Northeast Technical Ctr
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Subject: SOI-Cranberry Bog Research Studies; 22-26 January, 5-9 & 20 February 1990

To: Rex O. Tracy
State Conservationist
USDA-Soil Conservation Service
451 West Street
Amherst, MA 01002

Date: 26 February 1990

Purpose:
To conduct ground-penetrating radar (GPR) studies within cranberry bogs in Plymouth County. Results from this study will be used to characterize bogs and soil map units. Computer-graphic images of bogs will be prepared and made available for possible inclusion in the soil survey or technical reports for Plymouth County. Results from this study will be presented before the Eight International Soil Correlation Meeting on Classification and Management of Wet Soils to be held in Louisiana and Texas from 7 to 20 October 1990.

Principal Participants:
Steve Beaulieu, Soil Conservationists, SCS, Middleboro, MA
Joan Davenport, Agricultural Scientist, Ocean Spray Cranberries, Inc., Lakeville, MA
Jim Doolittle, Soil Specialist (GPR), SCS, Chester, PA
Peter Fletcher, Soil Scientist, SCS, Middleboro, MA
Jim Turenne, Soil Specialist (GPR), SCS, Middleboro, MA
Jim Walsh, Soil Conservation Tech., SCS, Taunton, MA

Activities:
The cranberry growers arranged an aggressive schedule of activities for the weeks of 22-26 January and 5-9 February 1990. Sites and purpose(s) of investigations included:

Douglas Beaton's Bog (Wareham) January 16, 1990 -Used GPR to profile water table and determine direction(s) of ground water flow.

George Andruk's Bog (Hanson) January 17, 1990 -Used GPR to profile underlying glacial stratigraphy and locate potential sources of sand and gravel.

Robert Zamboni's Bog (Bryantville) January 17, 1990 -Used GPR to profile peat near subsiding dike structure.

David Mann's Bog (Hanson) January 18, 1990 -Used GPR to profile underlying glacial stratigraphy and locate potential sources of coarse sand and gravel.

Ray Mellow's Gravel Pit (Assawompset Pond) January 19, 1990 -Used GPR to profile underlying glacial stratigraphy and locate potential sources of coarse sand and gravel.

John Sarkes' Bog (Harwich) February 6, 1990 -Used EM38 and EM31 to measure terrain conductivity in bog suspected of receiving leachate from an adjoining landfill site.

Ray Mello's Bog (Rochester) February 6, 1990 -Used EM38 and EM31 to measure terrain conductivity in bog suspected of receiving leachate from a nearby landfill site. Used GPR to profile peat and to estimate peat thickness and volume. In addition, will use computer graphics to construct two-dimensional contour maps and three-dimensional surface net diagrams of this bog.

Kirby Gilmore's Bog (Rochester) February 7, 1990 -Used GPR to profile peat and to estimate peat thickness and volume. In addition, will use computer graphics to construct two-dimensional contour maps and three-dimensional surface net diagrams of this bog.

John Decas' Bog (Rochester) February 8, 1990 -Used GPR to profile peat and to estimate peat thickness and volume. In addition, will use computer graphics to construct two-dimensional contour maps and three-dimensional surface net diagrams of this bog.

Paul and Linda Rinta's Bog (West Wareham) February 9, 1990 - Used GPR to profile peat and to estimate peat thickness and volume. In addition, will use computer graphics to construct two-dimensional contour maps and three-dimensional surface net diagrams of this bog.

Discussion and Results:
The GPR performed well at all sites. Profiling depths ranged from 15 to 45 feet in peat to 90 to 120 feet in coarse-textured outwash deposits. In peats, the maximum profiling depths is dependent on nutrient levels which, based on the GPR's response, appears to vary among the bogs studied on the Wareham Outwash Plain. Participants discussed the need to study variations in pH values and nutrient levels among the bogs, possible sources or origins of nutrient loadings, and implications to soil mapping.

The GPR was shown to be an effective tool for determining the thickness and volume of peat deposits, profiling the topography at the base of bogs, identifying restrictive

layers, and estimating the concentration of stumps and logs within bogs. As a management tool, the GPR profiles can be used to assess the effects of fill on "holes" within bogs, subsidence, and to determine the best location for earthen dikes and the amount of fill required to construct a dike. Cranberry growers were enthused by the survey results and the computer graphic diagrams of their bogs.

The GPR can be used for ground water investigations in southeast Massachusetts. The radar profiles can be used to chart the depths to the water table, direction of flow, and potential areas or sources of contamination. A concern of one grower was the possible contamination of his bog from waters flowing from a distance landfill. Radar profiles were "terrain corrected" and showed that the ground water surface sloped away from the bog. The potential of using parallel radar profiles and computer graphic techniques to extend point observations of water table depths across wide segments of the landscape was discussed. Graduate students from the University of Massachusetts are planning to conduct research on variations in water table depths within Plymouth County and would be interested in exploring this technique.

In a similar investigation, EM (electromagnetic induction) techniques were used to map the apparent terrain conductivity of a bog to depths of 1.5 and 6.0 meters. Variations in EM values can be related to differences in (i) moisture content, (ii) clay content, and (iii) soluble salts. In the investigated bogs, variations in EM values appeared to be related to changes in moisture contents and concentrations of soluble salts. Adjoining landfill sites were suspected sources of contamination. Inferences made from EM data support this contention at one site. However, all inferences made from maps of apparent terrain conductivity merely documents spatial relationships and any significance attached to the recorded values must be substantiated by laboratory analysis. The computer generated contour maps can be used to facilitate location of sites for observation and analysis.

The GPR is an excellent tool to map near-surface stratigraphic layers. However, as ground-truthing is needed to identify the particle size of each layer, the GPR is not viewed as an effective tool for the identification and detection of suitable sources of coarse sand and gravel in highly stratified mediums.

Recommendations:
Sufficient data has been collected to prepare a research paper for presentation at the Eight International Soil Correlation Meeting on Classification and Management of Wet Soils. In response to your letter of 2 February 1990, I will need no further field support from your staff to complete this research activity. However, as I wish to have

Peter Fletcher and Jim Turenne as co-authors on my paper, I would like to request that they be permitted to review drafts of and recommend changes to the paper. One additional day of field work will be needed to complete our obligations to the growers who supported this study. Jim Turenne has made plans to complete this field work.

Jim Turenne is preparing a detailed report of field investigations for the growers. I will continue to work closely with Jim and will prepare the necessary computer graphics needed to support his reports. In addition, Peter Fletcher has expressed a desire to have some of the graphics considered for publication in the Soil Survey Report of Plymouth County. I will prepare these graphics for his consideration.

Jim is becoming a fine radar specialist. I would like to recommend that I be scheduled into Massachusetts each year to work with Jim. During these training visits, I would provide refresher GPR training, guidance on making radar interpretation, and assist with his field work. Presently, I am annually scheduled for two weeks of training with the soil specialists (GPR) assigned to the SCS staff in Florida. I would welcome the opportunity to come to Massachusetts annually and provide Jim with a week of refresher GPR training.

This study has fostered interest in the use of GPR techniques in southeast Massachusetts. I hope that resources will be made available to continue GPR activities in Massachusetts and to make the use of this technique and integral and vital part of SCS's program within southern New England. I hope that similar research activities can be scheduled and that I may be of assistance to you in the coming years. With kind regards.

James A. Doolittle

James A. Doolittle
Soil Specialist (GPR)

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