

**United States Department of Agriculture  
Soil Conservation Service**

**Northeast NTC  
Chester, PA 19013**

**Subject:** Ground-penetrating radar field assistance, Jackson County, Florida,  
22-15 April 1991      **Date:** 29 April 1991

**To:** Wade Hurt  
State Soil Scientist  
Soil Conservation Service  
401, Southeast First Ave., Rm 248  
Gainesville, Florida 32601

**Purpose:**

To provide GPR field assistance for the Karst Cropland Nonpoint Source Hydrologic Unit study in Jackson County, Florida.

**Participants:**

Jeff Allen, Soil Project Leader, SCS, Blountstown, FL  
Joe Baxley, Soil Conservation Tech., SCS, Marianna, FL  
Eddie Cummings, Soil Specialist (GPR), SCS, Lake City, FL  
Jim Doolittle, Soil Specialist (GPR), SCS, Chester, PA  
Michael Jones, District Conservationist, SCS, Marianna, FL  
Richard Kszystynaik, Area Conservationist, SCS, Marianna, FL  
Daryl Leach, Soil Scientist, SCS, Blountstown, FL  
Douglas Lewis, Soil Specialist (GPR), SCS, Sebring, FL  
Alex Simmon, Florida Agric. and Consumer Services, Tallahassee, FL  
Andrew Williams, Soil Specialist (GPR), SCS, Pensacola, FL

**Activities:**

I arrived in Jackson County on the afternoon of 22 April 1991. Five potential sites for the nonpoint source hydrologic unit study were profiled with the ground-penetrating radar on 23 and 24 April 1991. An exit conference was held in the Marianna Field Office on 25 April. I returned to Chester, Pennsylvania, during the afternoon and evening of 25 April 1991

**Equipment:**

The ground-penetrating radar units used in this study were the Subsurface Interface Radar (SIR) System-3 and System-8 manufactured by Geophysical Survey Systems, Inc. The SIR System-3 consists of the PR-8304 profiling recorder and power distribution unit. Components of the SIR System-8 used in this study were the model 4800 control unit, ADTEK SR 8004H graphic recorder, and power distribution unit. Surveys were completed using a transmission cable (30 m), and the models 3205 (300 MHz) and 3110 (120 MHz) antennas. The systems were powered by 12-volt vehicular batteries.

**Discussion:**

Five sites were visited and traversed with both SIR System-8 and System-3 radar units using the 300 and 120 MHz antennas. Each traverse provided insight into the utility of using GPR techniques

and the information which could be collected with the GPR as part of the Karst Cropland study in Jackson County.

Sites investigated with the GPR included areas of Blanton (loamy, siliceous, thermic Grossarenic Paleudults), Chipola (loamy, siliceous, thermic Arenic Hapludults), Lakeland (thermic, coated Typic Quartzipsamments), Oktibbeha (very-fine, montmorillonitic, thermic, Ferric Hapludalfs), Orangeburg (fine-loamy, siliceous, thermic Typic Kandiudults), Red Bay (fine-loamy, siliceous, thermic Rhodic Kandiudults), and Troup (loamy, siliceous, thermic Grossarenic Kandiudults) soils. These series represent the dominate soils within the proposed study area.

The GPR was found to be suitable for supplementing existing soil information and for evaluating the thickness of surficial sand deposits and the depth to the argillic horizons. In addition, variations in the graphic signatures appearing on radar profiles were evident above depressions suspected of overlying sinkholes.

The 120 and 300 MHz antennas provided similar profiling depths. The high clay content of the argillic horizons limited the profiling depth of both antennas. While the graphic profiles produced with the 300 MHz antenna contained higher levels of background noise, the resolution of this antenna was considered superior to that of the 120 MHz antenna. Use of the 80 MHz antenna in this study is discouraged as resolution will be inferior and profiling depths will not be substantially increased.

As the profiling depth of the GPR is restricted to the upper part of the argillic horizon, GPR techniques can be used to estimate the thickness of the overlying coarse-textured sediments and boundary characteristics of the Bt horizon (abrupt or gradational). Use of GPR techniques in areas of Arenic and Grossarenic subgroups of Alfisols or Ultisols and Quartzipsamments will provide the greatest profiling depths and most information. In areas of Alfisols or Ultisols with moderately-fine or fine textured subsoils within depths of 20 inches, the use of the GPR will be severely depth restricted and will provide limited soil information.

In soils having argillic horizons within depths of 20 inches, the use of electromagnetic induction (EM) techniques is recommended. Electromagnetic induction techniques provide measurements of the bulk apparent electrical conductivity from depths 0.75 to 45 meters. Variations in conductivity have been correlated with variations in the amount and distribution of clay, soluble salts, and water. The spatial pattern of EM values may be correlated with the occurrence of sinkholes and other solution features, variations in the thickness of the sand overburden and the depth to finer textured materials, and the occurrence and distribution of contaminants in soils. The feasibility of using EM techniques should be explored in this project.

Random transects with the GPR may not provide sufficient information to access all areas having insufficient clay cover which allows

contaminants to enter the aquifer. The use of systematic or grid sampling across several representative areas of each map unit is recommended. Participants felt that grids established across representative areas of soil map units will provide more information than random transects. An analysis of spatial patterns may reveal soil-landscape relationships pertaining to the location of sinkholes and the movement of chemicals and runoff.

Grids should be located not only in representative areas of soil map units but, where possible, in areas containing inventory wells of the FDER. The recommended grid interval is 100 feet. Each grid should cover a fairly large area (>2000 ft sq) and include both the higher- and lower-lying landscape components encountered in each map unit. Grids could be sampled with both EM and GPR techniques. The relative elevation of each grid intersect should be obtained. Elevation data will provide information necessary to access soil-landscape relations.

Two-dimensional contour plots and three-dimensional surface net diagrams can be prepared of each grid site using PC-compatible graphic packages. These diagrams can be prepared from the elevation, EM, and GPR data collected at each grid site. Computer diagrams will provide high quality visual representations of each study site which will be most useful for characterizing soil-landscape relations and potential flow patterns of chemicals and runoff.

**Recommendations:**

1. The feasibility of using EM techniques to provide site information for the Karst Cropland Study in Jackson County should be accessed during my next scheduled field assistance visit (September 16-20, 1991). I will complete surveys and train soil specialists (GPR) on the use of GEONIC Ltd. EM-31, EM-34, and EM-38 meters. Results of field study will be prepared in graphic formats using the SURFER graphic package.

2. The use of grid sampling is recommended. Compared to random transects, systematic sampling with GPR and EM techniques near inventory well sites will provide a more comprehensive understanding of subsurface conditions which may allow contaminants to enter the aquifer.

3. The acquisition of a graphic package and workstation through this project. Available software packages (see enclosure) can provide high quality representation which summarize field, EM, and GPR data collected as part of the Karst Cropland Study. In addition, this software and workstation will provide a lasting benefit to GPR specialist making site assessments for various cooperators in Florida. I have the SURFER program which list for \$499 and is available through Golden Software, Golden, Colorado. However, other software packages are available and each has distinct attractions. I would recommend a work station with an AT&T or compatible computer and keyboard having at least 320 RAM, DOS 3.2 (or later), and a color

monitor with EGA video display card. I have and would recommend a Hewlett-Packard Paintjet Printer (Model 3630A).

Thanks once again for the opportunity to work with members of your staff in Florida. With kind regards.

James A. Doolittle  
Soil Specialist (GPR)

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