

# CEMETERY DELINEATION GUIDELINES

Council of Virginia Archaeologists – Cemetery Committee

## Contents

OVERVIEW.....1

ARCHAEOLOGICAL DELINEATION GUIDELINES .....1

CEMETERY REMOTE SENSING GUIDELINES.....2

**Remote Sensing Methodology** .....2

**Remote Sensing Options**.....3

*Ground Penetrating Radar*.....3

*Magnetic Gradiometer* .....4

*Electromagnetic Conductivity* .....4

*Electrical Resistivity*.....5

**Data Interpretation** .....5

**Reporting Standards**.....6

**Emerging Technologies** .....7

## OVERVIEW

Previously submitted to COVA for review with Archaeological Delineation Guidelines. Distributed to DHR for review and consideration.

## ARCHAEOLOGICAL DELINEATION GUIDELINES

Previously submitted to COVA for review. Distributed to DHR for review and consideration.

## CEMETERY REMOTE SENSING GUIDELINES

Draft guidelines for conducting remote sensing surveys in cemeteries to be included under “Evaluation of Human Remains and Cemeteries” in the *Guidelines for Conducting Historic Resources Survey in Virginia* (2017, in revision).

### REMOTE SENSING METHODOLOGY

The choice of field methods is to be based upon a research design and shall always reflect the current state of professional knowledge. Acknowledging that prescriptive field methods may limit the ability of a qualified specialist to implement creative methodologies, these guidelines are intended to provide the baseline or minimum data sampling strategy. The relevant survey design can and should be expanded as needed to meet project parameters and site conditions.

As an initial step, the cemetery should be visually inspected to record terrain changes, grave markers, vegetation, possible boundary markers, and other features of the cemetery. Photographs of existing conditions should be taken prior to vegetation clearing. The vegetation clearing will be conducted in a manner consistent with guidelines established for the archaeological delineation of cemeteries.

A survey grid shall be established with transects spaced at no greater than 50cm apart (25cm spacing preferred, where practical). Alternately, data collection must be done with appropriate, sub meter (preferred 5–10cm) RTK GPS connected geophysical equipment. The transects shall be placed to coordinate a high–density sampling strategy, with consideration that traditional western Christian burials are East/West in orientation. Generally, transects should be placed perpendicular to or at an obtuse angle to probable grave alignment in order to cross suspected burials the maximum number of times. If this is not possible, it should be explained in the report. The survey grid will include areas of both marked and unmarked graves and will extend beyond suspected cemetery boundaries.

All visible surface features (including but not limited to depressions, marker stones, fences/walls, significant vegetation) should be recorded on a scaled map. A semi–permanent datum shall be placed in the cemetery and their locations recorded with sub–decimeter accuracy GPS receiver. Survey grid boundaries should be recorded and shown on the map. The map shall include the location of anomalies in association with marked or unmarked burials.

All data should be recorded for post–processing. In field interpretation is not sufficient for cemetery mapping.

## REMOTE SENSING OPTIONS

GPR is the most commonly used instrument in cemeteries because it works in a diverse variety of settings and allows for three-dimensional data processing. Magnetic gradiometer, electromagnetic conductivity, magnetic susceptibility and electrical resistivity may also be helpful depending on the circumstances. Multiple instrument coverage is recommended when it is appropriate for the site conditions. All methods should be avoided where conditions limit the efficacy of the instrumentation. Two methods should always be used if a GPR survey cannot be conducted due to existing conditions (e.g. thick forests, or excessively wet soils). When these two other methodologies are employed, it is better if magnetic gradiometry is combined with either EM or ER. The absence of anomalies during surveys with sub-optimal conditions (dense vegetation, wet soils, clay-rich soils, etc.) should not be interpreted as an absence of human burials. If conditions are poor, or if the area has a high probability of containing human burials, a recommendation for further investigation, or no disturbance should be included in the final report.

### *Ground Penetrating Radar*

A ground penetrating radar survey will utilize the appropriate antenna for the specific cemetery (likely to be middle frequency 350 to 500MHz, but circumstances may recommend alternatives). Lower frequency antennae (100 to 250 MHz) do not provide high enough resolution to locate individual burials, but they may be able to locate the depth of old buried surfaces where a burial site/cemetery was deeply buried or had fill placed upon it.

The GPR survey will be consistent with the remote sensing methodology guidelines. The minimum sampling density will have a 25cm spacing (50 cm spacing can be appropriate depending on the cemetery and survey goals) with a minimum of 40 scans per meter with 512 samples per scan (Table 1).

Post-processing of GPR data is required. Field interpretation is not sufficient for the investigation of old or historic cemeteries. The report needs to include a description of the post-processing methodology/ies used during data analysis. Reporting should include (at minimum) example 2D profiles (radargrams) and 3D depth slice maps.

This methodology is less effective in areas with uneven, waterlogged, or soils with high conductivity. It is also not practical when the historic ground surface is deeply buried or when the cultural features to be mapped do not contrast sufficiently with the surrounding soils.

### *Magnetic Gradiometer*

A Magnetic Gradiometer (in the vertical configuration) is used to detect magnetic fluctuations in the surface soils that can help identify disturbed soils associated with graves. It also can identify ferrous metals associated with burials (e.g. grave goods and caskets). Only high-resolution gradiometers in the vertical configuration should be employed. The Magnetic Gradiometer field survey will be consistent with the remote sensing methodology guidelines. A grid will be established with 0.5 meter transects with a minimum of 8 readings per meter (Table 1). The most appropriate post-processing techniques for the Magnetic Gradiometer survey will be used. The report needs to include the post-processing methodology(ies) used in preparation of the 2D maps.

Many other types of magnetometers and gradiometers are used to detect large metal objects such as unexploded ordinances and underground storage tanks and cannot identify subtle soil variations associated with burials. This methodology is not practical in areas with large amounts of ferrous metals (e.g. urban environments, near fencing, metal signs, bollards, vehicles or general ferrous surface trash),

### *Electromagnetic Conductivity*

Electromagnetic Conductivity meters (EM) are used to detect fluctuations in soil conductivity that can help identify disturbed soils associated with graves. These instruments also measure the magnetic susceptibility of the soils which can detect variation and too can help identify burials. Only near surface instruments (1–1.5 meters sensor spacing) should be employed, including instruments with closely spaced coils. The EM field survey will be consistent with the remote sensing methodology guidelines. A grid will be established with 0.5 meter transects with a minimum of 10 readings per meter (Table 1). The most appropriate post processing techniques for the Electromagnetic Conductivity meters survey will be used. The report needs to include the post processing methodology(ies) used in preparation of the 2D diagrams maps.

As many other EMs are used to explore deeply buried geological features and are not useful for burial detection. This methodology is not practical in areas with extremely dry soils.

### *Electrical Resistivity*

Electrical Resistivity (ER) are used to detect fluctuations in soil resistivity that can help identify disturbed soils associated with graves. Only near-surface instruments should be employed, but preferably in an array configuration with no more than half meter to 1 meter spacing between probes.

The ER field survey will be consistent with the remote sensing methodology guidelines. A grid will be established with 0.5 meter transects with a minimum of 4 readings per meter (Table 1). The most appropriate post-processing techniques for the ER survey will be used. The report needs to include the post-processing methodology(ies) used in preparation of the 2D diagrams maps.

Many other ER probe configurations used to explore very deeply buried geological features are not useful for burial detection. This methodology is not practical in areas with extremely dry soils.

Remote Sensing Method	Minimum Sampling Strategy
Ground Penetrating Radar	0.25 meter transects, minimum 40 scans per meter with 512 samples per scan.
Magnetic Gradiometer	0.5 meter transects, minimum 8 readings per meter
Electromagnetic Conductivity	0.5 meter transects, minimum 10 readings per meter
Electrical Resistivity	0.5 meter transects, minimum 4 readings per meter

Table 1. Minimum Sampling Strategies for Remote Sensing methods

## DATA INTERPRETATION

All remote sensing data shall be collected and post-processed. In field interpretation is not sufficient for identifying historic human burials.

Interpretation and classification should be done by, or under the direct supervision of, a qualified professional with demonstrated professional experience in the use of remote sensing tools for archaeological survey in the eastern United States, preferably in cemetery or burial landscapes.

All identified anomalies will be interpreted and included in the report as an appendix. This will include a location, depth and size, and a brief description. Anomalies identified as possible human burials will be ranked by probability. It is recommended that the anomalies be identified as High, Medium, or Low probability or similar system. Classifications must be defined in the report. All anomalies identified as possible human burials will be depicted on a map, along with areas that are unclear or unknown due to soil condition factors or that were not surveyed due to site conditions, obstacles, etc. Any interpretation should be done in relationship to the real-world spatial referencing.

A detailed summary of post-processing methodology and interpretation will be included in the report.

## REPORTING STANDARDS

Each person directly responsible for collecting, processing, and interpretation of geophysical data should include a statement of professional qualifications and experience as a report appendix.

A methods section will be included for field data collection, post-processing, and data interpretation including how the results were characterized. The methods will detail the process, provide an explanation of these methods, and identify the software used for post-processing.

Descriptions of each anomaly identified should be included in the report. The descriptions will include, but are not limited to, the location, size and shape, depth, interpretation, and an ID number that will correspond to the map (may be portrayed in a table). Relevant graphics will be included to interpret the anomalies, this can include radargrams or other data visualizations.

A scaled map will depict grid data and survey extent. The map will include all possible human burial anomalies, ranked by certainty, as well as any cemetery features and

markers. Datums should be recorded on the map, with any other known landmarks for possible field reidentification.

Photographs should include, but not be limited to, the site before and after any vegetation clearing as well as any identifiable cemetery features.

The final report will also include the following

- Site conditions including the dates of the survey, soil types, moisture content, and vegetation.
- an explanation and justification for the instrument selection based on site conditions and research questions.
- Hardware used including any unit specifications such as frequency for GPR.
- Data visualizations including but not limited to time and depth slices, radargrams and georeferenced result maps.

## EMERGING TECHNOLOGIES

As other remote sensing techniques are introduced to the field or are not included in these guidelines, such as Human Remains Detecting Dogs (HRD), the methods employed will be clearly documented in the final report and will be consistent with the Reporting Standards outlined above. Interpretation and classification of the data collected should be done by, or under the direct supervision of, a qualified professional with demonstrated professional experience in archaeological survey in the eastern United States, preferably in cemetery or burial landscapes.