CHAPTER 9

What Lord Kitchener and the crew of the *Coromandel* saw:
Reconstructing historic landscapes using GIS

Pam Smith and Robert Keane

A LANDSCAPE ARCHAEOLOGICAL APPROACH was adopted by the Hills Face Zone Cultural Heritage Project team in order to identify and date the occupational histories of individual sites and cultural landscapes within the study area. An objective of the three year project was to identify and evaluate the context, morphology and the arrangement of archaeological evidence in order to explain colonial settlement processes. To achieve this objective the project used a Geographic Information System (GIS) and developed the Adelaide's Hills Face Heritage GIS Database.

The use of GIS by archaeologists to reconstruct historic landscapes is relatively recent, although the number of such studies are becoming increasingly popular and standards are being implemented by a number of heritage organizations (Bell and Bevan 2006; Crumley and Marquardt 1990; Jackson 1990). The current uses of GIS by archaeologists can be grouped into three broad categories:

- Site location models. These are generally used by cultural heritage managers, for example, National Parks and Wildlife staff[1] .
- GIS procedure related studies. Possibly the most popular use of such models by archaeologists is to develop predictions through quantitative site location studies. These usually rely on independent non-cultural environmental variables (such as slope, aspect, vegetation, radiant heat, water sources etc) to predict site locations.
- Research or problem solving tool.

The Hills Face Zone Cultural Heritage Project applied all of the above uses and took advantage of the latest in spatial technologies as well as information systems and technologies.

Extensive archaeological field surveys were undertaken during this project. Thirty eight archaeological field surveys were completed by staff and students from the Department of Archaeology, Flinders University and volunteers from the wider community. In addition, 160 visits were made to private landowners to record historic cultural impacts on their properties.

As a result of these visits over 900 individual features were recorded into the GIS database. Features were primarily recorded as geographic locations and in some cases as linear or area features. A site was considered to be a cluster of features with or without artefacts (see Binford 1992:46-7). It was not possible to collect or record artefacts, although they were noted on the Site Information Proforma (SIPs) during the field surveys. Features varied from a farm complex to an isolated fence post. Only a location defined as a site was associated with historical information and photographs on the GIS database.

The synthesis of many variables, both archaeological and environmental, and the use of multiple technologies, allowed us to interpret the spatial patterns representing the processes of colonization and to develop predictive models for colonial land use.

Spatial technologies have developed considerably over the last decade and have moved from being the domain of a few geographers and researchers to a tool that many disciplines are now using. These new technologies have also proved to be invaluable in interdisciplinary studies. This project used the latest in these technologies and the best resolution datasets available. The datasets are stored in an Oracle Object Relational Database Management System and accessed via ESRI's ArcSDE spatial data engine. Data were entered into the database using both conventional GIS software, ArcGIS, as well as via a Web interface. Analysis and interpretation of the data were conducted using ESRI's ArcGIS. Though the functionality and capability of the software is important, it is the precision and accuracy of the information or data used that limits our final abilities and results. This project used some of the most advanced data collection techniques and surveying technologies available. These included Global Positioning Systems (GPS), Differential GPS (sub 1 metre), theodolite (10cm) and subsurface detectors. The data collected is stored as vector data which means that the location or spatial component is stored as coordinates in the database. A point, for example, is stored as an easting and northing, a linear object as a line made up of a series of coordinates. To this spatial data we can relate aspatial or attribute data. Some of the

other data used during the interpretive and analysis stages were raster datasets. Rasters are used to represent contiguous surfaces like elevation or aerial photography and are stored as rows and columns with each cell having a value.

The relational databases allowed us to document many datasets for each site and interpret inter- and intra- site relationships. This dictated the organization and management of the data and allowed the retrieval and display of both spatial and aspatial data, including attribute and temporal data.[2] The linking of spatial data to aspatial attributes allowed us to describe 'real world' characteristics of archaeological and geographic phenomena and to combine aspatial and spatial query criteria (Stine and Lanter 1990:80). The database also allowed us to represent the multilayered interests present in individual colonial landscapes where colonists transferred their culture, technologies and social mores to an unfamiliar landscape (Anschuetz et al. 2001:185)[3] .

The areas surveyed were within the Hills Face Zone (see the *Preface*) – an area 90 km long and varying between 5 and 10 km wide. The data collected from the archaeological field surveys were entered into the database following each survey. As the project evolved it became apparent that it would be necessary to develop classification taxonomy, rather than depending on existing databases which generally gave priority to artefact analysis, e.g. the South Functional Classification Scheme (South 1977). Features were each described by type and fabric with extended secondary descriptions where appropriate. By the end of the three-year project it was possible to query the database to obtain information relating to historic themes across the colonial landscape and spatial relationships such as inter-site and relationships between sites and the environment. It was also possible to identify temporal changes in settlement patterns and to access a range of historic and archival data or attributes for each site using historic maps, photographs and archival documents.

It was also important for researchers to link each historic site to its nineteenth century environment Sketches and paintings dating from the first decade of the colony and historic photographs and maps were used where possible. The Australian Army's 1936 aerial photographs of the study area were located and by viewing our GIS data against these images we were able to identify settlement patterns as they appeared at the end of the first century of colonisation. This combination of environmental and archaeological variables allowed us to reconstruct historic landscapes and to develop predictive models for colonial land use (see Jackson 1990:274-283). Of particular use in developing these models were the slope and aspect information and locations of permanent water supplies.

The ability to represent both spatial and temporal change across a historic landscape has long been a goal of archaeologists and anthropologists (see Sahlins 1985). As early as 1988 Langran (1988) recognized that the analysis of temporal change in spatial information should be incorporated into the design of GIS databases. We were, therefore, particularly concerned to develop a GIS database that would allow us to represent colonial temporal and spatial change and also able to recognize the diversity of cultural signatures introduced by the colonists. We were also

concerned that the database would comply with the standards archaeologists are currently attempting to establish (Bell and Bevan 2006).

Traditional representations of temporal change in a given geographic space generally view time as a linear progression (Anschuetz et al. 2001:185) and earlier archaeological models used to interpret relationships between cities and urban/peripheral centres were examined (Rubertone and Thorbahn 1985; Green and Perlman 1985), but were considered less flexible than a landscape archaeological approach that incorporated GIS applications. As Adelaide's Hills Face Heritage GIS Database evolved we grouped dates into the following ranges 1836-1870; 1870-1900, 1900-1936. Each archaeological feature was coded by the date it first entered the historic record, although it was not possible to allocate an exact date to each feature. The spread of nineteenth century settlement was then able to be graphically illustrated by colour-coding the spatial patterns. Of particular interest was the gradual spread of networks of tracks and roads across the western face of the Mount Lofty Ranges and changes in preferred location of houses and associated structures including those related to water resources such as wells, tanks, dams, water channels and races.

Many historic landscapes across the study area have been reconstructed using Adelaide's Hills Face Heritage GIS Database and several examples are presented elsewhere in this volume (see the chapters *Dry stone walls and Water Wheels: Managing Water in colonial South Australia and Two Nineteenth Century Nurseries of the Adelaide Hills,* this volume). The three models of landscape reconstruction described in this chapter and have been designed to demonstrate the flexibility and enjoyment of using GIS in archaeology.

First, we attempted to answer the following two questions:

- Lord Kitchener is reputed to have sat under the shade of a *Eucalyptus leucoxylon*, the 'Kitchener Tree', to view a mock battle staged in Sturt Gorge in 1910. How much of the mock battle could he have seen from this position?
- The crew of the *Coromandel* are reputed to have climbed a large tree, the 'Coromandel Tree', in order to see when their ship left Glenelg and sailed down the Gulf of St. Vincent. How tall would the tree have to be in order for the sea to be visible?

We then use the results of archaeological field surveys in the Brownhill Creek catchment together with environmental variables such as slope, aspect, proximity to permanent water and radiant heat, to interpret spatial and temporal changes in settlement patterns.

LORD KITCHENER AND THE EVENTS OF 1910

The twentieth century military history of Sturt Gorge is associated with the visit of Lord Kitchener in 1910 and with both World War I and World War II. In 1909-1910 the government leaders in Britain, under Andrew Fisher's new Labour administration, were considering standardising Australia's ammunition and training methods with those of Britain. Although Germany was of some concern to Britain at this time, it was considered that threats to Australia were more likely to come from Japan. During 1910 Lord Kitchener was in Australia to assess Australia's military forces

and an outcome of his visit was the transition from a voluntary militia to a new compulsory system of military training (National Archives of Australia – various). During his visit to South Australia Lord Kitchener was taken to the Sturt Gorge, south of Adelaide, where the Australian Army demonstrated its preparedness to counter an invasion by enemy forces by staging a mock battle and firing 14 lb shells across the Sturt Gorge (Smith et al. 2005; pers. com. G. de Rose).

Blacks Road, now a major road running along the ridge of Flagstaff Hill, was a dirt track in 1910 and ended near the present intersection with Botanic Avenue, Flagstaff Hill and, incidentally, adjacent to the site of the base camp used in 1838 by surveyors undertaking the Trigonometrical Survey of the Adelaide Plains under the direction of Colonel William Light.[4] The military demonstration is believed to have taken place on a ridge on the north-facing side of the valley and Lord Kitchener is reported to have sat in the shade of a small eucalypt and watched the demonstration (pers. com. G. de Rose). An unprepossessing South Australian Blue Gum (*Eucalyptus leucoxylon*) that stood on the corner of Botanic Avenue and Blacks Road, Flagstaff Hill until late in 2005, was reported to have been the tree that shaded Lord Kitchener. The 14lb shells were fired in the general direction of Blackwood and, as a child, Gordon de Rose found remnants of these shells scattered around his family's farm in the gorge. One of these shells is illustrated below.

The many depressions made by the impact of the shells remain throughout the gorge and were recorded during an archaeological field survey undertaken by the Hills Face Zone Cultural Heritage Project using a hand-held Garmin GPS. Ten depressions were located on the steep northern side of the gorge and seventeen were identified on the southern slopes of the gorge in the vicinity of the flood control dam. The Sturt Gorge is largely inaccessible at this location and it is likely that many shell impacts remain unrecorded. The areas in which the shell depressions were recorded are illustrated in *Figure 2*.

Figure 1
14lb 1910 artillery shell found in Sturt Gorge.
Reproduced courtesy of Mr Gordon de Rose.

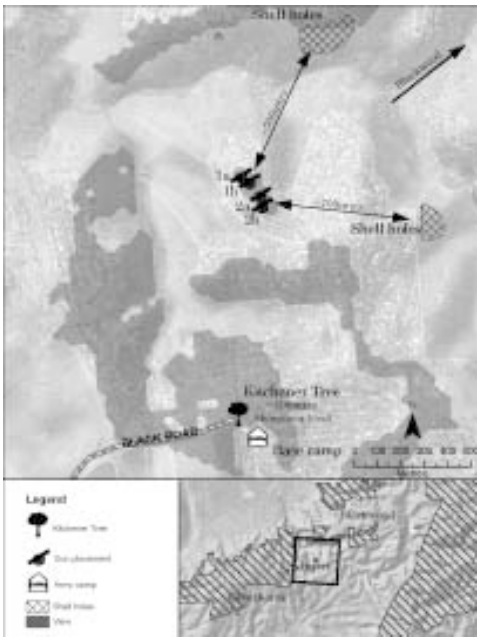

Figure 2
Aerial photograph of Sturt Gorge showing the locations of documented sites and the probable location of the artillery.
SOURCE R. Keane, GIS Consultant; Aerial Photograph by Aerometrex.

This map also illustrates the location of the Kitchener Tree and its height above sea-level. Viewscape analysis was used in order to identify the areas that would have been within Lord Kitchener's view to the north of the tree. This makes it possible to represent Lord Kitchener's view of Sturt Gorge and of the mock battle. As can be seen from the map, his view would have been limited to the ridge tops on the southern side of the valley.

Our hypothesis is that the artillery, comprising several guns, was located on the ridge tops at the locations marked 1a, 2a and 1b, 2b. This is based on the distance between position 1 and the shell holes on the northern side of the valley being the same as position 2 and the shell holes on the southern side of the valley, that is, 700 metres[5].

Based on this reconstruction, Lord Kitchener would have had a good view of the soldiers in action firing the guns from the ridgetops during the mock battle, although he would not have been able to see where the shells landed, unless he walked closer to the gorge – which he may have done.

It is probable that the artillery used to fire the 14 pound shells was similar to the artillery illustrated. This photograph was taken at the Glenthorne Remount Farm and although the date is uncertain, it is thought to date from World War I (1914-18).

Glenthorne was acquired by the Australian Commonwealth for the Australian Army in 1913 when it was known as the Glenthorne Remount Farm. At the time of Lord Kitchener's visit in 1910 the property was owned by Mr Harold Drew, however, the Australian Army are known to be using the property as a remount farm, or depot, in 1910 and it is probably that it was leased prior to being purchased. Refer to the map Happy Valley Area, a sketch plan by Major T.H. Smeaton, Glenthorne, 1910, reproduced in the chapter *Glenthorne Estate by the Field River: from Lizard Lodge to CSIRO Field Station*, this volume.

This map clearly identifies Glenthorne as an

Vale Kitchener's Tree

Black's Road was upgraded and widened during 2004 by Transport SA and at this time Transport SA applied to the Onkaparinga Council to remove a South Australian Blue gum (*Eucalyptus leucoxylon*), known locally as 'Kitchener's Tree'. Consultations between Transport SA, the Hills Face Zone Cultural Heritage Project and the Onkaparinga Council resulted in the tree being spared and a modification made to the road works proposal.

During 2005, however, a further application to remove the tree was made to the Onkaparinga Council: *Notice of Application for Category 2 Development – Development no 145/1903/2005/2M. Removal of Significant Tree on Council verge in front of no. 2 Botanic Avenue, Flagstaff Hill.*

This application was considered by the Council and an arboritist was consulted. A decision was made to remove the tree. Although the tree was found to have borers, the reason for the original application remains unknown. The Kitchen Tree was felled in late 2005.

During the discussions with Transport SA, they agreed to erect a plaque to mark the location of the tree had their application been successful. No such agreement was reached with the unknown applicant in 2005 and today the corner of Botanic Road and Black's Road is an open space and one of the more interesting markers of local history has been removed from the landscape.

Australian Army Remount Farm (later referred to as a Depot).

Glenthorne was only 3-4 km from the Sturt Gorge and the location where the mock battle took place (refer to the inset map in *Figure 3*). Glenthorne was also the closest military establishment to Sturt Gorge and it is probable that the artillery used to fire the 14 lb shells came from there.

WHAT THE CREW OF THE *Coromandel* SAW

During the first decade of the colony of South Australia many sailors are reputed to have jumped ship and lived 'rough' in the steep valleys of the Adelaide Hills until they felt it was safe to return to the city. Sailors who deserted their ships are frequently listed amongst the villains who, together with petty criminals and escaped convicts from the eastern states, held up travellers on the rough dirt tracks through the Adelaide Hills or who were cattle duffers (see Martin 1996).

The story of the sailors who deserted the *Coromandel* in 1837 is well known story – although the documentary evidence of the event is scant. The *Coromandel*, a three-masted sailing ship of 662 tons arrived at Glenelg from London on the 17th January, 1837 – only twenty two days after the proclamation of the new British colony. When the passengers disembarked a number of sailors also left the ship, apparently with the intention of staying in South Australia. By 21 January the Captain was ready to leave port, but was without a sufficient crew and a warrant was granted for the arrest of nine missing sailors. Those missing are known to have included: James Barrett, John Conend, Robert Cranson, Richard Jones, James Marshall, John Parsons, James Powell, Edward Reed and John Williams. None were apprehended, but all except Robert Cranson, surrendered on 13 March 1837, after Captain Chesser and the *Coromandel* had sailed from Glenelg. They were remanded for three days, after which they were discharged (Stark 1983; Flinders Ranges Research 2005).

Despite a lack of material evidence, the area around Star and Arrow Road, Cherry Gardens (on the eastern ridge above Coromandel Valley), is reputed to have been named after a trail of stars and arrows blazed on trees to guide the deserters from the *Coromandel,* who had made their way to Coromandel Valley by following the Sturt River. Also incorporated into local legend is the existence of a single large tree, the Coromandel Tree, located along the ridge now marked by the Star and Arrow road. This tree is reputed to have been used by the men as a look-out in order to see when the *Coromandel* and the dreaded Captain Chesser sailed south from Glenelg along the Gulf St. Vincent.

Today, when standing on the highest point of the ridge along which Star and Arrow Road runs, it seems impossible that there could have been a tree high enough for the sailors to have seen the Gulf St. Vincent. The next ridge to the west is beyond Coromandel Valley and there are several other high ridges before the ranges slope toward the plains and the sea.

As is often the case with GIS analysis, there are a number of ways to validate this local legend. In this chapter we will consider two methods. The first method is the most simplistic and includes using a Digital Elevation Model (DEM) and conducting multiple viewshed analysis until the object,

Glenelg, can be seen. This method has a number of shortfalls. First, it assumes that the trail followed the contemporary roadway. Second, the trail ended at the end of the current road. Neither of which we can be confident about. The image below shows the result of this type of analysis. It would require a deserter to be 50 metres up a tree to see the ship at Glenelg.

The second method uses the GIS to identify the locations where a view of their ship at Glenelg was possible. To achieve this we need to set a number of parameters to query the data. The parameters used are based on a most likely site description. The site would need to be relatively flat but with a steep downward slope to the Northwest. There should be no areas higher to the northwest for at least 2 kilometres and should be either within the viewshed of Glenelg or immediately south of Glenelg. The camp site would need to be quite flat and a large enough area for nine men to construct shelters, whilst not being visible from their ship at Glenelg. The parameters identified above allow us to set the following criteria for the location of the Coromandel tree:

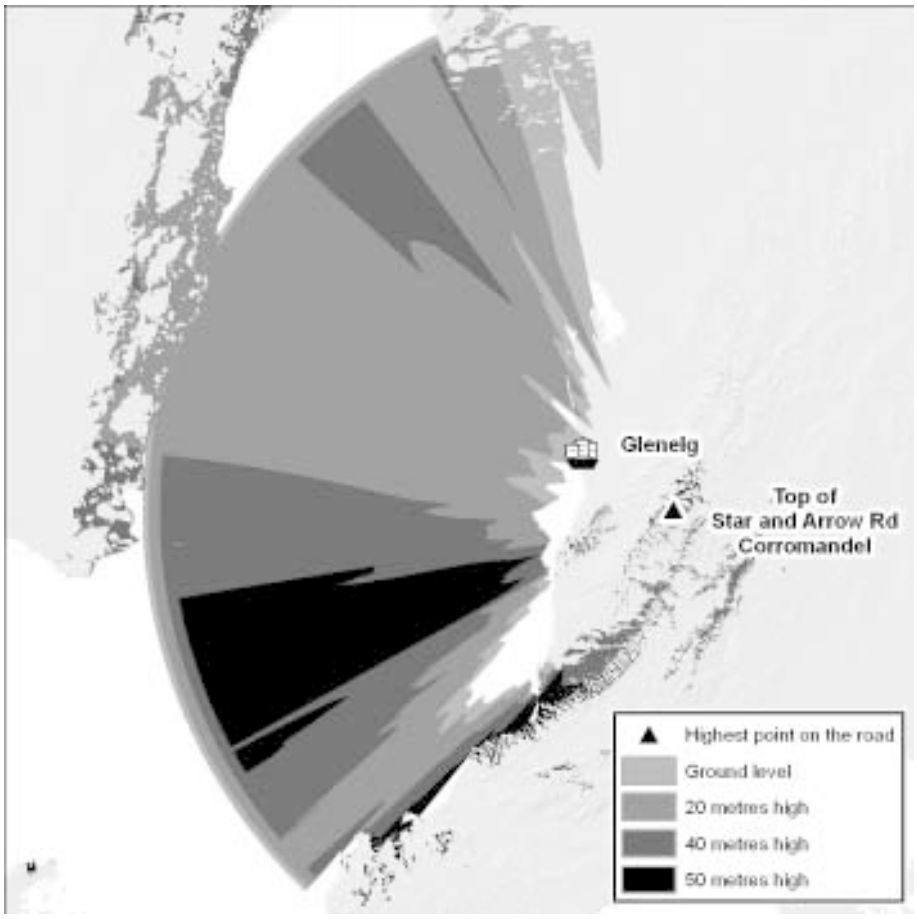

Figure 3
Viewshed analysis from the top of Star and Arrow Road. SOURCE Robert Keane, GIS Consultant

- Aspect between North and West.
- Slope of less than or equal to 4 degrees
- Steep slope to the northwest
- Maximun height for 2000 metres to the northwest
- Viewshed from the Glenelg less than 50 metres to the northwest

In addition, the criteria for the campsite would need to include:

- Slope of less than or equal to 1 degree
- Viewshed from ship not within 500 metres
- Area greater than 1000 square metres

Figure 4 shows the areas that meet the above criteria for both the tree and the camp site. As can be seen, there is only one location that meets the tree criteria and a number of sites clustered near the top of Star and Arrow road meet the campsite criteria.

Figure 5 shows the resulting viewshed for the location identified by the analysis above. It clearly shows that at this location has a clear view of Glenelg and the ship.

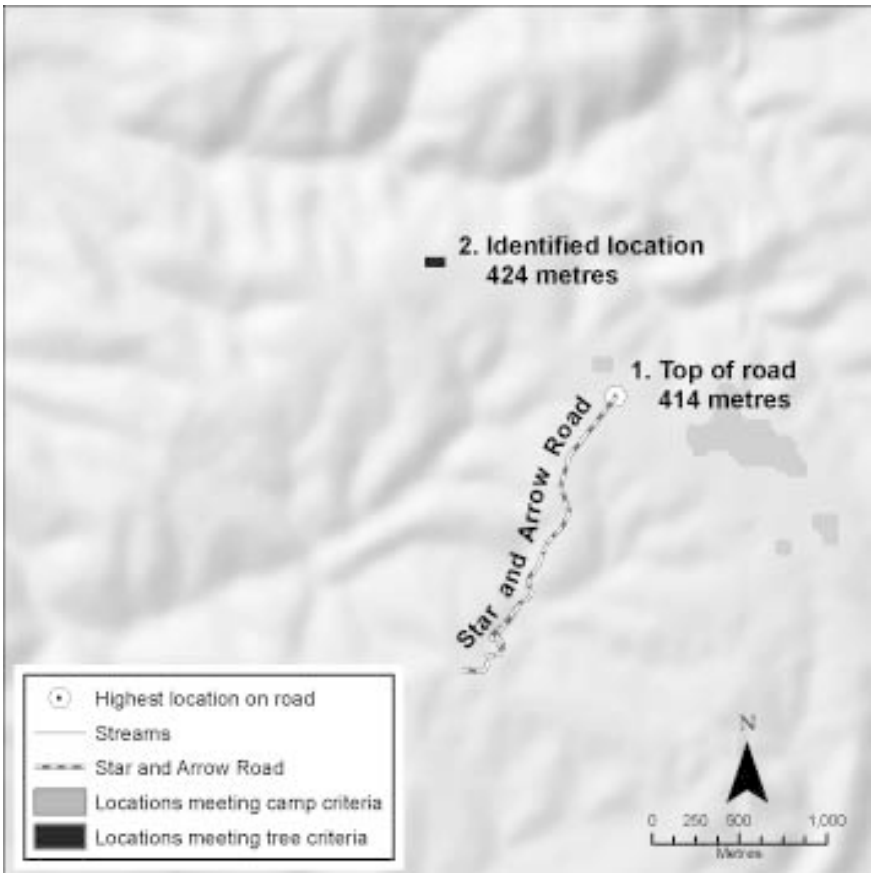

Figure 4
GIS analysis showing potential camp sites and tree locations. SOURCE Robert Keane, GIS Consultant

The top of Star and Arrow road is 1,250 metres southeast of the identified location, at 10 metres lower elevation and requires a height of 50 metres. From this we can create a formula to calculate the required height for any location between the two. First we must calculate a slope between the two locations as below where E_1 is the elevation at the top of Star and Arrow road and E_2 is the elevation at the identified location, H is the height require at E_1 and D is the distance between E_1 and E_2.

$$((E_1 - E_2) + H) / D$$

$$((414 - 424) + 50) / 1250 = 0.032$$

Now to calculate the required height at any location alone this line is as follows:

$$((E_1 - E_2) + H) \times 0.032$$

This equates to a rise of 1 metre above 424 metres for each 32 metres to the southeast. Although this is not proove the local legend, nor does it identify the location of the tree itself, it does provide

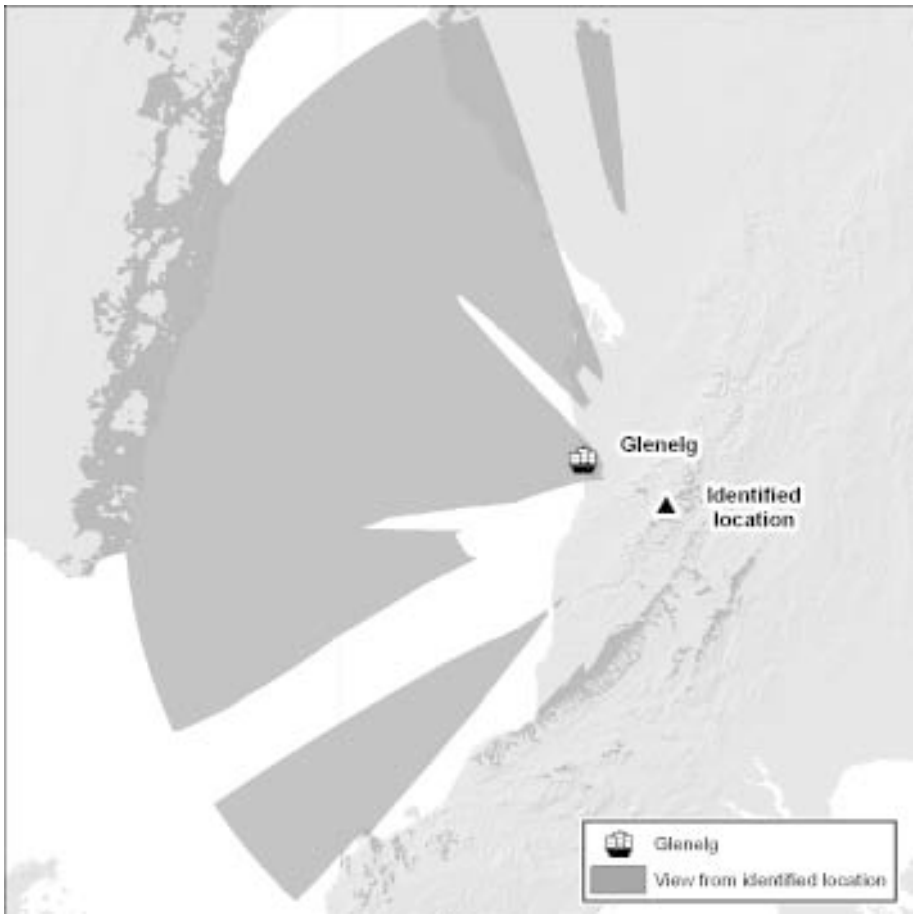

Figure 5
Viewshed from identified location. source Robert Keane, GIS Consultant

validity to the legend and demonstrates that the area identified is the only location that could meet the above criteria and provide a suitable hideaway for the deserters.

RECONSTRUCTING COLONIAL SETTLEMENT PATTERNS

Environmental data and Adelaide's Hills Face Heritage GIS Database were used to develop a spatial and temporal model of colonial settlement in the Brownhill Creek catchment, although the model could be applied to all valleys within the study area.

Brownhill Creek and its several tributaries were identified from the earliest years of the colony as containing many permanent springs and it was one of the more closely settled hills valleys during the nineteenth century. The settlement history of this region is described in the chapter, *Brownhill Creek and the Tilley Family*, this volume and, as the name suggests, it was the plentiful supply of

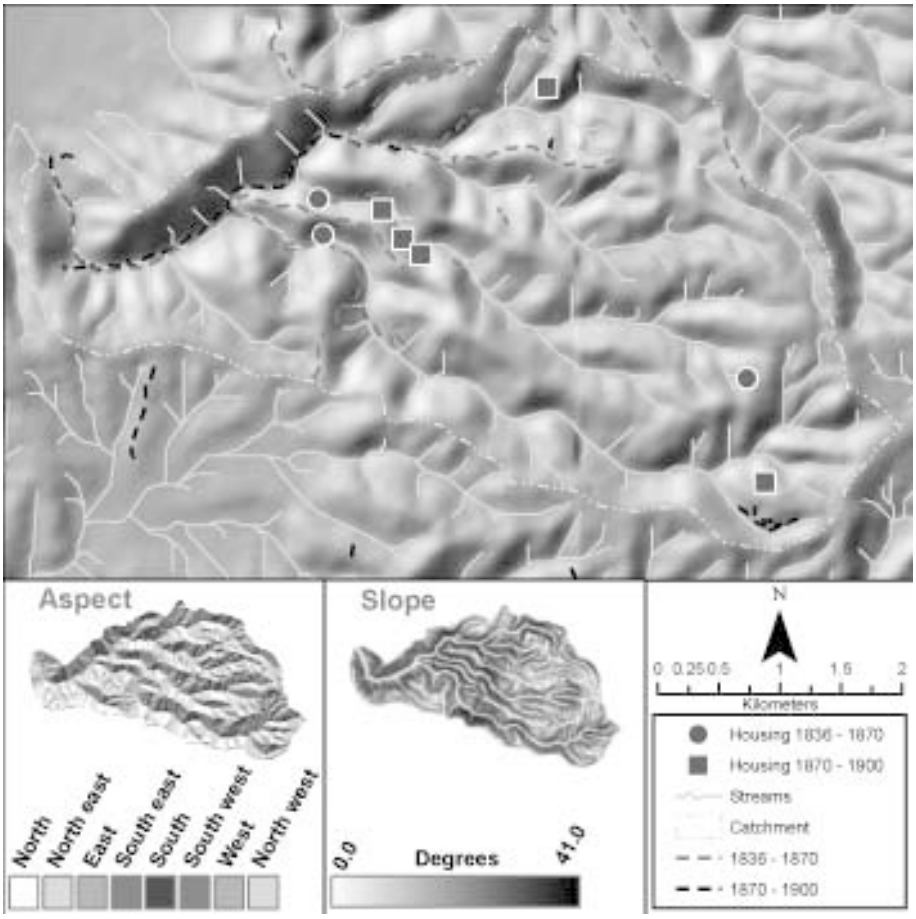

Figure 6

A map of the Brownhill Creek Catchment showing the degree of slope, the creek lines and the locations of houses constructed during the nineteenth century.

SOURCE Robert Keane, GIS consultant

permanent water and fertile soil that attracted market gardeners and orchardists into these valleys.

The nineteenth century houses and historic features along the valleys of the catchment were recorded by archaeological field surveys and the data entered in the GIS database. These features were then illustrated overlaying a 1936 aerial photograph and a number of environmental variables were measured. The most significant of variables were the degree of slope (measured by degree of slope), the aspect the feature faced (measured by compass degree) and its proximity to a permanent water supply (measured by distance in metres).

A three-dimensional image of the Brownhill Creek catchment isshown in *Figure 6*. This illustrates how the earliest cottages, those constructed in the 1836-1870 time frame, were constructed close to water. (At the completion of the project, we were able to demonstrate that, 20% of dwellings within this time period were constructed within 20 m of a creekline, half are within 50 m and more than 70% are within 100 m.) Factors taken into account in understanding this include the distance domestic water had to be carried in buckets and the usual decision to build on land that was unsuitable for market gardens or orchards, that is, land that was economically non-viable. House sites were, therefore, most frequently situated on a south-facing slope or at a rocky, non-arable location. Other environmental variables that assisted in developing a better understanding of colonial settlement included the curvature, showing that twice as many built in the valley as on hilltop, and aspect, which revealed the extent to which the northwest to east facing slopes were the areas selected for planting crops and orchards.

The structures and tracks through the valley have also been colour coded to represent time zones. This information has been based on the dates that houses were constructed, but is not able to be presented in a black and white presentation.

CONCLUSION

This chapter has explored just a few of the many possibilities that a GIS have to offer in the field of archeology and the study of historical landscapes. The examples above have also shown that even the most basic use of a GIS can yield results that would not be possible by any other means. From simple interpretations, like in Brownhill creek, to complex analysis, like the landscape modeling to identify the location of the Coromandel Tree, the GIS can provide many new insights into the past. As with all research though, the result achieve are limited by the quality of the input dataset.

This paper is the outcome of historical research, archaeological research and the application of Geographic Information Systems technology by a geographer and demonstrates the advantages of a multidisciplinary approach to the analysis of historical landscapes and their reconstruction.

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REFERENCES

Anschuetz, K.F., Wilshusen, R.H., Scheick, C.L. 2001 An archaeology of landscapes: Perspectives and directions. *Journal of Archaeological Research* 9:157-211.

Bell, T. and Bevan, A. 2006 A Survey of GIS Standards for the English Heritage Record Community. A report prepared for English Heritage by Oxford ArchDigital. www.english-heritage.org.uk/server/show/nav.2

Binford, L.R. 1992 Seeing the present and interpreting the past – and keeping things straight. In Rossignol, J. and Wandsnider, L. *Space, Time and Archaeological Landscapes*, pp.43-59. Plenum, New York.

Crumley, C.L. and Marquardt, W.H. 1990 Landscape: a unifying concept in regional analysis. In Allen, K.M.S., Green, S.W. and Zubrow, E.B.W. *Interpreting Space: GIS and Archaeology*, pp.73-79. Taylor and Francis, London

Flinders Ranges Research. 2005 Coromandel Valley. www.southaustralianhistory.com.au/coromandel.htm

Green, S.W. and Perlman, S.M. 1985 Frontiers, boundaries and open social systems. In Green, S.W. and Perlman, S.M. eds *The Archaeology of Frontiers and Boundaries,* pp. 1-9., Academic Press, New York.

Jackson, J.M. 1990 Building a historic settlement database in GIS. In Allen, K.M.S., Green, S.W. and Zubrow, E.B.W. *Interpreting Space: GIS and Archaeology*, pp. 274-283. Taylor and Francis, London

Langran, G. 1988 Temporal GIS design tradeoffs. Proceedings of GIS/LIS 1988, 2:890-899.

Martin, Robert 1996 *Under Mount Lofty, A history of the Stirling district in South Australia*, 2nd ed., District Council of Stirling, Stirling, South Australia.

Rubertone, P.E. and Thorbahn, P.F. 1985 Urban hinterlands as frontiers of colonization. In Green, S.W. and Perlman, S.M. *The Archaeology of Frontiers and Boundaries.* Academic Press, New York.

Sahlins, M. 1985 *Islands of History.* University of Chicago Press, Chicago.

Savage, S.H. 1990 GIS in archaeological research. In Allen, K.M.S., Green, S.W. and Zubrow, E.B.W. *Interpreting Space: GIS and Archaeology*, pp. 22-32. Taylor and Francis, London.

Stark, P.B. 1983 *Meadows History*. Report to the District Council of Meadows. District Council of Meadows, Meadows, South Australia.

Smith, P.A., Dennis, E. and de Rose, G. 2005 The Sturt Gorge. In Smith, P.A., Piddock, S. and Pate, F.D. 2005. Historic Sites and Landscapes: The Mitcham Hills. Reports of the Hills Face Zone Cultural Heritage Project, volume II. Department of Archaeology, Flinders University. Kopi Books, Belair, South Australia.

South, S. 1977 *Method and Theory in Historical Archaeology*. Academic Press, New York.

Stine, R.S. and Lanter, D.P. 1990 Considerations for archaeology database design. In Allen, K.M.S., Green, S.W. and Zubrow, E.B.W. *Interpreting Space: GIS and Archaeology*, 80-89. Taylor and Francis, London

ARCHIVES

National Archives of Australia. Department for Defence files CA 6 – MP 84/1, series M3612 1909-1910; series A2 1909; series A6662 1910.

NOTES

1 An Australian example of an ambitious heritage management project using GIS is Sydney University's Living with Heritage Project. See http://acl.arts.usyd.edu.au/angkor/lwh/

2 Earlier archaeological models for interpreting relationships between cities and urban centres were considered, but were considered less flexible than those incorporating GIS applications for archaeologists (Rubertone and Thorbahn 1985; Green and Perlman 1985)

3 Many mining and work camp sites provide examples of people from a diversity of cultural backgrounds working together. For example, see the box about the Railway Camps in the chapter *For Public Purposes: The Government Farm and Belair National Park 1840-1920*.

4 This map was published in 1839 by John Arrowsmith, London.

5 Inquiries into the artillery required to fire 14 lb shells in 1910 are continuing.