

Using Geophysical and Geomatic Techniques to Locate Unmarked Graves



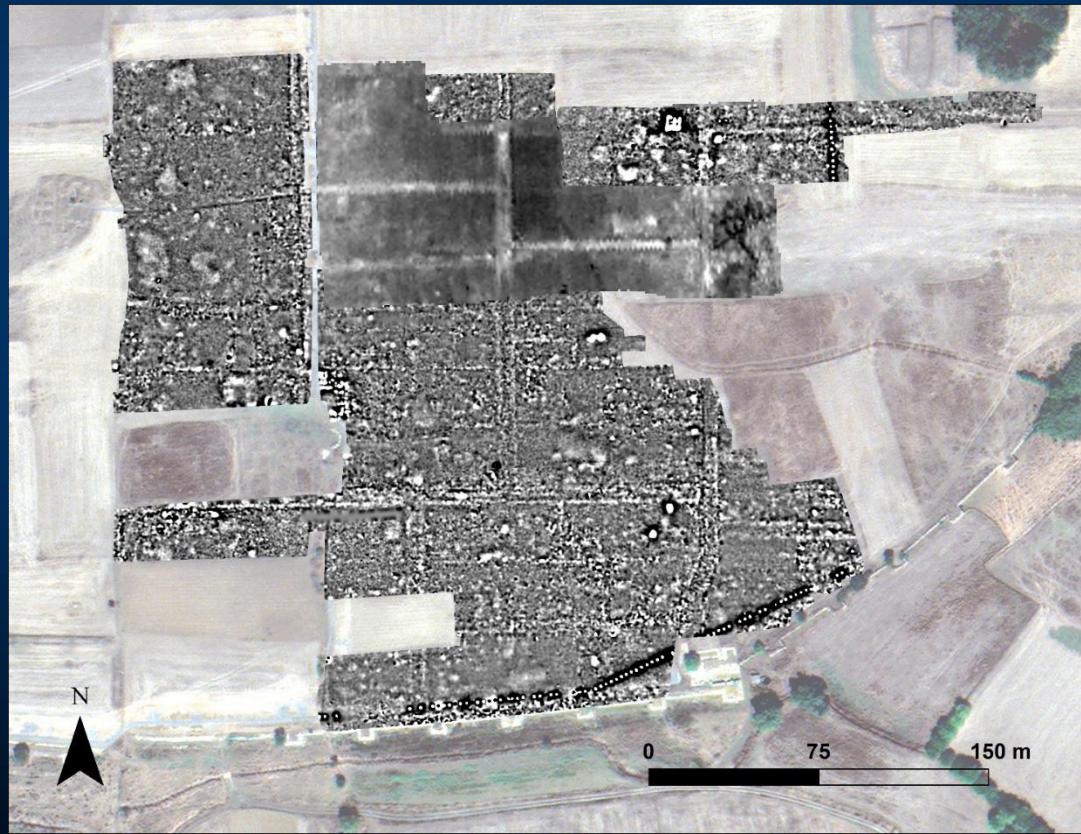
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Who am I?

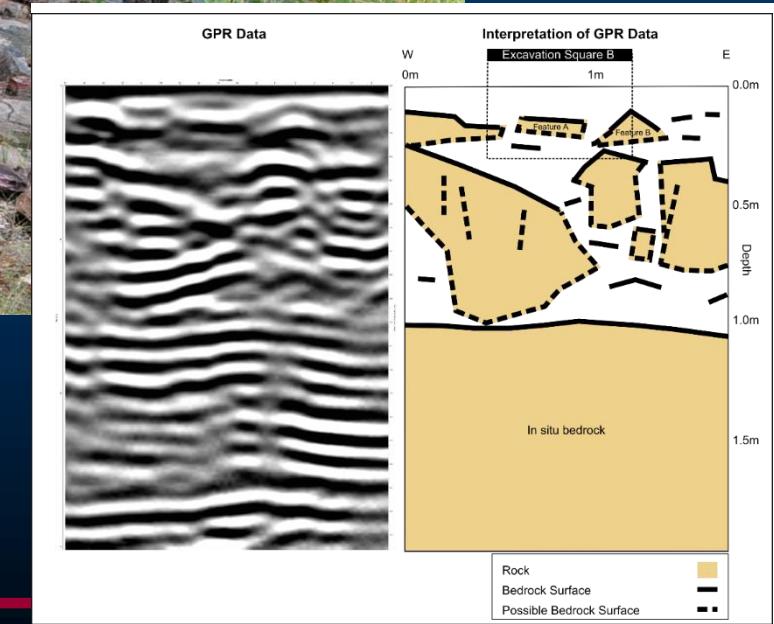
- ARC DECRA Research Fellow at Flinders University
- Former Postdoctoral Researcher at IMS-FORTH in Crete
- PhD from ANU in archaeological geochemistry
- BA (History and English) and BSc (Hons) (Earth Science) from UQ
- Commercial Roles with Precipice Training, Archaeometry and Ecophyte Technologies
- Australian expert in the location of unmarked grave with geophysical techniques



Mapping Ancient Greek and Cambodian Cities



Understanding Archaeological Caves



3D Modeling of Archaeological Sites



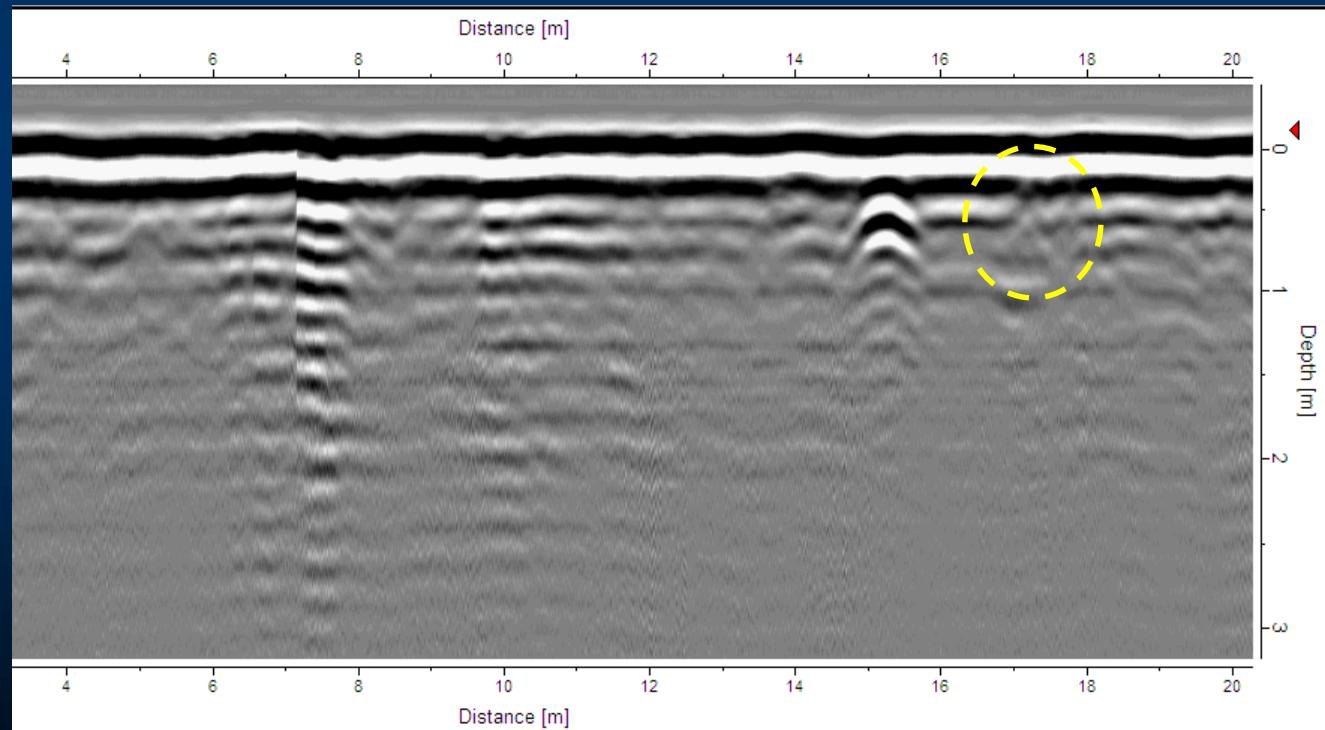
The Bad News....

- The direct detection of skeletal material with geophysical techniques is almost impossible
- How do we overcome this?



Geophysics for Burial Detection

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



This Means...

- Lots of high density geophysical data
- Detailed site recording
- High quality positioning



Technique Review

Geospatial

- UAV
- KAP
- Photogrammetry
- GIS
- RTK-GPS
- Total Station

Geophysical

- GPR
- Other Geophysical Methods



UAV

- Provides high resolution aerial photos and digital elevation models through photogrammetry
- Moderately cheap and can be deployed in many places
- Provides spatially accurate products when combined with survey grade GPS
- Essential first step



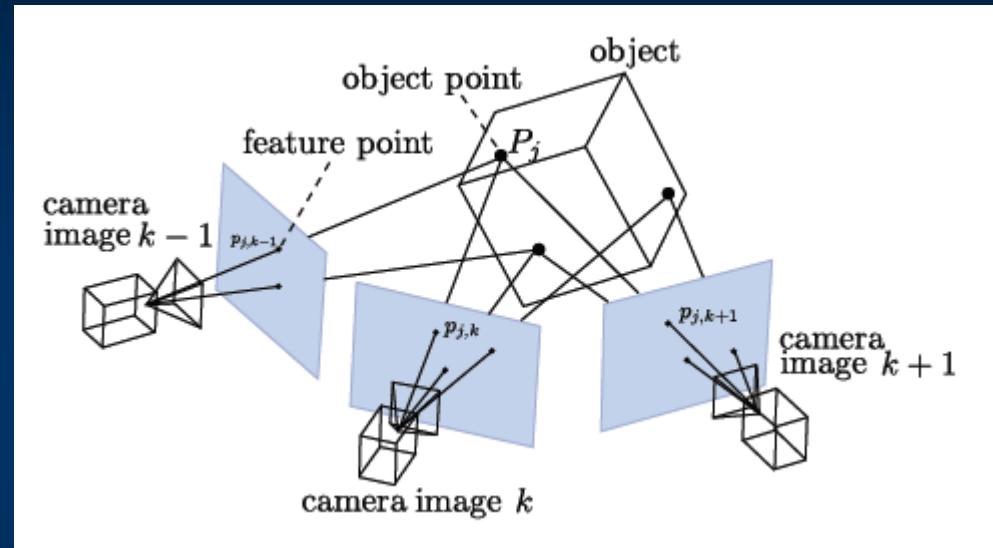
KAP

- As with UAV but cheaper and easier to use (except when it isn't windy)

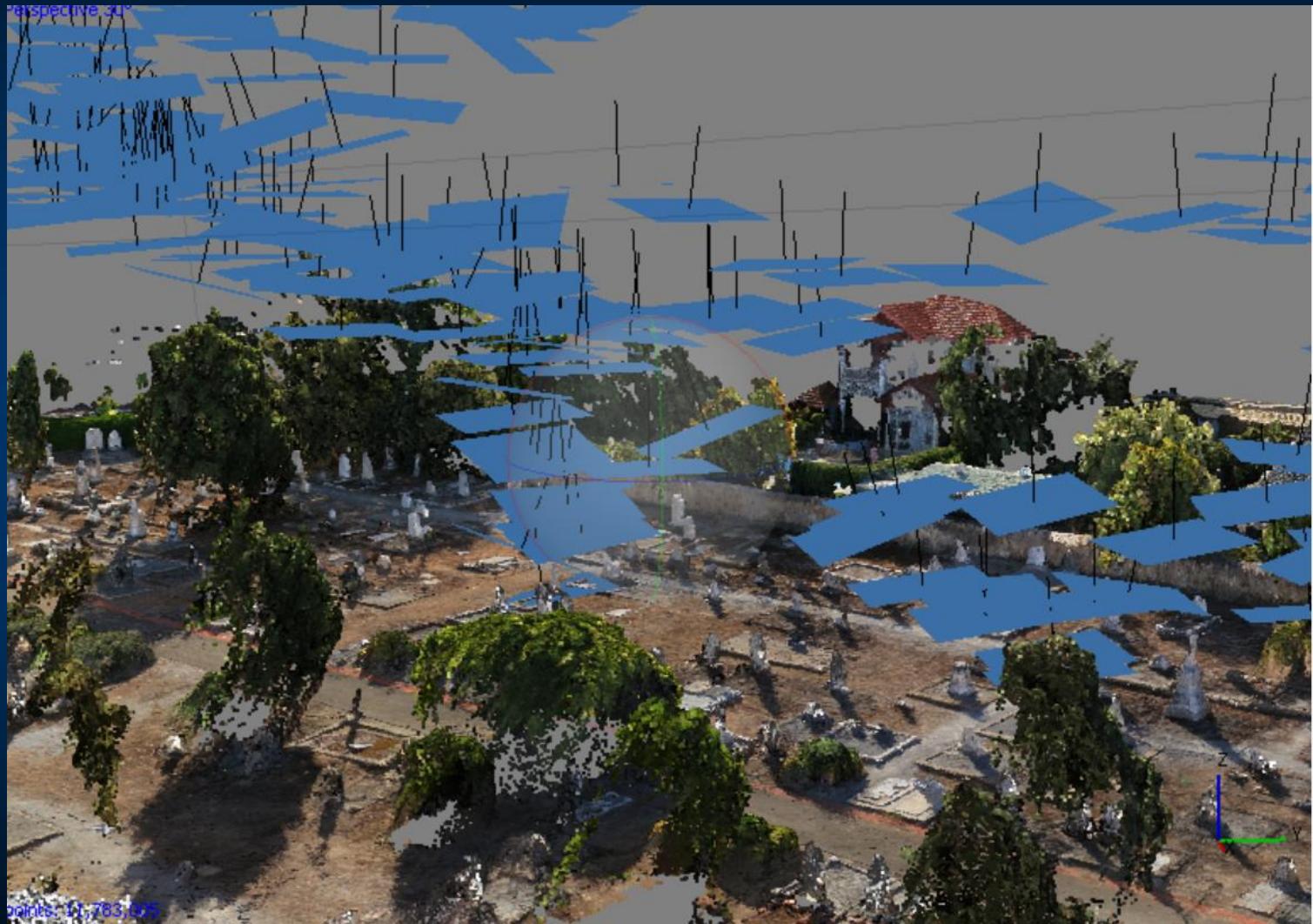


SFM Photogrammetry

- Measures geometry through photographs
- Different positions provide measure of distance
- No special camera required
- Can be integrated with positioning to provide absolute measurements

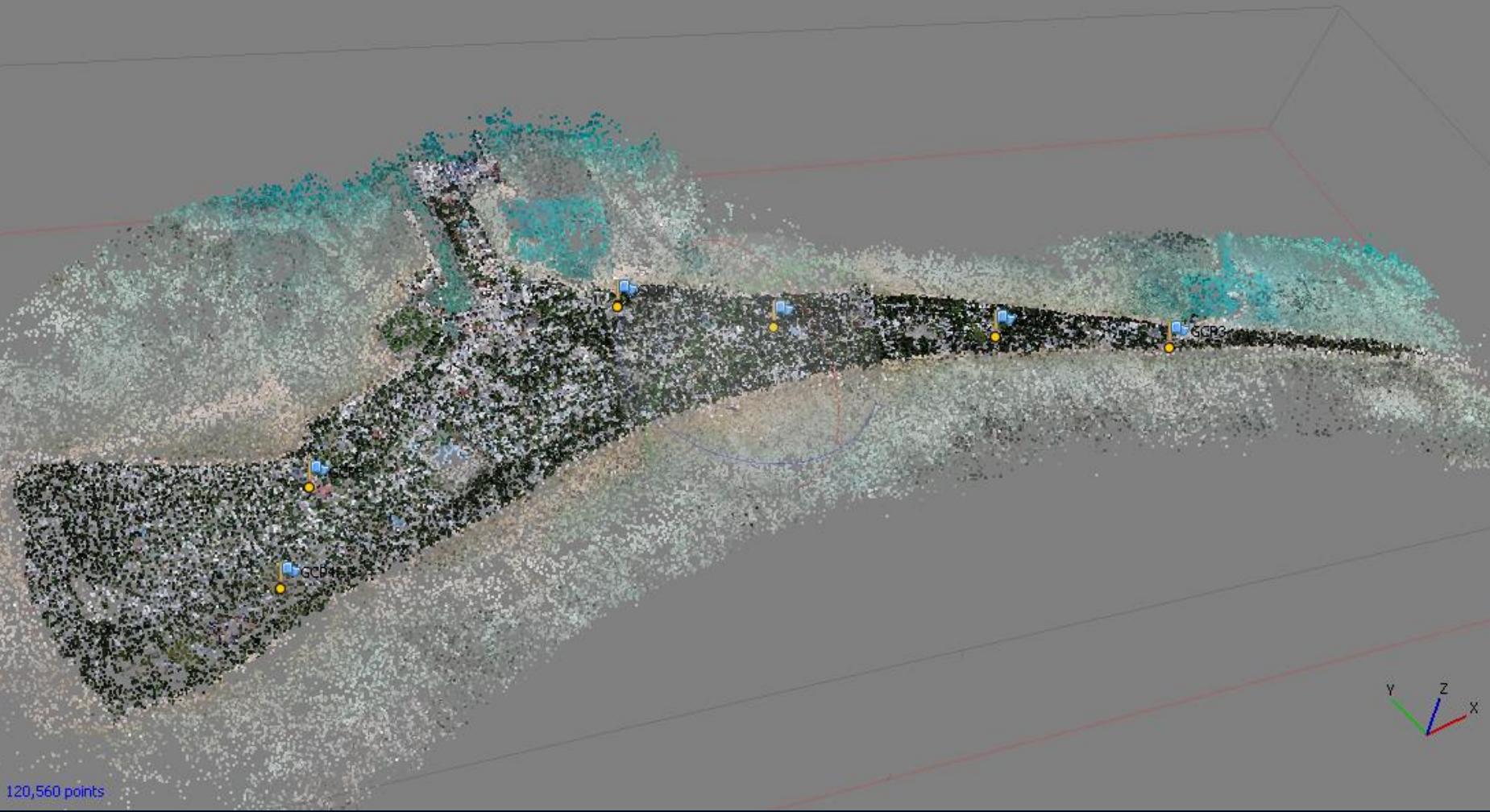


SFM Photogrammetry

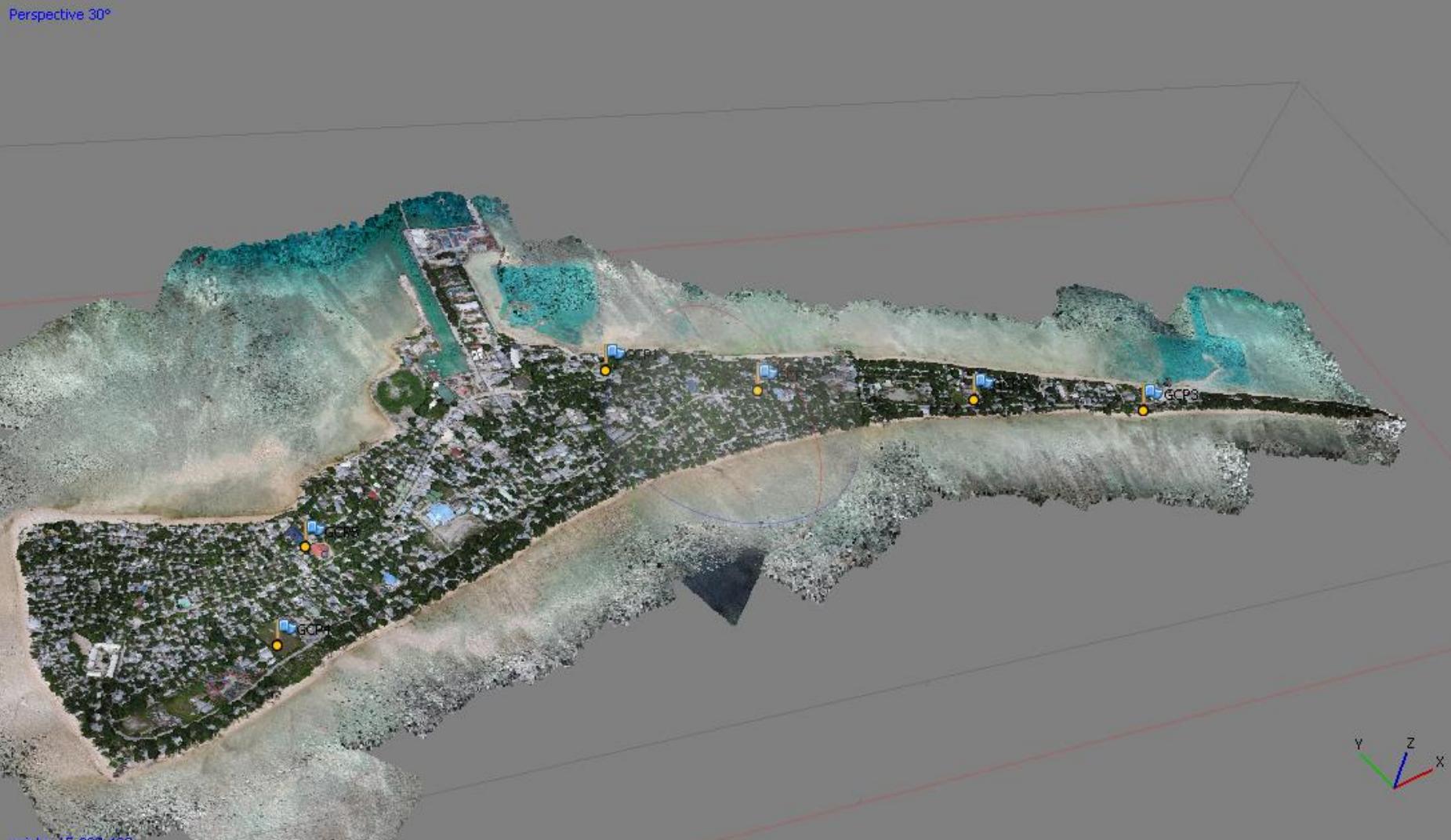


SFM Photogrammetry

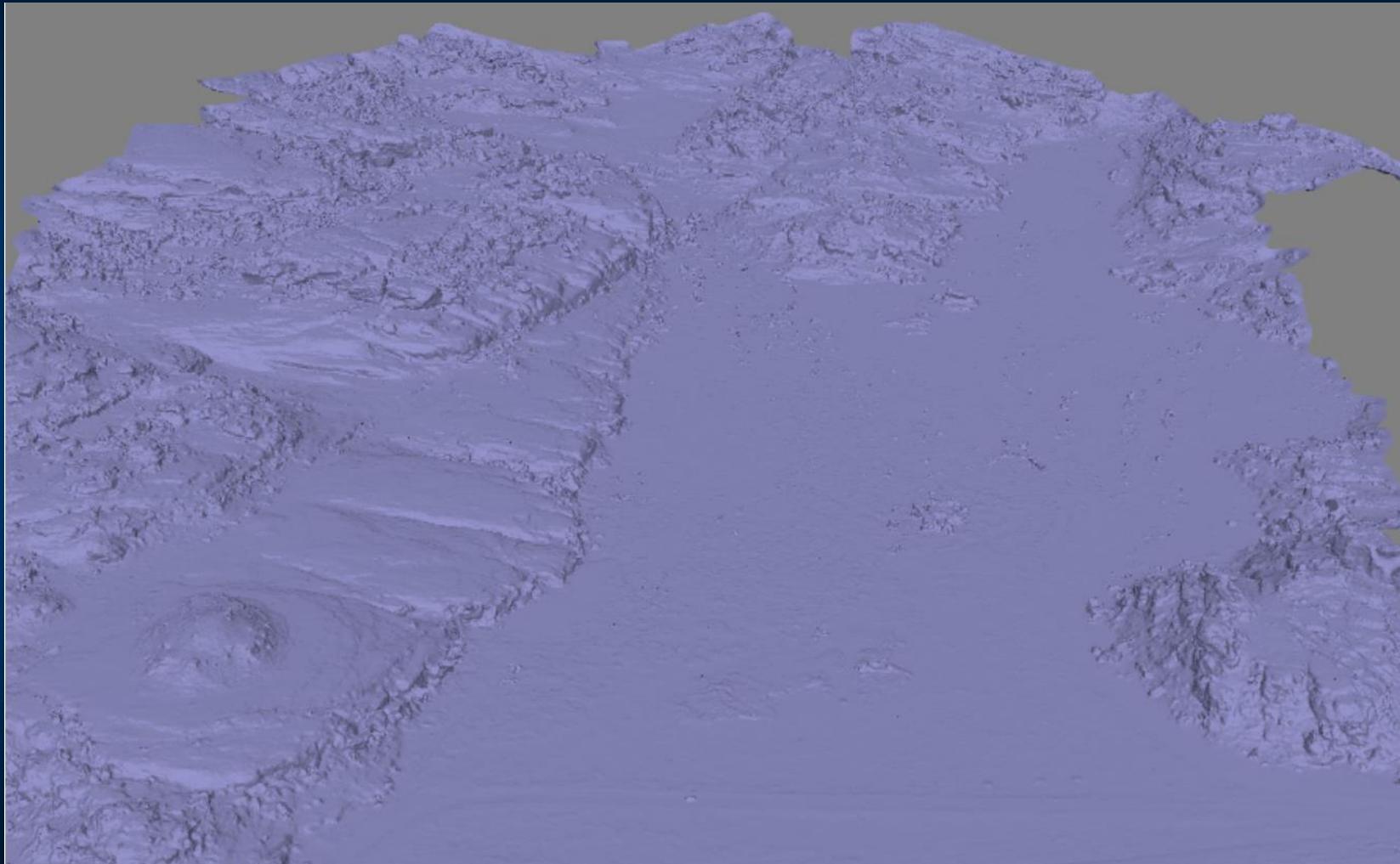
Perspective 30°



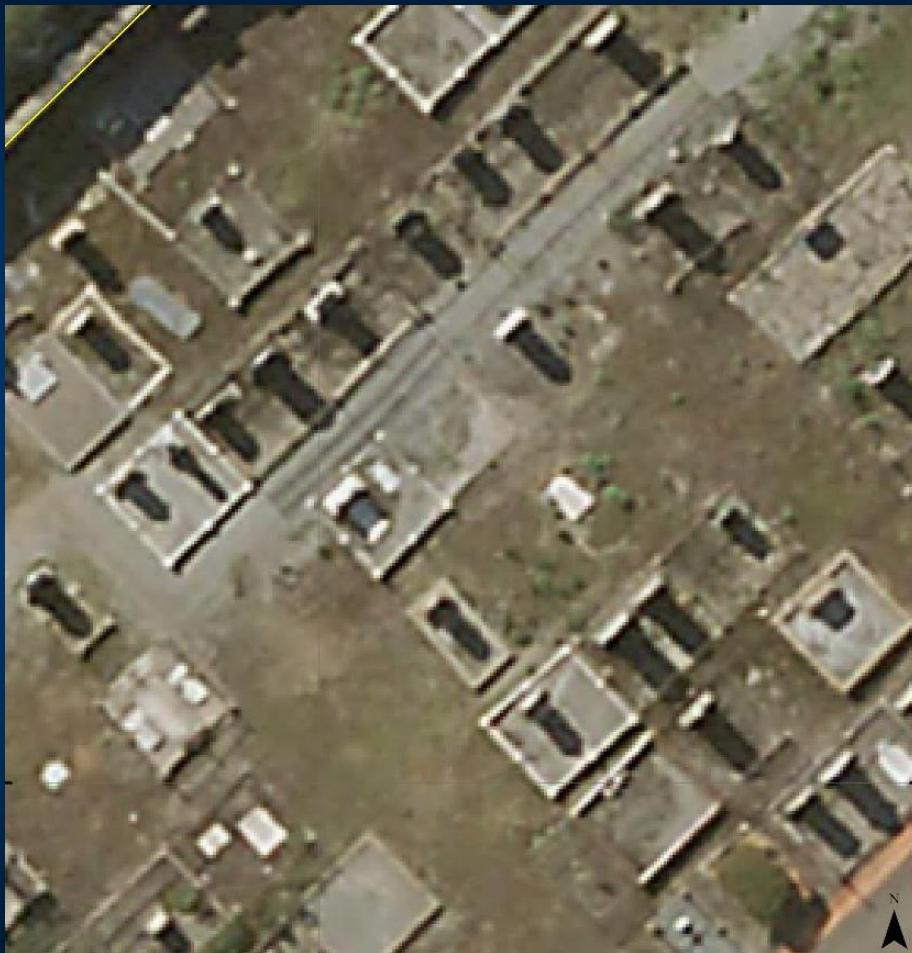
SFM Photogrammetry



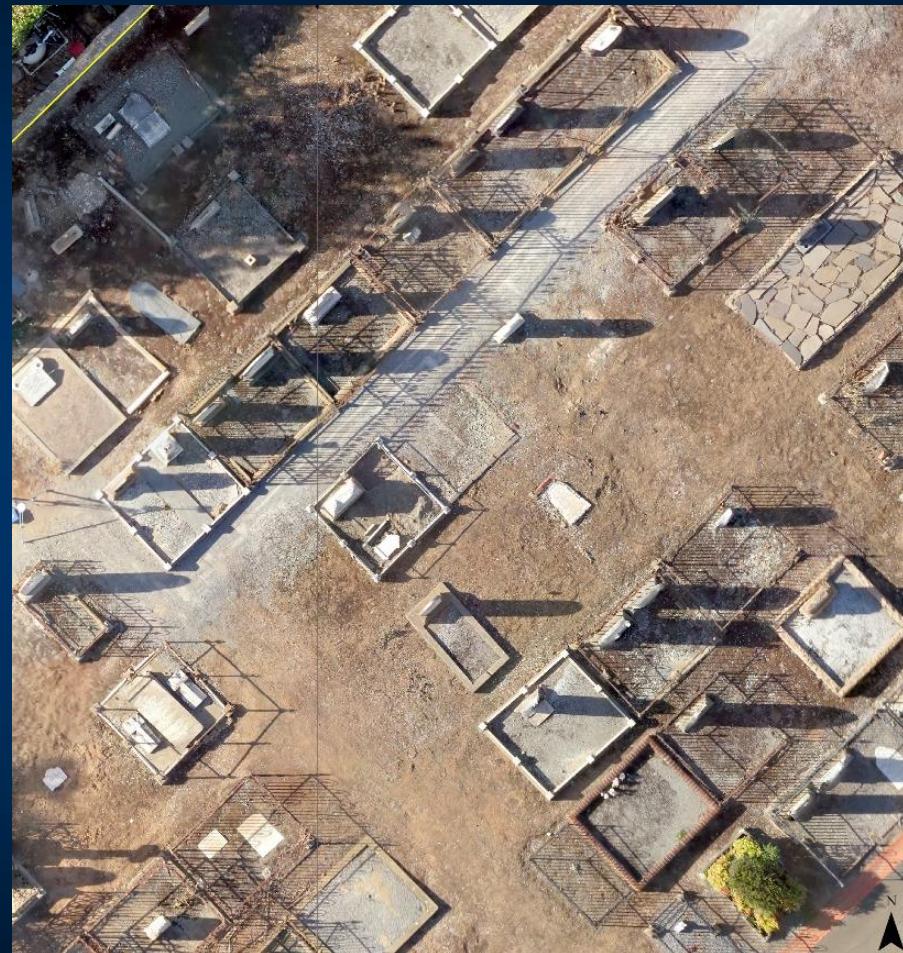
SFM Photogrammetry



How Good is the Data?

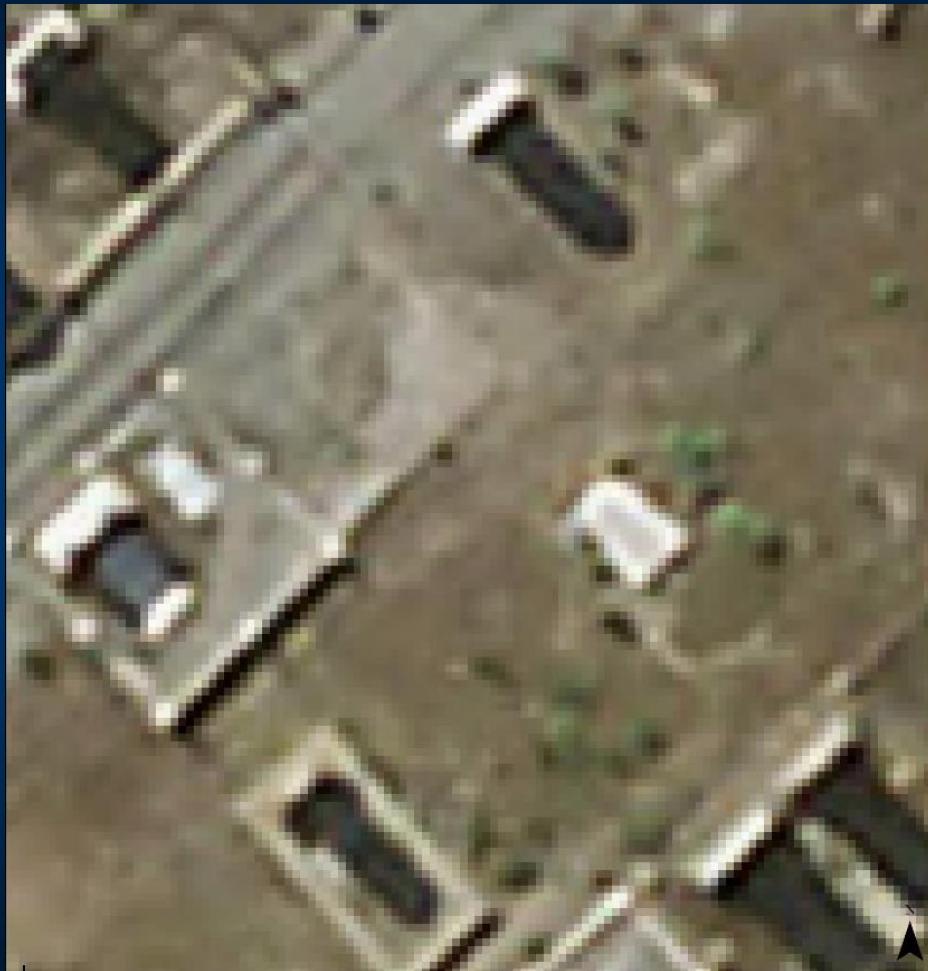


Satellite

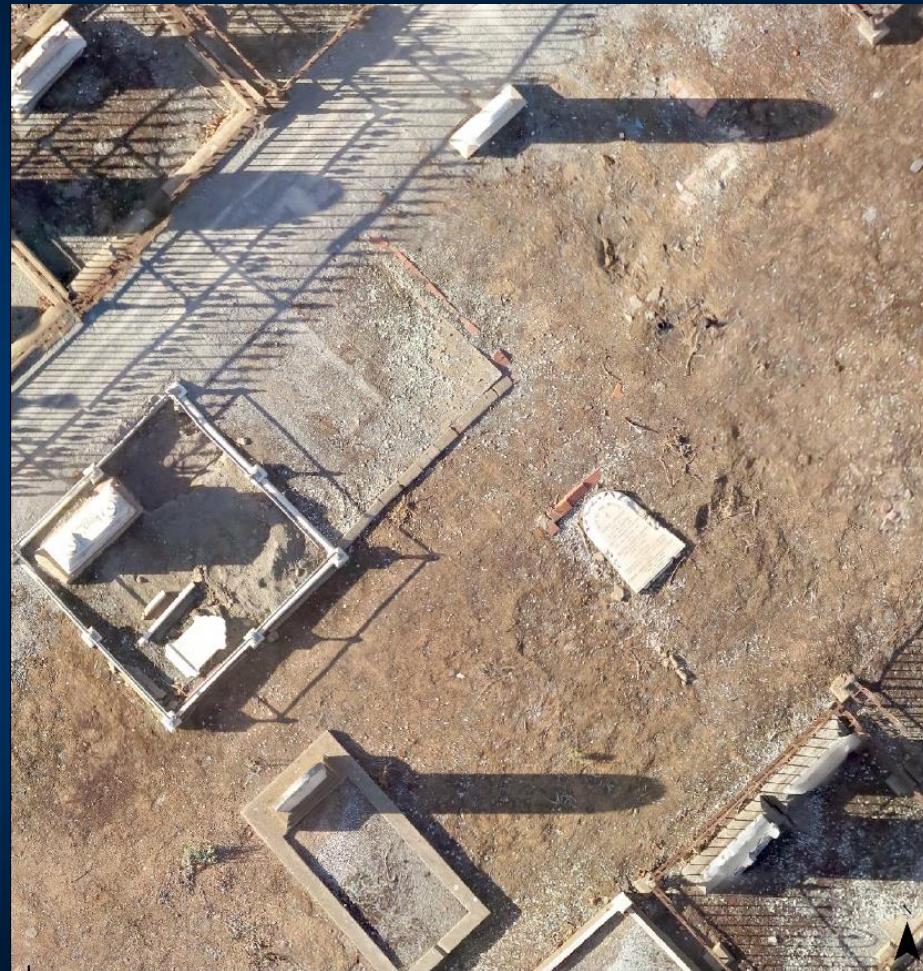


Kite

How Good is the Data?



Satellite



Kite

Just for fun.....



Satellite



Kite

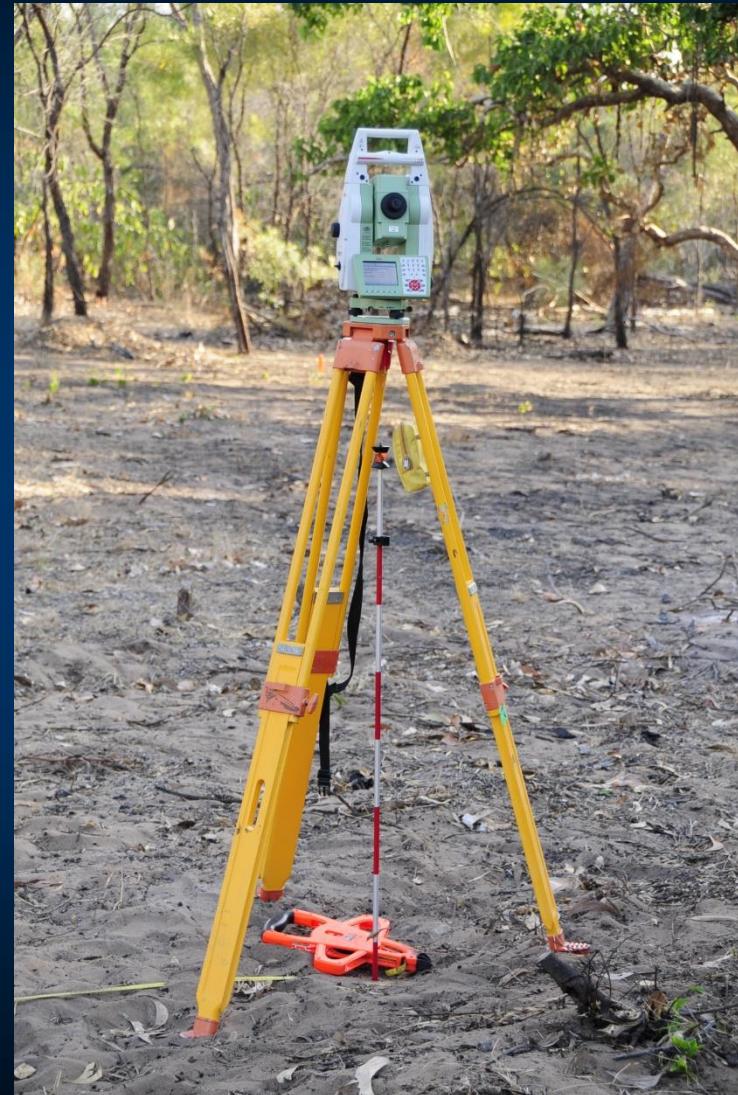
RTK-GPS

- Centimeter accurate positioning in X, Y and Z
- Uses a base station on a known position to correct the GPS
- Base station and rover communicate in the field to correct positions in real time
- Mounted on geophysical equipment to position survey results



Total Station

- Measures distance and azimuth using a laser
- Robotic function tracks the prism allowing mapping to be done by one person
- Provides faster survey and better precision than GPS and work in areas with overhead cover
- Uses GPS network for absolute positioning



GIS

- Digitally combines a variety of spatial data based on location
- Can include surveying, photographs, elevations, maps, plans and geophysical data



Geophysics

- Locates and maps geological and forensic features in the sub-surface
- Different techniques detect different physical properties
- Rapid Acquisition
- Non-destructive
- Quantitative

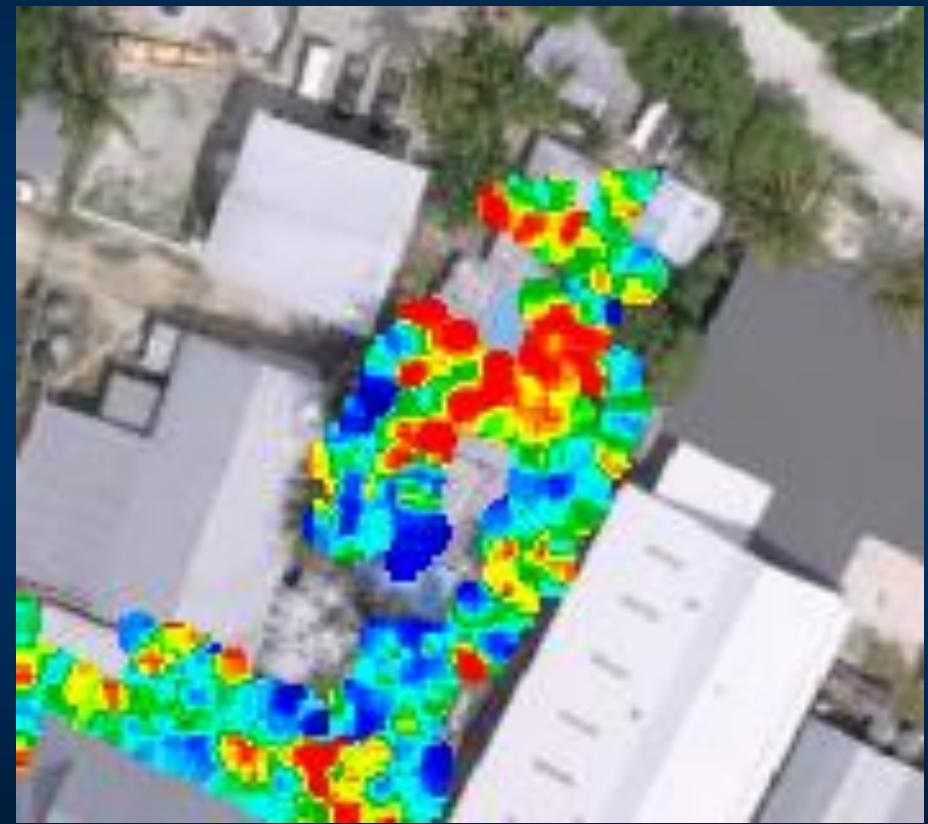
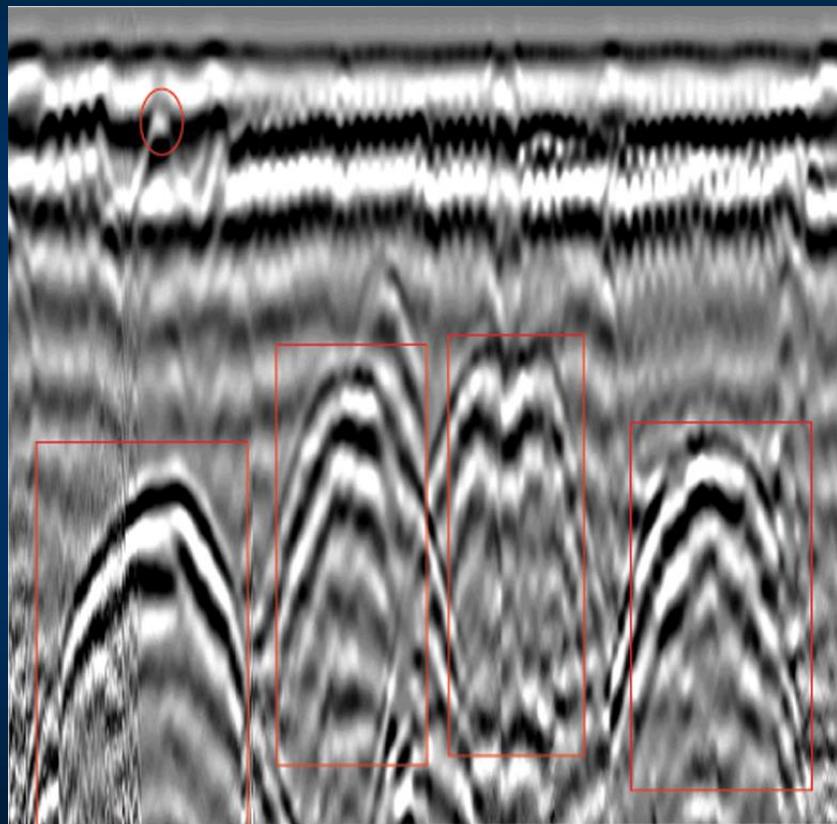


Ground Penetrating Radar (GPR)

- 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

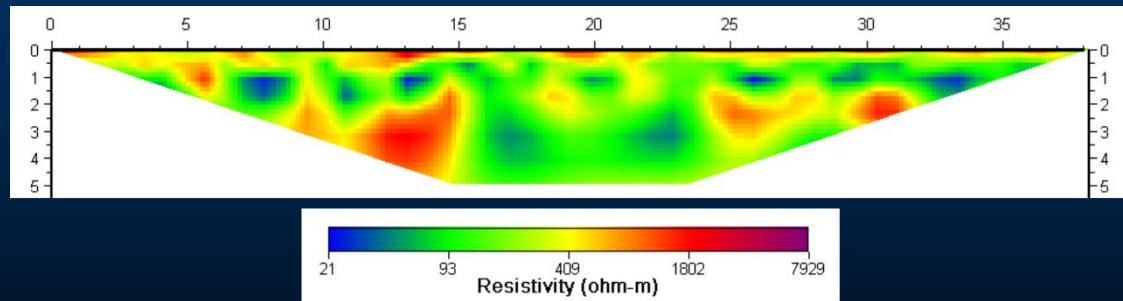


GPR Grave Mapping

- It is essential to see soil disturbance across multiple lines
- This defines the size and shape of the feature
- This information lets you interpret a feature as a grave
- Can provide a confidence level also



Other Geophysical Techniques



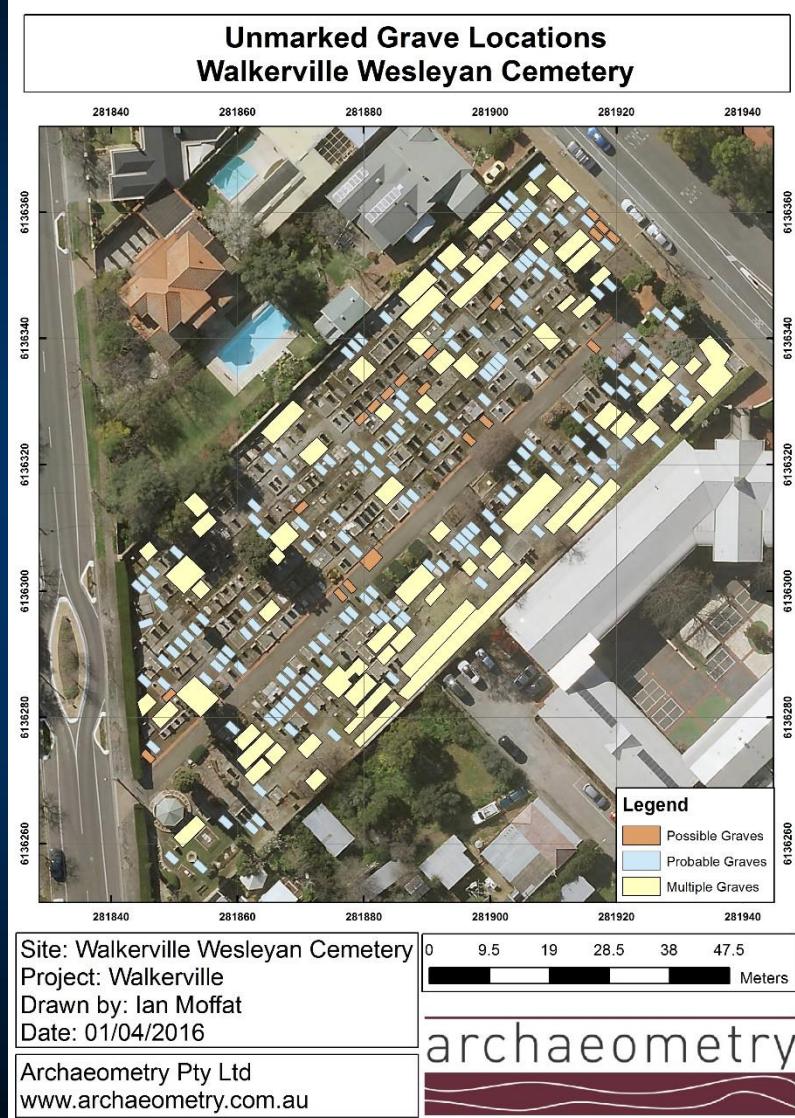
Case Study: Walkerville Wesleyan Cemetery

- Opened in 1849
- 647 GPR Lines collected
- Lines surveyed in with cm accuracy with RTK-GPS
- KAP data for site recording

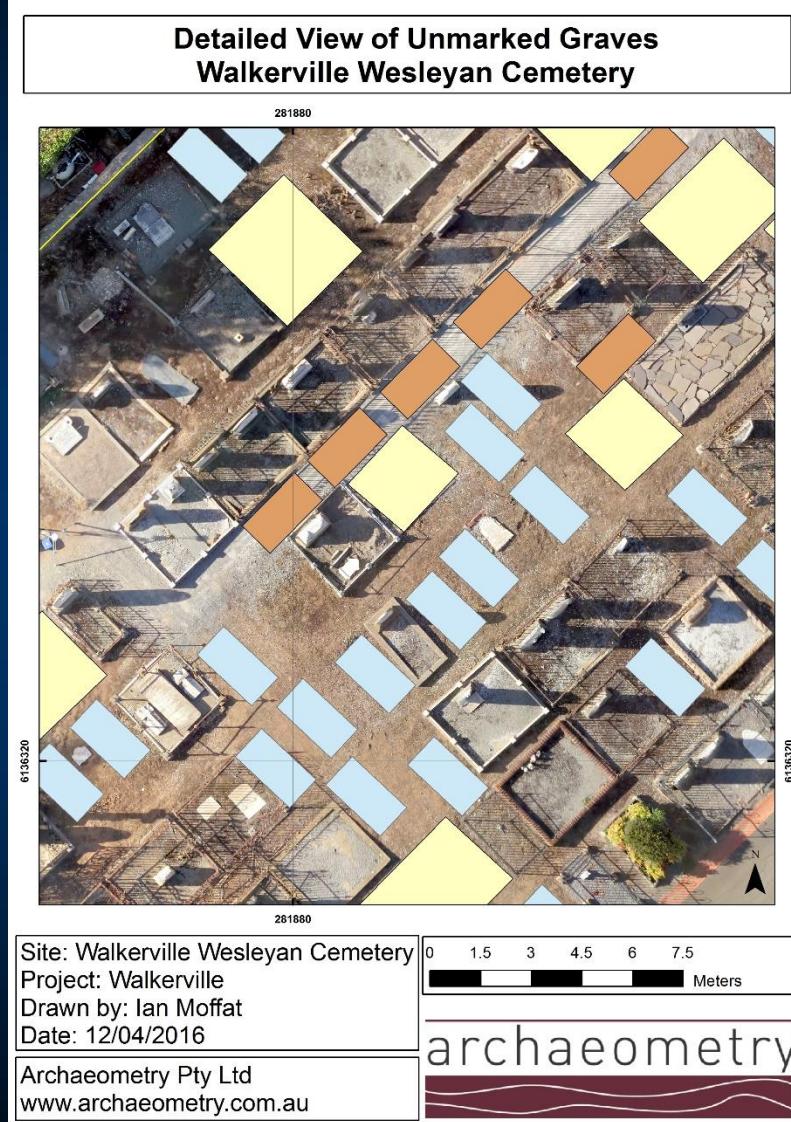


Case Study: Walkerville Wesleyan Cemetery

- 168 Probable Unmarked Graves
- 20 Possible Unmarked Graves
- 69 Areas with Multiple Graves



Case Study: Walkerville Wesleyan Cemetery



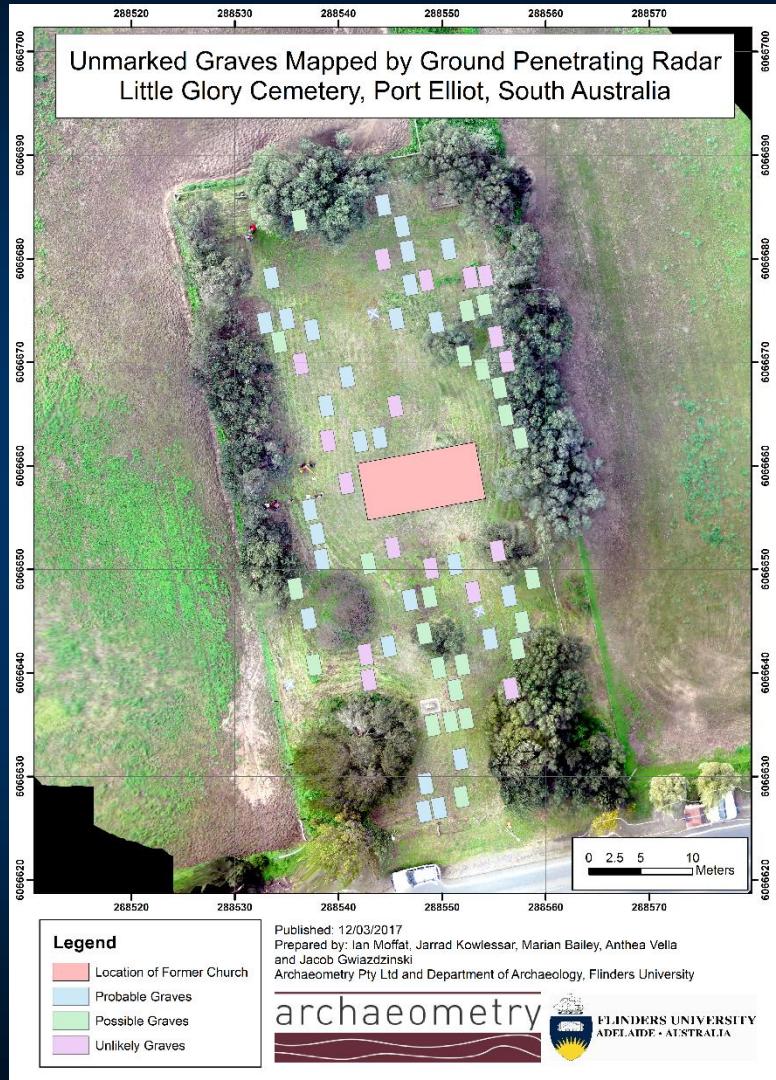
Case Study: Little Glory Cemetery, Port Elliot

- Chapel on site from 1857
- 2 marked graves
- 166 GPR Lines collected
- Lines surveyed in with cm accuracy with Total Station
- KAP data for site recording



Case Study: Little Glory

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



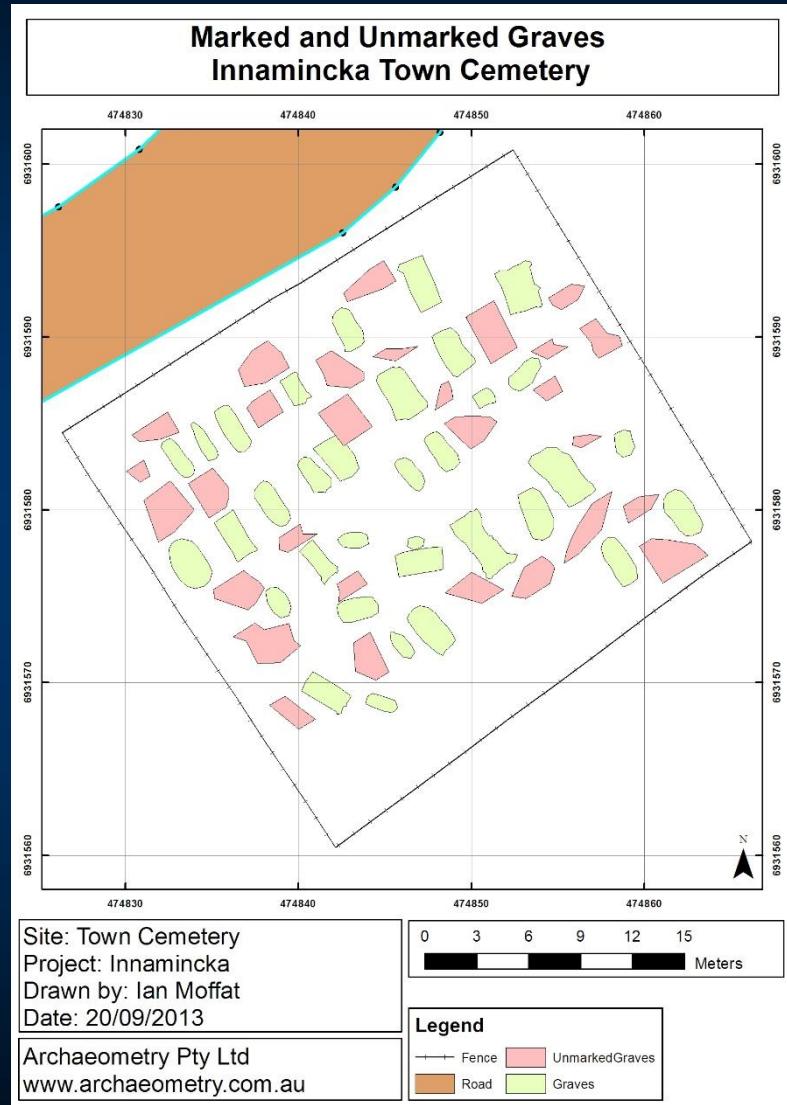
Case Study: Innamincka Town Cemetery

- Established in 1890
- 34 marked graves
- 60 GPR Lines collected
- Lines surveyed in with cm accuracy with RTK-GPS
- Satellite data for site recording



Case Study: Innamincka Town Cemetery

- 30 Unmarked Graves
- These have been marked by the Friends of Innamincka Reserves

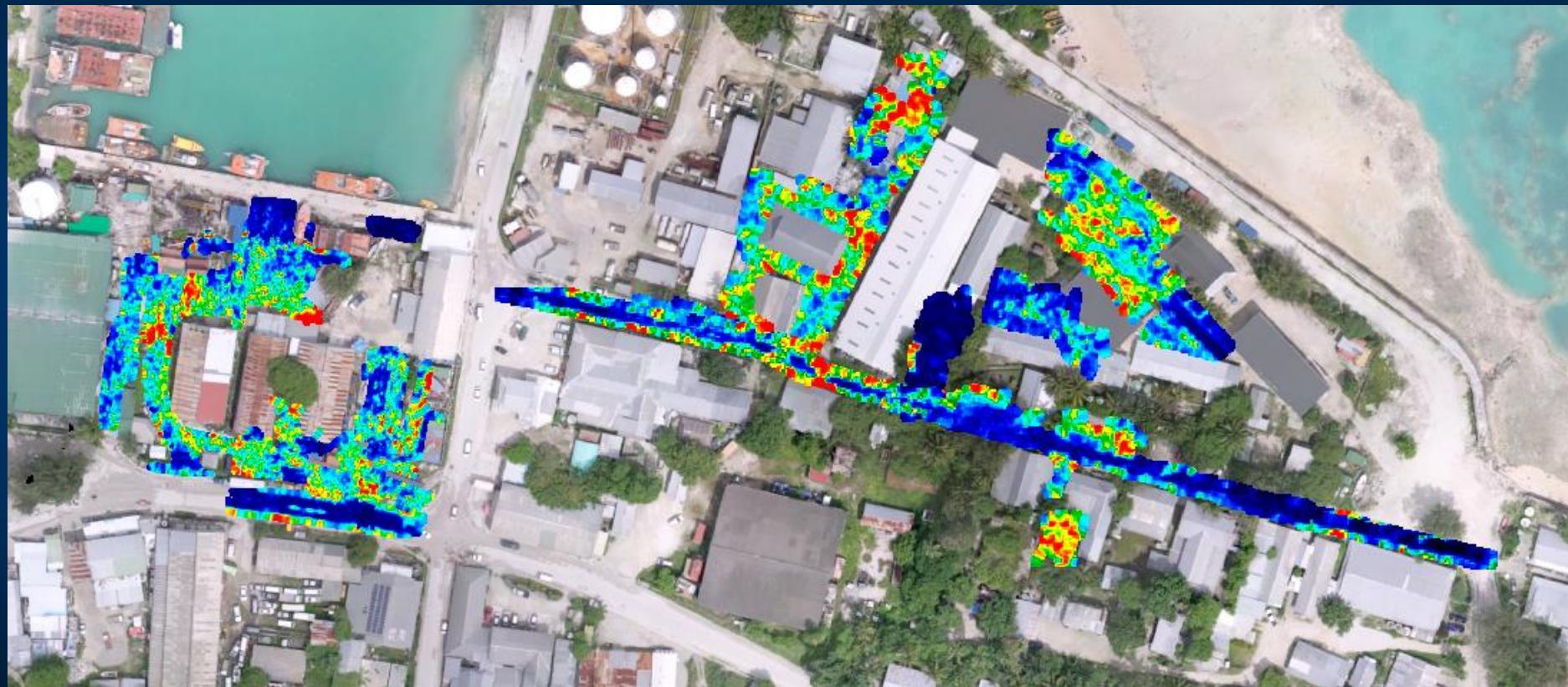


Case Study: Battle of Tarawa

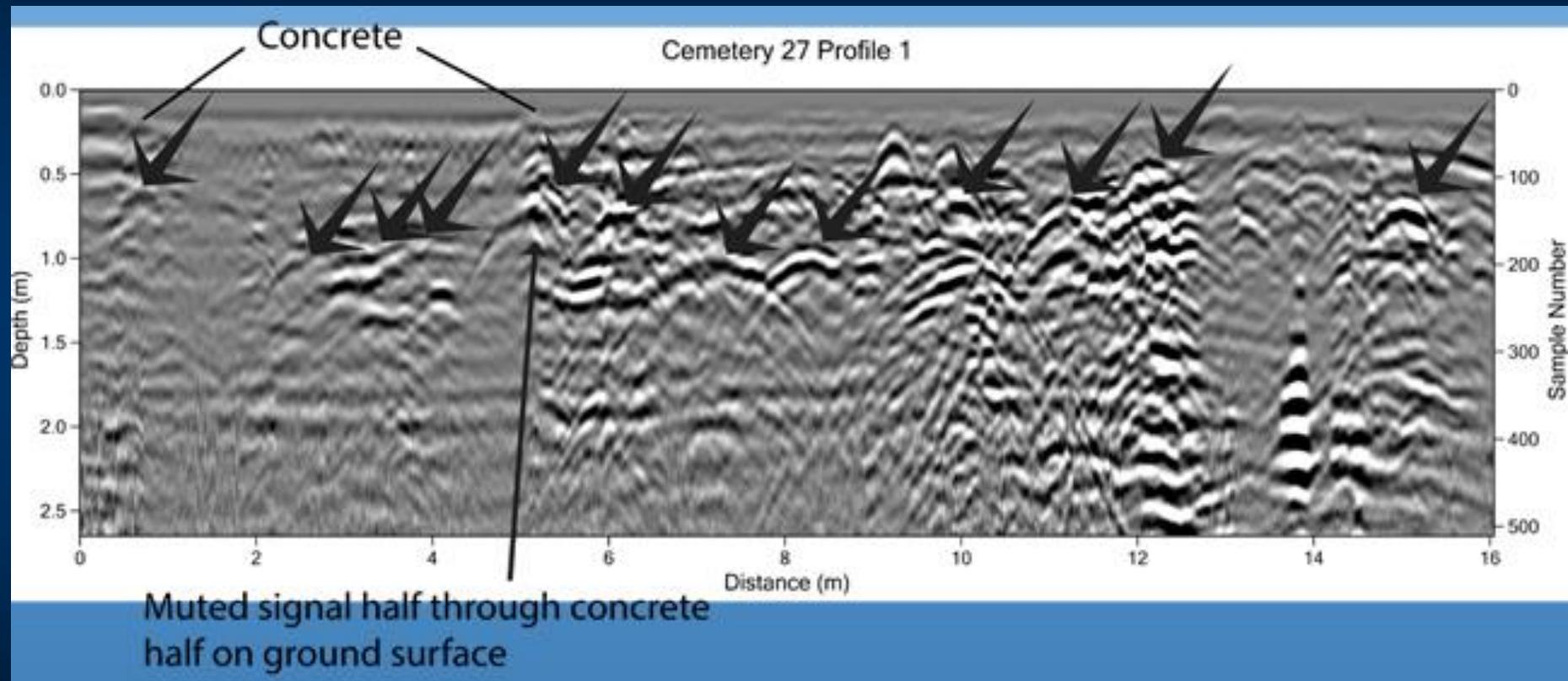
- Fought between American and Japanese 20-23 November 1943
- More than 6400 killed on an island of 1.43km^2
- Many hastily buried and subsequently covered by housing



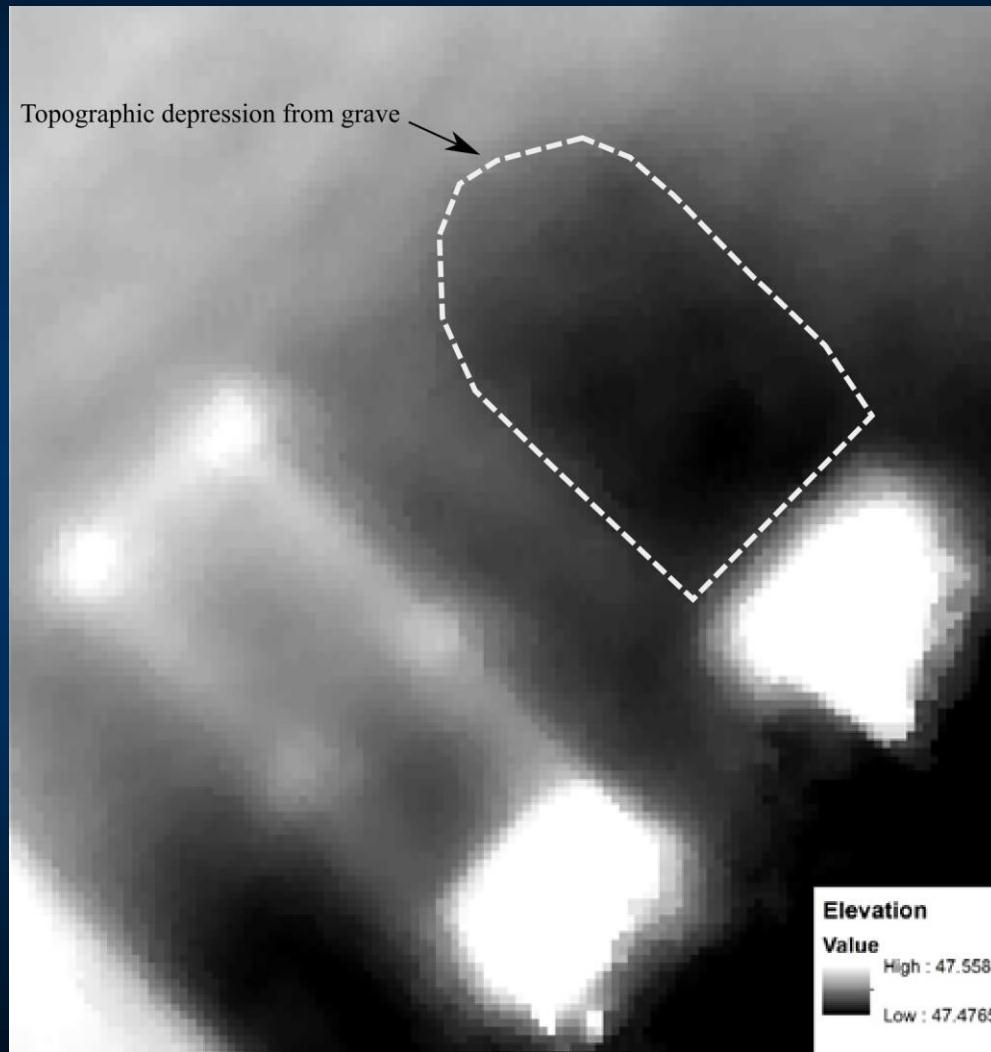
Broadscale GPR on Tarawa



GPR in Cemetery 27 (pre excavation)



The Really New Stuff.....



Summary of Presentation

- GPR and other 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
- Try them out for yourselves this afternoon!

