Author's photo

The author conducted an electrical-resistance survey at Layman's Cemetery. The probes at the bottom of the frame measure the flow of electricity when they are placed in contact with the soil.

Mapping unmarked graves at Layman's Cemetery

by Geoffrey Jones

Any observant person strolling through the Minneapolis Pioneers and Soldiers Memorial Cemetery will quickly realize the cemetery contains a great number of unmarked graves: Some grave markers are far apart, and in many areas there are rows of faint depressions and discolored grass, which indicate graves where no markers are present.

Located at Lake Street and Cedar Avenue in the heart of south Minneapolis, this cemetery is the resting place of many of the area's early Euro-American settlers. It is often referred to as Layman's Cemetery, after its original operators. Its colloquial name is used in this article, simply because it is less cumbersome than the official one. Although the cemetery is now cared for by the City of Minneapolis, past neglect has taken its toll.[1] Unfortunately, its condition is fairly typical of older historic cemeteries, and because of this it was chosen for an experimental study seeking to improve methods for mapping unmarked graves. Subsurface imaging of a small portion of the cemetery has revealed not only a high density of unmarked graves but also evidence that some of the existing markers may be misplaced.

Challenges in Cemetery Archaeology

Archaeology often provides us with information about the past that is not available by other means. The soil may hold traces of human activities for which records have been lost or that at the time were considered too prosaic for record. But now they are important to our understanding of the past. The archaeological record is also our only primary source of information for thousands of years of prehistory.

Unfortunately, archaeological excavation is inherently destructive, reducing portions of archaeological sites to recorded data and curated artifacts. Much of the focus of archaeology has shifted toward preservation rather than exploitation of archaeological resources. There are many reasons for this, ranging from the ever-accelerating pace of development to increasing cultural sensitivity.

Cemeteries, both historic and prehistoric, are often at issue, as their protection is often in conflict with the desires of developers. They are also a special subject in archaeology, not only because they are more stringently protected by law than other types of sites but also because of cultural respect for the dead and for their descendant communities. The study of cemeteries, whether for preservation, restoration, or research, must generally avoid invasive or destructive methods.

The most basic need may be to document the presence of graves and the extent of the cemetery. Missing or misplaced grave markers are common in historic cemeteries, and often even the limits of the cemetery are unknown. Many previously recorded prehistoric burial mounds were subsequently destroyed by plowing. Although intact burials often remain beneath the surface, records may be too inexact to relocate the mounds when they can no longer be identified visually. Unrecorded and unmarked cemeteries are sometimes discovered only when burials are accidentally exposed.

Geophysical Survey

One effective approach to cemetery study is geophysical imaging, which has been used with success on many cemeteries. While cemeteries present special technical challenges, several geophysical sensing technologies are useful in mapping subsurface archaeological features, including graves. The most commonly used geophysical tool for grave detec-

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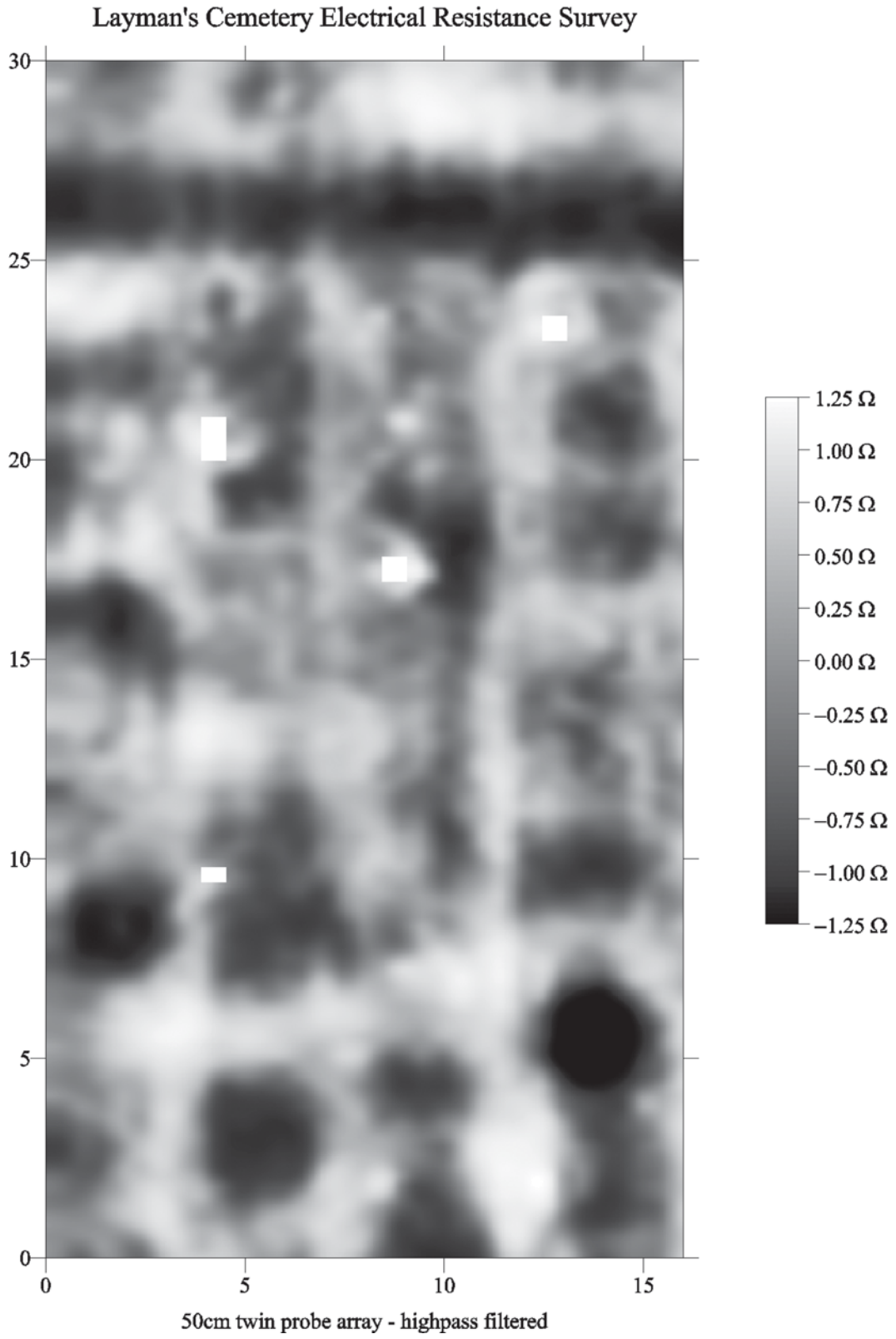

Fig. 1, showing results of the most successful survey configuration at Layman's Cemetery.

tion is ground-penetrating radar (GPR), favored because it is able to detect small subtle features at relatively great depth. Yet, while GPR can be a powerful tool in favorable soils (uniform sandy soils are ideal), its performance varies greatly

and is sometimes difficult to predict. Cemeteries can present a number of technical challenges that limit the usefulness of geophysical sensing technologies. In the absence of substantial components such as metal caskets or concrete vaults, graves are generally subtle targets (they do not show up well) after their organic components have decomposed. The detection of the graves is further complicated by their depth, which is relatively great in terms of the capabilities of the instruments. In historic cemeteries, the presence of metal interferes with magnetic and electromagnetic methods, as do some types of rock used in grave markers.

Of other existing geophysical methods, electrical-resistance survey may have the greatest potential for grave detection. An electrical-resistance meter can be thought of as similar to the familiar Ohm meters used for testing electrical circuits. Subsurface features may be mapped when they are more or less resistant to the flow of electricity than their surroundings. Disturbed or compacted soils may contrast with undisturbed soils, and intrusive materials may be of higher or lower resistance than their surroundings.

While success with electrical resistance methods has been inconsistent in the past, neither has much serious work been done to optimize them for cemetery survey. Layman's Cemetery was chosen as the subject for experimental work aimed at improving the performance of resistance methods for grave detection. A series of experimental surveys was performed on an area 16 by 30 meters (roughly 50 by 100 feet), about 1 percent of the ten-acre cemetery. The data generated was used for empirical comparison of different sensor configurations, sampling strategies, and data-processing techniques. GPR survey was also performed for comparison with the results from electrical resistance.

Survey Results

Although a technical discussion of the experimental work is unlikely to be of interest to most readers, the resulting subsurface maps are both intriguing and a good example of the possibilities of geophysical imaging.

Fig. 1 (opposite) shows the results of the most successful survey configuration. This image represents only moderate depth beneath the ground, and anomalies result mainly from disturbed soil within the grave shaft, rather than the body or coffin. Apparent graves are associated with low electrical resistance (darker shades).

Although individual graves may be indistinct, rectilinear patterning indicates a high density of graves in north-south rows, typical of Euro-American cemeteries. The deceased are generally positioned with their heads to the west, in rows formed of side–by-side graves. The east-west linear anomaly appearing at approximately N26 is thought to be a utility line, perhaps intruding into burials.

In Fig. 2, areas of low resistance are reduced to a uniform shade. The shaded areas may represent clusters of burials or possible family plots, but it is possible that the apparent gaps contain burials that are simply less detectable.

The locations of a number of individual graves are indicated on the map by black rectangles. Presumed graves are somewhat obscured by their close proximity to one another. The few grave markers within this area do not correlate well with the geophysical patterning. This suggests that many grave markers are missing or displaced.

For comparison, this survey from another cemetery shows good correlation

Electrical-resistance survey may have the greatest potential for grave detection of all geophysical methods.

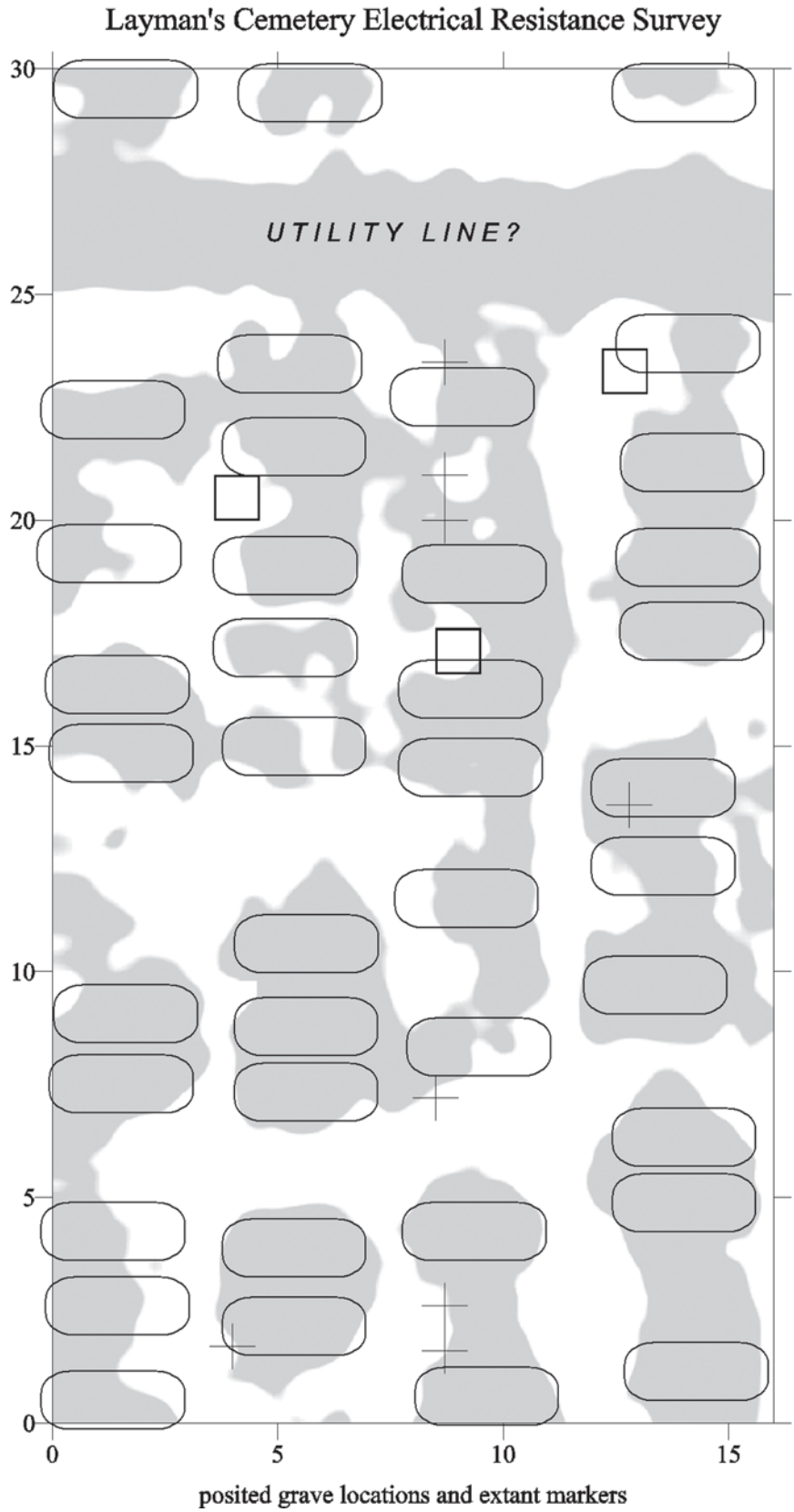

Fig. 2, showing areas of low resistance reduced to a uniform shade.

between graves and markers (Fig. 3).[2] This example is from a rural cemetery of approximately the same age. Although it was a GPR (rather than resistance) survey, the results are analogous. Headstones and footstones show good correlation with the geophysical patterning. Less distinct patterning outside the marked limits of the cemetery may indicate additional unmarked graves.

While GPR survey did detect some suspected graves at Layman's Cemetery (the results are not presented here), it was less successful than resistance. This was unexpected, and shows that multiple geophysical methods can increase the likelihood of successful detection. No geophysical method should be expected to detect every grave within a cemetery. Even where multiple methods have been largely successful, they measure different physical properties and may achieve different results.

Conclusion

Great caution must be taken in attempting archaeological interpretation based on geophysical imaging alone. On other types of sites, invasive methods such as soil coring or excavation may be used to test interpretations. In cemeteries, we must generally rely on less-direct methods. In this case, patterning is fairly clear, obviously man-made, and consistent with historic burial practices. Even without corroborating evidence, we may con-

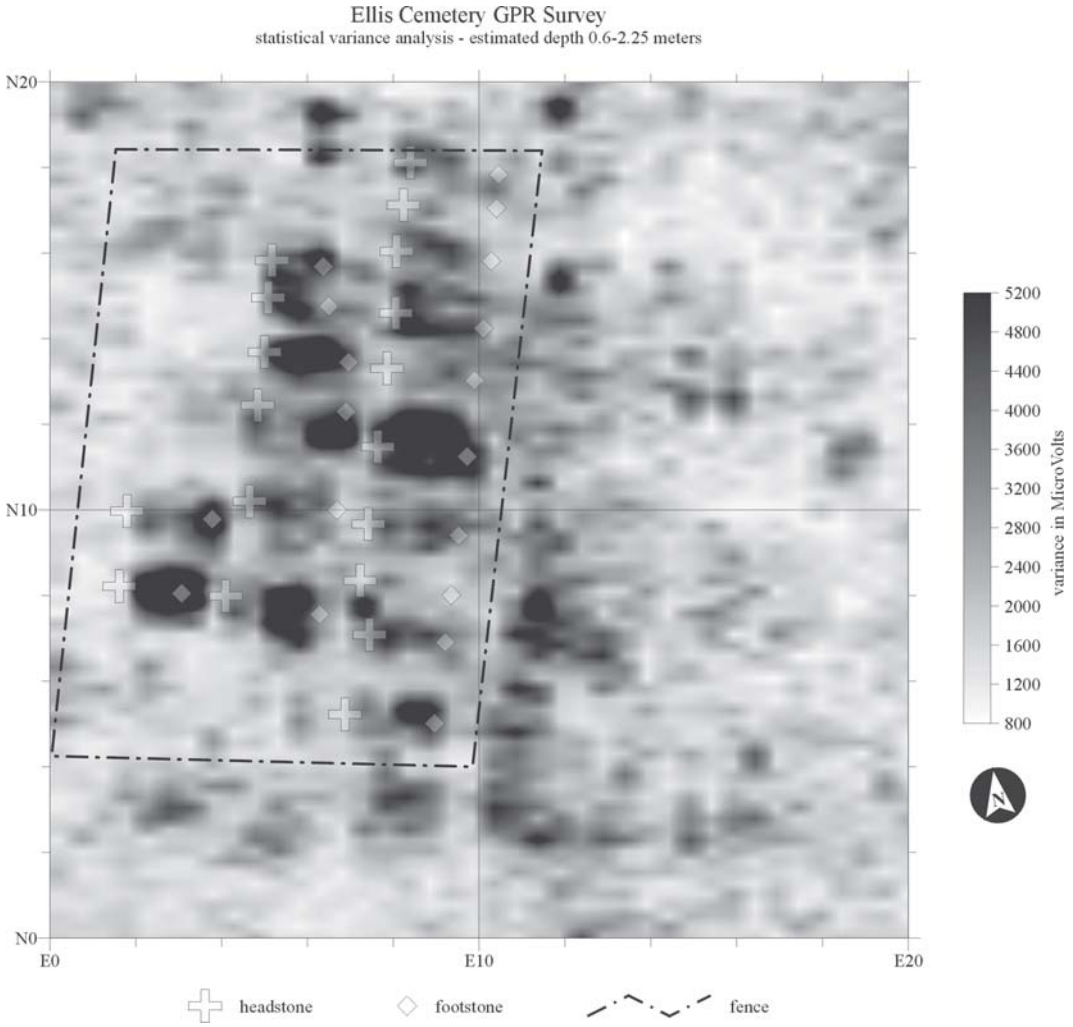

Fig. 3, a comparison survey from another cemetery, showing good correlation between graves and markers.

The data can be valuable for cemetery preservation and for historical research.

fidently conclude that the resistance survey has successfully detected a high density of graves (most of them unmarked) within the survey area.

Where geophysical results are more ambiguous, other sources of information become more important. Identification of unmarked graves may be based on many sources of information, including the patterning of existing grave markers, depressions, vegetation (different coloration or species), archival research and interviews. Multiple sources of information must be thought of as complementary rather than redundant. Geophysical methods are most effective as part of an integrated research program that brings together and compares many types of data.

Although this study was performed for technical (rather than historical) research, this type of data can be valuable both for cemetery preservation and historical research. As a preservation tool, geophysical imaging can help define the limits of cemeteries, relocate graves, and verify the absence of graves where cemeteries are in active use. For historical research, it has numerous possibilities, including locating the graves of famous persons and those of forgotten people, such as slaves and race-riot victims.

Notes

1. Susan Hunter Weir, "Layman's Cemetery: Minneapolis Pioneers and Soldiers Cemetery," *Hennepin History*, Summer 2003.
2. Geoffrey Jones, David L. Maki, and Michael L. Hargrave, 2003 *Ground Penetrating Radar Investigations of Four Historic Cemeteries on Fort Bragg, NC*. Archaeo-Physics Report of Investigation #48.

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