Route - File
Doolittle

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Subject: ENG- Engineering Assistance **Date:** 17 August 1995

To: Raymond J. Casey
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Purpose:
To use geophysical techniques to locate buried tile lines in agricultural fields and to assist the assessment of wetland delineations.

Participants:
James Doolittle, Research Soil Scientist, NRCS, Chester, PA
Dave Sullivan, State Geologist, NRCS, Syracuse, NY
Edward Stein. Area Soil Resource Specialist, NRCS, Utica, NY
Mike Townsend, State Biologist, NRCS, Syracuse, NY

Activities:
On 15 August 1995, a drained area of Lyons soil was investigated with both electromagnetic induction (EM) and ground-penetrating radar (GPR) techniques. The study site was located in Oneida County near the town of Bridgewater.

Equipment:
The electromagnetic induction meter was the EM38, manufactured by Geonics Limited*. The meter is portable and requires only one person to operate. Principles of operation have been described by McNeill (1986). The observation depth of an EM meter is dependent upon intercoil spacing, transmission frequency, and coil orientation relative to the ground surface. The EM38 meter has a fixed intercoil spacing of about 1.0 m. It operates at a frequency of 13.2 kHz. The EM38 meter has effective observation depths of about 0.75 and 1.5 m in the horizontal and vertical dipole orientations, respectively (McNeill, 1986). Values of apparent conductivity are expressed in milliSiemens per meter (mS/m).

The radar unit used in this study was the Subsurface Interface Radar (SIR) System-2, manufactured by Geophysical Survey Systems, Inc. (GSSI).* The use and operation of GPR have been discussed by Morey (1974), Doolittle (1987), and Daniels and others (1988). The SIR System-2 consists of a digital control unit (DC-2) with keypad, VGA video screen,

* Trade names are used to provide specific information. Their mention does not constitute endorsement by USDA-NRCS.

and connector panel. The system was powered by a 12-VDC battery. A model 3110 (120 mHz) antenna was used in this investigation.

Field Methods:
Three traverse were made with the EM38 meter in areas suspected to be underlain by drainage tiles. The area was in a delineation of Lyons (fine-loamy, mixed, nonacid, mesic Mollic Haplaquepts) soils. An interval of about 3 feet was used between observations. At each observation point, measurements were obtained with the EM38 meter (placed on the ground) in the vertical dipole orientation. A 100 foot radar traverse was conducted with GPR. The interval between flagged observation points was about 5 feet.

Results:
The use of EM techniques proved inappropriate to locate buried (2 to 4 feet) plastic drainage tiles with dimensions of 4 to 6 inches. In areas of Lyons soil, EM responses were observed to vary from 7 to 17 mS/m. Variations were attributed to changes in moisture, clay, and soluble salt (calcium carbonate) contents. General trends were observed across the study site. These trends were principally attributed to observable changes in vegetation and associated moisture contents. No abrupt or discernible changes in response were observed indicating the location of buried drainage tiles. In areas of Lyons soils, the use of EM techniques is inappropriate for this application.

Ground-penetrating radar detected a known, buried culvert. While the use of GPR is suitable for this application, its site-specific performance, requisite for operator experience, cost, and availability prohibit routine and extensive use.

With kind regards.

J. A. Doolittle

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cc:
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References:

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

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