United States
Department of
Agriculture

Soil
Conservation
Service

Northeast NTC
160 E. 7th Street
Chester, PA 19013

Subject: SOI - GPR Study of Depth to Bedrock, Mt. Airy, Maryland, 9 April 1986

Date: April 22, 1986

To: David Yost
State Soil Scientist
Soil Conservation Service
College Park, MD

430

PURPOSE

To evaluate the performance of the ground-penetrating radar in determining the depth to phyllite bedrock.

PARTICIPANTS

James A. Doolittle, Soil Specialist (GPR), NENTC, SCS, Chester, PA
Carl Robinette, Area Soil Scientist, SCS, Frederick, MD
David Yost, State Soil Scientist, SCS, College Park, MD

EQUIPMENT

The equipment used during this field trip was the SIR System-8 with the ADTEK SR-8004H graphic recorder. The 120 and 80 MH_z antennas were used with the models 705DA and 705DA2 transceivers. Generally, the 120 MH_z antenna with the model 705DA transceiver provided the best resolution of the soil/bedrock interface within the upper 1.5 meters of the soil profile. In areas where this interface is deeper, best results were obtained when multiple transects were conducted with each antenna and compared.

The scanning time on the control unit was set at either 98 or 110 nanoseconds. Assuming a velocity of propagation of 9 nanoseconds/foot for loamy sediments, the established scanning times provided approximated probing depths of 10 and 12 feet respectively.

The equipment operated well with no observed malfunctions.

DISCUSSION

The potential for using ground-penetrating radar (GPR) techniques to chart the depth to bedrock has been explored in fourteen states. Results range from exceptional in areas of moderately-coarse textured soils underlain by granitic bedrock in Massachusetts, New Hampshire, and Maine; to poor in areas of fine and moderately-fine textured soils underlain by limestone in Texas and Tennessee.

Areas underlain by phyllites are extensive in the Northeast. To the GPR, these areas pose unique system and interpretation problems. Phyllites are low grade metamorphic rocks which retain original bedding planes and have orientated minute crystals. These features provide conductive pathways which rapidly dissipates the radar's energy and limits its probing depth. In areas underlain by phyllites, the soil/bedrock interface is often irregular in depth, highly weathered, and grades gradually from soil to saprolite to unweathered bedrock. Broad, gradational boundaries are weak reflectors of electromagnetic energy and are often difficult to discern or interpret on graphic profiles.

Moderately-fine textured soils underlain at variable depths by members of Ijamsville Formation were investigated. Once calibrated, the GPR worked well and effectively charted the soil/bedrock interface from depths of 1.4 feet to 5.0 feet (maximum depth of occurrence within study site). However, the GPR failed to detect the soil/bedrock interface in finer textured, wetter, or more calcareous soils at the second site. This point highlights the site specific nature of the radar.

Inferences can be drawn concerning the nature of the soil/bedrock interface form the images appearing on the graphic profiles. Areas of saprolite are poorer reflectors of electromagnetic energy and appear as gray images. Areas of less weathered bedrock are more contrasting with the overlying soil materials and produce strong reflections which are recorded as darker images on the graphic profiles.

In many areas of Maryland, the GPR appears to have excellent potential for bedrock investigations and quality control work, such as documenting the proportion of soils in various soil map units.

Thanks for the opportunity to conduct these tests in your state and to work with you.

James A. Doolittle
Soil Specialist (GPR)

cc:
O. Rice

JADoolittle/ef