United States Department of Agriculture

Natural Resources Conservation Service

5 Radnor Corporate Center, Suite 200 Radnor, PA 19087-4585

Subject: Geophysical Assistance -- Archaeological

Date: 2 November 1998

To: Margo L. Wallace
State Conservationist
USDA-NRCS,
16 Professional Road
Storrs, Connecticut 06268-1299

PURPOSE:

To assist Connecticut NRCS Staff, the Connecticut State Archaeologist, and students enrolled in the Hartford Renaissance Magnet program at the Lewis Fox Middle School assess the number and locations of African-American graves within the "Ancient Burying Grounds", Hartford, Connecticut.

PARTICIPANTS:

Nicholas Bellantoni, Connecticut State Archaeologist, University of Connecticut, Storrs, CT
Rudy Chlanda, Geologist, USDA-NRCS, Amherst, MA
Howard Denslow, Resource Conservationist, USDA-NRCS, Storrs, CT
Jim Doolittle, Research Soil Scientist, USDA-NRCS, Radnor, PA
Shawn McVey, Asst. State Soil Scientist, USDA-NRCS, Storrs, CT
Pamela Silvestri, Archaeologist, Vernon, CT

ACTIVITIES:

All field activities were completed on 26 October 1998.

EQUIPMENT:

The ground-penetrating radar (GPR) unit used in this study was the Subsurface Interface Radar (SIR) System-2, manufactured by Geophysical Survey Systems, Inc.[1] The SIR System-2 consists of a digital control unit (DC-2) with keypad, VGA video screen, and connector panel. A 12-volt battery powered the system. Morey (1974), Doolittle (1987), and Daniels and others (1988) have discussed the use and operation of GPR. The antenna used was the model 5103 (400 mHz).

To help summarize the results of this study, the SURFER for Windows software program developed by Golden Software Inc. was used to construct two-dimensional simulations.[2] Grids were created using kriging methods.

BACKGROUND:

A group of Hartford middle-students initiated a research project to better understand the histories of slaves and freed African-Americans interred within the "Ancient Burying Grounds," Hartford, Connecticut. These students have found evidence that over 300 African-Americans were buried within the "Ancient Burying Grounds" in unmarked graves. At the request of the student's teacher, Ms. Billie Anthony, and the Connecticut State Archaeologist, Nicholas Bellantoni, NRCS provided ground-penetrating radar field assistance.

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[1] Trade names have been used in this report to provide specific information. Their use does not constitute endorsement.
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Killam (1990) believes that most bones are too small and not directly detectable with GPR. This author noted that the disruption of soil horizons makes most graves and some cultural features detectable. However, in soils that lack contrasting horizons or geologic strata, the detection of a grave shaft is improbable. In addition, with the passage of time, natural soil-forming processes erase signs of disturbances.

In highly attenuating soils, profiling depths are restricted and many subsurface features are not directly sensed with GPR. Under highly attenuating conditions, the location and identification of buried cultural features are frequently inferred from bowed, disrupted, or disturbed soil horizons. At many sites, the most distinctive feature of a grave is the disturbed soil materials that fill and cover the grave shaft (Bevan, 1991). However, caution must be exercised in interpreting these features as a number of artificial and natural processes can produce disturbed soil conditions.

Cultural features are difficult to distinguish in soils having numerous rock fragments, roots, animal burrows, modern cultural features, debris or fill layers. These scattering bodies produce undesired subsurface reflections that complicate radar imagery and can mask reflections from buried cultural features. Frequently, "desired" cultural features are indistinguishable from background clutter. In soils having numerous scattering bodies, GPR surveys often provide little meaningful information to supplement traditional sampling methods (Bruzewicz et al., 1986). The identification of buried cultural features were complicated by scattering bodies in surveys conducted by Bevan (1991), Dolphin and Yetter (1985), Doolittle (1988), and Vaughan (1986).

Results:

Radar profiles collected within the cemetery were interpretable and contained an abundance of subsurface information. Depth of observation, while unconfirmed, was considered adequate for the detection of burials (a scanning time of 40 nanoseconds was used). A cursory review of the radar profiles revealed numerous point and planar reflectors. The radar records contain an abundance of additional, less expressed point reflectors. These may also represent burials. However, because of their poor expression, interpretations were considered imprudent without some ground-truth verification of the faint imagery. Other reflectors were more strongly expressed on radar profiles. Forty-seven of these reflectors were considered to be *very conspicuous*. Some of these prominent point reflectors are believed to represent burials. Some may represent rock fragments, roots, or other buried cultural features.

The approximate locations of point reflectors are plotted in Figure 1. The alignment of two or more point reflectors frequently provides strong evidence of a burial. In Figure 1, several point reflectors located in adjacent rows are aligned. These aligned reflectors provide stronger indications of possible burials. A prominent, subsurface planar reflector was evident on 6 radar traverses. Though irregularly shaped, the area occupied by this reflector was adjoining on consecutive radar profiles. The strong reflection from this reflector suggests a buried cultural layer or feature.

CONCLUSIONS:

1. Interpretations contained in this report are considered preliminary estimates of site conditions. These interpretations do not substitute for direct observations, but rather reduce their number, direct their placement, and supplement their interpretations. Interpretations should be verified by ground-truth observations.

2. A large number of buried point reflectors were identified within the grid. Some of these reflectors are believed to represent burials. A review of the radar profiles showed that several point reflectors are aligned and suggest eleven likely burials. Location maps have been prepared for the two surveyed areas. These maps may help archaeologists develop search strategies.

3. A high probability exists that unmarked graves are present in the area surveyed with GPR. As the radar detects but does not identify subsurface features, it is uncertain whether these features represent the graves of African-Americans.

4. Copies of the radar profiles from the Ancient Burial Grounds have been turned over to Nicholas Bellantoni for use and further interpretations.

It was my pleasure to be of some assistance to you, your staff, and the students of the Lewis Fox Middle School.

With kind regards,

James A. Doolittle
Research Soil Scientist

cc:
N. Bellantoni, State Archaeologist, Connecticut State Museum of Natural History, U-214, Storrs, CT 06269-4214
J. Culver, Acting Director, USDA-NRCS, National Soil Survey Center, Federal Building, Room 152,100 Centennial Mall North, Lincoln, NE 68508-3866
H. Denslow, Resource Conservationist, USDA-NRCS, 16 Professional Park Road, Storrs, CT 06268-1299
C. Olson, National Leader, Soil Survey Investigations, USDA- NRCS, National Soil Survey Center, Federal Building, Room 152, 100 Centennial Mall North, Lincoln, NE 68508-3866.
S. McVey, Assistant State Soil Scientist, USDA-NRCS, 16 Professional Park Road, Storrs, CT 06268-1299
H. Smith, Director of Soils Survey Division, USDA-NRCS, Room 4250 South Building, 14th & Independence Ave. SW, Washington, DC 20250

References

Batey, Richard A. 1987. Subsurface interface radar at Sepphoris, Israel, 1985. Journal of Field Archaeology 14(1): 1-8.

Berg, F. and H. Bruch. 1982. Georadar: Archaeological interpretation of soil radar data. Second Nordic Conference on the Application of Scientific Methods in Archaeology. Elsinore, Denmark, 17-19 August 1981. In: PACT 7:285-294.

Bevan, Bruce W. 1977. Ground-penetrating radar at Valley Forge. Geophysical Survey Systems, Inc. Hudson, New Hampshire.

Bevan, Bruce W. 1984a. Environmental effects on ground-penetrating radar. pp. 201-204. In: Abstract, 54th Annual International SEG Meeting, held at Atlanta, Georgia. Dec. 2-6, 1984.

Bevan, Bruce W. 1984b. Looking backward: geophysical location of historic structures. pp. 285-301. In: The Scope of Historical Archaeology, Essays in honor of John L. Cotter. Ed. David G. Orr and Daniel G. Crozier. Temple University, Philadelphia.

Bevan, Bruce W. 1991. The search for graves. Geophysics 56(9):1310-1319.

Bevan, Bruce and Jeffrey Kenyon. 1975. Ground-probing radar for historical archaeology. MASCA (Museum Applied Science Center for Archaeology) University of Pennsylvania, Philadelphia. Newsletter 11(2):2-7.

Bevan, Bruce W., David G. Orr, and Brooke S. Blades. 1984. The discovery of the Taylor House at the Petersburg National Battlefield. Historical Archaeology 18:64-74.

Bruzewicz, A. J., C. R. Smith, D. E. Berwick, and J. E. Underwood. 1986. The use of ground-penetrating radar in cultural resource management. Technical Papers 1986 ACSM-ASPRS Annual Convention Vol. 5: 233-242.

Cole, D. P. 1988. Hi-tech archaeology: ground-penetrating radar. Biblical Archaeology Review 14(1): 38-40.

Daniels, D. J., D. J. Gunton, and H. F. Scott. 1988. Introduction to subsurface radar. IEE Proceedings 135F(4):278-320.

Davenport, G. C., T. J. Griffin, J. W. Lindemann, and D. Heimmer. 1990. Geoscientists and law enforcement professional work together in Colorado. Geotimes 35(7):13-15.

Dolphin, L. and T. J. Yetter. 1985. Geophysical survey at Third Mission Site, Santa Clara University. SRI Project 8745. SRI International, Menlo Park, California. p. 56.

Doolittle, J. A. 1987. Using ground-penetrating radar to increase the quality and efficiency of soil surveys. pp. 11-32. In: Reybold, W. U. and G. W. Peterson (eds.) Soil Survey Techniques, Soil Science Society of America. Special Publication No. 20. p. 98

Doolittle, J. A. 1988. Ground-penetrating radar (GPR) survey at Tell Halif, Israel. pp. 180-213. In: Technical Proceedings of the Second International Symposium on Geotechnical Applications of Ground-Penetrating Radar. Gainesville, Florida. March 6-10 1988.

Doolittle, J. A. and W. F. Miller. 1991. Use of ground-penetrating radar in archaeological investigations. pp. 81-94. In: Clifford A. Behrens and Thomas L. Sever (Eds.) Application of Space-Age Technology in Anthropology; November 28, 1990, Conference Proceedings. NASA John C. Stennis Space Center p. 270. Special Publication.

Gibson, J. L. 1989. Digging on the dock of the bay(ou): the 1988 excavation at Poverty Point. Univ. of Southwest Louisiana Center for Archaeological Studies. Report No 8 p. 227.

Grossman, Joel W. 1979. Ground-penetrating radar survey at Raritan Landing: an underground map of a buried settlement. Annual Meetings of the Society for American Archaeology, Vancouver, British Columbia. April 23-26, 1979. p. 15.

Hoving, G. L. 1986. Buried body search technology. Identification News. Feb. p. 3,15.

Imai, T., T. Sakayama, and T. Kanemori. 1987. Use of ground-probing radar and resistivity surveys for archaeological investigations. Geophysics 52(2): 137-150.

Kenyon, Jeff L. 1977. Ground-penetrating radar and its historical application to a historical archaeological site. Historical Archaeology 2:48-55.

Killam, E. W. 1990. The detection of human remains. Charles C. Thomas Publisher, Springfield, Illinois. p. 263

Mellett, James S. 1992. Location of human remains with ground penetrating radar. pp. 359-365. In: Hanninen, P. and S. Autio (Eds.) Fourth International Conference on Ground Penetrating Radar. June 8-13, 1992. Rovaniemi, Finland. Geological Survey of Finland, Special Paper 16. p. 365.

Morey, R. M. 1974. Continuous subsurface profiling by impulse radar. pp. 212-232. In: Proceedings, ASCE Engineering Foundation Conference on Subsurface Exploration for Underground Excavations and Heavy Construction, held at Henniker, New Hampshire. Aug. 11-16, 1974.

Parrington, Michael. 1979. Geophysical and aerial prospecting techniques at Valley Forge National Historical Park, Pennsylvania. Journal of Field Archaeology 6(2):193-201.

Rodriquez, W. C., and Bass, W. M. 1985. Decomposition of burials and methods that may aid in their location. J. Forensic Science. 30(3):836-852.

Sakayama, T., T. M. Osada, and K. Tamura. 1988. Some examples of archaeological investigations using ground probing radar. pp. 57-60. In: Technical Proceedings of the Second International Symposium on Geotechnical Applications of Ground-Penetrating Radar. Gainesville, Florida. March 6-10 1988.

Strongman, K. B. 1992. Forensic application of ground-penetrating radar. pp. 203-212. In: Pilon, J. A. (ed.) Ground Penetrating Radar. Geological Survey of Canada, Ottawa, Canada. Paper 90-4. p. 241.

Vaughan, C. J. 1986. Ground-penetrating radar survey in archaeological investigations. Geophysics 51(3):595-604.

Vickers, Roger S. and Lambert T. Dolphin. 1975. A communication on the archaeological radar experiment at Chaco Canyon, New Mexico. MASCA Newsletter 11(1):1-3.

Vickers, Roger, Lambert Dolphin, and David Johnson. 1976. Archaeological investigations at Chaco Canyon using subsurface radar. pp. 81-101. In: Remote Sensing Experiments in Cultural Resource Studies, assembled by Thomas R. Lyons, Chaco Center, USDI-NPS and University of New Mexico.

Weymouth, John W. and Bruce W. Bevan. 1983. Combined magnetic and ground penetrating radar survey of an archaeological site in Oklahoma. pp. 1.1-1.4. In: Digest International Geoscience and Remote Sensing Symposium (IGARDD'83') Vol. 1.

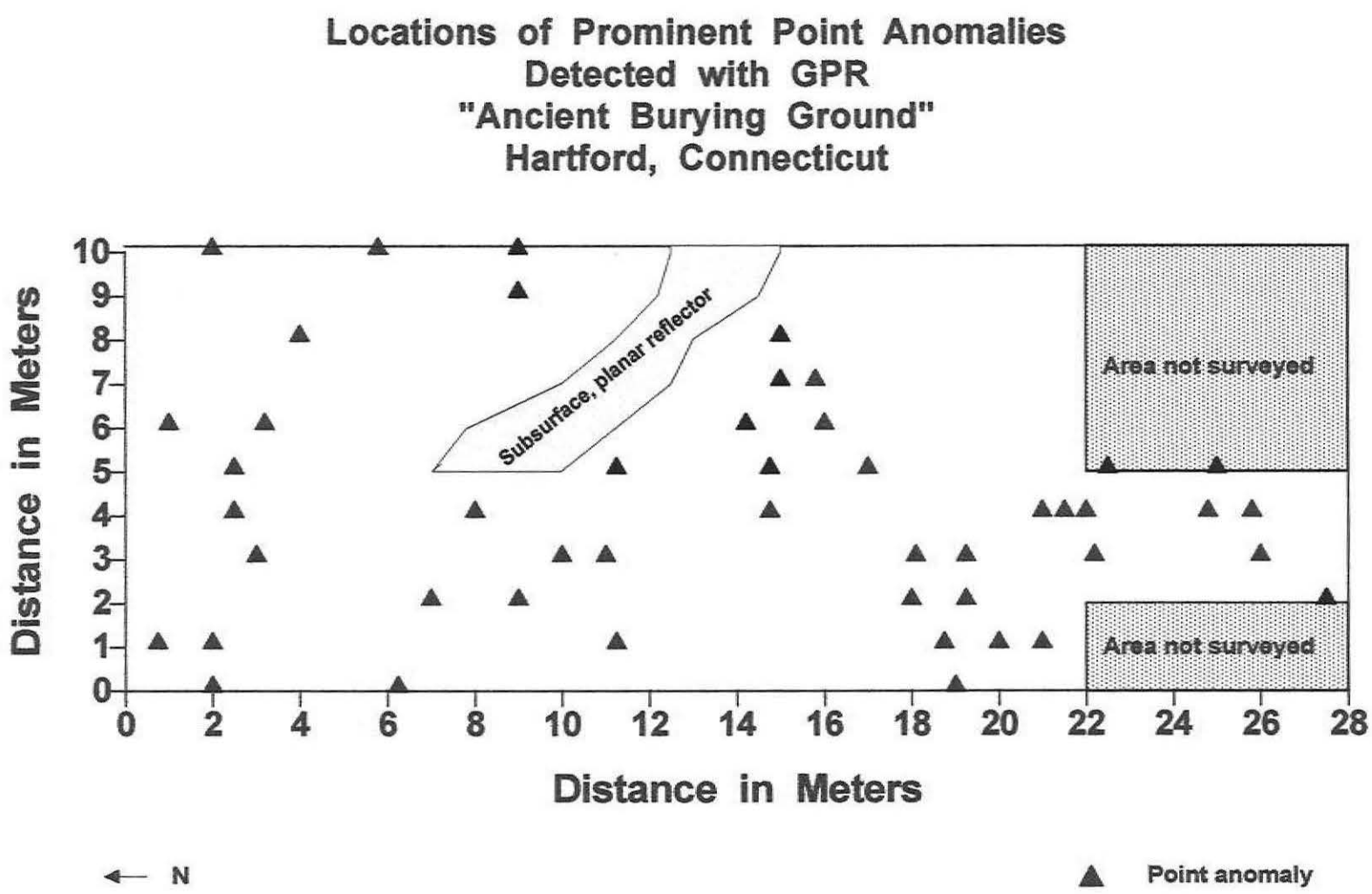
Locations of Prominent Point Anomalies
Detected with GPR
"Ancient Burying Ground"
Hartford, Connecticut
Distance in Meters
Distance in Meters
Subsurface, planar reflector
Area not surveyed
Area not surveyed
N
Point anomaly

Figure 1