelines have been subject to extensive erosion and deflation. This process of wind

erosion has been on-going for many decades, and low rainfall and prevailing west-southwest winds has maintained the eroded areas in a devegetated condition. Total grazing pressure in the region has dropped considerably over the last 50 years as rangeland management has developed, new more evenly spaced watering points and fences have been established and the rabbit population has declined following the introduction of the Rabbit Calici Virus (RCV).

Deflation of ground surfaces in eroded areas is not readily controlled, and any deliberate intervention in these areas could lead to disturbance of archaeological sites and damage to WH values. The expansion of Mungo National Park to include 25% of the WHA will help reduce the impacts of domestic grazers on rangeland vegetation, although populations of feral and native grazers will require continued control programs.

Visitor/tourism pressures

Public visitation to the Willandra Lakes Region is confined to Mungo National Park, and visitation to areas outside the park is confined to small numbers of specialist groups, Aboriginal Elders and students. The general trend in visitor numbers to Mungo National Park from 1981 to 2001 is shown in Section II.4. In 2001 some 40,000 people visited the park. There is a marked seasonality to the visitation pattern with peaks in visitation through the cooler months and especially in the 3 school holiday periods in Autumn, Winter and Spring.

Facilities for overnight visits are provided in two NPWS campgrounds, shearers quarters and at Mungo Lodge, a private commercial tourist resort immediately to the west of Mungo National Park. An independent survey of visitors (Archer & Griffin 2002) has shown a very high level of visitor satisfaction with the park and its facilities, although the study also indicated a low level of awareness on the World Heritage status of the area.

Visitor impacts are potentially a major issue in the conservation of WH values through pilfering of cultural heritage objects and general erosive effects of foot traffic. A detailed study of visitor impacts was undertaken in 1997 in an effort to quantify the impacts of visitors (Midgley et al 1998). This study found that tourists were touching, moving and in some cases removing artefacts in visitation areas. In areas where access was formalised along paths and sites were sign posted less impact was noted.

Following this study NPWS revised the facilities for public access to the Walls of China visitor area, the main public access point to the Mungo Lunette. The car park was re-located some 500m to the west of its original position to alleviate car park congestion and erosion of the foreshore; a boardwalk was established across the foredune of the lunette to eliminate further erosion of pedestrian access tracks; a viewing platform and rest area was established at the end of the boardwalk to encourage visitors to stop and view the area rather than walk across the lunette, and additional signage was introduced to make the public aware of the problems of disturbing or removing items from the park. Additional boardwalk construction is planned for 2003 to extend the Walls of China boardwalk and further reduce visitor impacts on the area.

Number of inhabitants living within the property

There are less than 40 permanent residents of the Willandra WHA. This number has

dropped slightly in recent years due to land acquisition by the NSW government and property amalgamations.

Most of the permanent residents are based on private leasehold grazing properties and are engaged in works associated with the management of these properties. There is a far larger visiting population of ca. 40,000 per year, however these visits are short term and restricted to Mungo National Park and Mungo Lodge.

Three properties recently acquired by the government have no permanent residents at present, although this may change as new staff are employed at Mungo National Park and new enterprises are developed by the Aboriginal Elders of the region.

II.6. MONITORING

Current monitoring program

While site rehabilitation work was noted as a high priority in the 1996 Plan of Management, *site monitoring* was not similarly identified. As a result there has been no development of systematic monitoring the WHA until recently. This omission was recognised by TSAC in early 1996 and during 1997. The TSAC committee resolved that there was a need to develop site monitoring and identify the protocols for a research component associated with site monitoring. An outcome of this resolution was the research by Midgley et al (1998) (see below).

Periodic but not scheduled inspections of locations where burials occur has taken place since the establishment of the WHA. The purpose of these inspections has been to identify any new burials that may have eroded and undertake appropriate conservation work (recording and reburial) as required. In 1995 23 monitoring points to measure the rate of erosion near burials were been installed and are periodically measured to gauge erosion rates.

A project to develop a more detailed and systematic monitoring program for Aboriginal archaeological sites in the WHA has recently commenced. For the purposes of this project monitoring is taken in a broad context of both time and areal extent. Monitoring is defined as the repeated gathering of specified information. This means management of a place can be on the basis of careful observation rather than guesswork or anecdotal information on what changes are occurring. The specific information required is site condition, as measured by recording and mapping site components, erosion and impacts, over time.

This information will be gathered by:

- Making repeated observations about a place, over a long time period (5 - 20 years)
- Regularly visiting sites and places and systematically making the same observations about the place, and
- Identifying the cause of unwanted change

Ten locations were chosen in 2002 for developing a detailed recording and monitoring program, and this sample may expand as the program is developed. The program and structure of this monitoring program centre on the detailed mapping and recording of archaeological sites in a systematic framework that will allow repeated recording and monitoring of change. Monitoring by these methods will provide information about trends in the condition of sites and whether they are unchanged, eroding, aggrading,

being pilfered, or are subject to other detrimental processes.

Several other monitoring programs have been established that monitor the condition of rangeland vegetation in the WHA. Rangeland Assessment Plots (RAP) have been established by DLWC at 11 locations within grazing properties. This program was established more than 10 years ago and is routinely monitored each year. The main aim of the program is to monitor change in pasture growth under grazing across a range of vegetation communities. Transects and photopoints are used to monitor recruitment, change in cover of trees, shrubs, grasses and forbs and change in soil surface condition. As an outcome, landholders are provided with annual reports and advice on management. Since 2000 NPWS has undertaken Rangeland Vegetation Monitoring at 6 locations in the WHA to monitor the impacts of various grazing animals (rabbits, sheep, kangaroos) on plant species and biomass. Three of these are within Mungo National Park and 3 are within Garnpang Station which was recently (October 2002) added to Mungo National Park. NPWS also undertakes annual Autumn studies of kangaroo populations in Mungo National Park.

Results of current monitoring program and of Key Indicator measurement

The following draft list of key indicators has been identified for the Willandra Region.

1. Integrity of geomorphological and fluvial features.
2. Retention of both known and as yet undiscovered evidence of giant extinct marsupial species, except for authorised removals.
3. Integrity and state of preservation of archaeological sites.
4. Retention of archaeological materials *in situ.*, except where removal is authorised.

1. Integrity of geomorphological and fluvial features.

The integrity of the geomorphological and fluvial features is closely associated with erosion and land management. The Technical & Scientific Advisory Committee is currently assessing the adequacy of an erosion monitoring report (Elderidge and Tozer 1996). It is expected that the development of a more systematic approach to erosion monitoring will be an item for discussion at upcoming TSAC and CMC meetings.

There has been very limited vegetation clearing in the WHA since its establishment in 1981, and clearing has been confined to small areas of woody weed control and areas along new fencelines and pipelines. Following WH Listing in 1981a number of Cultivation Permits on lakebed areas of Garnpang, Balmoral and Prungle Station were revoked. No new licences for clearing have been issued since 1981. A number of areas are subject to Cultivation Permits on lakebeds that were natural openings and had low cultural heritage significance. No new permits for cropping have been issued in the last decade and at present 3674 ha. (1.53%) of the WHA is licensed for cultivation on Gol Gol, Turlee, Banoon and Prungle Stations.

2. Retention of both known and as yet undiscovered evidence of giant extinct marsupial and megafaunal species, except for authorised removals.

The remains of giant extinct marsupial species are a rare feature in the Region and their occurrence is limited to a small number of locations where erosion has exposed Pleistocene sediments. Intermittent inspections of these locations has taken place and there has been no indication that unauthorised removal of materials has occurred.

Controlled collection of extinct marsupial and megafaunal remains has taken place at 2 locations over the last 2 years at WOC-1 and GG-16.

3. Integrity and state of preservation of archaeological sites.

Since 1995 23 monitoring points have been established near a number of burial sites. These points show that highly variable processes of erosion are underway across key archaeological areas of the landscape. While some areas have shown negligible erosion in the last 7 years, others have shown land surface erosion rates of up to 8cm per year.

The Aboriginal Site Monitoring Program referred to above is still being developed. One of the limitations on the implementation of this program has been a lack of other comparable works. A review of management operations and studies from other parts of the world has shown that while monitoring is an established methodology for some types of Aboriginal archaeology (e.g. Lambert 1995, 2000) there is no established methodology for monitoring the types of archaeological sites that exist in the WHA.

4. Retention of archaeological materials in situ., except where removal is authorised.

The management and control of Aboriginal objects is controlled in NSW by the National Parks and Wildlife Act (1974) and it is illegal to collect, damage or disturb any object without the permission of the Director General, NPWS.

The major contributor to unauthorised removal of archaeological materials is public access to cultural heritage sites. A recent study in the Willandra (Midgley et. al 1998, see also the discussion under Section II.5) found that management of tourists was a major factor in retaining archaeological materials in situ. Within the WHA tourism access is limited to designated areas in Mungo National Park and the vast majority of locations in the region are located in areas closed to the public, or on private leasehold lands. Two of the sites studied in Midgley et al (1998) are included in the Aboriginal archaeological sites monitoring program (see above).

APPENDIX 1

References, scientific and technical studies and publications relevant to the Willandra Lakes Region World Heritage Area

- Aboriginal Catholic Ministry. 1989. *Lake Mungo. We the Mutthi Mutthi People*. Thornbury: Aboriginal Catholic Ministry.
- Adams, G and A. J. Mortlock. 1974. "Thermoluminescent Dating of Baked Sand From Fire Hearths at Lake Mungo, New South Wales." *Archaeology and Physical Anthropology in Oceania* 9:236.
- Adamson, D., M. A. J. Williams, and J. T. Baxter. 1985. "Complete Late Quaternary History of the Nile, Murray-Darling and Ganges Basins - Three River Systems Presently Linked to the Southern Oscillation." *Proceedings of the Manchester Conference*, In press.
- Adcock, Gregory J., Elizabeth S. Dennis, Simon Eastel, Gavin A. Huttley, Larss S. Jermin, James W. Peacock, and Alan Thorne. 2001. "Mitochondrial DNA Sequences in Ancient Australians: Implications for Modern Human Origins." *Proceedings of the National Academy of Science* 98(2):537-42.
- Allen, H. R. 1974. "The Bagundji on the Darling Basin: Cereal Gatherers in an Uncertain Environment." *World Archaeology* 5:309-22.
- . 1986. "Environmental History in South-Western New South Wales, North-Western Victoria During the Late Pleistocene." *The Pleistocene Perspective*, vol. 2, Southhampton: World Archaeology Conference.
- . 1990. "Environmental History in Southwestern New South Wales During the Pleistocene." Pp. 296-321 in *The World at 18,000 BP Volume 2: Low Latitudes*, Editors C. Gamble and O. Soffer. London: Unwin-Hyman.
- . 1972. "Where the Crow Flies Backwards: Man and Land in the Darling Basin." Unpublished Ph.D. Thesis, Department of Prehistory, Research School of Pacific Studies, Australian National University, Canberra.
- Anderson, M., J. Capel, D. Galloway, D. Holmes, G. Houghton, L. Male, S. Moss, J. Potter, B. Pyemont, P. Thorley, A. Yeomans, and G. Russell. 1984. "Aboriginal Occupation of the Lake Mungo Region During Mid-Late Holocene Times." *Quaternary Australasia* 2(1 & 2):16-23.
- Archer, David and Tony Griffin. 2002. *A Study of Visitor Use and Satisfaction in Mungo National Park*. A report prepared for NSW National Parks & Wildlife Service Far West Region. Sydney: University of Technology Sydney.
- Balme, J. 1991. "The Antiquity of Grinding Stones in Semi-Arid Western New South Wales." *Australian Archaeology* 32:3-9.

-
- Barbetti, M. 1973. "Archaeomagnetic and Radiocarbon Studies of Aboriginal Fireplaces." Unpublished Ph.D. Thesis, Australian National University, Canberra.
- . 1977. "Measurements of Recent Geomagnetic Variation in Southeastern Australia and the Question of Dipole Wobble." *Earth and Planetary Science Letters* 36:207-18.
- Barbetti, M. and H. R. Allen. 1972. "Prehistoric Man at Lake Mungo, Australia, by 32,000 Years B.P." *Nature* 240:46-48.
- Barbetti, M. and M. W. McElhinny. 1972. "Evidence of a Geomagnetic Excursion 30,000 Years BP." *Nature* 239:327-30.
- . 1976. "The Lake Mungo Geomagnetic Excursion." *Philosophical Transactions of the Royal Society of London Series A* 281:515-42.
- Barbetti, M. and H. A. Polach. 1973. "ANU Radiocarbon Date List V." *Radiocarbon* 15(2):241-51.
- Barton, C. E. 1978. "Magnetic Studies of Some Australian Lake Sediments." Unpublished Ph.D. Thesis, Australian National University, Canberra.
- Beckler, H. 1993. *A Journey to Cooper's Creek*. Melbourne: Melbourne University Press.
- Bell, W. T. 1976. "Studies in Thermoluminescence Dating in Australia." Unpublished Ph.D. Thesis, Australian National University, Canberra.
- . 1991. "Thermoluminescence Dates for Lake Mungo Fireplaces and the Implications for Radiocarbon Dating." *Archaeometry* 33:43-50.
- Boles, W. E. and A. W. McAlland. 1985. *An Inventory of the Birds of the Willandra Lakes World Heritage Region*.
- Bowler, J. M. 1983. "15 to 10KA: Southern Australia: Hydrologic Evidence." Pp. 69-71 in *Proceedings of the First CLIMANZ Conference, Feb 1-13 1981, Howmans Gap, Victoria, Australia*, Editors J. M. A. Chappell and A. Grindrod. Canberra: Department of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National University.
- . 1983. "18 +/- 2KA: Southern Australia: Hydrologic Evidence." Pp. 48-50 in *Proceedings of the First CLIMANZ Conference, Feb 1-13 1981, Howmans Gap, Victoria, Australia*, Editors J. M. A. Chappell and A. Grindrod. Canberra: Department of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National University.
- . 1984. "Australian Lakes in the Quaternary. Quaternary Studies in Australia: Future Directions." *Bureau of Mineral Resources, Geology and Geophysics Record* 14:40-46.
- . 1975. "Deglacial Events in Southern Australia: Their Age, Nature and

Palaeoclimatic Significance." Pp. 75-82 in *Quaternary Studies*, Editors R. P. Suggage and M. M. Creswell. Auckland: Royal Society of New Zealand.

———. 1980. *Geomorphologic Study, Mungo National Park*. Unpublished report prepared for the NSW National Parks and Wildlife Service.

———. 1990. "Human Occupation and Environmental Change: The Ancient Record From the Willandra Lakes." Pp. 152-61 in *The Mallee Lands: A Conservation Perspective*, Editors J. C. Noble, P. J. Joss, and G. K. Jones. Melbourne: Commonwealth Scientific, Industrial and Research Organization.

———. 2001. *Lake Mungo: Geology and Archaeology Dating Survey: Special Project. Stratigraphy, Sedimentology, Burial Ages and Environmental Evolution*. Melbourne: School of Earth Sciences.

———. 1970. "Late Quaternary Environments: A Study of Lakes and Associated Sediments in South Eastern Australia." Unpublished Ph.D. Thesis, Australian National University, Canberra.

———. 1983. "Lunettes As Indices of Hydrologic Change: A Review of Australian Evidence." *Proceedings of the Royal Society of Victoria* 95:147-68.

———. 1980. "Quaternary Chronology and Palaeohydrology in the Evolution of Mallee Landscapes." Pp. 17-36 in *Aeolian Landscapes in the Semi-Arid Zone of South Eastern Australia*, Editors R. R. Storrier and M. E. Stannard. Wagga Wagga: Australian Society of Soil Science, Inc.

———. 1986. "Quaternary Landform Evolution." Pp. 117-47 in *Australia - A Geography. Volume 1 - The Natural Environment*, 2 ed. Editor D.N. Jeans. Sydney: Sydney University Press.

Bowler, J. M. and R. Jones. 1978. "Australia Was a Land of Lakes." *Geographical Magazine* 51:679-85.

Bowler, J. M., R. Jones, H. R. Allen, and A. G. Thorne. 1970. "Pleistocene Human Remains From Australia: A Living Site and Human Cremation From Lake Mungo." *World Archaeology* 2:39-60.

Bowler, J. M. and J. W. Magee. 1986. *Geomorphology of the Willandra Lakes World Heritage Area*. A report to the Willandra Lakes World Heritage Plan of Management Committee.

———. 2000. "Redating Australia's Oldest Human Remains: a Sceptic's View." *Journal of Human Evolution* 38(5):719-26.

Bowler, J.M. 2002. *Lake Mungo: Window to Australia's Past*. Interactive CD-ROM. Melbourne University Press.

Bowler, J. M. and H. A. Polach. 1971. "Radiocarbon Analysis of Soil Carbonates." Pp. 98-108 in *Palaeopedology - Origin, Nature and Dating of Palaeosols*, Editor D. H. Yaalon. Jerusalem: International Society of Soil Science and Israel University.

-
- Bowler, J. M. and A. G. Thorne. 1976. "Human Remains From Lake Mungo. Discovery and Excavation of Lake Mungo III." Pp. 127-38 in *The Origin of the Australians*, Editors R. L. Kirk and A. G. Thorne. New Jersey: Humanities Press.
- Bowler, J. M., A. G. Thorne, and H. A. Polach. 1972. "Pleistocene Man in Australia: Age and Significance of the Mungo Skeleton." *Nature* 240:48-50.
- Bowler, J. M. and R. J. Wasson. 1984. "Glacial Age Environments of Inland Australia." Pp. 183-208 in *Late Cainozoic Palaeoclimates of the Southern Hemisphere*, Editor J. C. Voel. Rotterdam: A.A. Balkema.
- Brown, P. 2000. "Australian Pleistocene Variation and the Sex of Lake Mungo 3." *Journal of Human Evolution* 38(5):743-49.
- Cameron, A. L. P. 1899. "Aboriginal Names of Places." *Science of Man and Journal of the Royal Anthropological Society of Australasia* 2:195.
- Clark, P. M. 1987. *Willandra Lakes World Heritage Area Archaeological Resource Study*. A report to the New South Wales Department of Planning and the Western Lands Commission of NSW, Sydney.
- Clark, P. M. and M. Barbetti. 1982. "Fires, Hearths and Palaeomagnetism." Pp. 144-50 in *Archaeometry: An Australasian Perspective. Occasional Papers in Prehistory No. 14*, Editors W. Ambrose and P. Duerden. Canberra: Research School of Pacific Studies.
- Dare-Edwards, A. J. 1979. "Late Quaternary Soils on Clay Dunes of the Willandra Lakes." Unpublished Ph.D. Thesis, Australian National University, Canberra.
- . 1980. "Potential of Soil Stratigraphy." Pp. 37-38 in *Aeolian Landscapes in the Semi-Arid Zone of South Eastern Australia*, Editors R. R. Storrier and M. E. Stannard. Wagga Wagga: Australian Society of Soil Science.
- Donaldson, Karen. n.d. *Interim Report on the Significance of the W.L.W.H.A. to the Aboriginal People of Western New South Wales*. Unpublished draft manuscript.
- Donovan and Associates. 1986. *Willandra Lakes World Heritage Region Study of the European Cultural History: European Cultural History Study*. A report to the Willandra Lakes World Heritage Region Consultative Committee.
- Eldridge, D. J. 1987. *Soil Survey and Assessment of Erosion Willandra Lakes World Heritage Area*. A report to the Soil Conservation Service of New South Wales.
- . 1987. *Soils and Erosion Willandra Lakes World Heritage Area*. Draft report to the Soil Conservation Service of NSW.
- Eldridge, D.J., and Tozer, M.E. 1996. *Erosion Status of the Willandra Lakes Region World Heritage Area*. Report prepared for the Willandra Lakes Region World Heritage Property Community Management Council, Department of Land and Water Conservation.

-
- Fatchen, T. J. a. A. 1992. *Willandra Lakes World Heritage Region Draft Plan of Management*. A report prepared for the NSW Department of Environment and Planning.
- . 1985. *Willandra Lakes World Heritage Region Geomorphological Heritage Assessment of Part 'Prungle' and Part 'Benenong'*. A report prepared for the NSW Department of Environment and Planning.
- Fatchen, T. J. and Fatchen D.H. 1989. *Rabbit, Kangaroo and Goat Populations in the Willandra Lakes World Heritage Region*. A report prepared for the NSW Department of Environment and Planning.
- Feary, S. 1981. "The Potential of Freshwater Mussel Shells As Seasonal Indicators in Archaeology." Unpublished B.A.(Hons) Thesis, Australian National University, Canberra.
- Flood, J. 1983. *Archaeology of the Dreamtime*. Sydney: Collins.
- Fox, A. 1992. *Mungo National Park Guidebook*. Broken Hill: NSW National Parks and Wildlife Service.
- Fuller, N. 1985. "Archaeological Sites in the Garnpang/Gogolo and Garnpang/Leaghur Interlake Zones." Unpublished B.A. (Hons) Thesis, Australian National University, Canberra.
- Gates, G. 1986. *Groundwater Investigation at Prungle Lake in the Willandra Lakes World Heritage Region. Hydrological Report No. 1986/9*. A report to the Water Resources Commission, NSW.
- Gillespie, R. and R. Roberts. 2000. "On the Reliability of Age Estimates for Human Remains at Lake Mungo." *Journal of Human Evolution* 38(5):727-32.
- Gostin, O. 1993. *Accessing the Dreaming: Heritage, Conservation and Tourism at Mungo National Park*. Adelaide: University of South Australia.
- Green, D. R. 1988. *List of Species Willandra Lakes World Heritage Area*. A report to the Soil Conservation Service, NSW.
- . 1987. *Management Guidelines for Key Archaeological Sites, Willandra Lakes World Heritage Area*. A report to the National Parks and Wildlife Service, NSW. Sydney.
- . 1988. *Stocking Rates and Land Management Willandra Lakes World Heritage Area*. A report to the Soil Conservation Service, NSW.
- Grun, R., N. A. Spooner, A. Thorne, G. Mortimer, J. J. Simpson, M. T. McCulloch, L. Taylor, and D. Curnoe. 2000. "Age of the Lake Mungo 3 Skeleton, Reply to Bowler & Magee and to Gillespie and Roberts." *Journal of Human Evolution* 38(5):733-41.
- Hercus, L. 1993. *Paakantyi Dictionary*. Canberra: Panther Publishing and Printing.
- Hope, G. S. and J. M. A. Chappell. 1978. "Lakes of the Ancestral Darling: Work in

Progress." *Australian Quaternary Newsletter* 12:16-25.

Hope, J. H. 1978. "Pleistocene Mammal Extinctions: The Problem of Mungo and Menindee." *Alcheringa* 2:65-82.

———. 1981. "Regional Environmental Plan for the Willandra Lakes World Heritage Region." *Australian Archaeology* 20:32-36.

———. 1985. "Regional Environmental Plan for the Willandra Lakes World Heritage Region." *Australian Archaeology* 20:32-36.

———. 1983. "The Vertebrate Record, 15 - 10KA in Western New South Wales." Pp. 76 in *Proceedings of the First CLIMANZ Conference, Feb 1-13 1981, Howmans Gap, Victoria, Australia*, Editors J. M. A. Chappell and A. Grindrod. Canberra: Department of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National University.

———. 1983. "The Vertebrate Record, 18 +/- 2KA in Western New South Wales." Pp. 57 in *Proceedings of the First CLIMANZ Conference, Feb 1-13 1981, Howmans Gap, Victoria, Australia*, Editors J. M. A. Chappell and A. Grindrod. Canberra: Department of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National University.

———. 1983. "The Vertebrate Record, 25 - 20KA in Western New South Wales." Pp. 35 in *Proceedings of the First CLIMANZ Conference, Feb 1-13 1981, Howmans Gap, Victoria, Australia*, Editors J. M. A. Chappell and A. Grindrod. Canberra: Department of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National University.

———. 1983. "The Vertebrate Record, 32 +/- 5KA in Western New South Wales." Pp. 13 in *Proceedings of the First CLIMANZ Conference, Feb 1-13 1981, Howmans Gap, Victoria, Australia*, Editors J. M. A. Chappell and A. Grindrod. Canberra: Department of Biogeography and Geomorphology, Research School of Pacific Studies, Australian National University.

Hope, J. H., T. Donaldson, and L. Hercus. n.d. *The Aboriginal People at the Willandra Lakes*. Unpublished manuscript.

Hope, J. H. and B. Thom. 1974. "Lake Mungo." *Australian Quaternary Newsletter* 3:6-7.

Huxtable, J. and M. J. Aitken. 1977. "Thermoluminescence Dating of Lake Mungo Geomagnetic Polarity Excursion." *Nature* 265:40-41.

Johnston, H. 1993. "Pleistocene Shell Middens of the Willandra Lakes." Pp. 197-203 in *Sahul in Review. Pleistocene Archaeology in Australia, New Guinea and Island Melanesia*, Editors M. A. Smith, M. Spriggs, and B. Fankhauser. Canberra: Dept. of Prehistory, Research School of Pacific Studies, Australian National University.

Johnston, H and P Clark . 1998. "Willandra Lakes Archaeological Investigations ." *Archaeology in Oceania* 33(3):105-19.

-
- Jones, R. 1973. "Emerging Picture of Pleistocene Australians." *Nature* 246:278-81.
- Jones, R. and J. M. Bowler. 1980. "Struggle for the Savanna: Northern Australia in Ecological and Prehistoric Perspective." Pp. 3-31 in *Northern Australia: Options and Implications*, Editor R. Jones. Canberra: Research School of Pacific Studies, Australian National University.
- Kefous, K. 1977. "We Have a Fish With Ears...and Wonder If Its Useful." Unpublished B.Sc (Hons) Thesis, Australian National University, Canberra.
- Kellett, J. R. 1989. "The Ivanhoe Block - Its Structure, Hydrogeology and Effect on Groundwaters of the Riverine Plain of New South Wales." *BMR Journal of Geology and Geophysics* 11(243):333-53.
- Lambert, David. 1995. "Colour Monitoring." In A. Thorn and J. Brunet (eds.) *Preservation of Rock Art*, pp. 77-79. Australian Rock Art Research Association Inc, Melbourne.
- Lambert, David. 2000 *Monitoring Painting Sites*. Paper given at the Australian Rock Art Research Association Inc Conference, Alice Springs. 2000.
- Magee, J. W. 1988. "Chemical and Clastic Sediments and Late Quaternary History, Prungle Lakes, New South Wales." Unpublished M.Sc Thesis, Australian National University, Canberra.
- . 1991. "Late Quaternary Lacustrine, Groundwater, Aeolian and Pedogenic Gypsum in the Prungle Lakes, Southeastern Australia." *Palaeogeography, Palaeoclimatology, Palaeoecology* 84:3-42.
- . 1976. *The Willandra Lakes Region Southwestern New South Wales Resource Survey*. A report to the National Parks and Wildlife Service of New South Wales, Sydney.
- McBryde, Isabel. 1996. "Dream the Impossible Dream ?: Shared Heritage, Shared Values, or Shared Understanding of Disparate Values ?" *Australia ICOMOS Selected Papers: Historic Environment* 84:8-14.
- . 1997. "Past and Present Indivisible ? Archaeology and Society, Archaeology in Society." Pp. 63-84 in *John Mulvaney, the Humanities and the Public Intellectual*, eds Tim Bonyhady and Tom Griffiths. Melbourne: Melbourne University Press.
- McIntyre, M. and J. H. Hope. 1978. "Procoptodon Fossils From the Willandra Lakes, Western New South Wales." *The Artifact* 3:117-32.
- Midgley, E., Spennemann, D., and Johnston, H. 1998. "The Impact of Visitors on Aboriginal Sites in Mungo National Park." *Archaeology in Oceania* 33(3):221-31.
- Milne, A. K. and A. L. O'Neill. 1989. *Feasibility Study for Using LANDSAT Imagery to Monitor Land Cover Change in the Willandra Lakes World Heritage Region*. Report prepared by the Centre for Remote Sensing, University of New South Wales for the Willandra Lakes World Heritage Plan of Management Committee.

-
- Muhlen-Schulte, R. 1985. "Mungo Rocks. A Technological Analysis of Stone Assemblages From Lake Mungo." Unpublished B.A. (Hons) Thesis, Australian National University, Canberra.
- Mulvaney, D. J. and J. M. Bowler. 1981. "Lake Mungo and the Willandra Lakes." Pp. 180-183 in *The Heritage of Australia. The Illustrated Register of the National Estate*, Melbourne: MacMillan.
- Mulvaney, J. 1978. "Creativity in the Aboriginal Past." *Aboriginal Art in Australia*, Editor R. Edwards. Sydney: Ure Smith.
- . 1975. *The Prehistory of Australia*. Ringwood: Penguin Books.
- Neumayer, G. 1869. "Third Trip With the Victorian Exploring Expedition." Pp. 10-16 in *Results of the Magnetic Survey of the Colony of Victoria*, G. Neumayer. Mannheim: Schneider.
- NSW National Parks and Wildlife Service. 1985. *National Estate Program 1984/85 Project No. 1 Lake Mungo Artefacts Repository*.
- . 1977. *Project No. 32 Acquisition of Lake Mungo Site - \$15,000 1977/78 National Estate Program*.
- . 1988. *Willandra Lakes and Lord Howe Island. Submission for Commonwealth Funds, NSW National Parks and Wildlife Service*. Submission for Commonwealth Funds.
- O'Neill, A. L. and D. J. Eldridge. n.d. *Satellite Monitoring of Soils, Vegetation and Grazing Impacts in the Semi-Arid Region of Western New South Wales*.
- Oysten, B. 1996. "Thermoluminescence Age Determinations for the Mungo III Human Burial, Lake Mungo, Southeastern Australia." *Quaternary Science Reviews (Quaternary Geochronology)* 15:739-49.
- Pannell Kerr Forster Consulting. 1991. *Wentworth and Balranald Shires Local Tourism Plan*. Sydney: PKF Consulting.
- Pardoe, C. 1991. "Review Article. Competing Paradigms and Ancient Human Remains: The State of the Discipline." *Archaeology in Oceania* 26:79-85.
- Pels, S. 1969. "The Murray Basin." Pp. 499-511 in *Geology of New South Wales*, Editor G. H. Parkham. Sydney: Geological Society of Australia.
- Polach, H. A., M. J. Head, and J. D. Gower. 1978. "ANU Radiocarbon Date List VI." *Radiocarbon* 20(3):360-385.
- Polach, H. A., J. F. Lovering, and J. M. Bowler. 1970. "ANU Radiocarbon Date List IV." *Radiocarbon* 12:1-18.
- Powell, J. M. and M. Williams, Editors. 1975. *Australian Space, Australian Time:*

Geographical Perspectives. Oxford: Oxford University Press.

Pressey, R. 1990. *Willandra Lakes World Heritage Region Regional Environmental Study (Draft for Review)*. Sydney: NSW National Parks and Wildlife Service.

Randell, J. O. 1977. *The Pastoral Pattersons: the History of Myles Patterson and His Descendants 1882- 1976*. Melbourne: Queensbury Hill Press.

Redhead, M. 1984. "Thermoluminescence Dating of Some Australian Sedimentary Deposits." Unpublished Ph.D. Thesis, Australian National University, Canberra.

Rice, B. 1986. *Aspects of the Vegetation of the Willandra Lakes World Heritage Region*. Final Report to the NSW Department of Environment and Planning on Investigations under the National Estate Program. Sydney.

Robinson, J. 1982. "Lake Mungo: An Analysis of the Surface Collection." Unpublished M.A. Thesis, Australian National University, Canberra.

Sadler, R. A. 1985. *Fauna Study. Reptiles and Amphibians of the Willandra Lakes World Heritage Region*. A report prepared for the Willandra Lakes World Heritage Region Consultative Committee. Sydney: Herpetology Department, Australian Museum.

Shawcross, W. 1975. "Thirty Thousand Years and More." *Hemisphere* 19:26-31.

Shawcross, W. and M. Kaye. 1980. "Australian Archaeology. Implications of Interdisciplinary Research." *Interdisciplinary Science Reviews* 5:112-28.

Shawcross, W. 1998. "Archaeological Excavations at Mungo." *Archaeology in Oceania* 33(3):183-200.

Simpson, John J. and Rainer Grun. 1998. "Non-Destructive Gamma Spectrometric U-Series Dating." *Quaternary Geochronology* 17:1009-22.

Smith, M. 1985. "A Morphological Comparison of Central Australian Seedgrinding Implements and Australian Pleistocene-Age Grindstones." *The Beagle. Occasional Papers of the Northern Territory Museum of Arts and Sciences* 2(1):23-38.

Thorne, A. G. 1981. "The Arrival and Adaptation of Australian Aborigines." Pp. 393-402 in *Ecological Biogeography of Australia*, Editor A. Keast. The Hague: Junk.

———. 1980. "The Arrival of Man in Australia." Pp. 96-100 in *The Cambridge Encyclopaedia of Archaeology*, Editor A. Sherratt. Cambridge: Cambridge University Press.

———. 1977. "The Centre and the Edge: the Significance of Australasian Hominids to African Palaeoanthropology." Pp. ?? in *Proceedings of the 8th Panafrican Congress of Prehistory and Quaternary Studies, Nairobi*, editors R. E. Leakey and B. A. Ogot. Nairobi: The International Louis Leakey Memorial Institute for African Prehistory.

———. 1975. "Kow Swamp and Lake Mungo." Unpublished Ph D. Thesis, University of Sydney, Sydney.

———. 1980. "The Longest Link: Human Evolution in Southeast Asia and the Settlement of Australia." Pp. 35-43 in *Indonesia: Australian Perspectives*, Editors J. J. Fox, R. G. Garnout, P. T. McCawley, and J. A. C. Mackie. Canberra: Research Institute of Pacific Studies, Australian National University.

———. 1976. "Morphological Contrasts in Pleistocene Australians." Pp. 95-112 in *The Origin of the Australians*, Editors R. L. Kirk and A. G. Thorne. New Jersey: Humanities Press.

———. 1971. "Mungo and Kow Swamp: Morphological Variation in Pleistocene Australians." *Mankind* 8(2):85-89.

———. 1977. "Separation or Reconciliation? Biological Clues to the Development of Australian Society." Pp. 187-204 in *Sunda and Sahul. Prehistoric Studies in Southeast Asia, Melanesia and Australia*, Editors J. Allen, J. Golson, and R. Jones. London: Academic Press.

Thorne, A. G. and S. R. Wilson. 1977. "Pleistocene and Recent Australians: A Multivariate Comparison." *Journal of Human Evolution* 6:393-402.

Thorne, A. G. and M. H. Wolpoff. 1981. "Regional Continuity in Australian Pleistocene Hominid Evolution." *American Journal of Physical Anthropology* 55:337-49.

Tideman, C. R. 1988. "A Survey of the Mammal Fauna of the Willandra Lakes World Heritage Region, New South Wales." *Australian Zoologist* 24(2):197-204.

Tidemann, C. R. 1985. *The Mammal Fauna of the Willandra Lakes World Heritage Area, New South Wales*. Report to the Department of Environment and Planning, New South Wales. Canberra: Zoology Department, Australian National University.

Walshe, K. 1987. "Faunal Bone Material From the Mungo B Excavation." Unpublished B.A. (Hons) Thesis, Australian National University, Canberra.

Wasson, R. J. 1989. "Landforms." Pp. 13-34 in *Mediterranean Landscapes in Australia: Mallee Ecosystems and Their Management*, editors J. C. Noble and R. A. Bradstock. Melbourne: Commonwealth Scientific and Industrial Research Organisation.

Webb, S. G. 1989. *The Willandra Lakes Hominids*. Canberra: Department of Prehistory, Research School of Pacific Studies, Australian National University.

Webb, S. G. 2002. *Three Burials From GG16, Willandra Lakes World Heritage Region, Western New South Wales*. Unpublished Report to the NSW National Parks & Wildlife Service.

Wicks, Maurice. 2000. "Tracing the Origins of Silcrete Artefacts." Unpublished Bachelor of Arts (Hons) Thesis, Australian National University, Canberra.

Williams, D. 1987. "The Case of the Shattered Stones: An Analysis of Three Aboriginal Quarry/Reduction Sites From the Willandra Lakes World Heritage Area, South Western New South Wales." Unpublished B.A. (Hons) Thesis, Australian National University, Canberra.

Yamasaki, R., T. Hamada, and C. Hamada. 1977. "Riken Natural Radiocarbon Measurements IX." *Radiocarbon* 19:62-95.