

Lake Wangary Cemetery Survey



1 Background

This geophysical survey of the Lake Wangary Cemetery was undertaken on April 29 & 30, 2019, with the aim of identifying locations that may contain unmarked graves.

This survey was undertaken by Andrew Frost, assisted by Ian Moffat, Tiago Attorre and Michael Everett, all from Flinders University Archaeology Department.

1.1 Site Description

The site is located on Snapper Hill Rd, Wangary, and occupies part section 670, Hundred of Wangary. The site contains some 35 grave markers in two distinct sections. The older section contains grave markers dating from 1886, including two graves that are marked “near here”.

The surface of the site was largely clear of small plants and debris, with a group of small trees in the north-west corner, a line of trees along the eastern and southern boundaries. The site surface was cleared using heavy machinery in 1984. This clearing could have inadvertently removed any unseen grave markings. There is a large bush centred in the older section. This bush interrupted the Ground Penetrating Radar (GPR) lines, and burrows from a small animal (possibly rabbit) could be seen under the lower canopy. It can be seen from the drone image (see Figure 1) that this bush could easily be masking up to four grave sites.

The soil of the site is classified within the Dept. of Environment Water and Natural Resources State Land & Soil Mapping Program (Hall et al 2009) as comprising 45% shallow calcareous loam on calcrete and 55% shallow sandy loam on calcrete. The immediate area surrounding the site is characterised by mixed farm land and typical coastal mallee shrubland.

The site survey was carried out in what proved to be the end of a particularly dry summer. The nearest weather station (Point AVOID) recorded only 22 mm of rain for the four previous months.

1.2 Site history

The site of the Lake Wangary Cemetery was proclaimed in 1882, as indicated by the interpretive sign located at the entrance of the site. Burials took place from this time until the early 1900's, and resumed again in the mid 80's. As the site was proclaimed in 1882, and the earliest grave marker is from 1886, there could possibly be an unknown number of burials that took place over the ensuing four years. A local historian has also indicated that the site may contain the graves of sealers that perished in nearby waters, date unknown. There are no indigenous graves known to be within this site.

2 Description of Methods

The geophysical methods used within this site are non-invasive and non-destructive. After processing data captured by either Ground Penetrating Radar (GPR) or Electrical Resistivity Tomography (ERT), disturbances in the stratigraphy of the soil to the target depth are sought (Conyers 2012). Often within the GPR traces the edges of any possible graves can be seen. The ERT will record changes in resistivity of the soil, with disturbed soil often showing higher resistivity, due to an increase in air space between the soil particles. Any disturbances in the stratigraphy that conform to a predefined size and shape are classified as 'probable' or 'possible'. The probable disturbances either conform in size and shape, or size, shape and proximity to both GPR and ERT picks (see section 4).

It should be noted that neither of these methods carry an absolute guarantee of success (Bevan 1990), and that for the geophysical prospection of individual graves there are no clear cut guidelines (Sarris & Papadopoulos 2012).

2.1 Ground Penetrating Radar (GPR)

Ground Penetrating Radar (GPR) is one of the most favoured methods to map burial sites, as it can map both physical and chemical changes in the ground. The GRP uses electromagnetic radiation found in the microwave band (typically 10 MHz to 2.6 GHz) to send pulses into the subsurface profile, these are reflected off sub-surface discontinuities. The GPR unit comprises of both transmitter and receiver antennae. The returning pulses are measured in elapsed travel time.

2.2 Electrical Resistivity Tomography (ERT)

Electrical Resistivity Tomography, or ERT, has become, since the 1970's, a popular and efficient method to search for underground targets, such as groundwater, subsurface cavities, faults and fissures, and in an archaeological context, buried foundations and burial sites (Reynolds 2011). ERT sends a low-frequency current between electrodes, the spacing is sequentially increased by the

controlling computer. The depth of the scan is dictated by the distance between electrodes. The relative electrical conductivity between each pairing of electrodes is measured, with the conductivity changing according to the subsurface materials the current passes through.

This survey used a FlashRes 64 ERT unit, with 120V used for all survey lines. ERT line 1 used an electrode spacing of 0.25 m, all other ERT lines used an electrode spacing of 0.5 m.

3 Data Acquisition

3.1 Survey Design

Seven survey grids were setup in the older section of the site. Grids one through six were based on a datum that ran the length of the survey site, and separated the old and new sections. Grid seven extended grid six into the new section. Two extra grids, grid 8 & 9, were located adjacent the site to the north of the access road. All points within the survey sites 1 –7 were captured using a Leica TS16 total station, in conjunction with a GNSS Smartnet antenna GPS, points within grids 8 and 9 were not captured due to inclement weather.



Figure 1: Overview of grids within the Lake Wangary Cemetery

3.2 Ground Penetrating Radar

GPR scan lines were set at 0.5 m for all grids. Grids 1, 6 & 7 were scanned in a north – south orientation, the remaining grids were orientated east – west. Sample frequency was set at 450 MHz,

trace interval was 1cm. As the surface of the site was clear of debris all GPR traces were carried out in a straight forward manner.

3.2.1 GPR Data Process

The ground penetrating radar data was processed using the ReflexW v9.0.5 data processing software. In all 187 radar scan lines were processed. A standard process flow was applied to all traces.



Figure 2: Location of Grids 8 & 9.



Figure 3: Overview of GPR trace lines.

3.3 Electrical Resistivity Tomography

Four ERT lines were set through the old section of the site. Line 1 ran east – west through existing graves in Grid 5. Lines 2 and 3 ran north – south through Grids 1,3,5 & 6. These two lines were surveyed in two parts, these parts became 1, 1A and 2, 2A. Line 4 was partially incomplete, as due to inclement weather part two was not surveyed. Electrode spacing was set at 0.25 m on line 1, with a 0.5 m spacing used in all other lines. All lines used the Wenner as well as the Dipole – Dipole protocols, with a voltage of 120, 1 sec. on. 0.2 sec off.

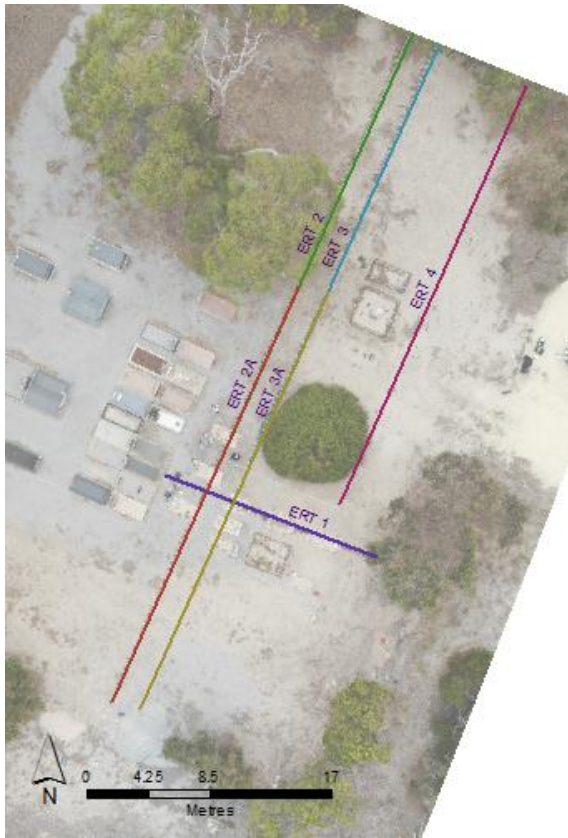


Figure 4: ERT survey lines.

3.3.1 ERT Data Process

Raw ERT data was processed using the Res2 software. All Dipole – Dipole protocol data was filtered to remove noise.

4 Data Analysis

4.1 Ground Penetrating Radar

187 radar scans were processed. In total 116 breaks in stratigraphy were identified. Once spatially displayed within a GIS these 'picks' were assessed for their spatial relationship to adjacent picks. Picks that conformed spatially to an approximate 1.8 m x 0.7 m rectangle were marked as possible grave sites. Of note was the presence in nearly all GPR scans of a stratigraphic layer between 1 and 2 m in depth. This layer was interpreted as being an underlying calcrete layer (see Figure 6).



Figure 5: Stratigraphic breaks identified by GPR.

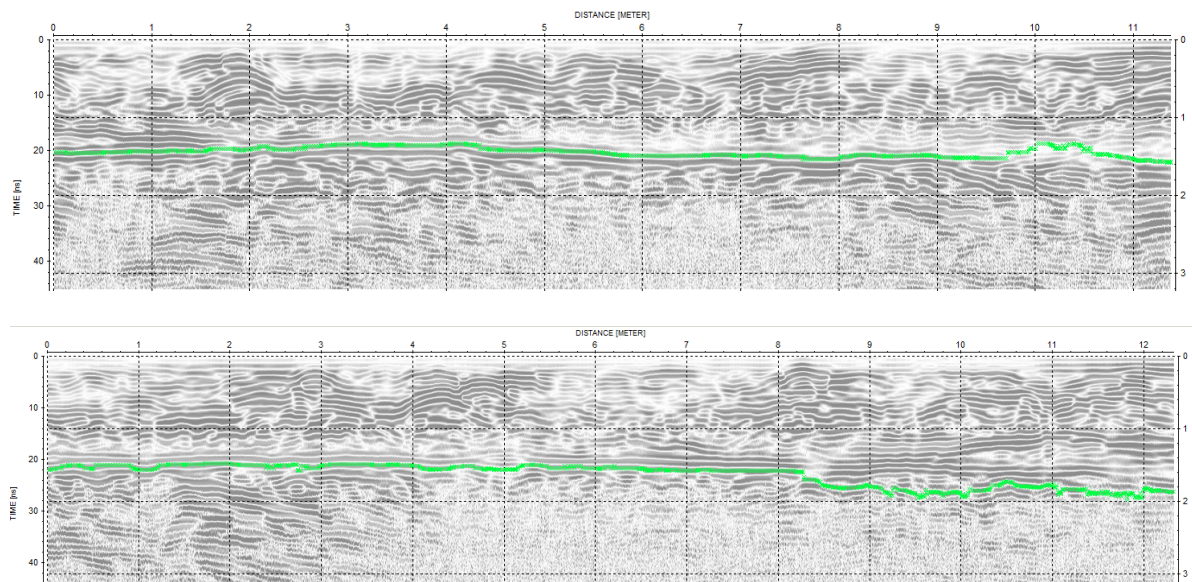


Figure 6: Possible calcrete layer identified by GPR.

Of note within the GPR picks is the possible location within grid 2 of a possible gravesite adjacent to the site marked “Hull, nee Barnes”.

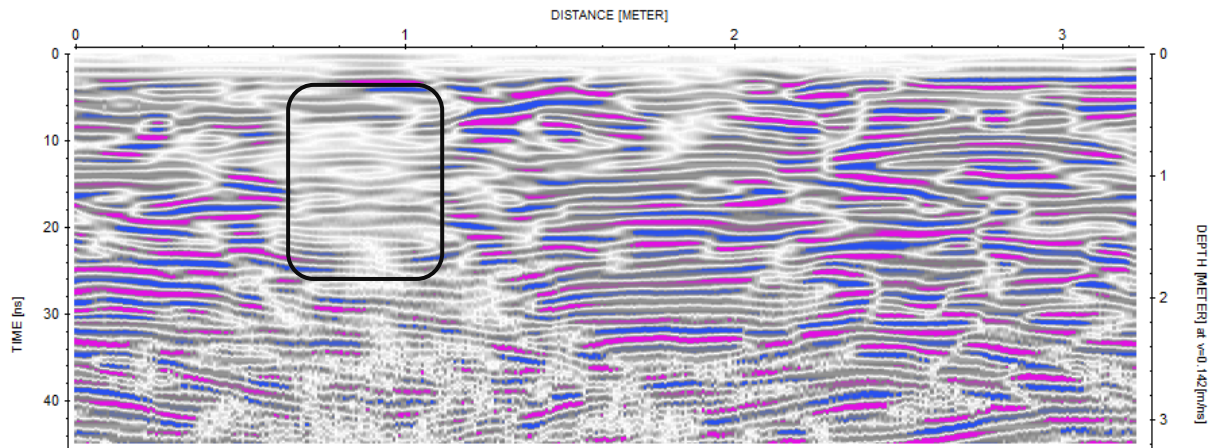


Figure 7: Stratigraphic break in Grid 2 adjacent gravesite of "Hull".

4.2 ERT

Six ERT scanlines were processed, in total 63 areas of interest were identified. ERT line 1 ran east – west through existing graves. These graves showed quite clearly in the Wenner protocol scan of line 1 as areas of high resistivity, (see figure 7).

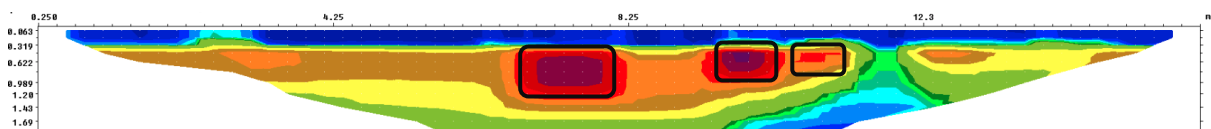


Figure 8: ERT inversion of line 1. Existing graves highlighted in black.

Lines 2, 3 & 4 ran in a north – south orientation through grid 1. These three survey lines returned 32 areas of high resistivity, and this corresponds to the number of picks identified by GPR. Also of note is the high resistivity reading as line 3 passes by the large bush located within the survey area. This area could indicate the location of the burrow, as noted above.

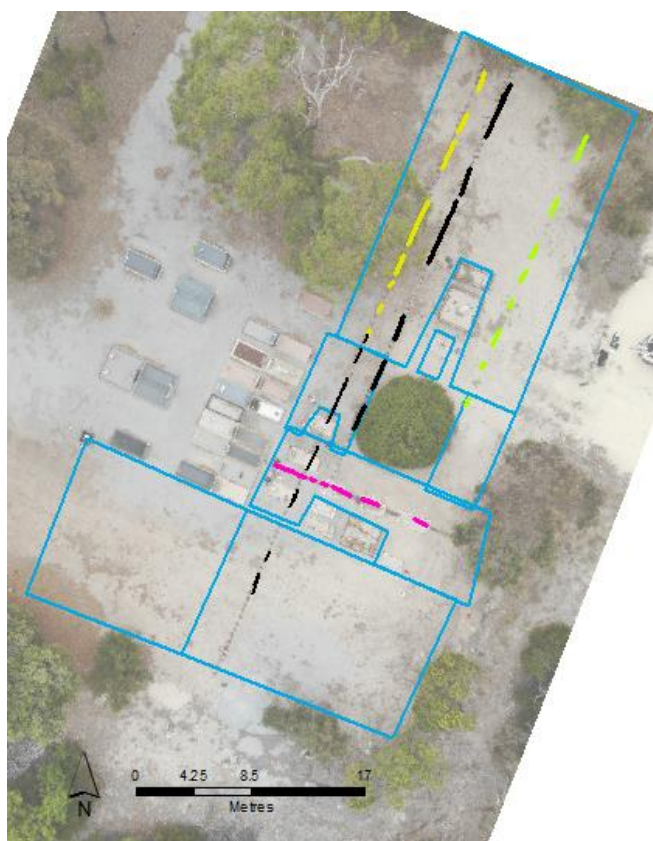


Figure 9: ERT stratigraphic disturbances.

5 Conclusions and recommendations

63 occurrences of stratigraphic disturbances were identified by the ERT survey, and a further 125 occurrences were identified by using the GPR. Of these 125 GPR picks 76 were located in grid 1, with a further 25 located in grid 6. Inclement weather prevented further ERT survey along line 4, completing this ERT line would give the opportunity to offer further surety to the GPR picks that were identified in grid 4 and Grid 6.

Of these 188 combined stratigraphic disturbances a total of 23 probable grave sites were identified, with a further two sites being classed as possible. The probable graves in grid 1 could have occurred in the four years between proclamation and first recorded burial. Children's graves are hard to identify, due to the reduced area of stratigraphic disturbance, and so it is worth noting that no children's graves were identified in this survey. It would not be unlikely that some of the disturbances in grid 1 are, in fact, the burial sites of children, given the high infant mortality rate of the late 19th century. Further investigation and methodology refinement is required to further this knowledge.

It is suggested that if possible, a further ERT survey is carried out, firstly to extend the ERT line 4, and to further survey grid 1. As noted previously, this survey was carried out at the end of a particularly dry period, and so it would be of interest to resurvey part, or all, of this site, to compare the effects that soil moisture have in the methods employed.

It is also suggested that if more precise methodologies are developed in the coming years, these methods could be employed to reassess the findings of this report.

An electronic version of this map can be found here: <http://arcg.is/0zGyi5>



Figure 10: Probable and possible burial sites within the survey grids.

References

Bevan, B.W. 1991, 'The search for graves', *Geophysics*, vol. 56, no. 9, pp. 1310 – 1319.

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