United States Department of Agriculture

Soil Conservation Service

Northeast NTC
160 East 7th Street
Chester, PA 19013-6092
215-499-3960

Subject: Archaeological Field Assistance, South Carolina; 3-8 February, 1991

Date: 28 February 1991

To: Billy Abercrombie
State Conservationist
Soil Conservation Service
Columbia, SC

Purpose:
To provide GPR field assistance to the South Carolina Park Service at Charles Towne Landing and Old Dorchester State Parks.

Participants:
Donnie Barker, State Park Archaeologist, SCDPRT, Columbia, SC
Daniel Bell, Cultural Resource Coordinator, SCDPRT, Charleston, SC
Janson Cox, Superintendent, Charles Towne Landing State Park, SCDPRT, Charleston, SC
Charles Cumbee, Superintendent, Old Dorchester State Park, SCDPRT, Summerville, SC
David DeWees, Park Ranger, Old Dorchester State Park, SCDPRT, Summerville, SC
James Doolittle, Soil Specialist, SCS, Chester, PA

Activities:
Archaeological site investigations were conducted at Old Charles Towne Landing State Park, Charleston, on 4 and 5 February; and at Old Dorchester on 5 to 7 February.

Background:
Charles Towne Landing was founded in 1670 and was the first permanent English settlement in South Carolina. After the threat of Spanish raids had ended, the presence of a better natural port at Charleston lead to the abandonment of Charles Towne Landing. Today, the site of this settlement is a state owned historic park and nature preserve.

Dorchester was settled in 1696 by a group of Congregationalists from Dorchester, Massachusetts Bay Colony. The forty-five acre site was located at the head of navigation on the Ashley River. At the time of the Revolutionary War, Dorchester was the third largest city in South Carolina. After and because of the war, Dorchester declined and, like Old Charles Towne Landing, was eventually abandoned. Today, other than a tabby fortification, a wharf, and the remnants of some foundation walls, little remains of Dorchester.

During the past nine years SCS has expanded the use of ground-penetrating radar (GPR) techniques. In an effort to transfer this technology, SCS has used GPR techniques at various archaeological sites. The GPR field study at Old Charles Towne Landing and Old

Dorchester, South Carolina, provided a unique opportunity to further test field procedures and develop interpretative skills while working with co-operating agencies to preserve our cultural heritage.

Maps, based on limited historic records, were available for Old Charles Towne Landing and Old Dorchester showing landownership patterns and the suspected locations of various historic structures and features. The primary objectives of this survey were to: (1) define the boundaries of an abandoned burial site at Old Charles Towne Landing and (2) confirm the presence and chart the locations of former structures at Old Dorchester.

Results:

Charles Towne Landing

An attempt was made to locate the extension of the old palisade wall and earthen fortification at Charles Towne Landing. The fortification protected the original settlement (1670). No surficial evidence of the extension of this former structure remains. However, the park has reconstructed a portion of this wall. Two transects were established in a direction which would intercept the extension. The imagery on the radar profiles was exceedingly complex and difficult to interpret without further ground-truth observations. Because of limited time and the lack of ground-truth observations, no interpretations were not made of these short reconnaissance traverses.

An irregular, rectangular grid was established across the site of an old cemetery. The grid was 330 feet long and from 20 to 100 feet wide. The grid interval was 10 feet. The survey area was gridded with survey flags and partially surveyed with the GPR on 4 February. The survey was completed on 5 February.

The surface layers had a calculated dielectric permittivity of 25. The propagation velocity was 0.06 m/nanoseconds. The 120 MHz antenna was used with a scanning time of 60 nanoseconds. This time provided a profiling depth of about 1.8 meters. However, the soil was consistently profiled to depths of about 1 meter.

A chart was prepared of the survey area showing all surface features (i.e. trees, fire places) and subsurface anomalies (i.e. roots, pipelines, suspected grave sites). The chart revealed the area believed to have the highest concentration of subsurface anomalies and the extent of the burial ground.

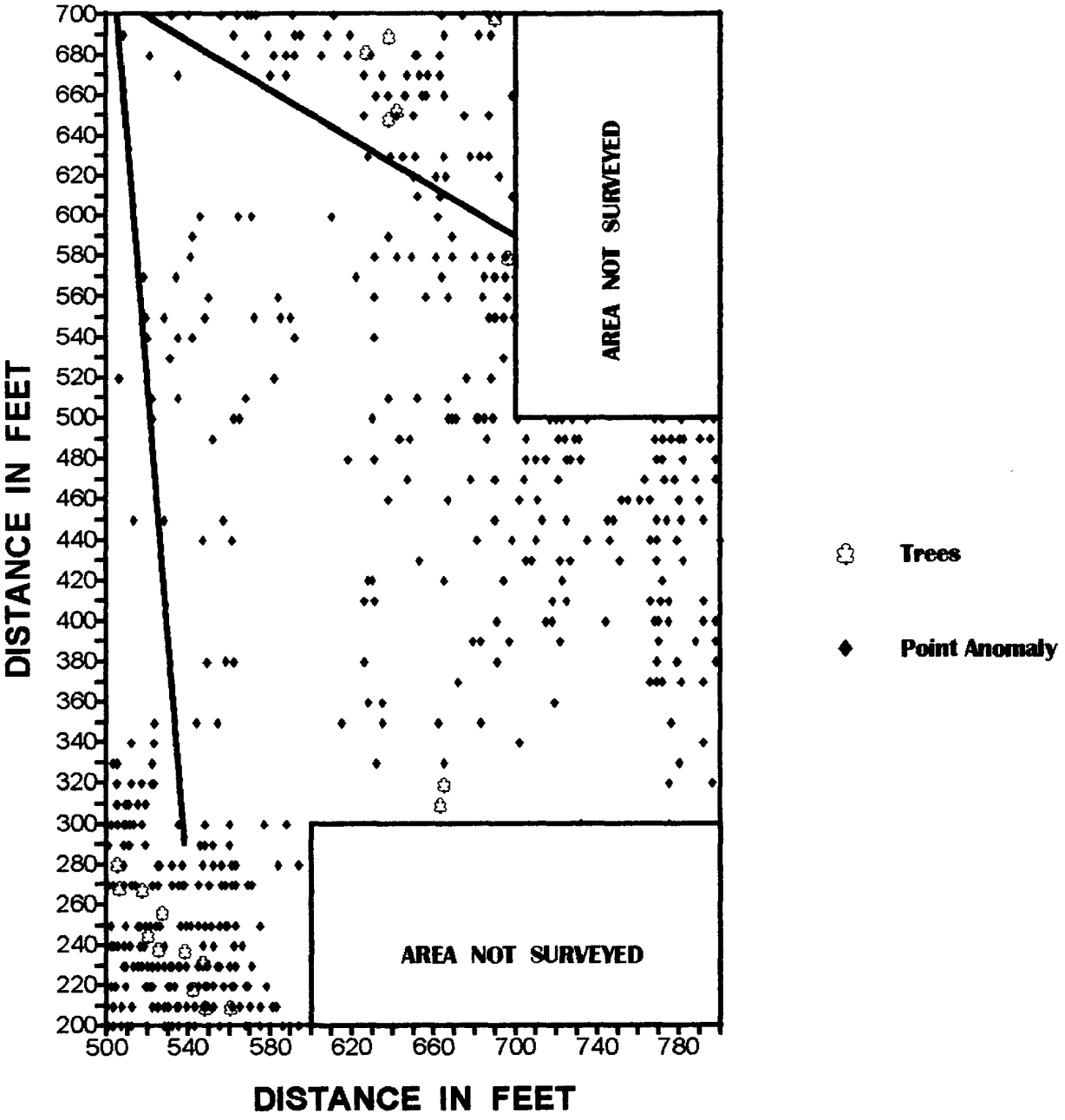
The identity of four suspected images were confirmed with small pits. These observations revealed: a shell midden; a deposit of charcoal; a deposit of cultural debris; and disturbed soil conditions. On the basis of radar interpretations, the disturbed soil site was believed to be underlain by a burial. At this site, archaeologist latter uncovered a casket which contained human remains.

Old Dorchester

Two rectangular grid were established along the east side of the road from the park entrance to the south end of the grassed Market Place. The grids were 280 and 430 feet long and from 30 feet wide.

OLD CHARLES TOWNE LANDING
CHARLESTON, SOUTH CAROLINA

LOCATIONS OF IDENTIFIED POINT ANOMALIES



The grid interval was 10 feet. The survey area was gridded with survey flags and surveyed with the GPR on 5 February.

Based on the depth to a known, buried metallic reflector, the dielectric permittivity of the surface layers was 11. The propagation velocity was 0.08 m/nanoseconds. The 120 MHz antenna was used with a scanning time of 45 nanoseconds. This time provided a profiling depth of about 1.8 meters. However, due to the high clay content of the subsoil, the profiling depth was generally less than 1 meter.

Generally, the radar profiles from these two grids lacked subsurface anomalies. Featured identified on the radar profiles included: two buried utility lines, areas of fill material, a disturbed soil area, and an area having a high concentration of point reflectors. The area of disturbed soil conditions occurs in a location suspected of being the site of a former structure. The area containing the high concentration of point reflectors is located just to the south of a side road leading to the river. The point reflectors are believed to represent the rubble from a former structure.

On 6 February, a large rectangular grid were established along the west side of High Street. The grid was 500 feet long and 50 feet wide. The long axis of this grid extended in a northerly direction from the walls of the old tabby fortification. The grid interval was 10 feet. The survey area was gridded with 306 survey flags and profiled with the GPR.

Numerous subsurface anomalies were discerned on the radar profiles from this grid. High concentrations of trees, stumps, and roots complicated radar interpretations. The buried remnants of five possible structures, two wells, and a subsurface strata believed to represent a layer of unique occupational history were identified on the radar profiles and located within this grid.

Later, additional grids were established over the locations of two structures and a well-like feature identified on the radar profiles. Based on an interpretation of the radar imagery, one of the structures and the well-like feature represent the most promising features for further archaeological investigations.

The large structure was singled out for a more detailed investigations because of its size and the complexity of subsurface reflectors. The presence of several buried foundation walls were inferred from the complex patterns occurring on the radar imagery. The dimensions of this buried structure are approximately 45 by 35 feet. These dimensions were estimated from a more detailed radar survey of the area. Using the grid intersects from the larger (500 by 50 foot) rectangular grid, a small area was re-surveyed with a 5 foot grid interval. The more intense sampling scheme enabled the more precise definition of the location and extent of the former structure. The detailed grid measured 55 by 60 feet. Following an interpretation of the results of the radar survey, the corners of the structure were delimited in the field.

A large rectangular grid were established across the grassed Market Place. The grid was 350 feet long and 200 feet wide. The grid

intervals were 50 (east/west) and 25 (north/south) feet. The survey area was gridded with 72 survey flags and profiled with the GPR on 6 February.

Although the grid was exceedingly coarse and many small subsurface features were undoubtedly missed, the reconnaissance survey of the Market Place revealed an area which is comparatively free of subsurface anomalies. A single structural complex and an artificial subsurface strata were identified on the radar profiles of the Market Place. The structural complex is located along the border with Bay Street. Using a 10 (east/west) by 5 (north/south) foot grid interval, the structural complex was re-surveyed with the GPR. This survey revealed substantial rubble but a general lack of foundation walls. In addition, several trench-like areas containing dissimilar earthen materials were identified within this complex.

Within the Market Place, an area underlain by what appeared to be an artificial subsurface strata was identified. This strata was interpreted to be an artifact as it was: (i) linear, (ii) contrasted with adjacent soil materials, and (iii) had abrupt, vertical walls. The strata was probed and the sediments were found to be coarser-textured and darker colored than the adjacent soil materials.

Conclusions:
I feel that this field study was highly successful and most productive. The radar profiles and grid maps provide archaeologists with value information into the survey areas and may help to establish future excavation strategies. The boundaries of an area containing high concentrations of burials were defined at Old Charles Towne Landing. The location of several buried structural features were identified at Old Dorchester. These structural features were located and identified with the GPR. These features lacked surface expressions and would probably not have been (or at least as easily) discerned and delimited without the use of the GPR.

All radar profiles and prepared grid maps of the study areas have been returned to Donnie Barker under a separate cover letter. I thank you for this opportunity to work in your state.

With kind regards.

James A. Doolittle
Soil Scientist (GPR)

cc:
D. Barker, State Park Archaeologist, SCDPRT, Columbia, SC
A. Dornbusch, Jr., Director, MWNTC, SCS, Lincoln, NE
E. Knox, National Leader, SSI, SCS, NSSC, Lincoln, NE
C. Olson, Research Soil Scientist, SSI, SCS, NSSC, Lincoln, NE
B. Stuckey, State Soil Scientist, SCS, Columbia, SC

COMPENDIUM

Ground-Penetrating Radar:
In recent years, ground-penetrating radar (GPR) techniques have been used to locate buried artifacts in various areas of the United States and Canada (Bevan, 1984a and 1984b; Bevan and Kenyon, 1975; Bevan et al., 1984; Kenyon, 1977; Parrington, 1979; Vaughan, 1986; Vickers and Dolphin, 1975; and Weymouth and Bevan, 1983). These studies have documented the nondestructive efficiency of using GPR methods to locate buried artifacts. The radar data collected from these studies have been used to locate buried artifacts, facilitate excavation planning, and aid site interpretations.

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) antennas and the model 3102 (500 MHz) transducer. The system was powered by a 12-volt vehicular battery. In large open areas, the antennas were towed behind a four-wheel drive vehicle at an average speed of 2.0 km h-1. In the more densely vegetated areas the antennas were pulled by hand at approximately the same average speed.

The performance of the GPR is highly site specific and soil dependent. The maximum probing depth of the GPR is, to a large degree, determined by the electrical conductivity of the soil. Soils having high conductivities rapidly dissipate the radar's energy and restrict its probing depth. The principal factors influencing the conductivity of soils are: (1) water content, (2) the amount and type of salts in solution, and (3) the amount and type of clays.

The majority of the artifacts discerned on the radar's graphic profiles at Old Charles Towne Landing and Old Dorchester were not deeply buried. In the selected study sites rates of signal attenuation were not limiting and profiling depths attained with the 500 MHz antenna were more than adequate for the purpose of this survey.

The artifacts and fill materials found within the study sites were often more resistive and therefore less attenuating and depth restricting than the surrounding soil materials. The artifacts were composed of dissimilar materials which contrasted with the surrounding soil materials and produced relatively strong radar reflections. As a general rule, the more abrupt and electrically contrasting an interface separating two materials, the stronger the reflected radar signal.

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

Survey Procedures:
The most efficient method to chart the location of buried artifacts is to prepare a grid on the area to be surveyed. The grid interval is dependent upon the purpose of the survey, the time available for the survey, the features being identified, and the desired level of detection. Bevan (1984b) described three levels of surveying intensities for the GPR. These levels include: (1) locating an archaeological site, (2) defining the boundaries of the site, and (3) charting the internal features of the site. Generally, within each of these levels, the grid interval will decrease as survey intensity increases.

The expected size of the features being detected with the radar will dictate the grid interval. In relatively detailed surveys, Vaughan (1986) used a 1 meter spacing to locate grave sites while Bevan et al. (1984) used a 1.5 meter spacing to locate buried foundation walls. For the grids constructed in this survey, the grid spacing varied from about 5 to 50 feet. Generally, the 50 foot grid interval was preferred for reconnaissance surveys conducted in broad areas (Market Place). A 10 foot interval was selected for charting the internal structural features of a defined site. These intervals were chosen based on considerations of available time (4 days), the features being identified (buried structures or grave sites), and the desired level of detection (detection of the major buried structures and areas of burial concentrations).

Linear features such as burials and buried foundation walls are detect by conducting several parallel traverses, preferably perpendicular to the long axis of the feature, with the GPR. Generally, reliable detection of a buried artifact requires similar imagery on three to six transects.

After the grids had been established, properly marked and recorded, passes with the antenna were made along each grid line. As the antenna past each flagged reference position along a grid line, the operator depressed an event marker which impressed a dashed vertical line on the graphic profile. The dashed vertical lines represent know reference points along the graphic profiles and were used to determine the location of identifiable images.

Interpreting the Graphic Profiles:
The interpretation of the radar's imagery requires more time and effort than the acquisition of the profiled data. Interpretations are substantiated by excavations. Excavations help to correlate the radar imagery with observed features and to determine what features were detected with the radar.

The enclosed figure demonstrates how a radar profile can be analyzed for interpretations. In this figure, the horizontal scale represents units of distance traveled along a transect line. This scale is dependent upon the speed of antenna advance along the transect line and the rate of paper advance through the graphic recorder. The vertical scale is a time or depth scale based upon the velocity of signal propagation. The dashed vertical lines are event markers inserted on the graphic profile by the field operator to indicate known antenna positions or reference points along a transect. The evenly spaced, thin, horizontal lines are scale

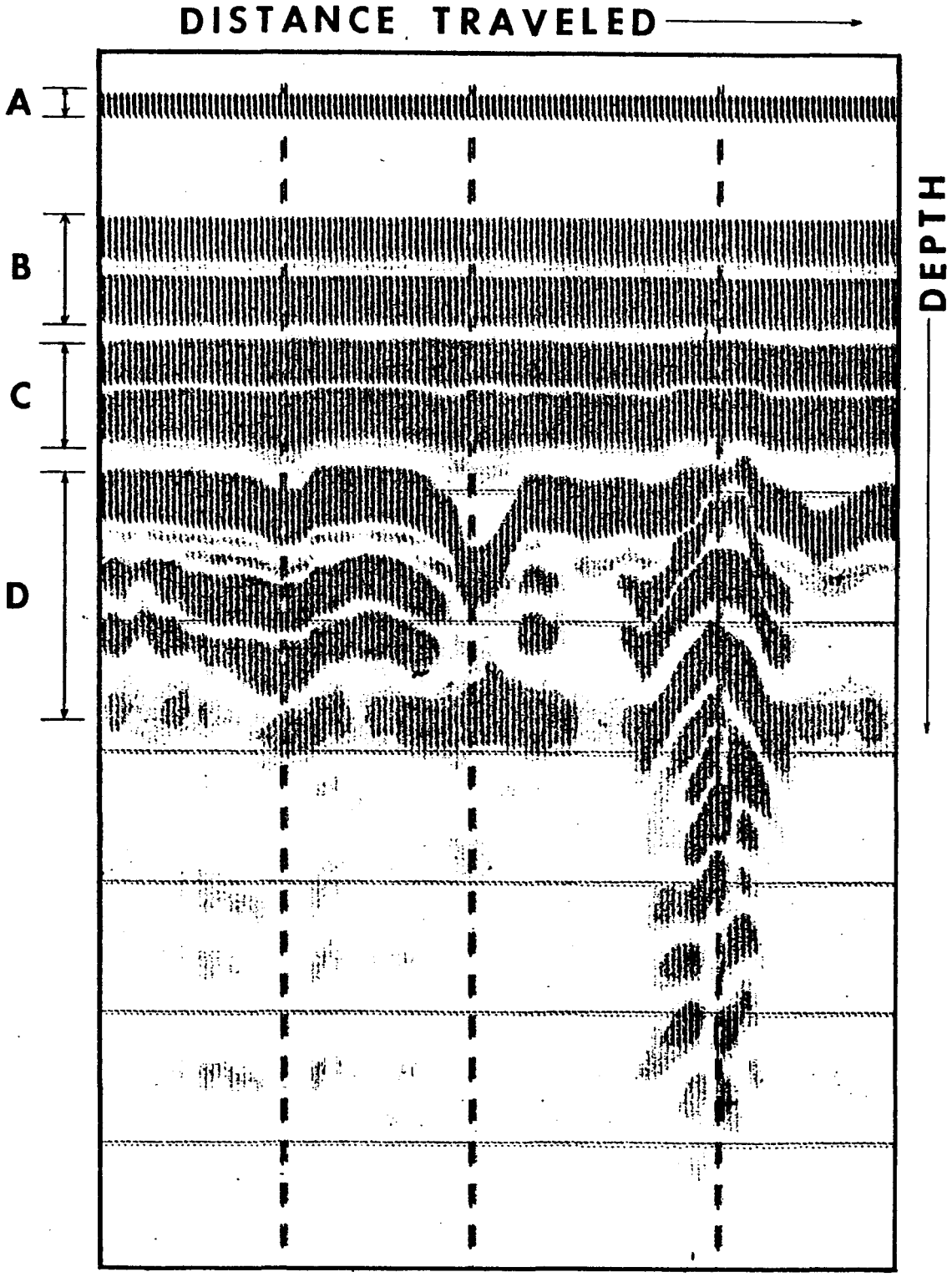

FIG. 1

A GRAPHIC PROFILE

lines. Scale lines provide reference planes for relative depth assessments.

Most graphic profiles will contain four basic components: start of scan image (A), inherent system images (B), surface images (C), and subsurface images (D). All of these components, with the exception of the start of scan image, are generally displayed as a group of multiple dark bands unless limited by high rates of signal attenuation or the proximity of two or more closely spaced interface signals. These bands, produced by oscillations in the reflected signals, limit the ability of the radar to discriminate shallow or closely spaced interfaces.

The start of scan image (A) is a result of the direct coupling of the transmit and receive antennas. Though a source of unwanted clutter, the start of scan image is often used as a time reference line.

Reflections inherent in each of the system's antennas are the first series of multiple bands on graphic profiles. These reflections (B) are a source of unwanted background noise on most graphic profiles.

The surface images (C) represent the first significant interface signal. Below the images from the surface and near surface features are the images from subsurface interfaces (D). These interfaces represent reflections from either plane or point reflectors. Most soil horizons, layers of debris, and buried walls (traversed parallel with their long axes) will appear as plane reflectors. The parallel multiple bands appearing in the left-hand portion of this figure are plane reflectors.

Small objects, such as rocks, roots, buried pipes, burials, or foundation walls (when crossed perpendicular to their long axis) will appear as point reflectors and will produce hyperbolic patterns similar to the images in the right-hand portion of this profile. Variations in the shape of the hyperbola are caused by variations in: (1) the angle at which the feature was crossed, (2) the speed of antenna advance across the top of the feature, (3) the velocity of pulse propagation, and (4) the shape and orientation of the buried object.