File GPR

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Northeast NTC
CHESTER, PA 19013

SUBJECT: Ground-Penetrating Radar (GPR) Field Studies in Warren and Sussex Counties, New Jersey; 9 to 13 March 1992

DATE: 19 March 1992

To: Ronnie L. Taylor
State Soil Scientist
USDA-Soil Conservation Service
Somerset, New Jersey

Purpose:
To evaluate the potential of using GPR as a quality control tool for use in the updating of soil information in Warren and Sussex Counties, New Jersey.

Participants:
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Activities:
Field studies were conducted in accordance with the "Itinerary for ground-penetrating radar project" prepared by David Kingsbury.

Equipment:
The ground-penetrating radar unit used in this study is the Subsurface Interface Radar (SIR) System-8 manufactured by Geophysical Survey Systems, Inc. [1.] Components of the SIR System-8 used in this study were the model 4800 control unit, ADTEK SR 8004H graphic recorder, ADTEK DT 6000 tape recorder, power distribution unit, transmission cable (30 m), and the model 3110 (120 MHz) antenna. A scanning time of 140 nanoseconds and a scanning rate of 25.6 scans/sec were used for mineral soils. The system was powered by a 12-volt marine battery.

The electromagnetic induction meter used in the study conducted on the Gardner farm was the EM-31 meter manufactured by GEONICS Limited. [1.] Measurements of conductivity are expressed as milliSiemens per meter (ms/m).

The LORAN-C geo-referencing system used on 13 March 1992 was a Voyager unit. Lenore Matula received training on the operation of this unit. The unit has been loaned to Lenore for use in soil sampling with Dr. Robert Grossman of the Soil Survey Investigations Staff (NSSC, Lincoln, NE) scheduled for later in this month; and for soil survey-related activities.

Results:
Depth to Bedrock:
In Warren County, the radar was used to estimate the depth to bedrock in areas of Bartley (fine-loamy, mixed, mesic Typic Fragiudalfs), Bath (coarse-loamy, mixed, mesic Typic Fragiochrepts), Nassau (loamy-skeletal, mixed, mesic Lithic Dystrochrepts), Wassaic (fine-loamy, mixed, mesic Glossoboric Hapludalfs), and Washington (fine-loamy, mixed, mesic Ultic Hapludalfs) soils. While the maximum depth probed with GPR was about 15 feet, detailed and consistent imagery was obtained to depths of only 8 feet.

This study was too limited in scope to address the composition of soil map units traversed with GPR in Warren County. However, the traversed area of very deep Washington (WaB - Washington loam, 3 to 8% slopes) was dominated by moderately-deep and shallow soils, while the traversed areas of shallow Nassau (NbB - Nassau shaly silt loam, 3 to 8% slopes) were dominated by deep and very deep soils with argillic horizons. In addition, the traversed area of map unit RWF (Rock outcrop-Wassaic complex, 25 to 45 % slopes) contained 45% deep and very deep soils. These inconsistency were suspected and known to exist by staff and field soil scientists.

The radar imagery from areas of Bartley and Bath soils revealed a weakly expressed subsurface horizon beneath the argillic horizon. Auger observations confirmed the presence of this interface.

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1. Use of trade names in this report is for identification purposes only and does not constitute endorsement by the author or SCS.

However, field and staff soils scientists did not interpreted this interface as a fragic horizon.

TABLE 1

DEPTH TO BEDROCK

TRANSECT #	MAP UNIT	SHALLOW	MOD-DEEP	DEEP	VERY DEEP
1	WoB	0%	88%	12%	0%
2	WaB	25%	75%	0%	0%
3	WoB	50%	40%	0%	10%
4	RWF	9%	46%	36%	9%
11a	NbB	0%	0%	22%	78%
11b	BaB	0%	100%	0%	0%
12	BfC	15%	54%	0%	31%
13	NbB	4%	21%	54%	22%

Areas of Adrian muck (Ad) and Carlisle muck (Ck) near Stevens Island were transected with GPR. Adrian is a member of the sandy or sandy-skeletal, mixed, euic, mesic Terric Medisaprists and Carlisle is a member of the euic, mesic Typic Medisaprists families. Maximum profiling depth of the 120 MHz antenna in these soils was about 5feet. Auger observations and radar interpretations were used to prepared Table 2.

TABLE 2

Taxonomic subgroups of Histisols

TRANSECT #	MAP UNIT	TERRIC	TYPIC
6	Ad	100%	0%
7	Ad	100%	0%
8	Ad	100%	0%
9	Ck	36%	64%
10	Ck	0%	100%

All radar profiles were turned over to David Kingsbury for review and analysis.

Recommendations:

1. This field study addressed the potential of using GPR methods as a quality control tool for soil surveys in northwestern New Jersey. The results of this study indicate that Ground-penetrating radar techniques can be used to help update the composition of soil map units in Warren and Sussex counties. The utility of using GPR to extend the depth of observation and determine the depth to bedrock are discussed in the enclosed articles. Traditional transect methods are too slow, labor intense, and ineffective for determining the depth to bedrock. I urge the scheduling by the New Jersey Soil Staff

of NSSC - GPR field assistance. Field studies should immediately address the composition of map unit in areas of moderately deep or shallow Bartley, Bath, Nassau, Rockaway, and Wassaic soils.

2. The potential of using EM techniques for site assessments, ground water and mineralogical studies in south New Jersey should be explored in the near future.

3. I hope that the LORAN-C unit will be used in the upcoming sampling trip by Dr. Robert Grossman. I would be interested in learning of Lenore Matula's experiences with and impressions of the unit.

The field study was exceptionally well prepared. The efforts, enthusiasm, and participation of all were greatly appreciated. I enjoyed this opportunity to work with your fine staff and to provide GPR assistance to New Jersey.

With kind regards.

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Soil Specialist

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