United States Department of Agriculture

Soil Conservation Service

401 S.E. First Avenue, Room 248
Gainesville, Florida
32601

December 28, 1984

John C. Corey, Research Manager
Environmental Science Division
E.I. DuPont DeNemours & Company
Atomic Energy Division
Savannah River Laboratory
Aiken, South Carolina 29808-0001

SUBJECT: Demonstration of Ground-Penetrating Radar (GPR) System

Dear Mr. Corey:

Purpose: To demonstrate and to determine the effectiveness of the ground-penetrating radar (GPR) for detecting buried containers of waste in disposal sites at the Savannah River Plant (SRP).

Location: Savannah River Plant, South Carolina.

Procedure: The equipment utilized during this field trip was the SIR System-8, with the ADTEK SR-8004H graphic recorder and the ADTEK DT-6000 tape recorder, manufactured by Geophysical Survey Systems, Incorporated (trade names have been provided for reference and do not constitute endorsement). The 80 and 120 MHz antennas were used for the investigations of waste disposal sites because of their greater effective powers of penetration. The 300 MHz antenna was used on an archeological site because of its greater powers of resolution. The system was powered by either a 12 volt battery or a portable generator.

Waste disposal sites had been previously located based on records and surface observations. The GPR system was towed across each site in a random pattern (though typically perpendicular to the features long axis) at speeds of 3 to 5 km/hr. The equipment operated well and no malfunctions were noted.

Results: The GPR performed well in the study area. At all sites the GPR provided some information. However, the relative quality of the graphic profiles is dependent on the skills of the interpreter and the needs of the user.

On the enclosed figures, the GPR has recorded a buried landfill and undisturbed soil features at the Z area demonstration site, and several "point objects" within the burial grounds.

It is difficult to approximate the depth scale in each of the transects without ground-truth boring data. The materials are ansiotrophic, and each layer will have different electromagnetic properties which effect the rate of signal propagation. The approximated, relative dielectric constant of the profile is used to calculate the depth scale according to the formula:

$$T(ns) = d(m) \times \sqrt{\frac{Er}{0.15}}$$

where: T(ns) = time in nanoseconds
d(m) = distance in meters
Er = relative dielectric constant

Based on "tabled values", the dielectric constant of wet loamy soil is 19, while for dry loamy soil it is 2.5. Assuming that the investigated sediments were loamy and had a moisture content somewhere between these two extremes, the effective depths of the enclosed figures lie between 2.9 and 8.0 meters at the landfill site, and between 3.4 and 9.4 meters at the waste disposal site. The actual depths profiled can be readily ascertained with limited ground-truth borings.

Conclusions: The GPR appears to be a viable tool for the survey of buried waste sites and possibly archeological features at SRP. The GPR is extremely site specific and soil conditions are a prime consideration in all field investigations. With the GPR, solid objects buried in landfills often appear on graphic profiles. To fully and reliably use the GPR for this purpose would require further experience in this area and perhaps supporting and complementory geophysical tools.

A copy of all recorded tapes from this investigation are returned with this letter. I enjoyed the opportunity to work with your staff and SRP and to demonstrate the potential application of the GPR.

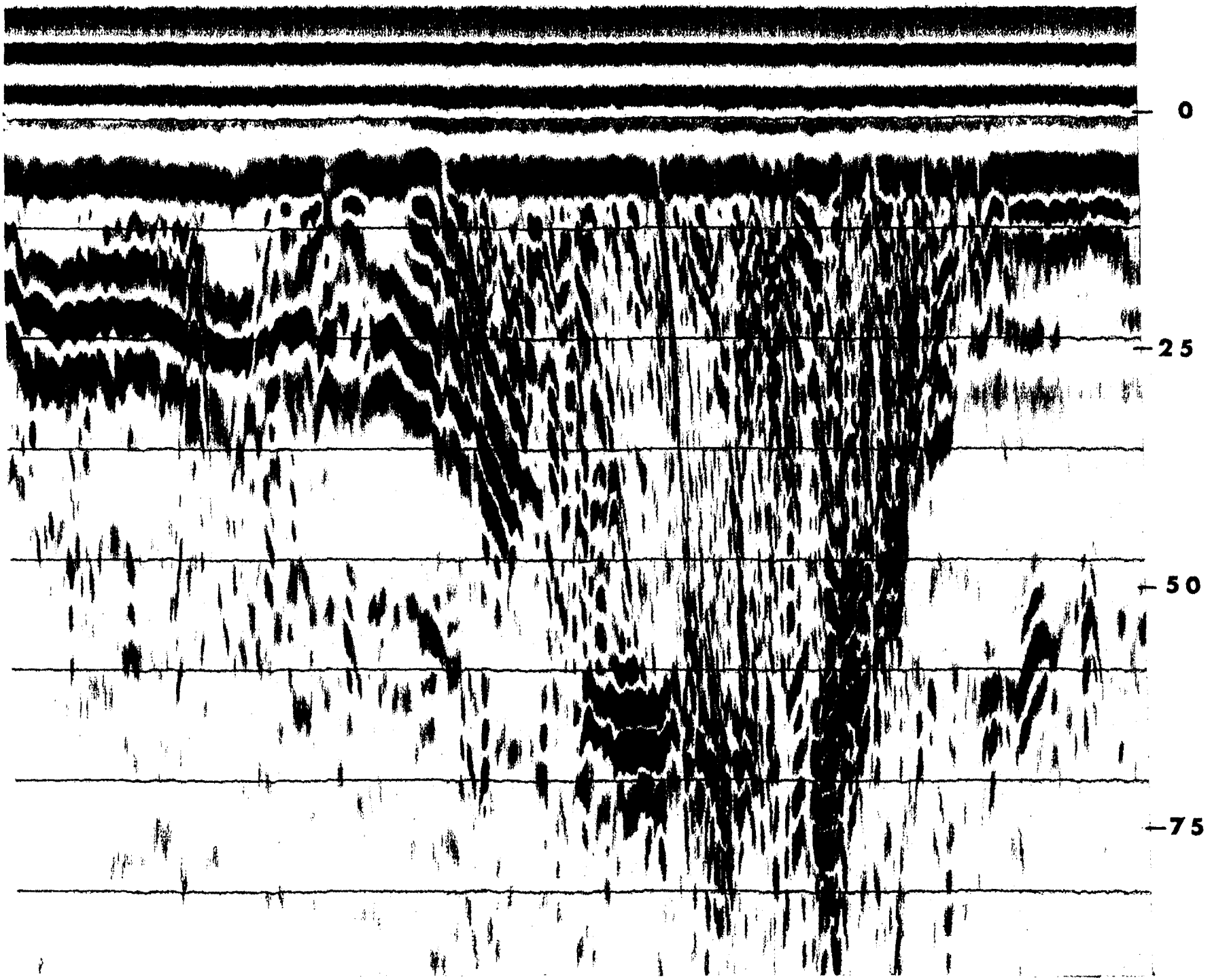
Sincerely,

James A. Doolittle

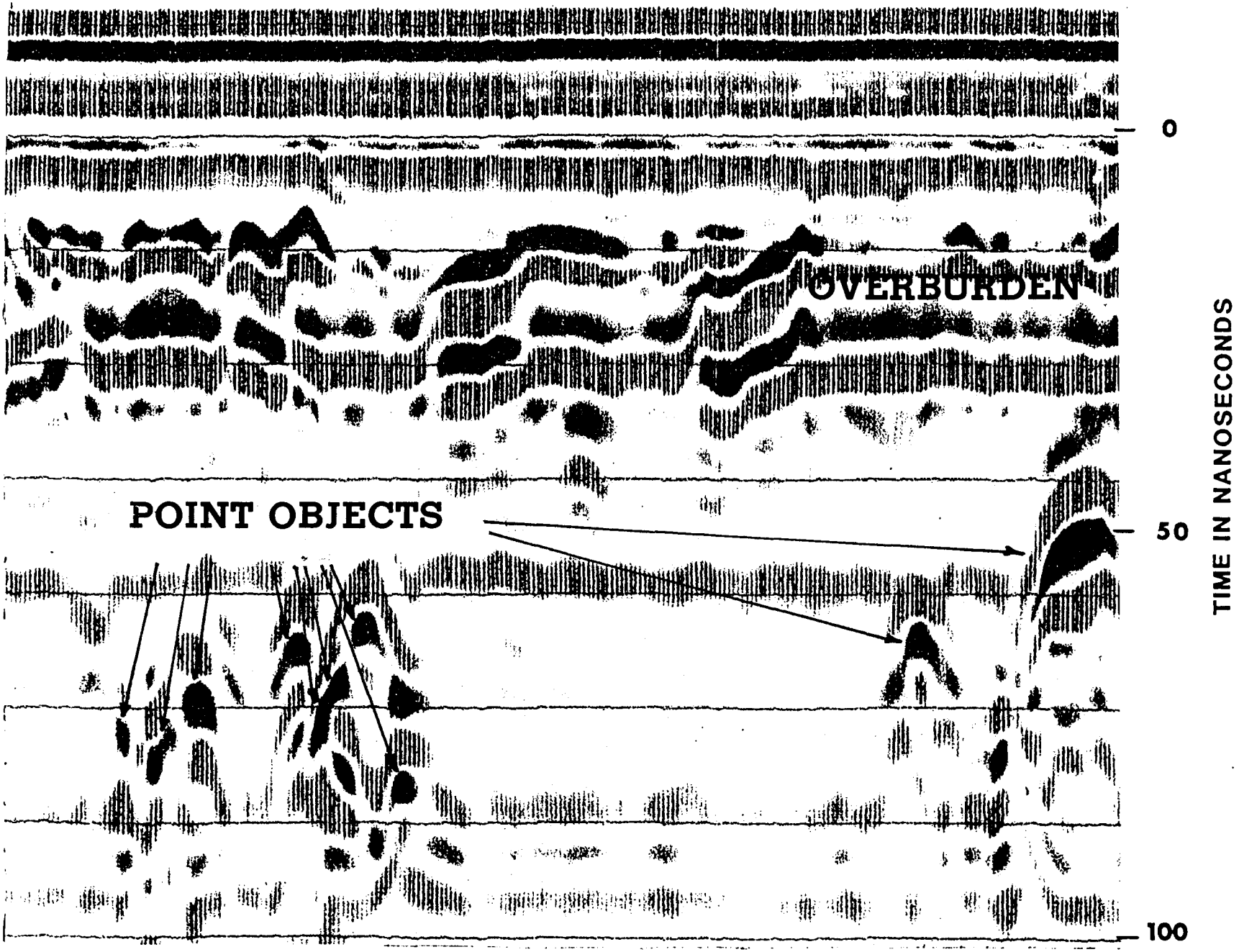
James A. Doolittle
Soil Specialist (GPR)

Enclosures

cc:
Richard W. Arnold, Director, Soils Division, SCS, Washington, D.C.
Jerry S. Lee, Director, SNTC, SCS, Ft. Worth, TX
Billy Abercrombie, State Conservationist, SCS, Columbia, SC
James W. Mitchell, State Conservationist, SCS, Gainesville, FL



GPR PROFILE OF A LANDFILL SITE



GPR PROFILE OF A WASTE DISPOSAL SITE