

Searching for the Beaumont Children and other adventures in unmarked graves



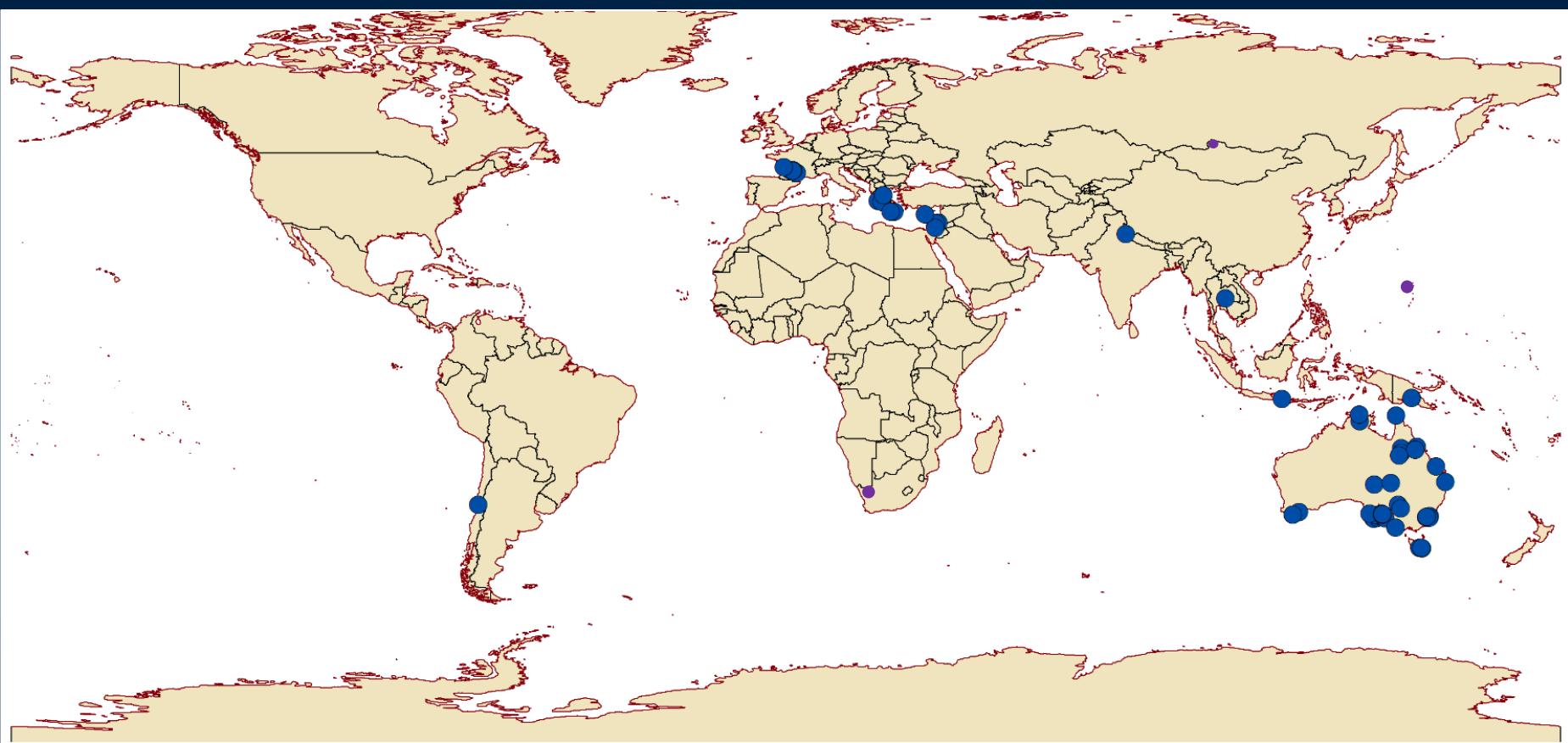
Dr Ian Moffat
Flinders University

Who am I?

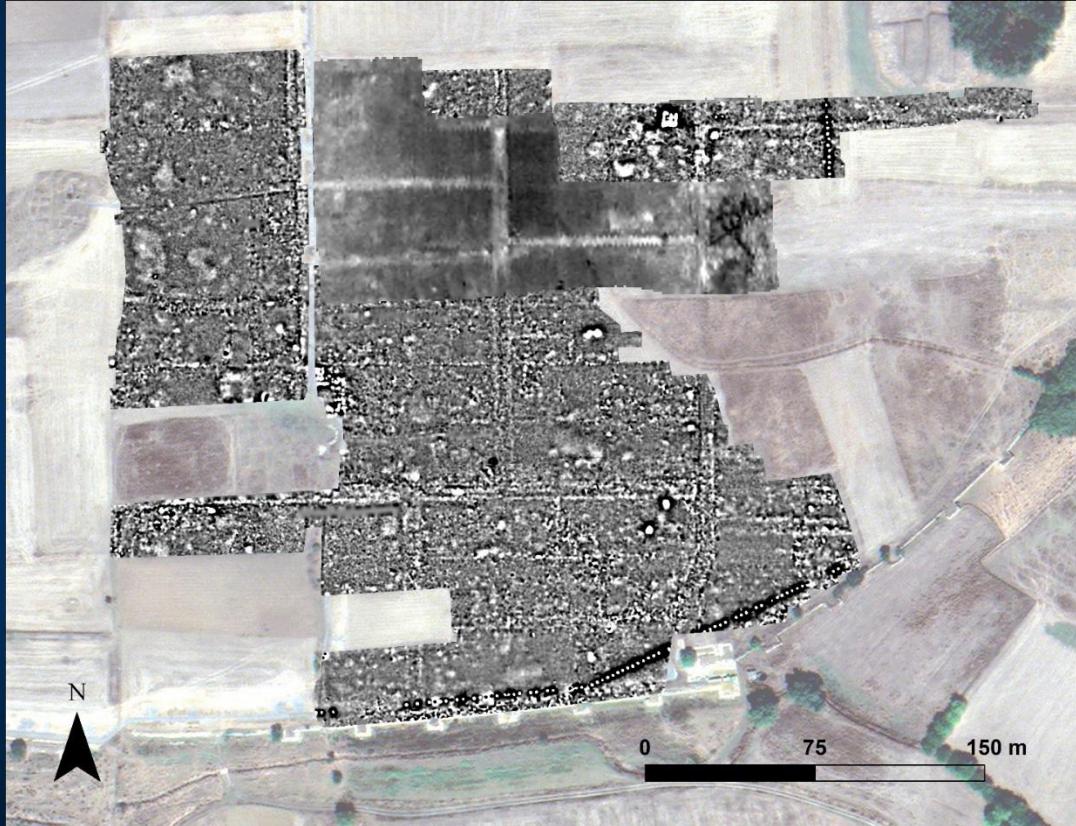
- ARC DECRA Senior Research Fellow in Archaeological Science at Flinders University
- Former Commonwealth Rutherford Fellow at the University of Cambridge
- Former Postdoctoral Researcher at IMS-FORTH in Crete
- PhD from ANU in archaeological geochemistry
- BA (History and English) and BSc (Hons) (Earth Science) from UQ



Where do I work?



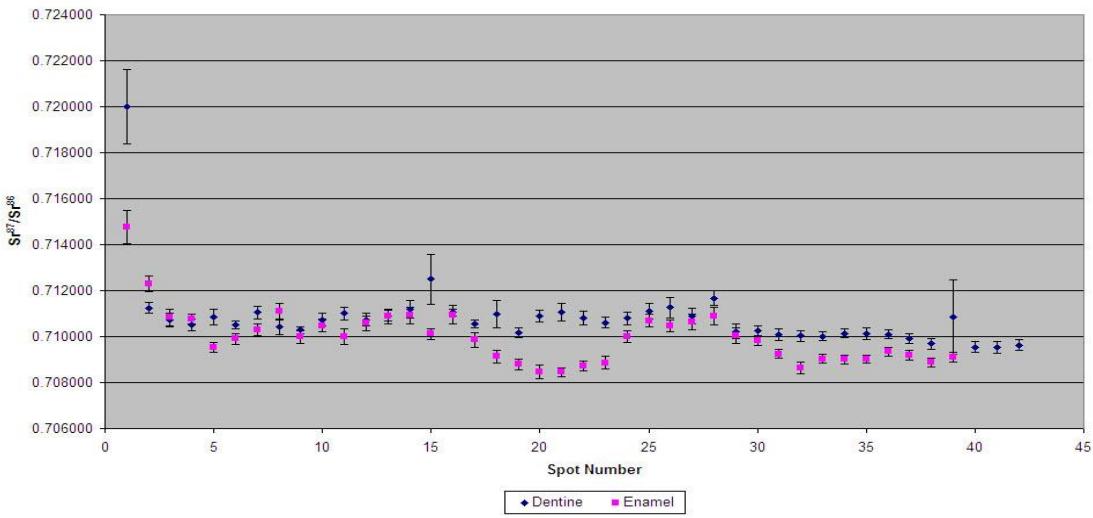
Landscape Scale Digital Archaeology



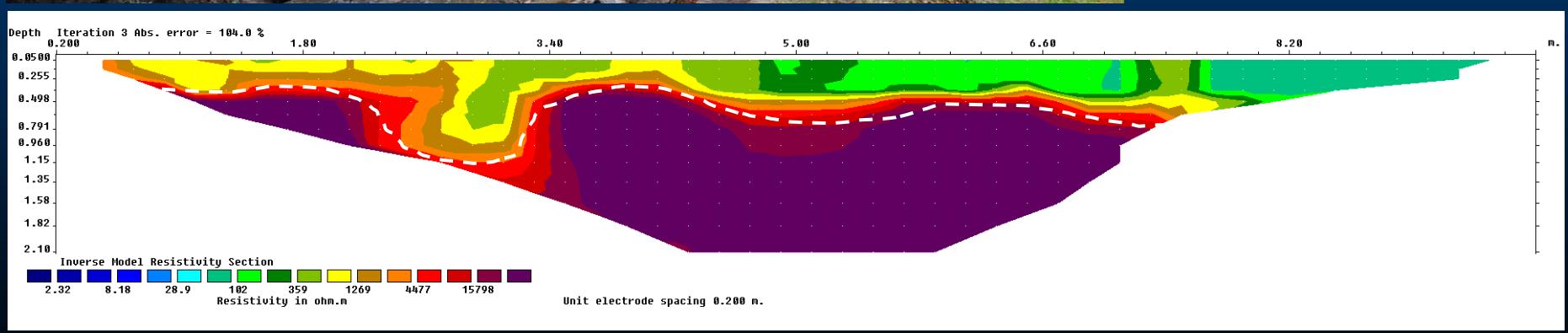
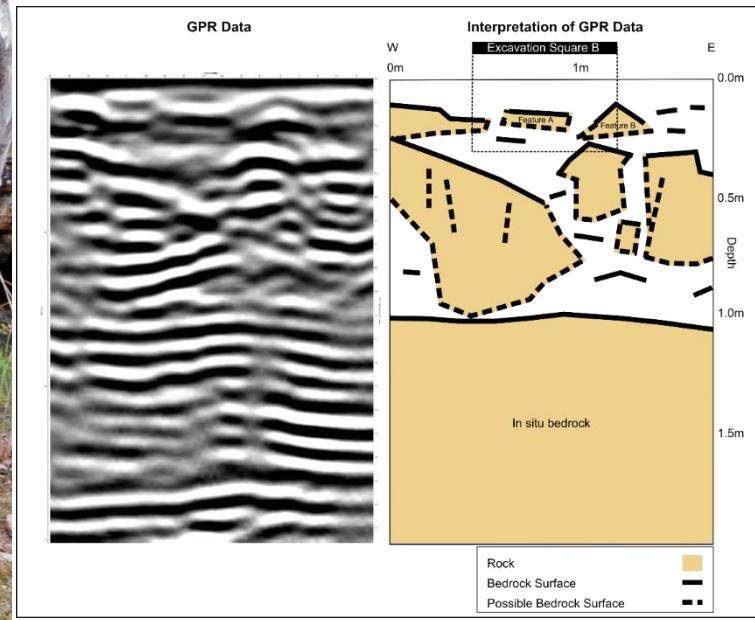
Geochemistry of Biogenic Carbonates



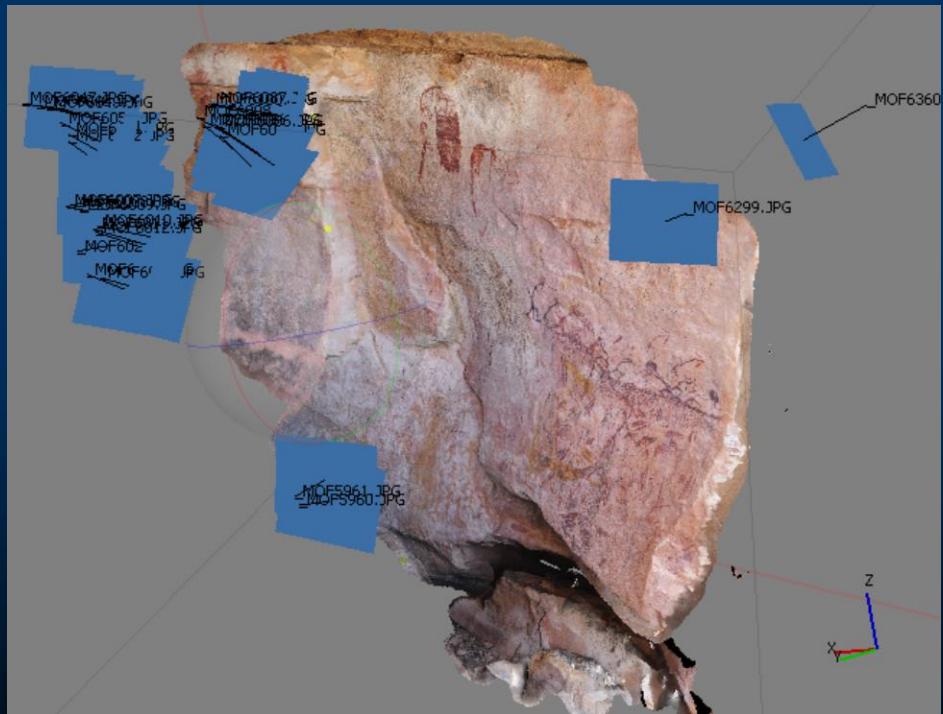
Sample 852, Skhul, Israel



Understanding Archaeological Caves



3D Modeling of Archaeological Sites



Burials are a Critical Research Challenge

Mapping unmarked graves in cemeteries

Locating areas for repatriation

Forensic investigations

Development surveys

There are ~50,000 unmarked graves in West Terrace Cemetery alone....

Is geophysics the solution?

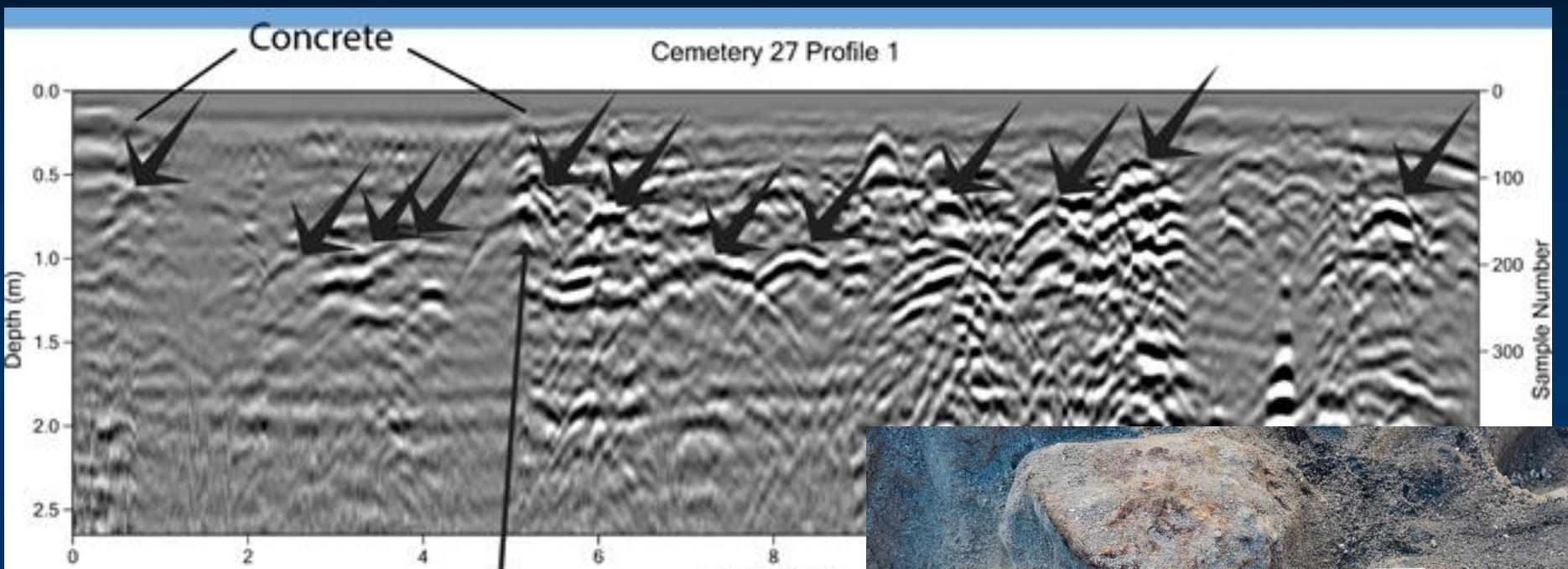


The Bad News....

- The direct detection of skeletal material with geophysical techniques is almost impossible

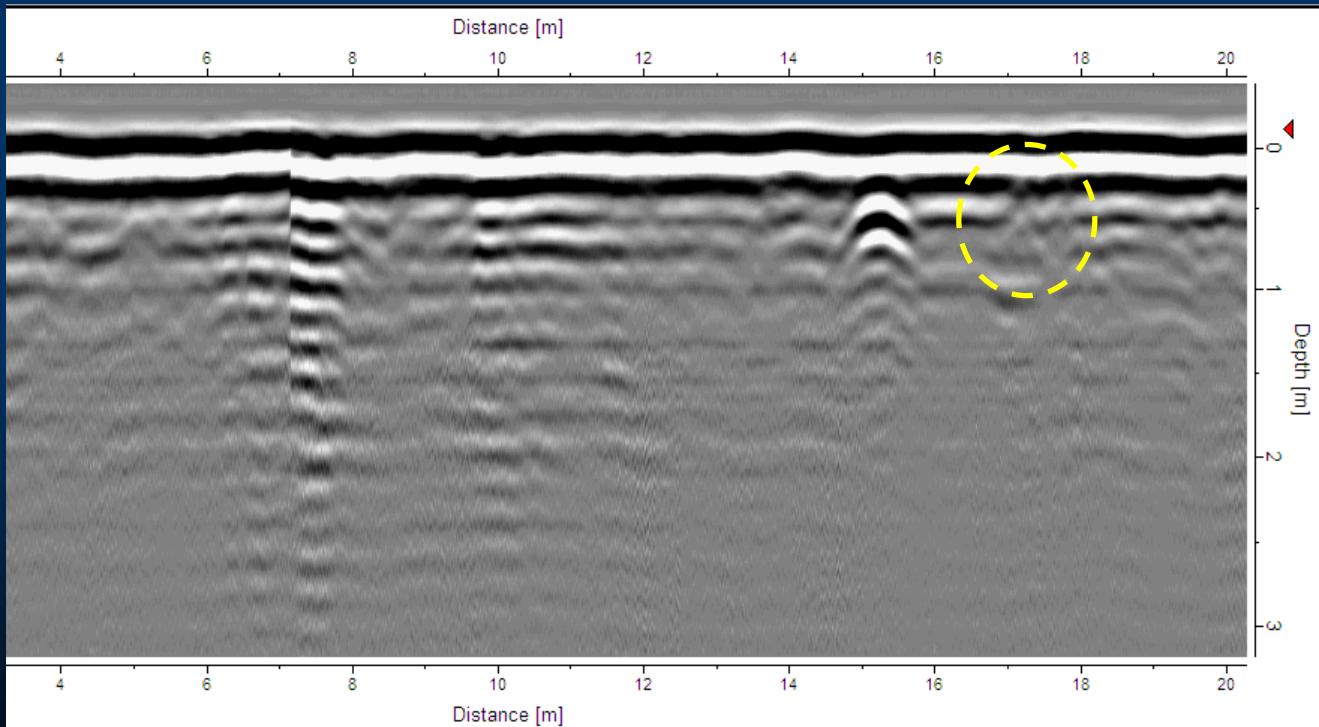


Can you find me a bone detector?



Geophysics for Burial Detection

- Most geophysical methods detect soil disturbance or material culture items associated with burials

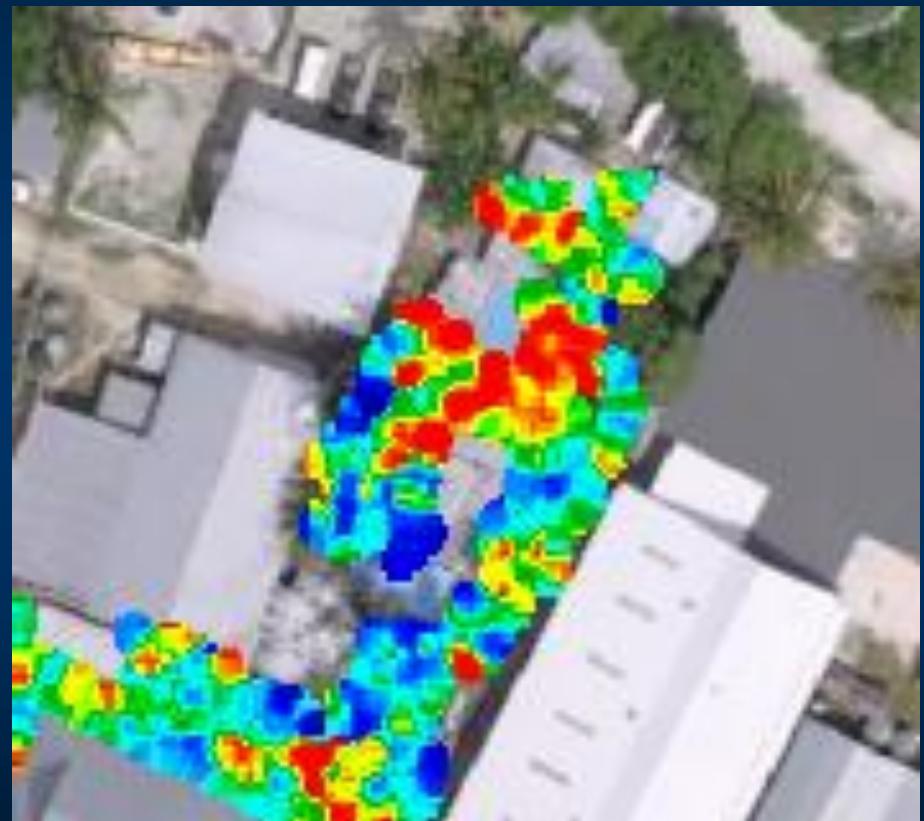
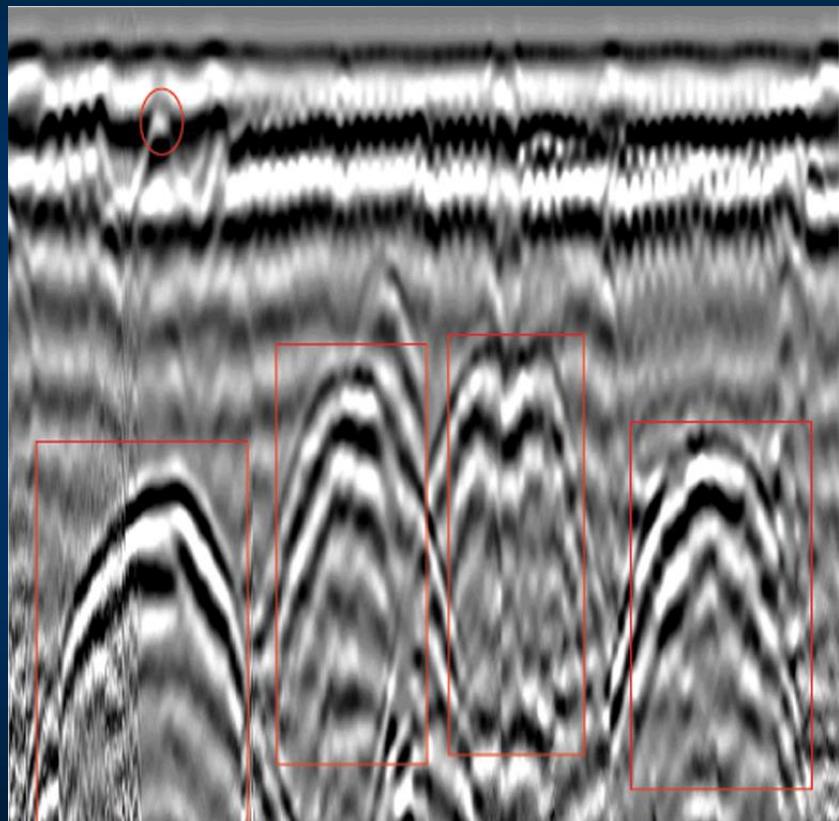


Ground Penetrating Radar (GPR)

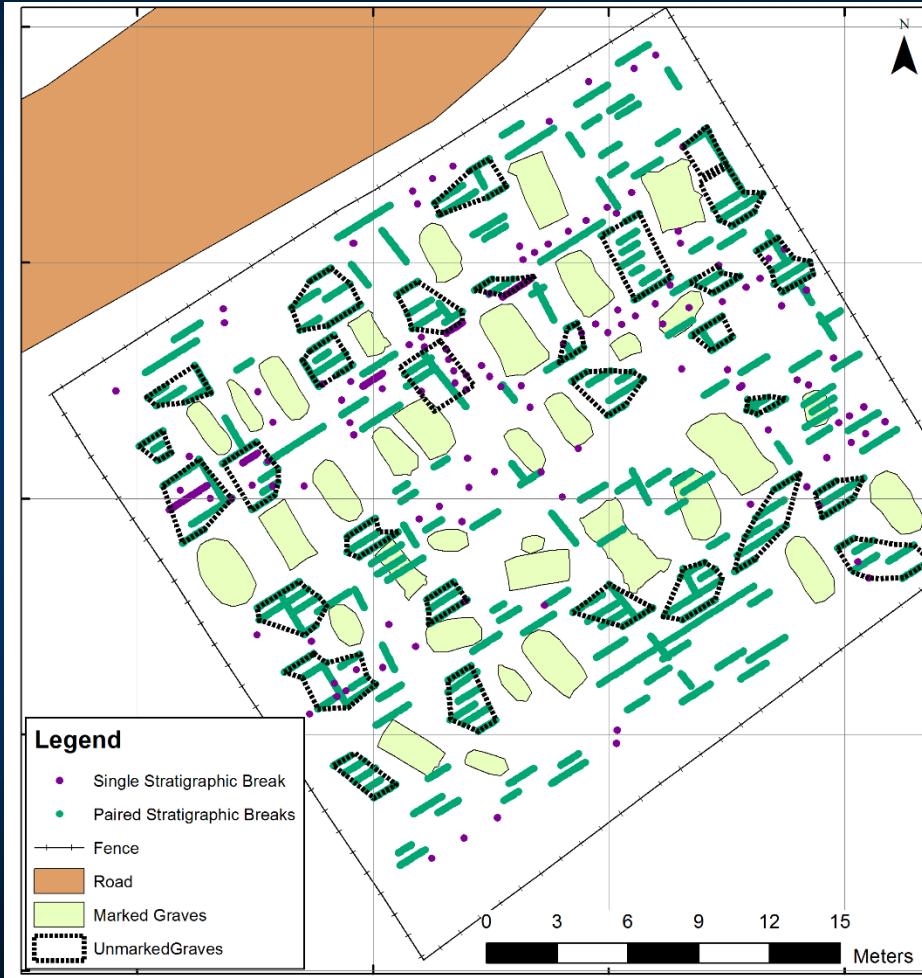
- Measures dielectric permittivity (effectively conductivity) of the subsurface
- Detects most forensic and geological features
- Produces 2D or 3D data
- Processing intensive but produces high value data



2D and 3D GPR



GPR Grave Mapping



Electrical Resistivity Tomography

- Measures the resistance of the subsurface in profiles or as 1D soundings.
- Practically approximately 70m penetration in urban areas dependent on electrode spacing and array length.
- Electrode spacing governs possible target size.
- Expensive because of slow line kilometer rate and requires specialist interpretation.



Resistivity

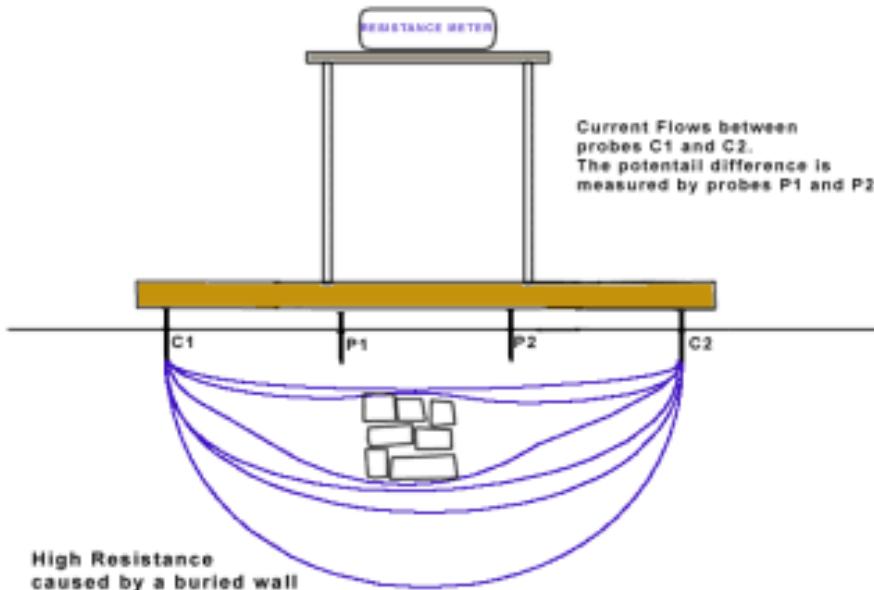
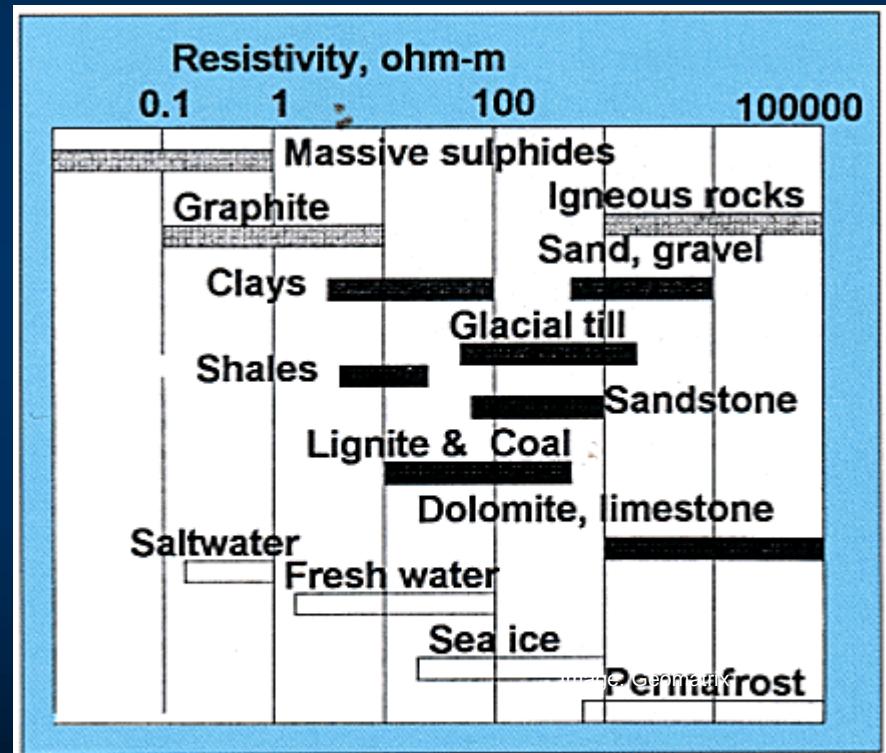
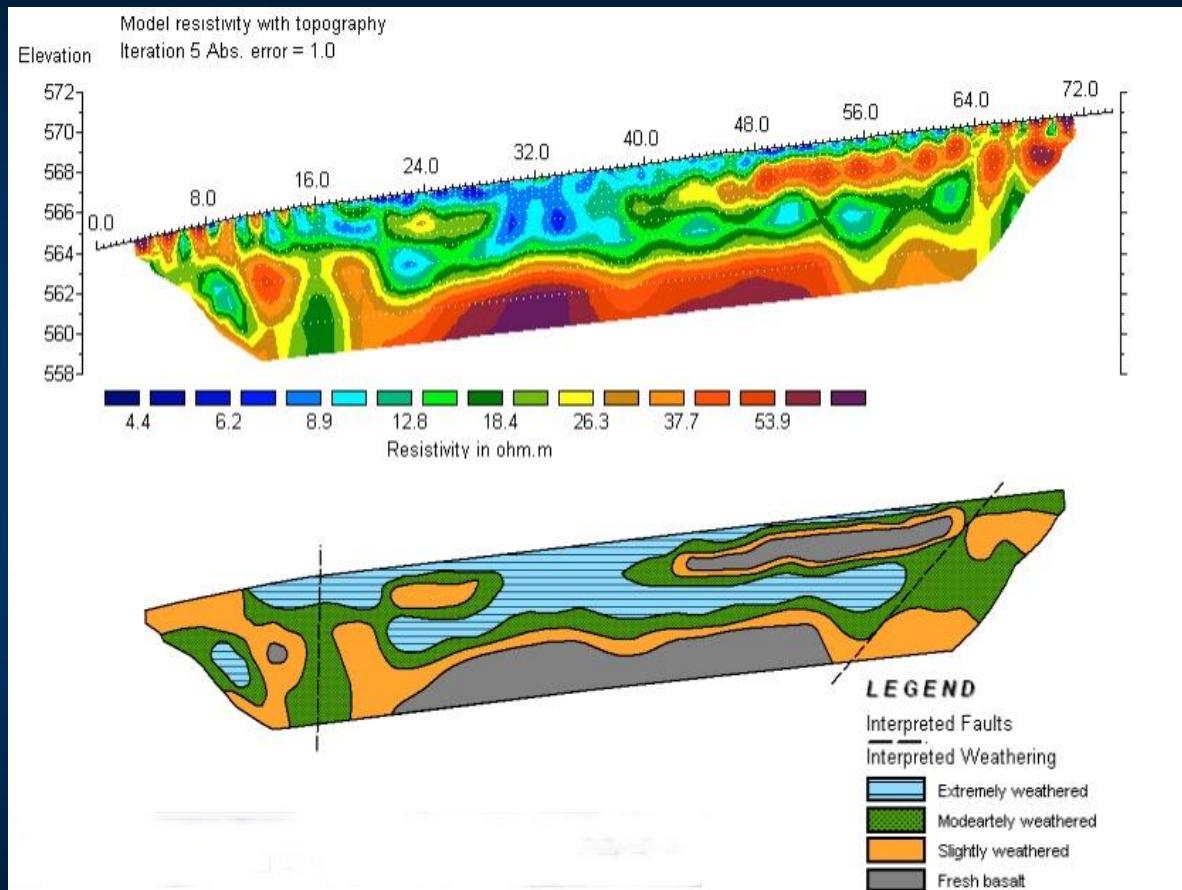


Image: J.M. Leigh Surveys

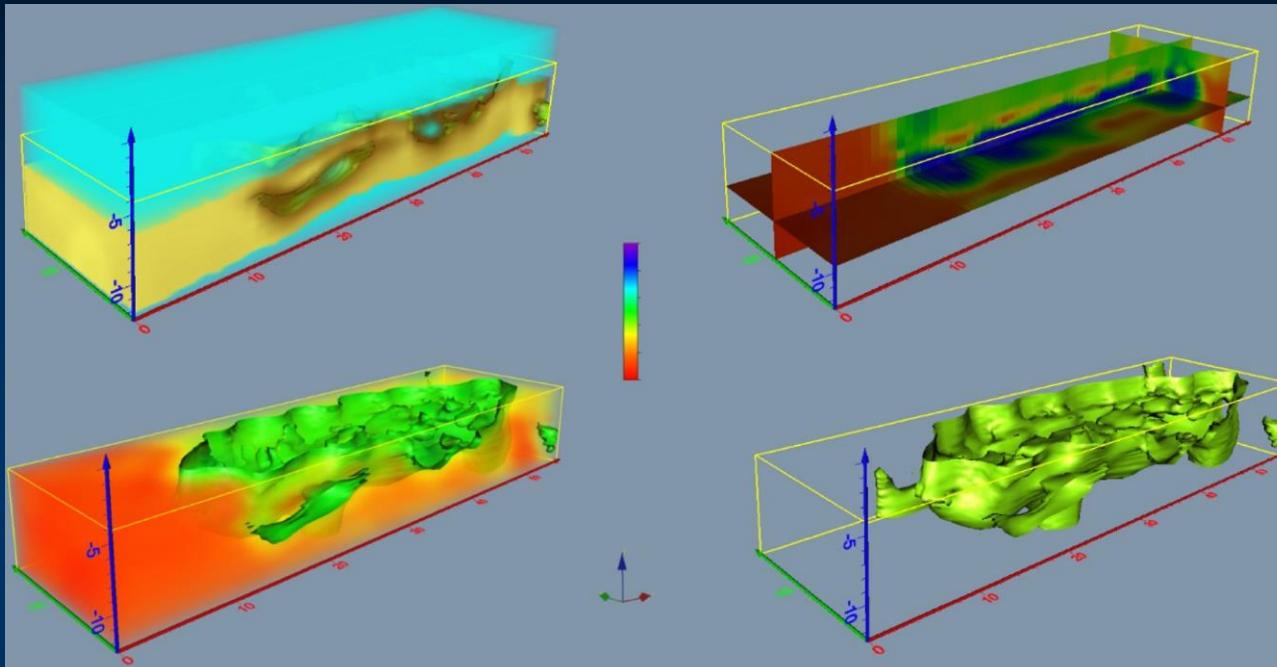


Approximate electrical resistivity ranges for different types of rock, soil and water

2D ERT



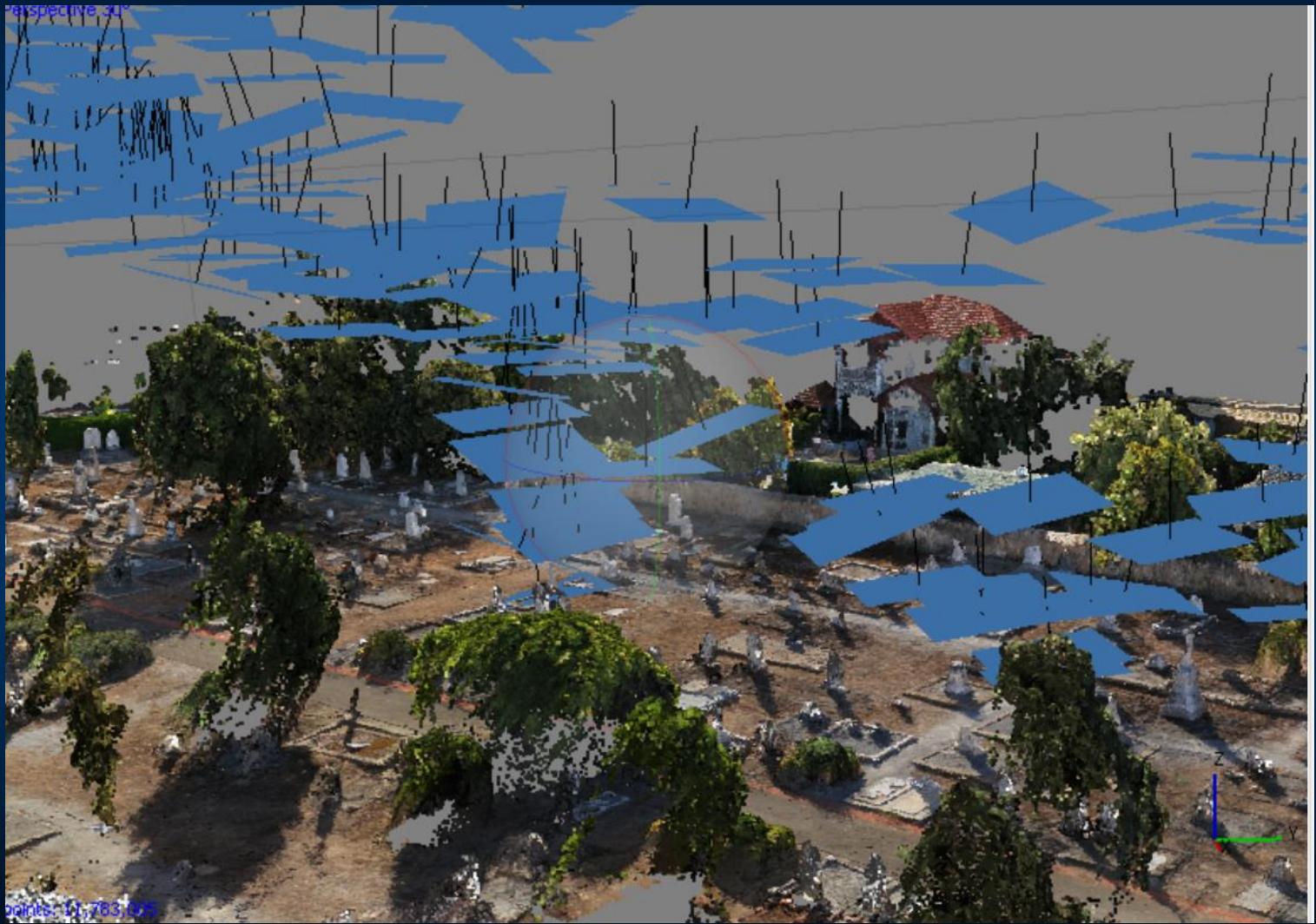
3D ERT



Mapping the graves

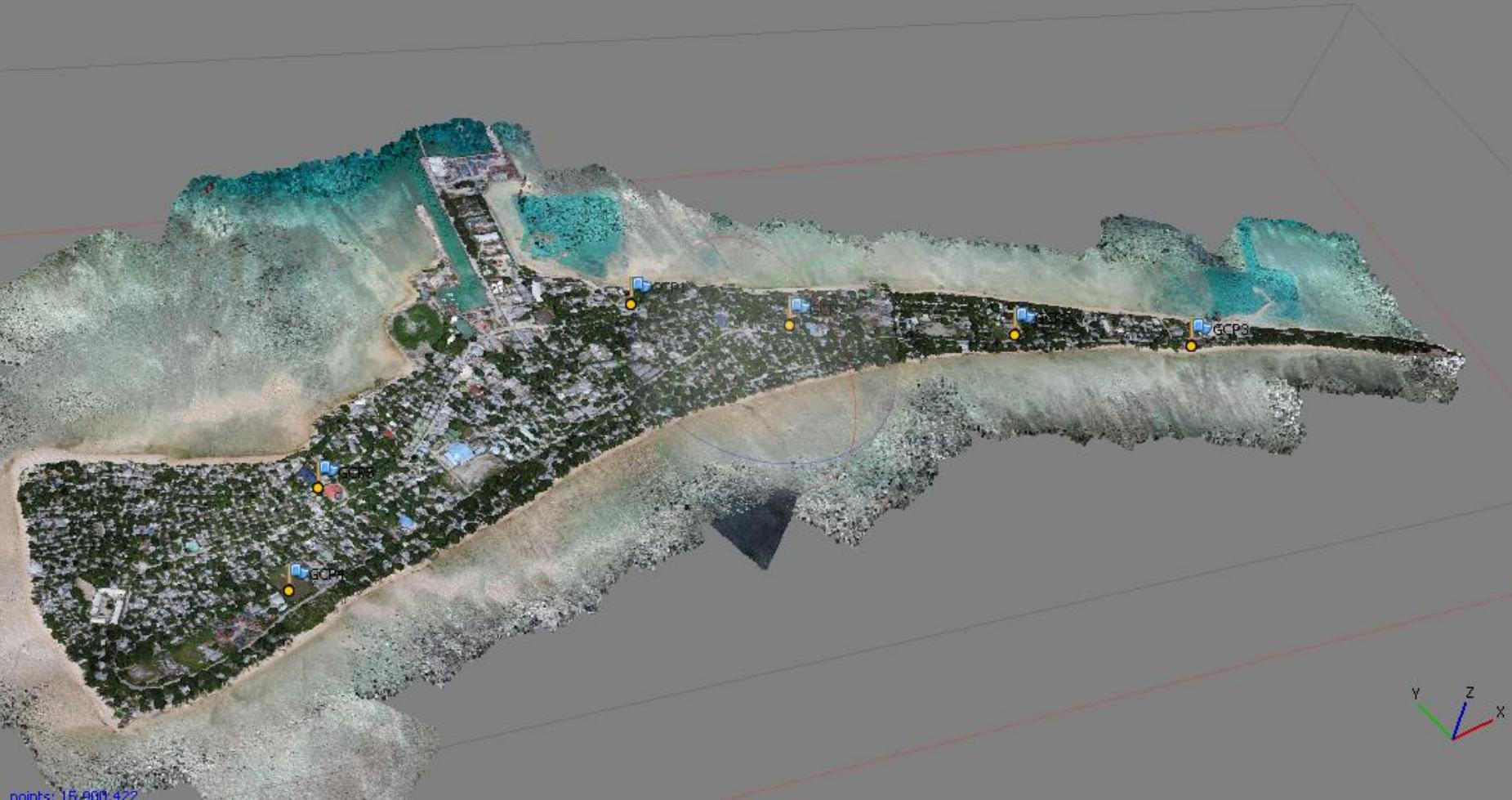


SFM Photogrammetry



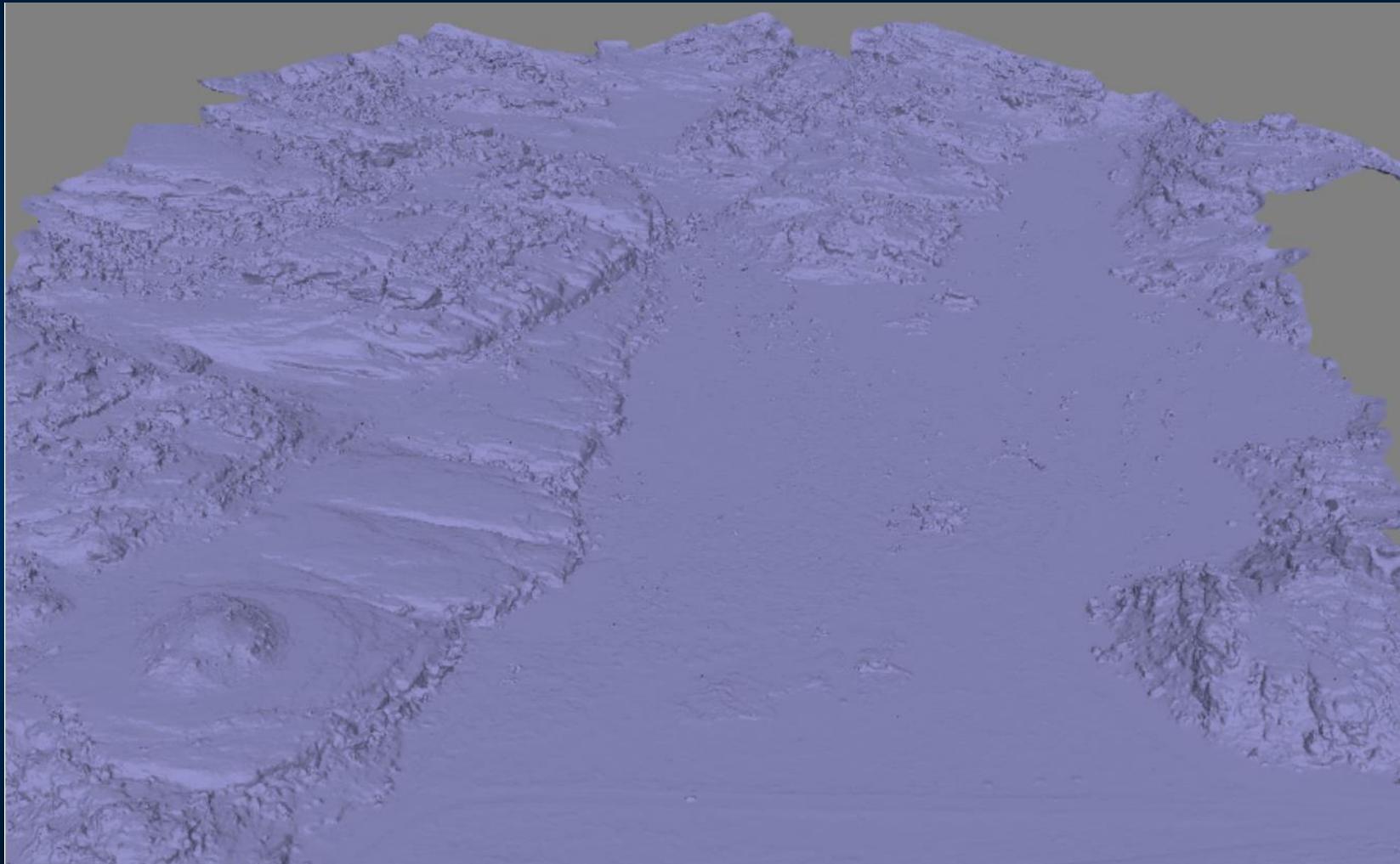
SFM Photogrammetry

Perspective 30°

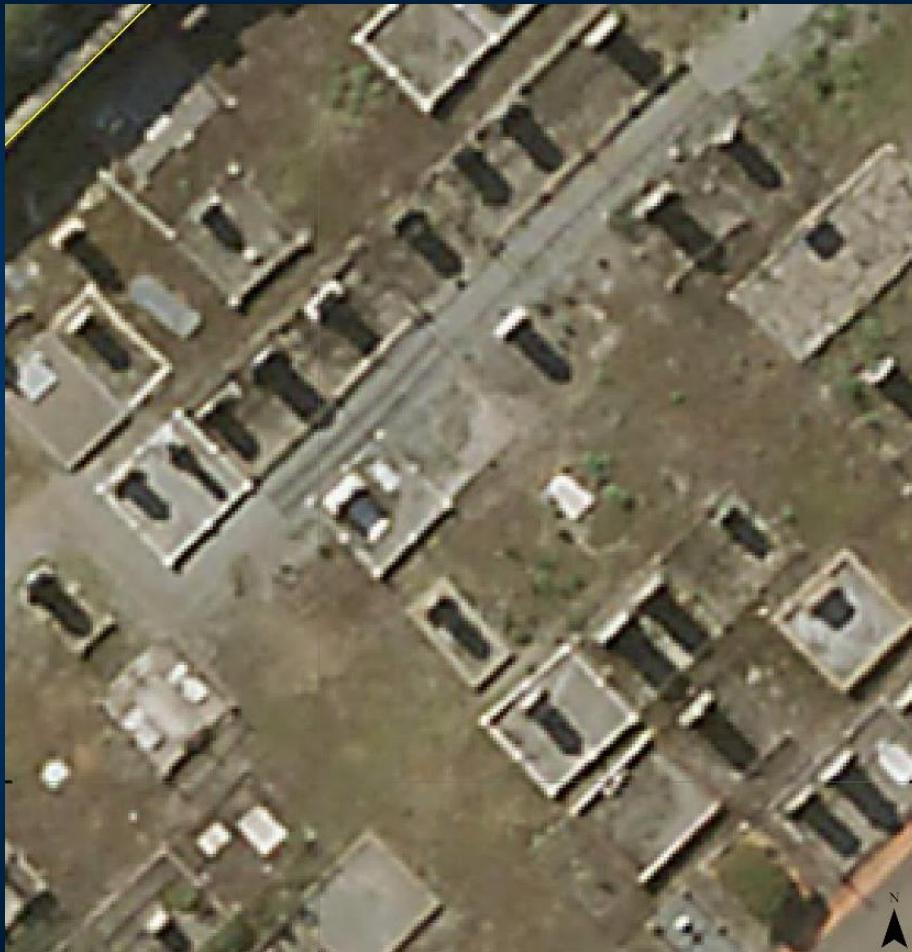


points: 15,000,422

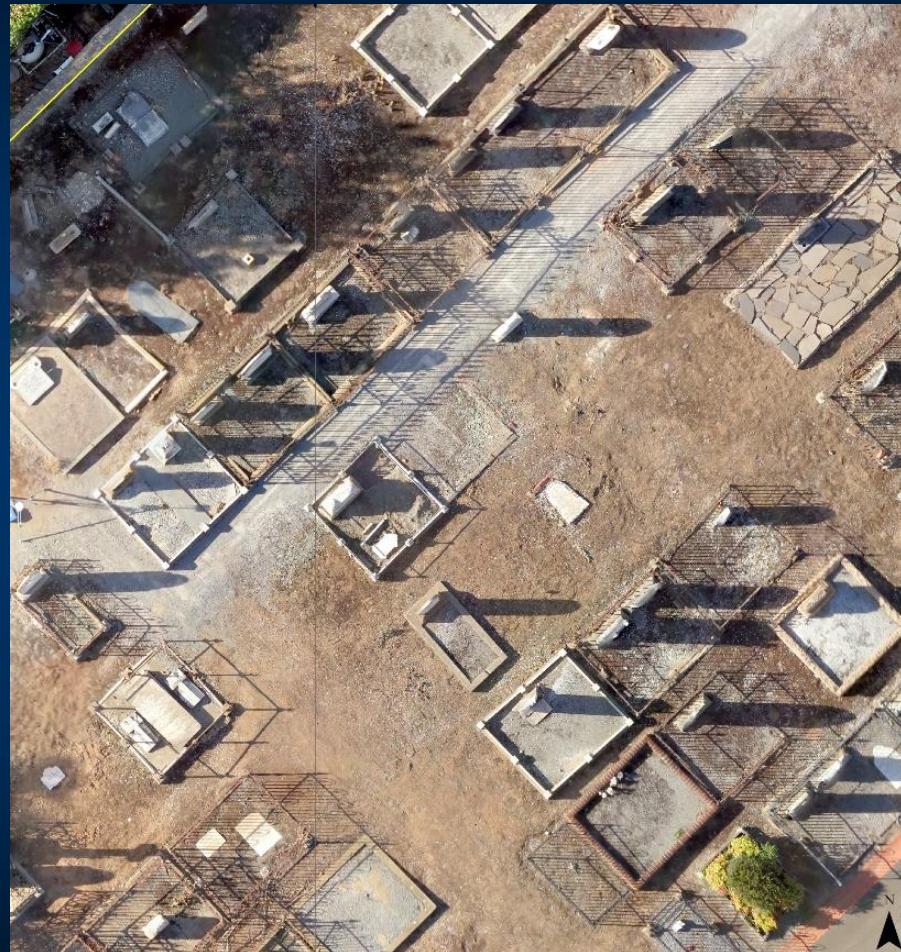
SFM Photogrammetry



How Good is the Data?

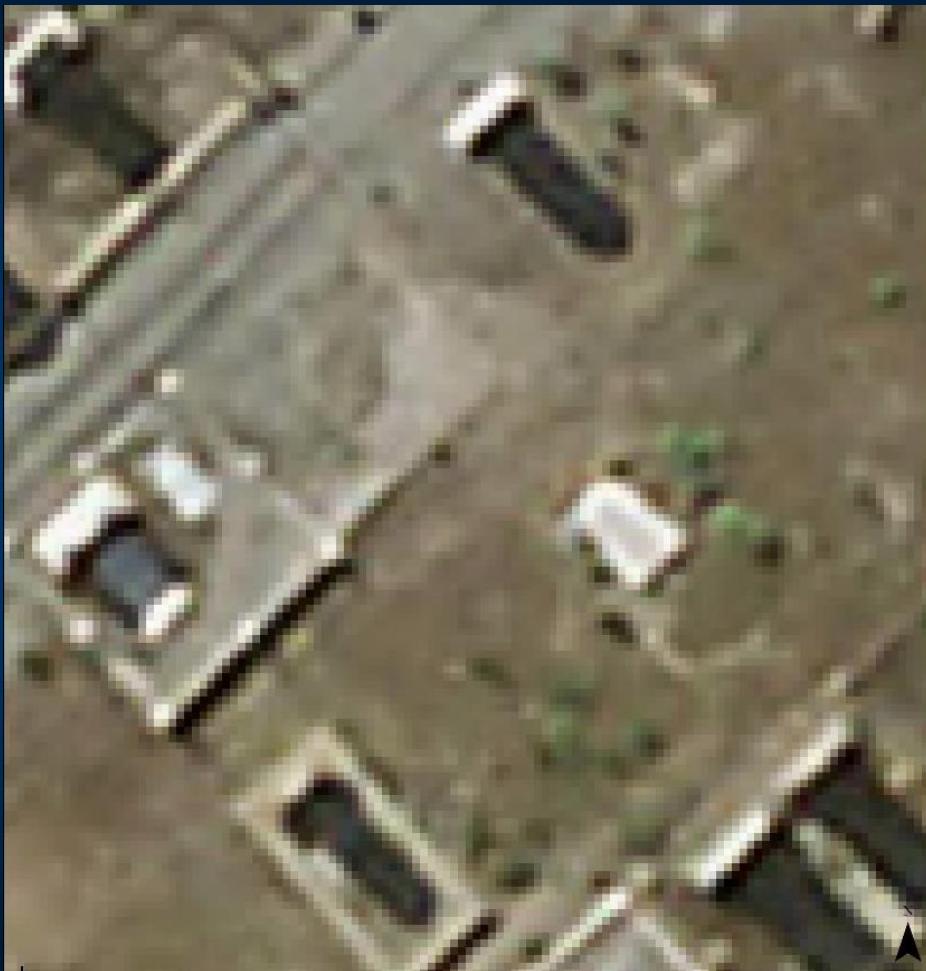


Satellite

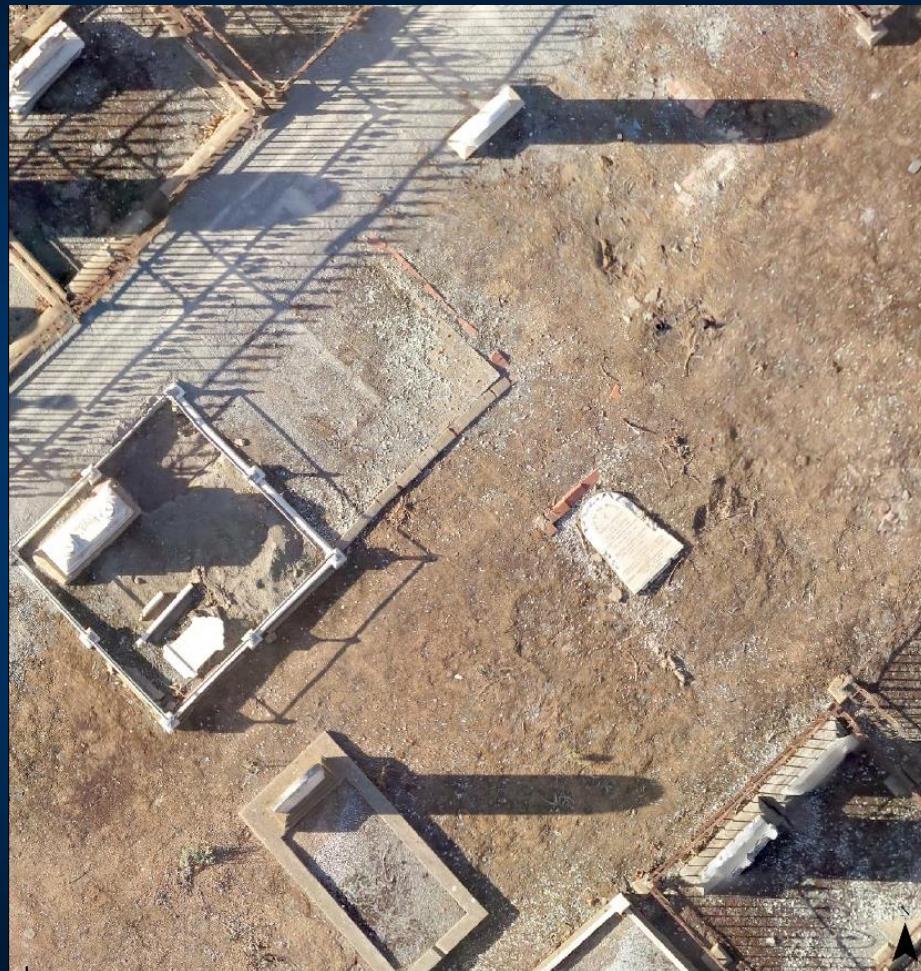


Kite

Not bad...



Satellite



Kite

Bloody good!

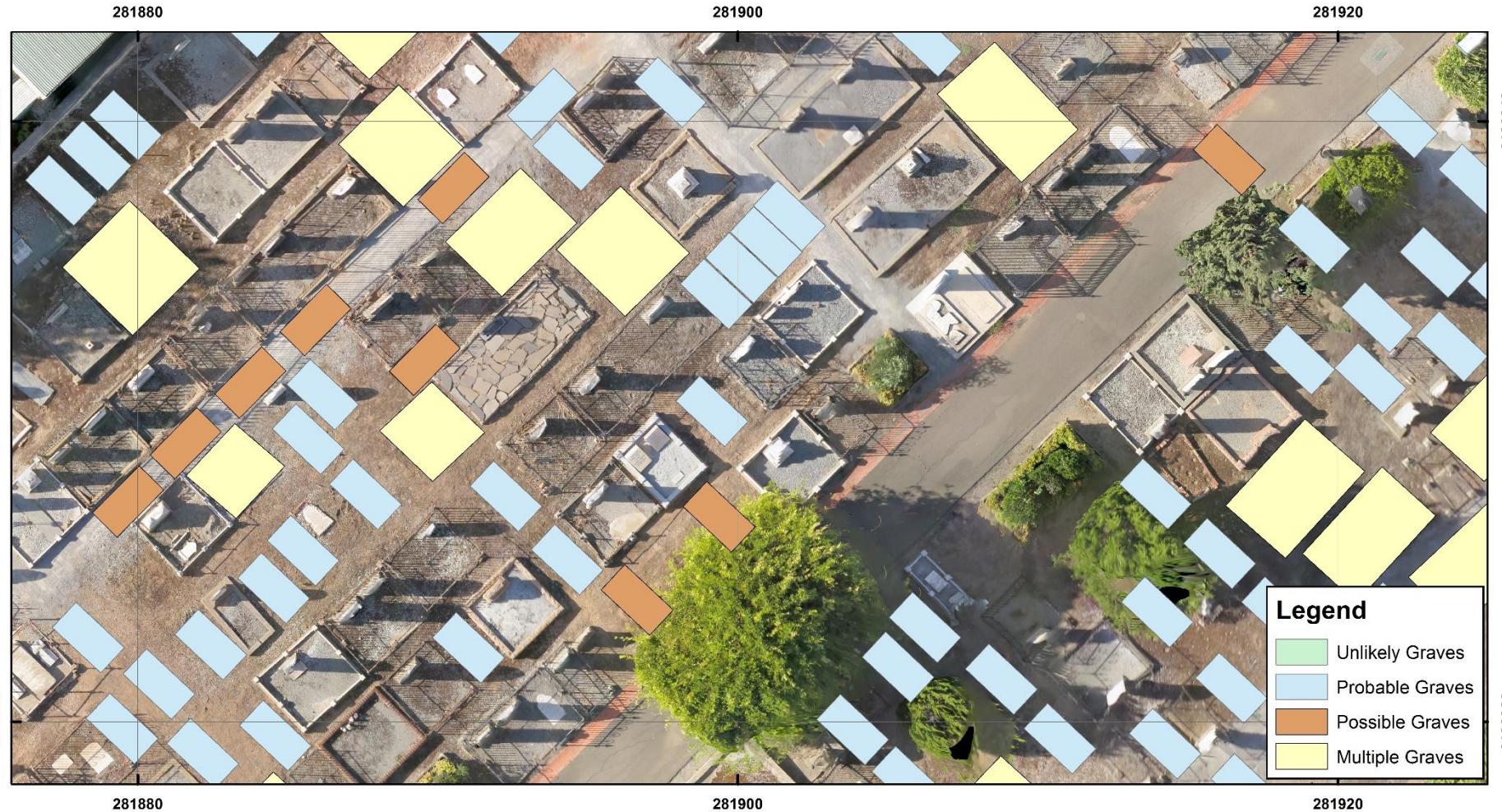


Satellite



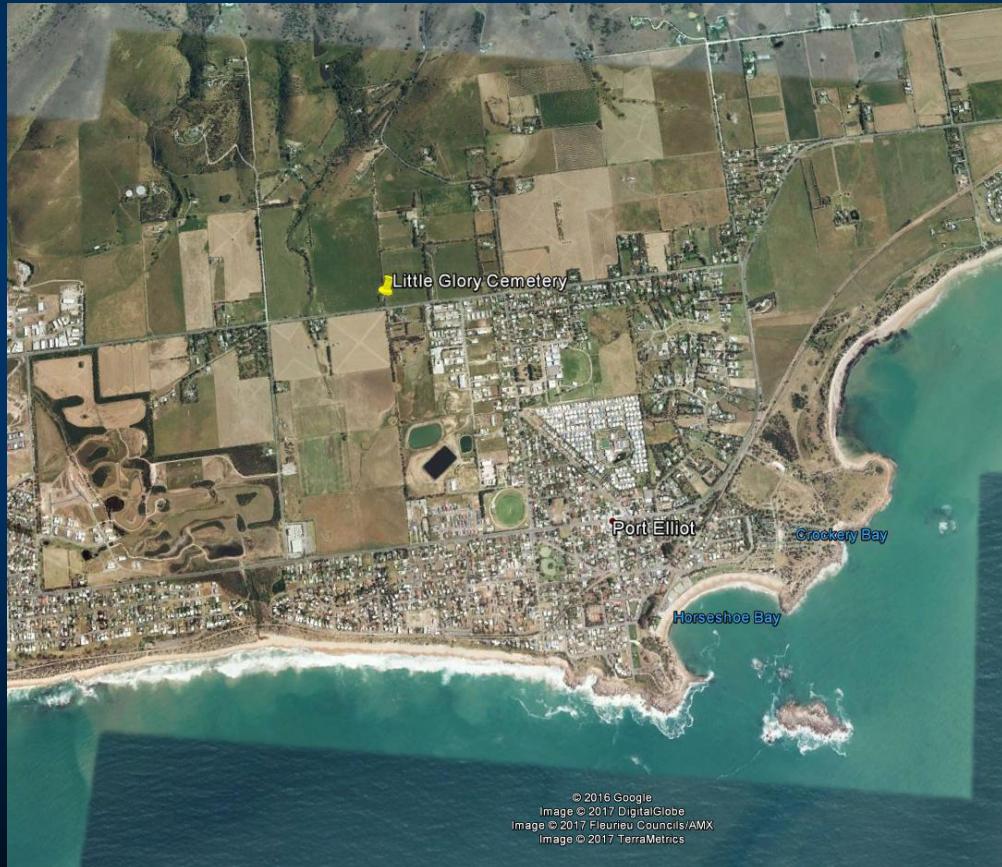
Kite

Pulling it all together



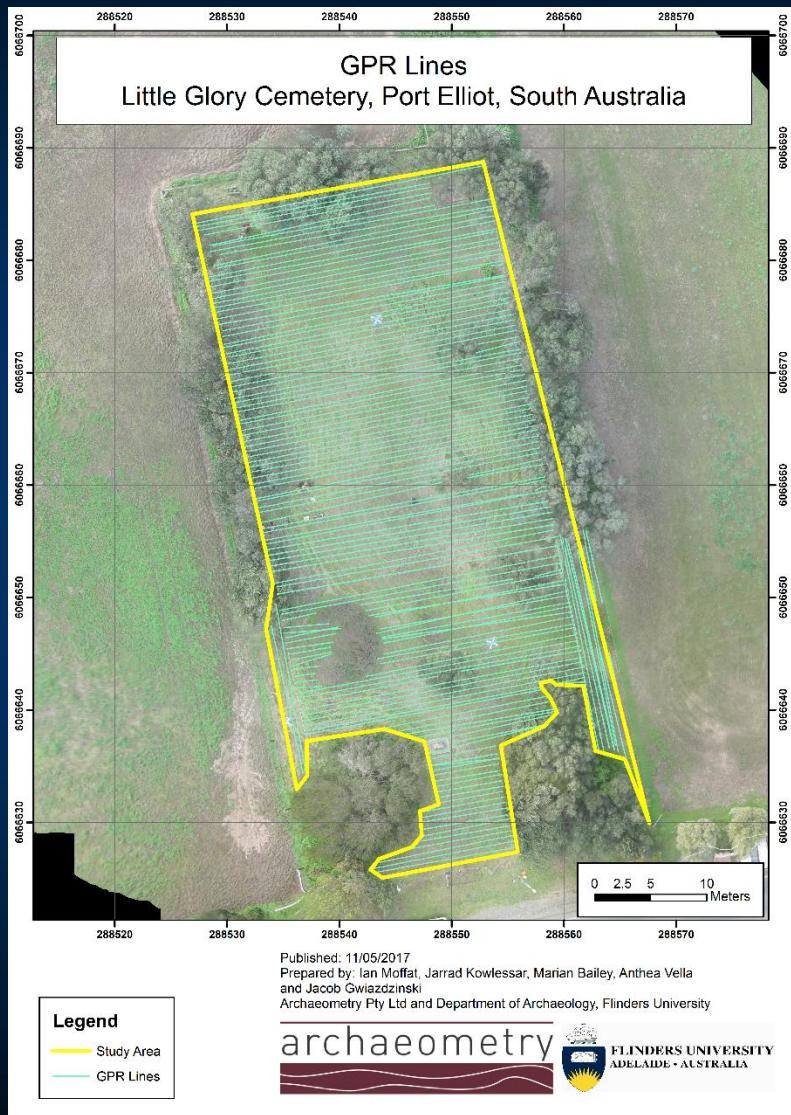
Case Study: Little Glory Cemetery

- Chapel on site from 1857
- 2 marked graves



Little Glory Cemetery: Data Collection

- 166 GPR Lines collected
- Lines surveyed in with cm accuracy with Total Station
- KAP data for site recording

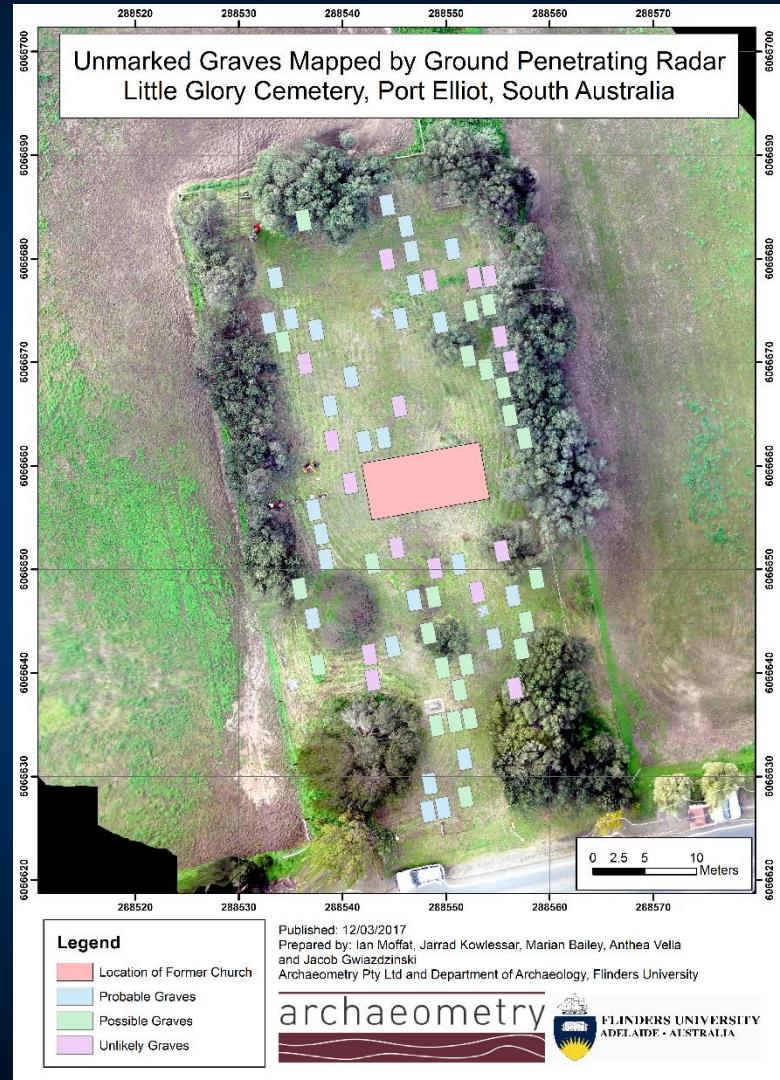


Little Glory Cemetery: 3D Modelling



Little Glory Cemetery: Results

- 28 Probable Unmarked Graves
- 24 Possible Unmarked Graves
- 17 Areas with Multiple Graves



Case Study: Battle of Tarawa

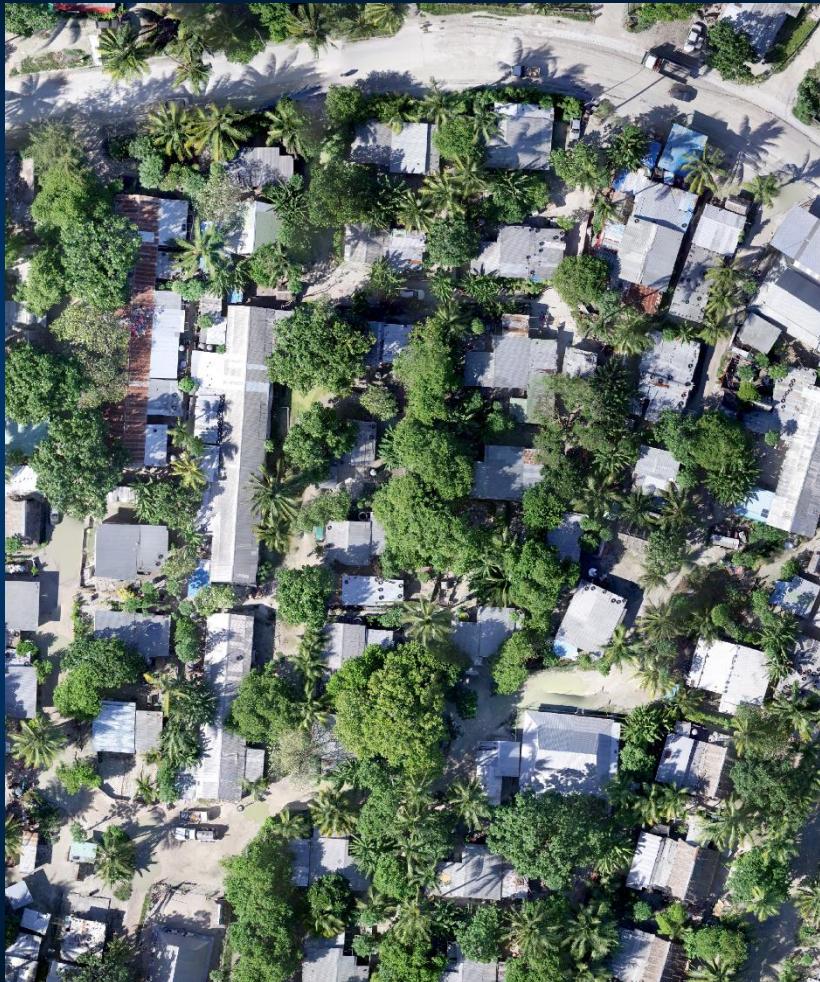
- Fought between American and Japanese 20-23 November 1943
- More than 6400 killed on an island of 1.43km^2
- Many hastily buried and subsequently covered by housing



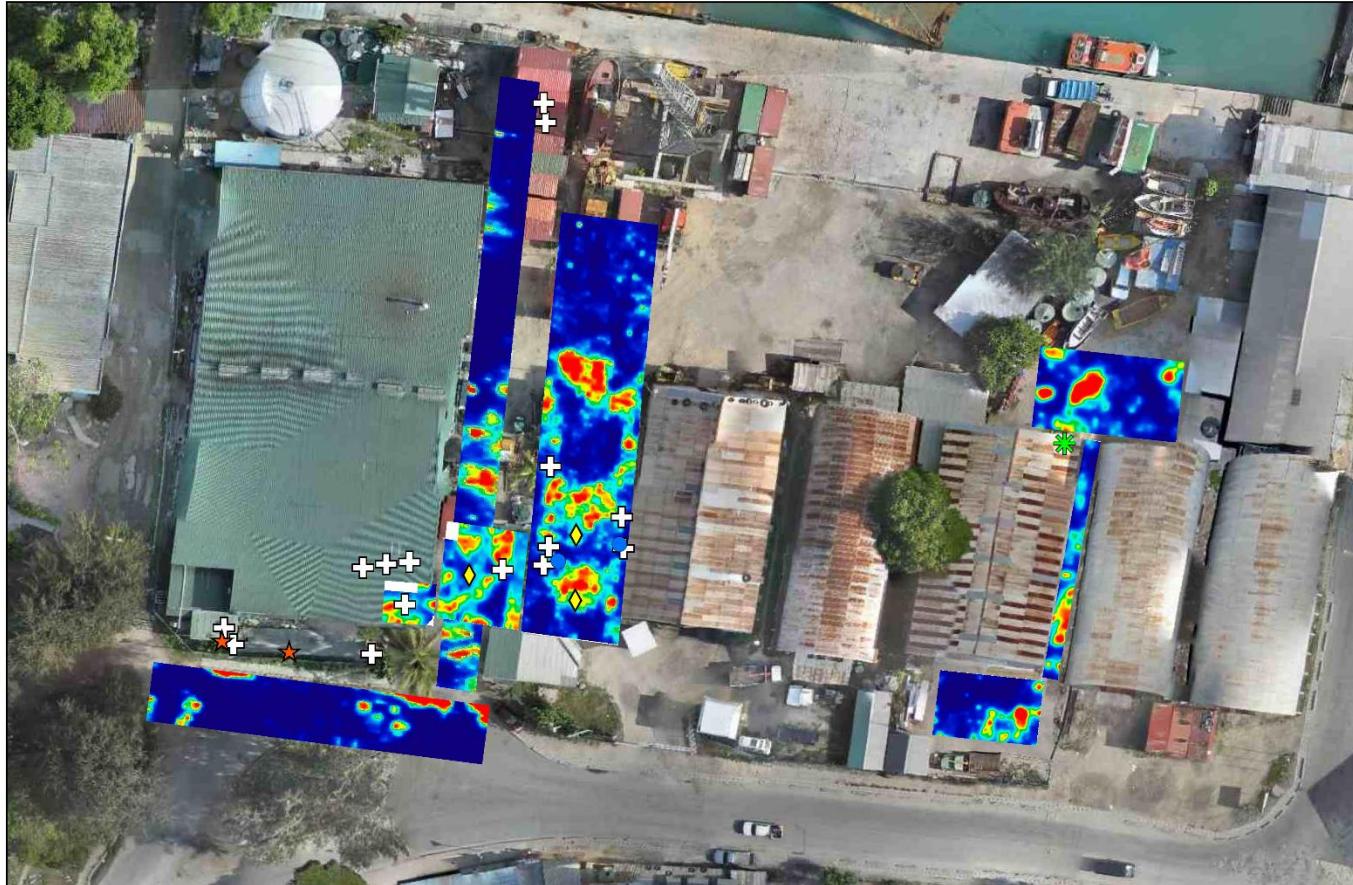
Tarawa: UAV Photography



Tarawa: Historic Aerial Photos



Tarawa: Geophysics



**HISTORY
FLIGHT**

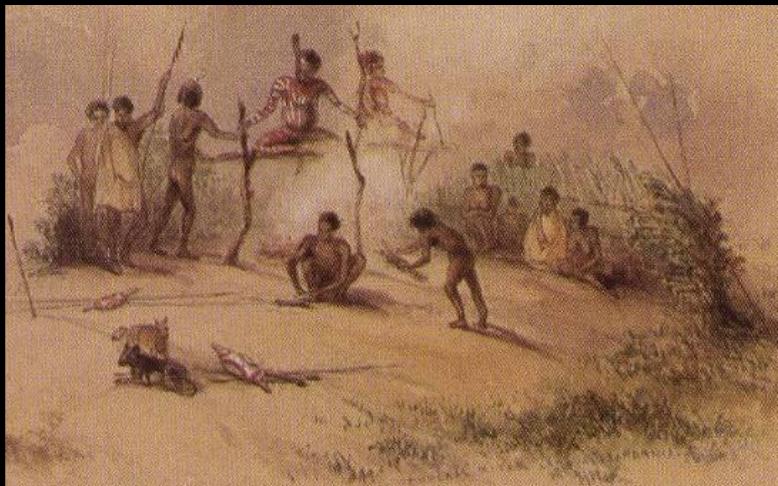
- Herman Sturmer Recovery Location
- WWII Remains Recovered
- Buster Alert
- GPR Possible Burials
- Positive Human Decomp Sample

0 10 20 40 Meters
1:600

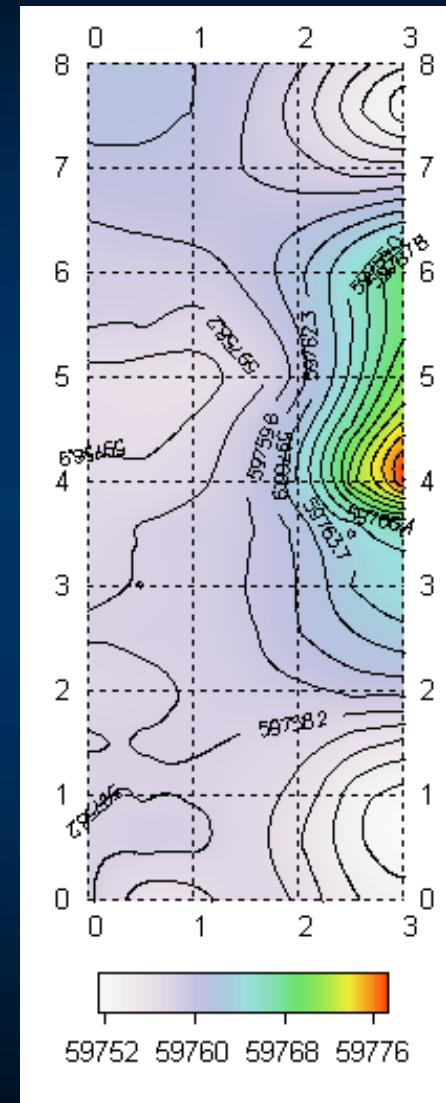
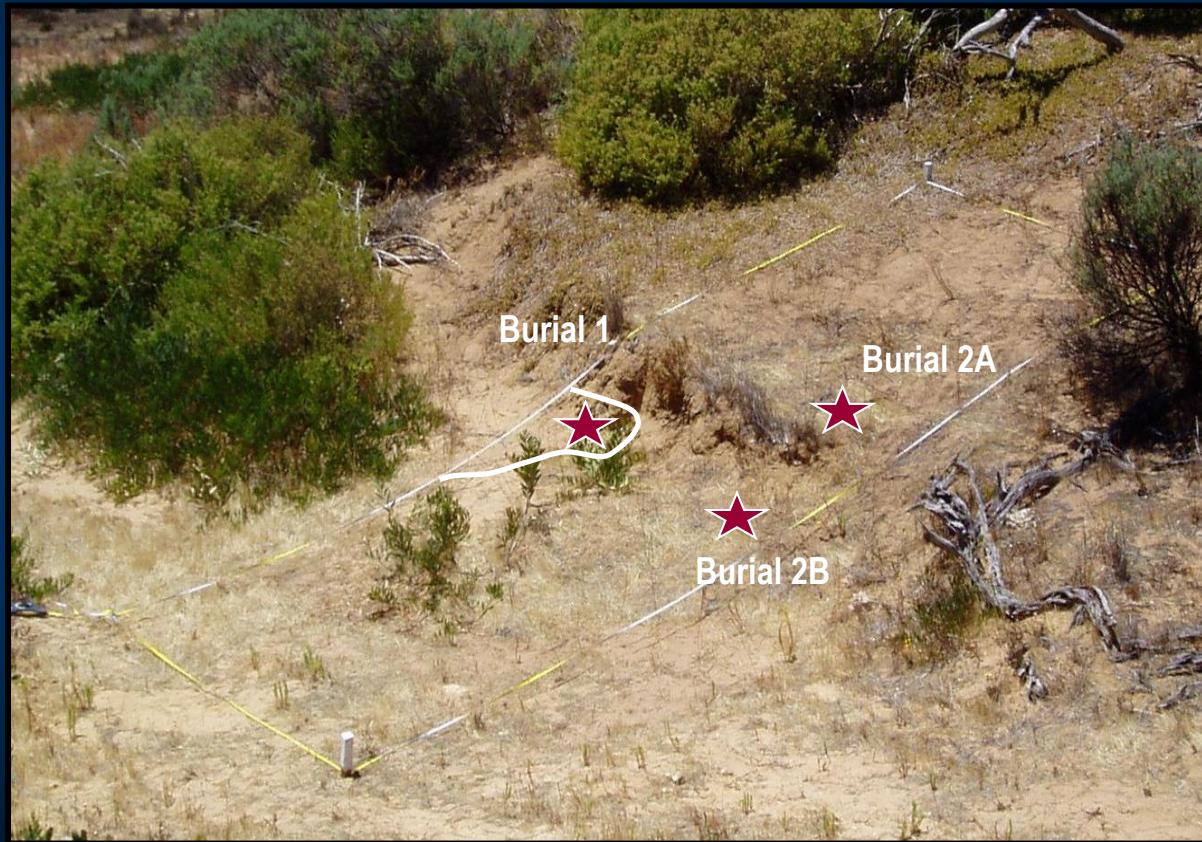


Case Study: Hacks Point

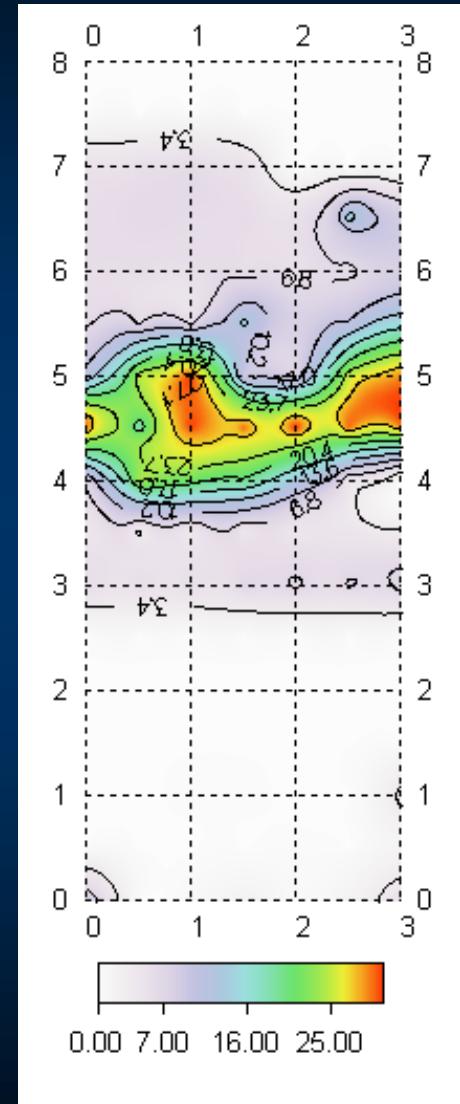
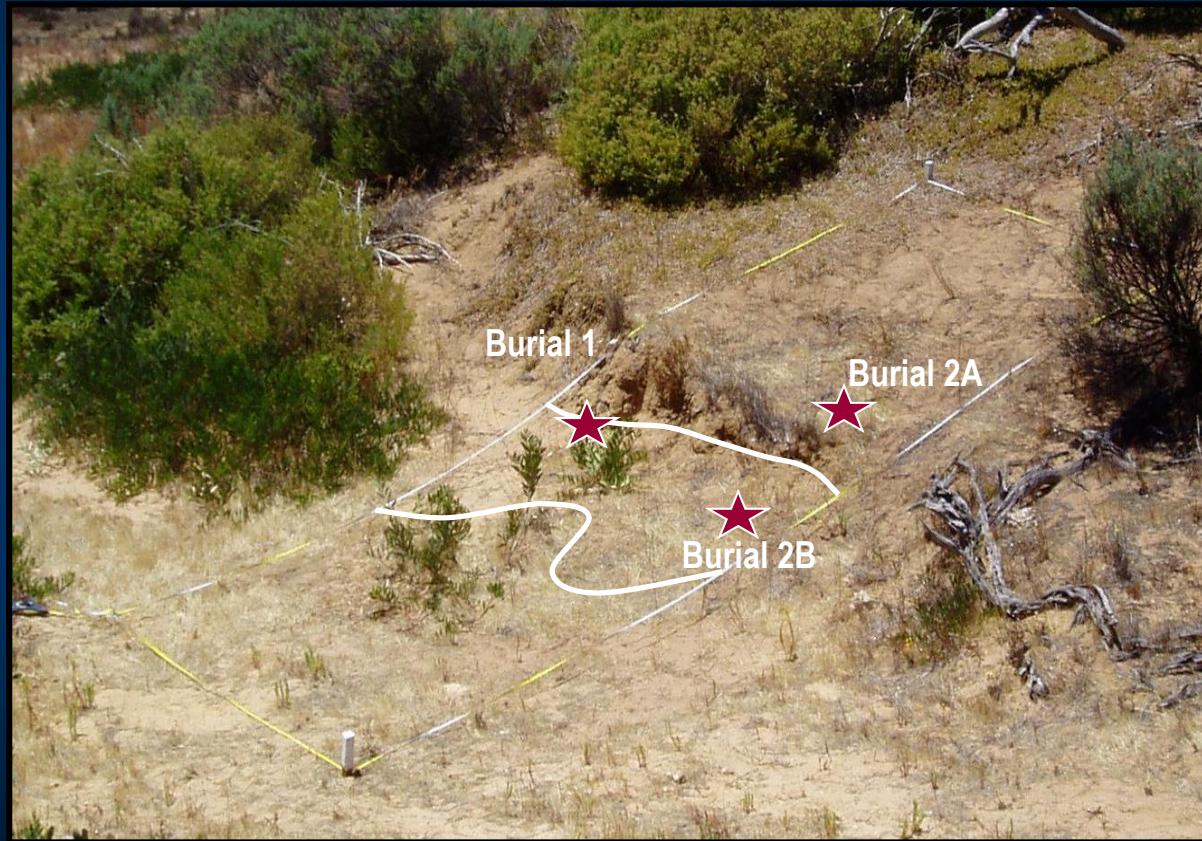
- Rapidly eroding area with skeletal material exposed on the surface
- Geophysical survey in advance of excavation and reburials
- Subsurface is heavily disturbed by rabbit burrows making GPR and ERT ineffective
- Possible to map burials based on burning signature from funerary practices



Hacks Point: Magnetics



Hacks Point: EMI



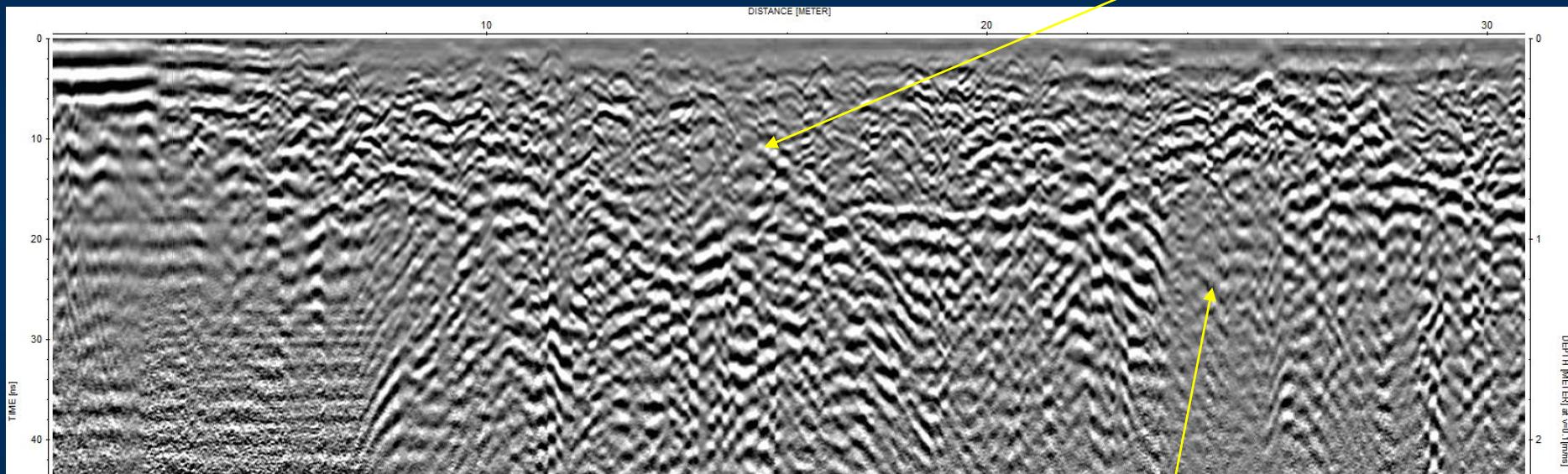
Castalloy Site

- Witness account of an excavation on this site the same weekend that Jane, Aarna and Grant Beaumont disappeared
- Extremely challenging site for geophysics because of anthropogenic fill



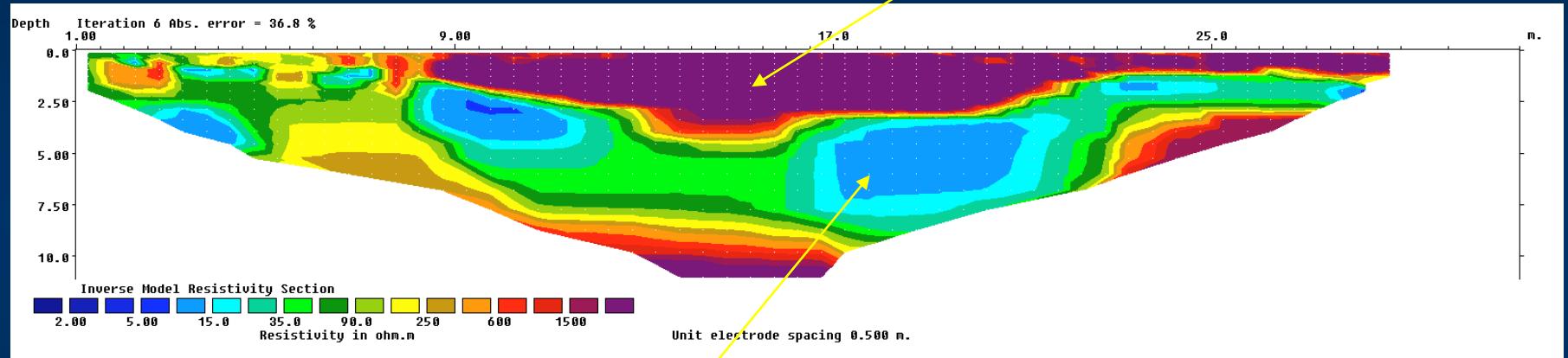
Castalloy: GPR Profile

Extensive, very disturbed, fill



Soil Disturbance

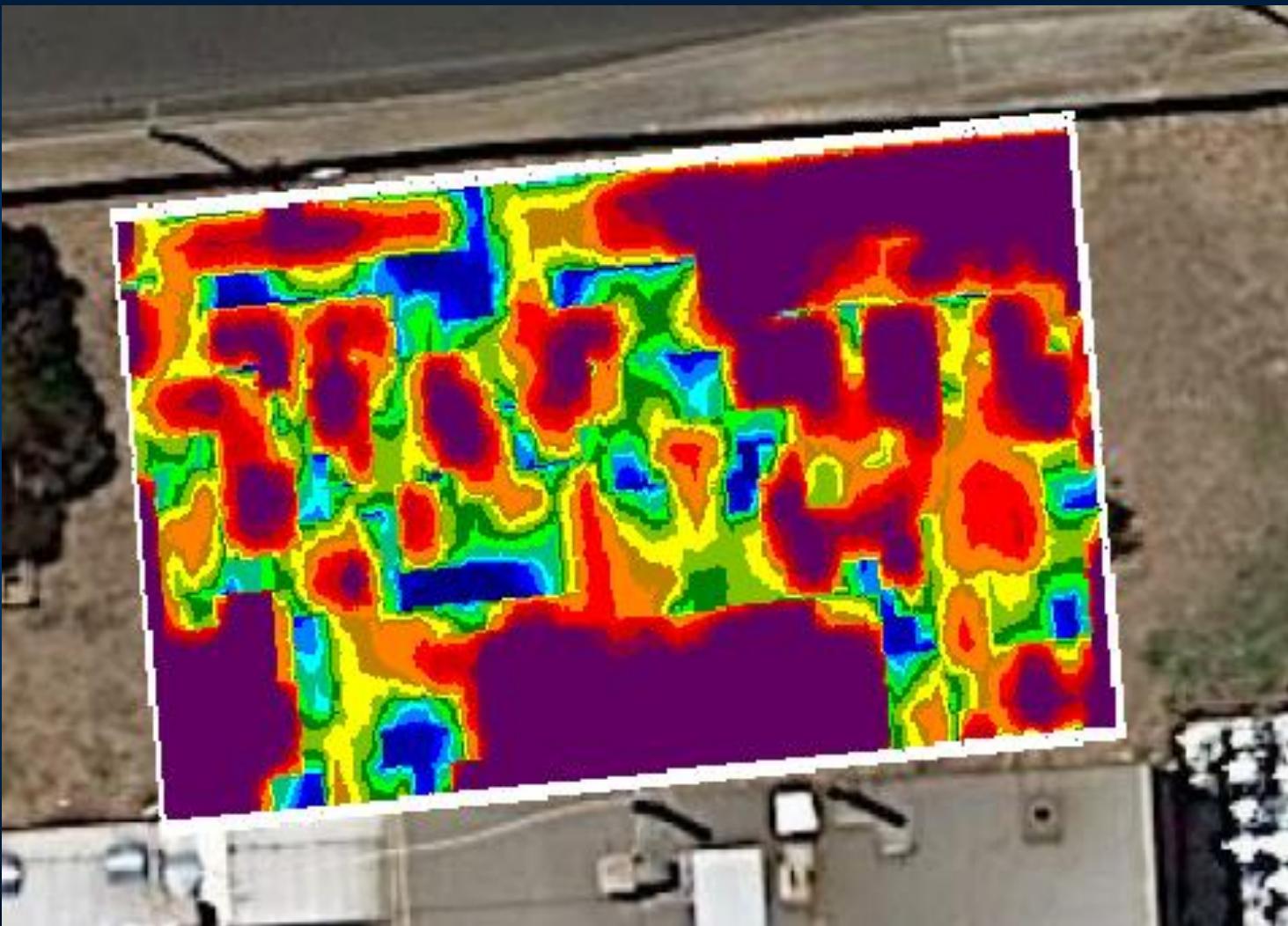
Castalloy: ERT Profile



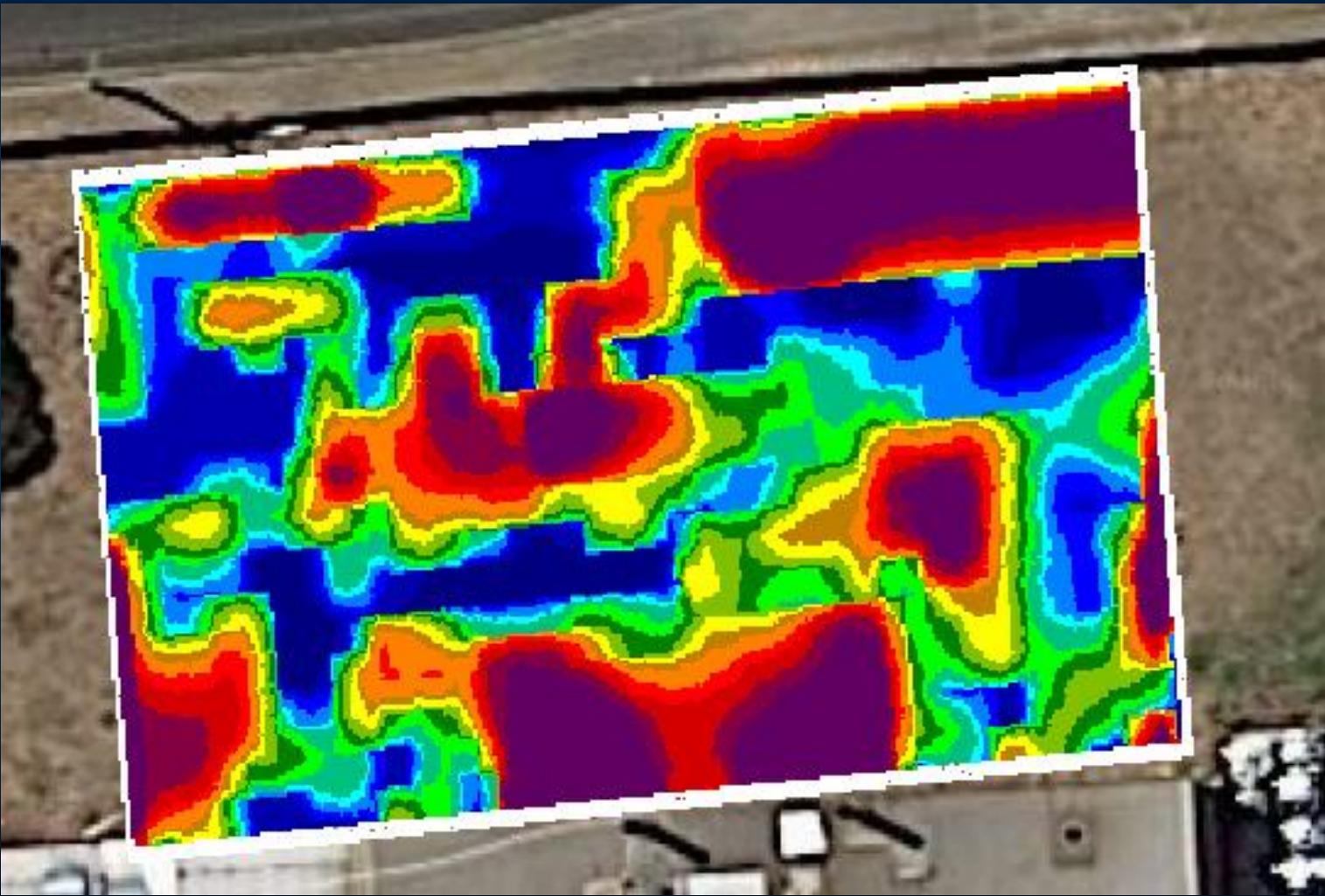
Extensive fill

Conductive Unconsolidated Sediment

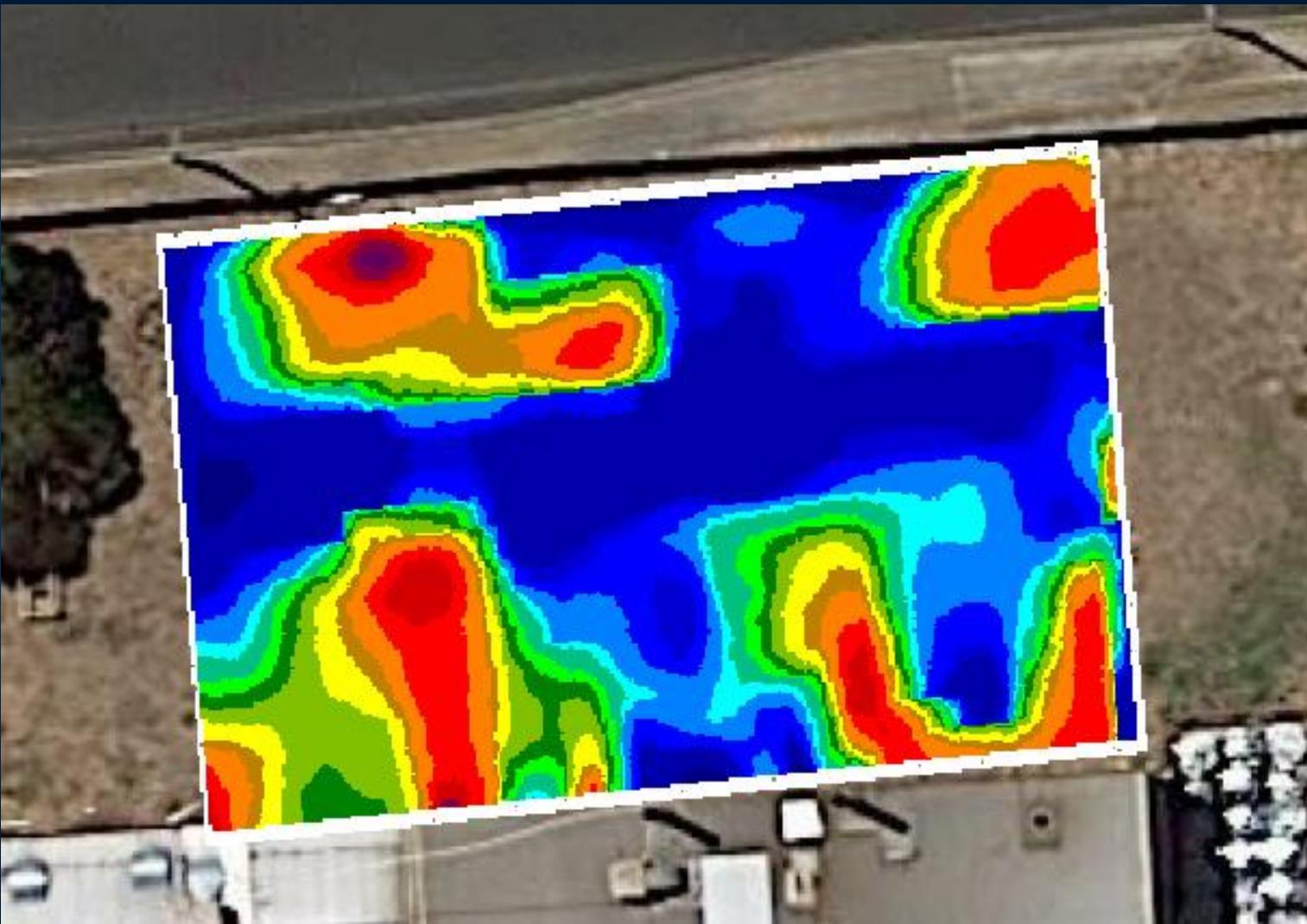
Castalloy: ERT Slice (1.25-1.5m depth)



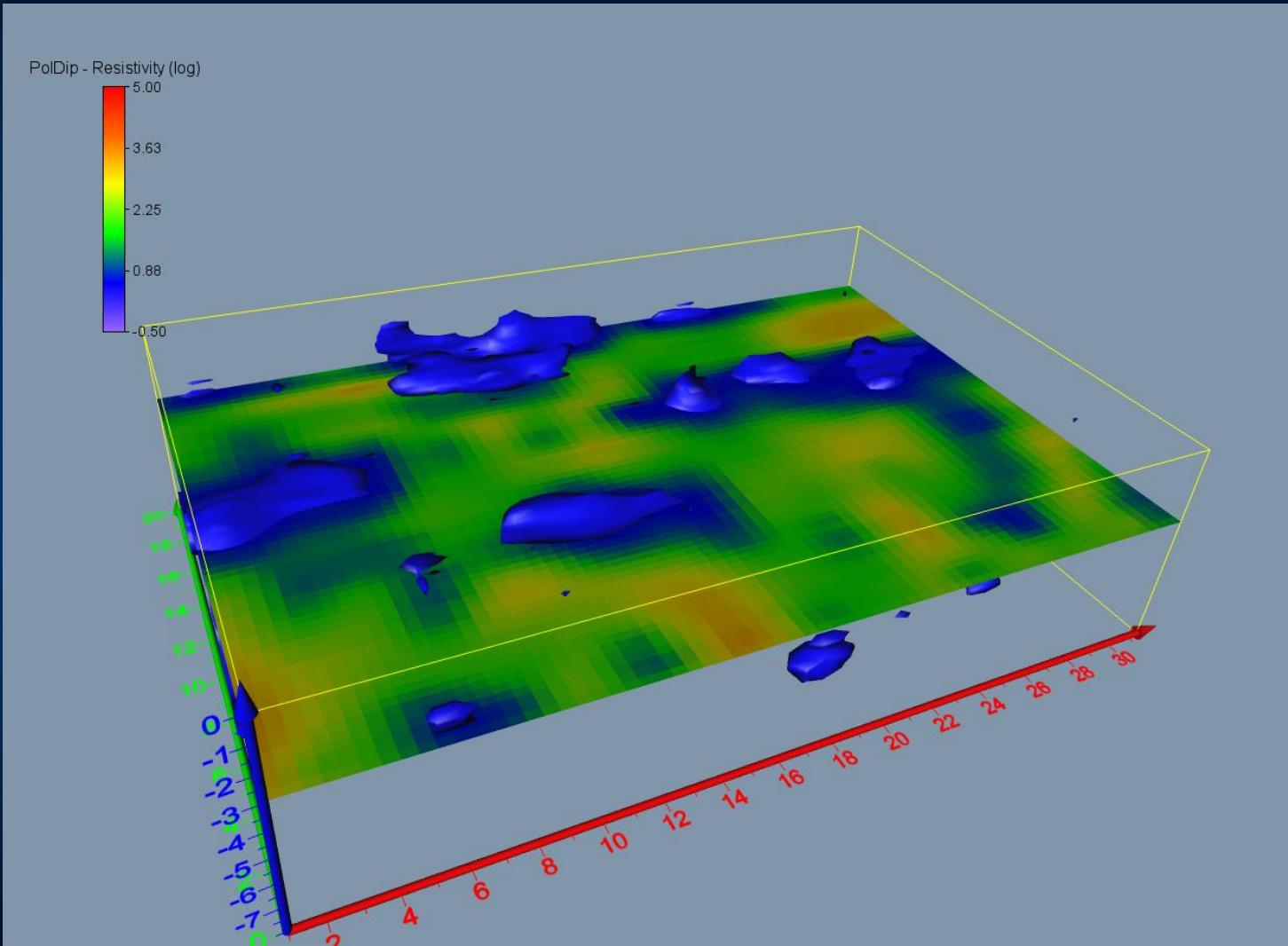
Castalloy: ERT Slice (2-2.5m depth)



Castalloy: ERT Slice (3.5-4m depth)



Castalloy: 3D Data Cube

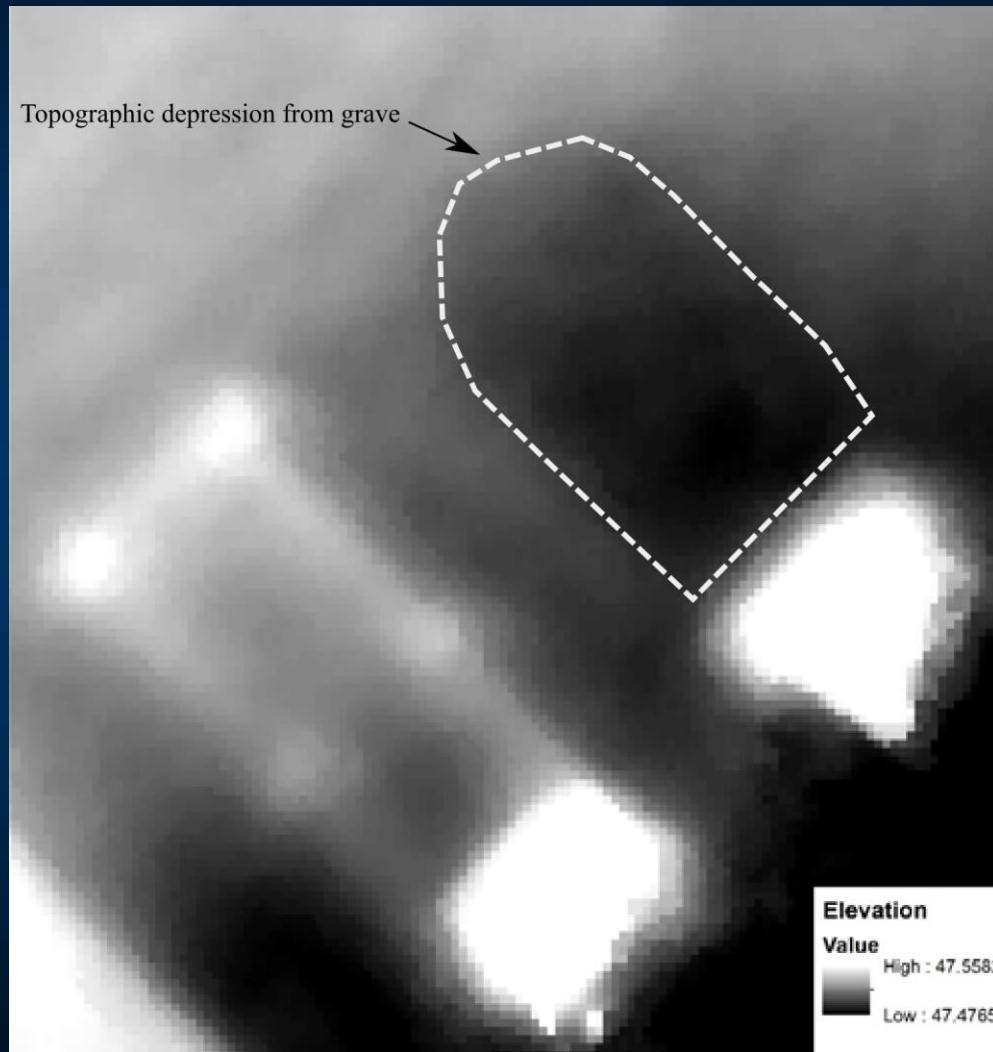


So what?

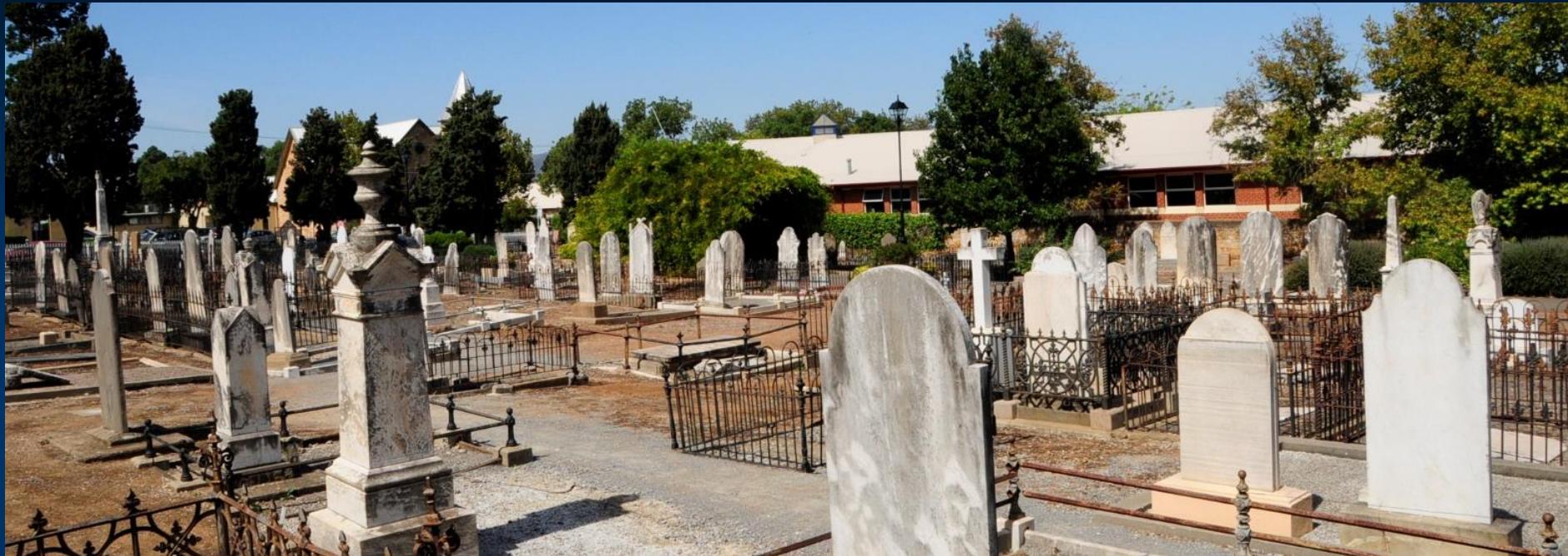
- Geophysical techniques provide a rapid, non-invasive and relatively inexpensive means of mapping unmarked graves
- Geomatic techniques are essential for mapping the site and pulling all the data together
- These methods are contributing to a range of different projects in South Australia and the world



What's next.....



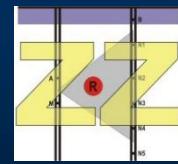
Questions?



Sir Mark Mitchell Foundation



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