Formerly Utilized Sites Remedial
Action Program (FUSRAP)

Maywood Chemical Company Superfund Site

ADMINISTRATIVE RECORD

Document Number

MISS- 031.

US Army Corps
of Engineers®

Bechtel

Oak Ridge Corporate Center
151 Lafayette Drive
P.O. Box 350
Oak Ridge, Tennessee 37831-0350

Facsimile: (615) 220-2100

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DOE Contract No. DE-AC05-91OR21949
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U.S. Environmental Protection Agency, Region II
Jacob K. Javits Federal Building
26 Federal Plaza
New York, NY 10278

Attention: Mr. Jeff Gratz
Federal Facilities Section

Subject: Results from Ground Penetrating Radar Survey, Stepan Chemical Company and Muscarelle Sites, Maywood, New Jersey

Dear Mr. Gratz:

At Susan Cange's request, please find enclosed a copy of the ground penetrating radar survey report for the site area that you have requested.

If there are any questions, please contact Susan Cange at 615-576-5724.

Very truly yours,

SD Liedle

S. D. Liedle
Project Manager - FUSRAP

SDL:rtn:0599
Enclosure: As stated

cc: S. Cange, DOE

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Weston Geophysical
CORPORATION

November 26, 1990

Mr. Don Downing
BECHTEL NATIONAL, INC.
800 Oak Ridge Turnpike
Oak Ridge, TN 37850

Subject: Results from Ground Penetrating Radar Survey
Stepan Chemical Company and Muscarelle Sites
Maywood, New Jersey

Dear Mr. Downing:

In accordance with your authorization Weston Geophysical conducted a ground penetrating radar (GPR) survey on November 16 and 17, 1990 at the Stepan Chemical Company and Muscarelle sites in Maywood, New Jersey (Figure 1).

The purpose of this investigation was two-fold. At the Stepan site the intent of the survey was to identify possible buried metal objects such as pipes, tanks, steel I-beams, etc, as well as areas of possible backfill. At the Muscarelle site the purpose of the investigation was to identify and delineate the extent of a buried stream channel (Lodi Brook).

LOCATION AND SURVEY CONTROL

Geophysical data were acquired along a 10-foot grid established at each site by Weston Geophysical. The coordinates for the Muscarelle site are arbitrary and are based upon the measured distance from cultural artifacts (curb lines) and are not referenced to the coordinates on the plan map provided by Bechtel National. The coordinates of Area 1 at the Stepan site are based upon the surveyed positions provided by Bechtel National. The coordinates of Area 2 at the Stepan site are based upon the measured distance from cultural artifacts (fence lines), and are not referenced to the coordinates on the plan map provided by Bechtel National.

METHODS OF INVESTIGATION

The GPR survey method was used as specified to determine the depth and location of possible buried metal objects (pipes, tanks, etc) as well as to identify backfilled areas, and to delineate the position and extent of a buried stream channel.

A GSSI Sir System-8 ground penetrating radar system was used in conjunction with both 500 MHz (megahertz) and 300 MHz antennas to acquire data along the survey lines shown on Figures 2 and 3. Microwave energy, transmitted into the ground, is reflected back to the surface from interfaces between materials with differing electrical properties (dielectric and conductivity).

Typically, reflections occur from metallic objects and from lithologic changes. Internal soil structures such as stratification and slump features caused by excavation and subsequent backfilling may also be detected. Reflected GPR energy is detected by the radar antenna and displayed on a graphic recorder. Metallic objects such as tanks, pipes, etc., produce a characteristic strong parabolic signal on the GPR record. Appendix A discusses the GPR survey method in greater detail.

SUMMARY OF RESULTS

Preliminary interpretation of GPR data and recommendation of general areas for test borings were accomplished during the survey by the Weston Geophysical field geophysicist. Discussions of results and additional recommendations regarding boring locations are provided below for each of the sites investigated.

Muscarelle Site

GPR survey coverage and anomalies from the Muscarelle Site are presented on Figure 2. Key points to note on this figure include identification of the probable stream channel boundaries and a culvert (north end of site). A few discrete reflectors (point targets) indicative of buried objects or utilities were observed, particularly in the southwestern portion of the survey area. GPR reflectors indicative of backfill materials were evident throughout most of the site.

Variations in bedrock depth appeared to be represented on some GPR recordings, particularly in the northern half of the survey area. Bedrock depths were observed to gradually increase towards the west ends of Lines 14, 16, 17, and 18. Relatively shallow bedrock was noted on the east ends of Lines 1, 2 and 3.

The eastern boundary of the stream channel was inferred along most of the GPR traverses, except Lines 1+80 through 2+00 and 14 through 16. Data from these traverses did not indicate the changes in backfill materials or bedrock depths inferred to represent the stream channel on the remaining traverses.

The western boundary of the stream channel was difficult to identify on many of the GPR traverses, possibly due to conditions such as the channel boundary being very close to the traverse ends (Lines 1+30 to 1+70) or insufficient contrast between backfill materials within and outside the channel boundary (Lines 1 through 9 and 14 through 16). In addition, the interpreted position of the western boundary on traverses 0+30 through 1+20 appears unusually straight. This may be due to a trench containing utilities which disrupts the GPR reflections indicative of the backfilled stream channel; the channel may thus actually extend further to the west than is shown on Lines 0+30 through 1+20.

In the southern portion of the survey area, the stream channel was represented by prominent "ringing" of GPR signals. This ringing may represent backfill material (possibly electrically conductive, such as clay) which is different from backfill at the northern survey area.

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Mr. Don Downing
BECHTEL NATIONAL, INC.

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Stepan Chemical Company

GPR reflectors indicative of extensive backfill materials were evident throughout both of the Stepan Chemical Company sites Nos. 1 and 2; traverse locations, point targets, and areas of backfill which may include large or metallic objects are shown on Figures 3 and 4. Note that impediments to drilling may be encountered throughout either of the Stepan Chemical Company sites. However, borings placed outside the anomalous areas shown on Figures 3 and 4 are less likely to encounter difficult drilling conditions.

RECOMMENDATIONS

Test pits and/or borings are recommended to verify and better define the results of this survey program; the conditions disclosed by such efforts should be presented to Weston Geophysical for a possibly more complete interpretation of the radar recordings.

We appreciate the opportunity to provide geophysical services to Bechtel National, and welcome future opportunities to serve you.

Sincerely,

WESTON GEOPHYSICAL CORPORATION

Daniel J. Delea dg

Daniel J. Delea
Field Geophysicist

M. Blackey

Mark Blackey
Manager, Geophysical Services

DJD:MEB:dmg-3723J
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Enclosures

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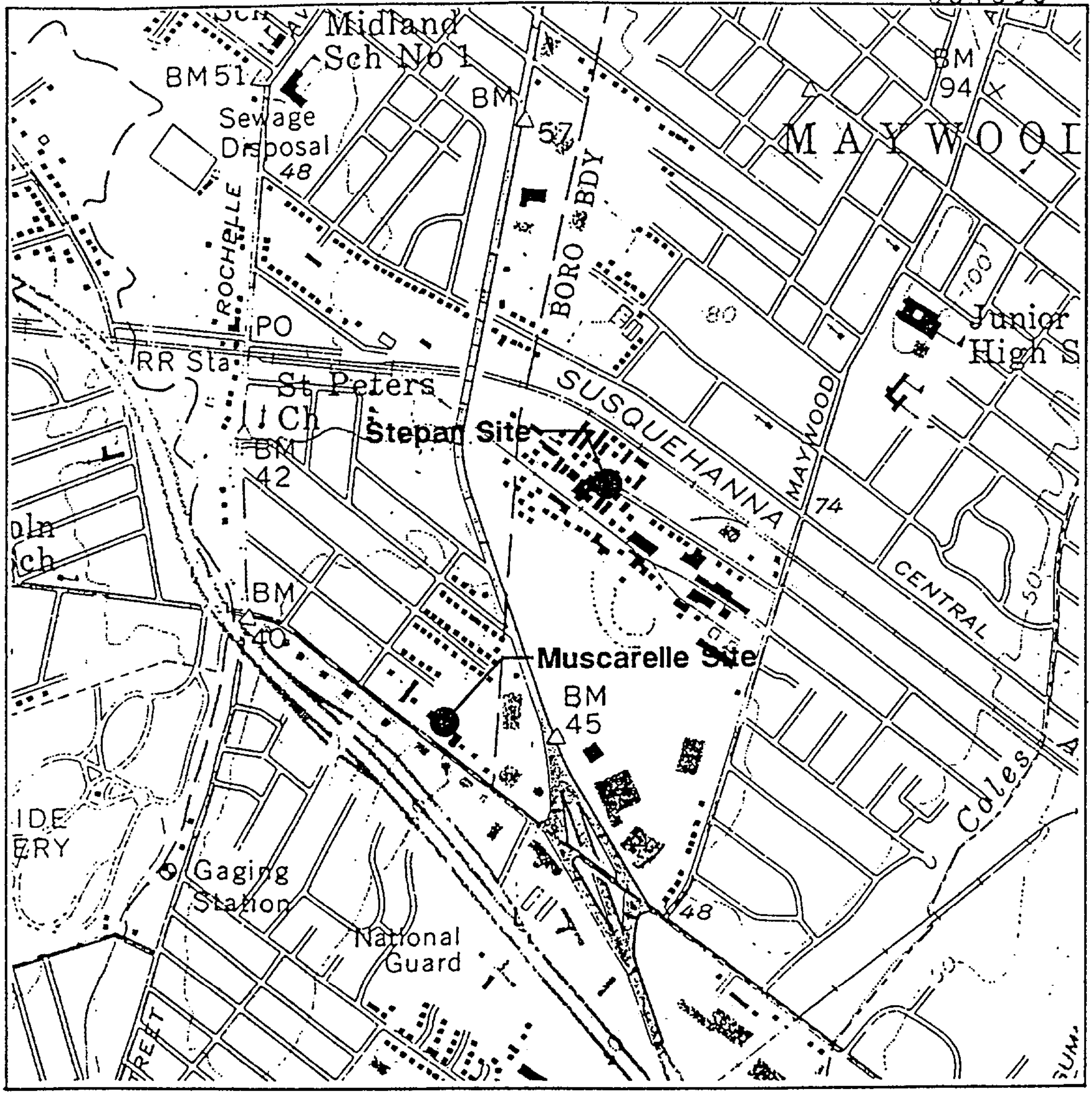
FIGURES



Basemap: U.S.G.S. 7.5 Minute Series (Topographic)
Hackensack,NJ Quadrangle

0 500 1000 1500
Scale in Feet

prepared by	GROUND PENETRATING RADAR SURVEY STEPAN CHEMICAL CO. SITES MAYWOOD, NEW JERSEY prepared for BECHTEL NATIONAL INC.	Area of Investigation	
checked by		Weston Geophysical	Fig. 1
reviewed by			

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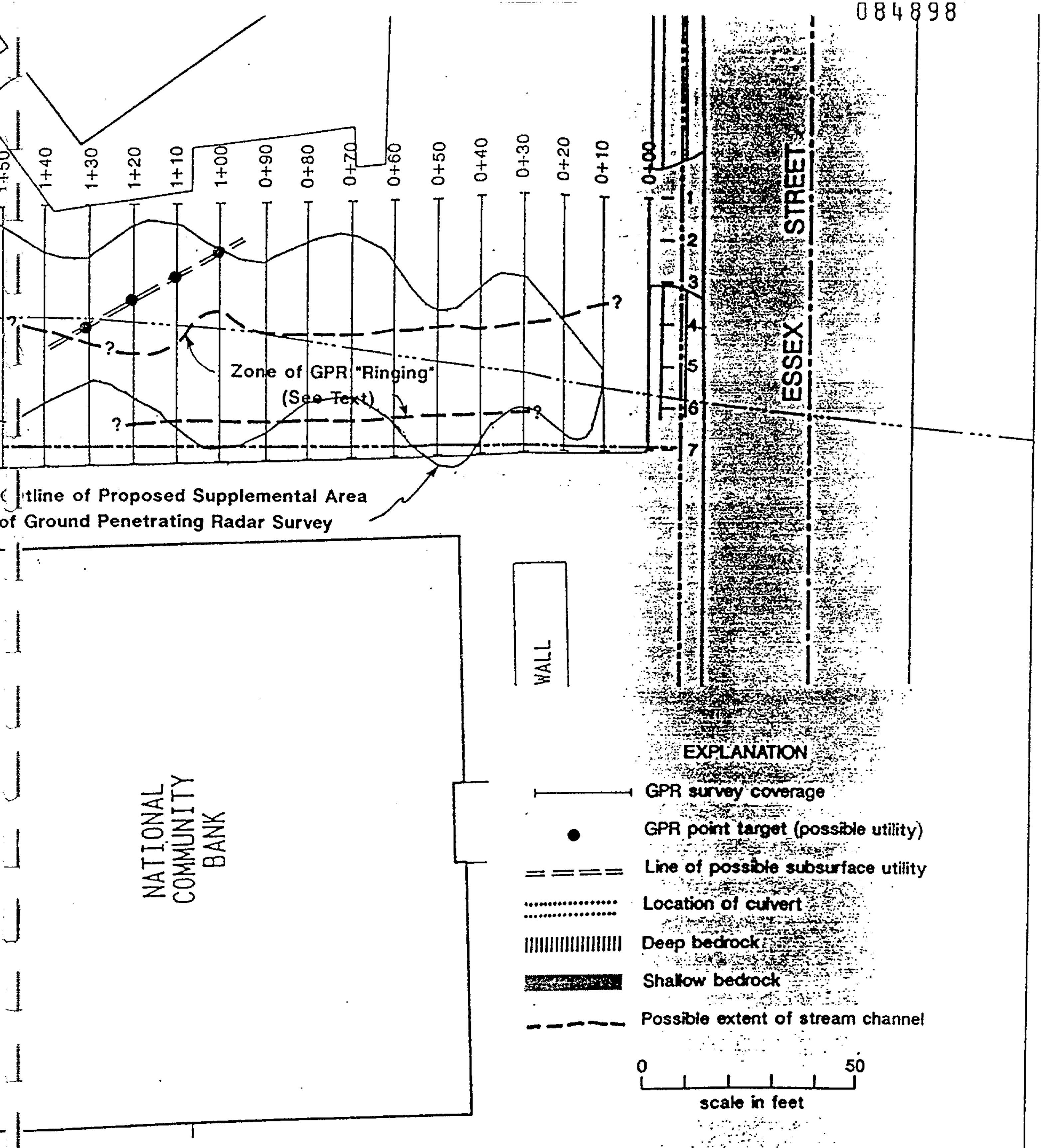

prepared by / checked by MB / reviewed by	GROUND PENETRATING RADAR SURVEY STEPAN CHEMICAL CO. SITES MAYWOOD, NEW JERSEY prepared for BECHTEL NATIONAL INC.	GPR Survey Coverage and Anomaly Map Muscarelle Site Weston Geophysical	Fig. 2

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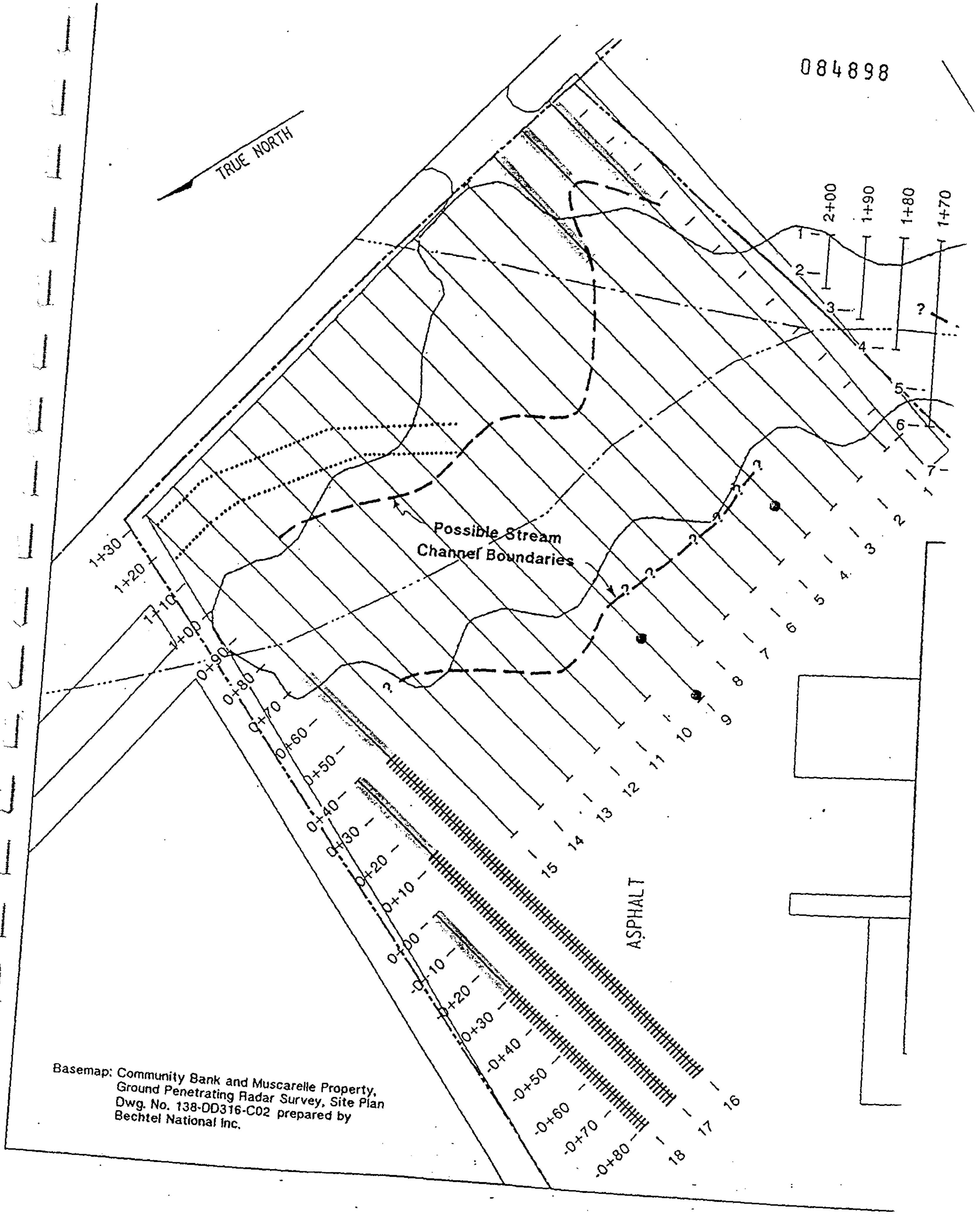
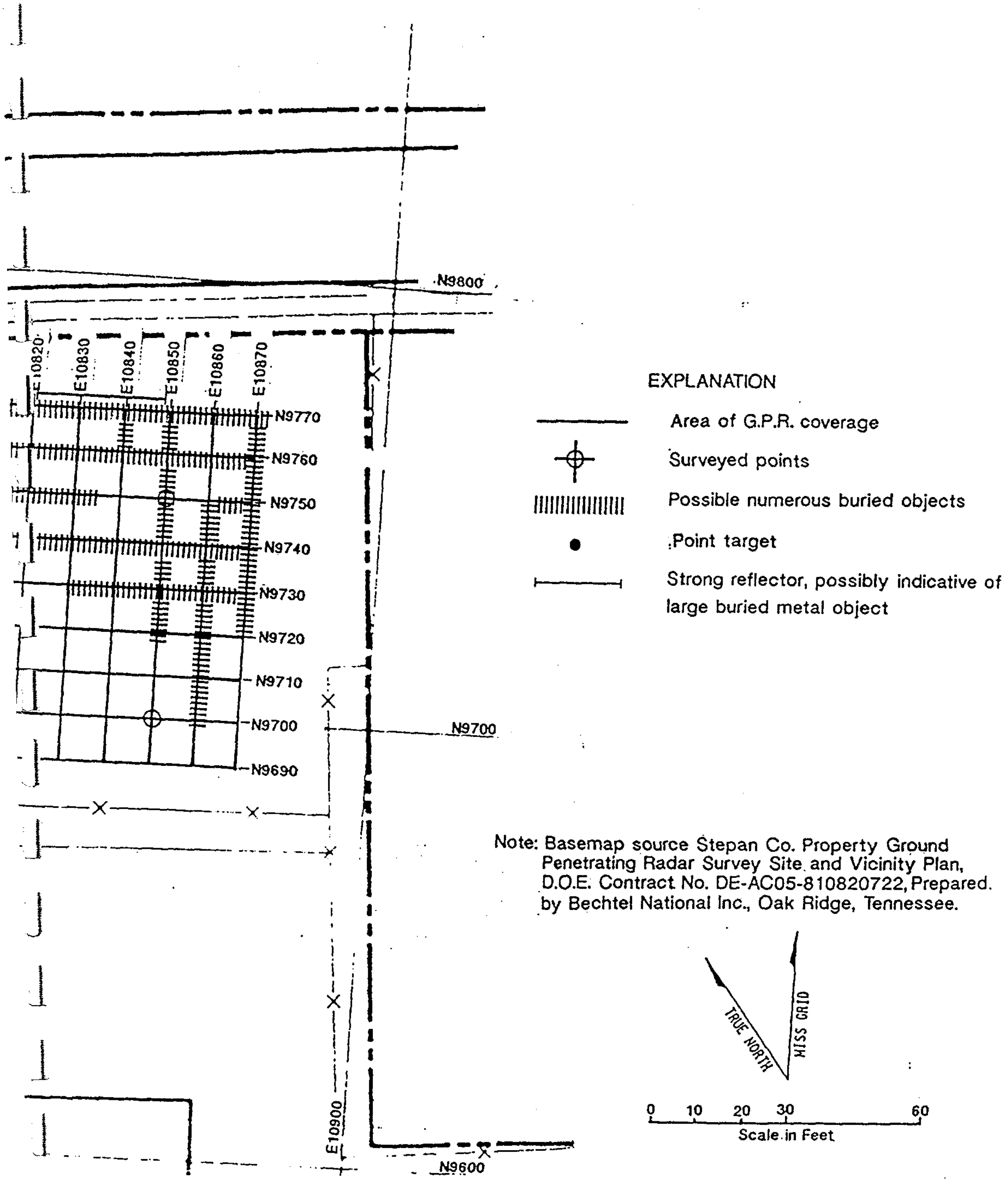


Basemap: Community Bank and Muscarelle Property, Ground Penetrating Radar Survey, Site Plan Dwg. No. 138-DD316-C02 prepared by Bechtel National Inc.



prepared by checked by reviewed by	GROUND PENETRATING RADAR SURVEY STEPAN CHEMICAL CO. SITES MAYWOOD, NEW JERSEY prepared for BECHTEL NATIONAL INC.	GPR Survey Coverage and Anomaly Map Stepan Chemical Co. Area 1 Weston Geophysical — Fig. 3

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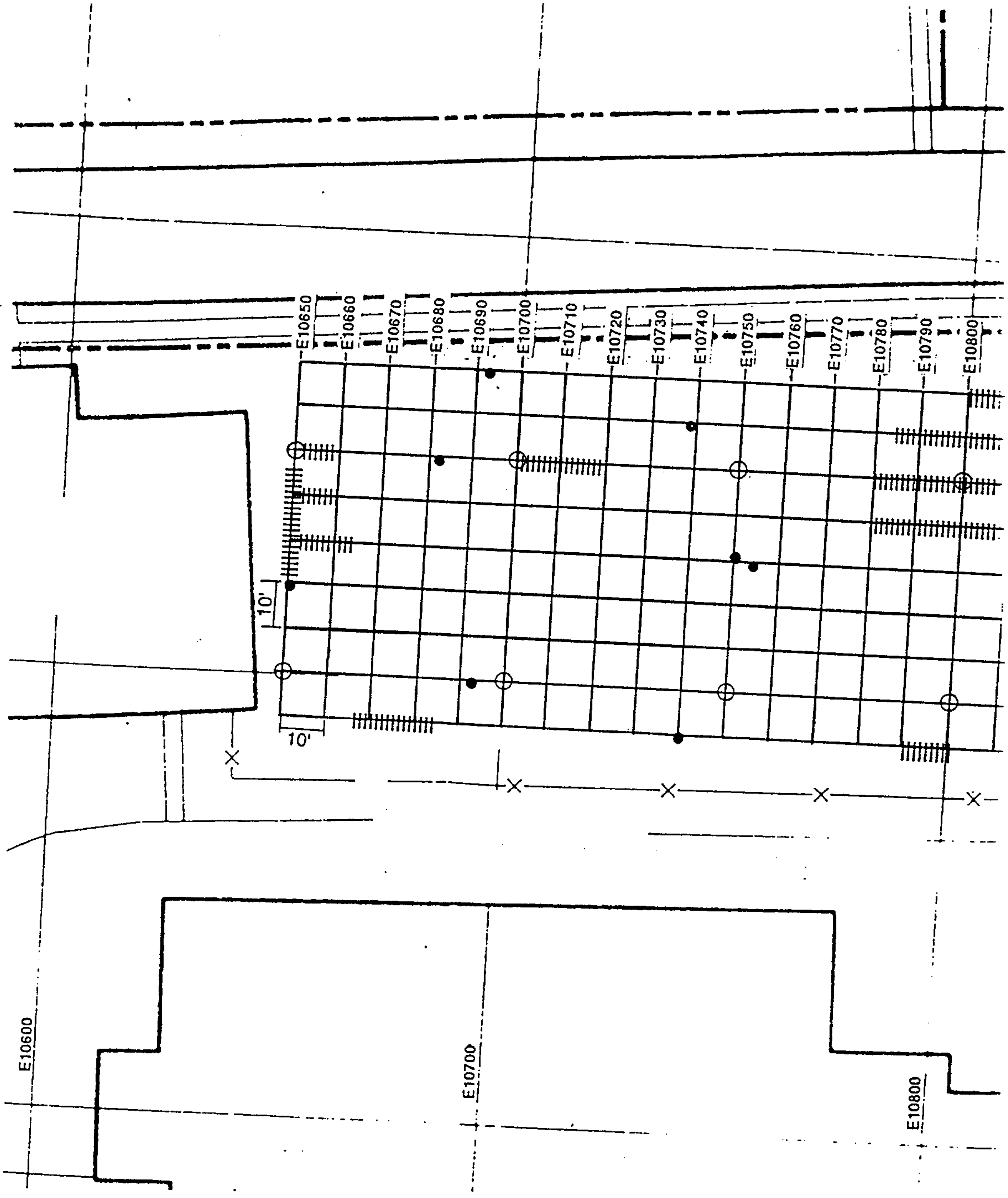
E10650
E10660
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E10680
E10690
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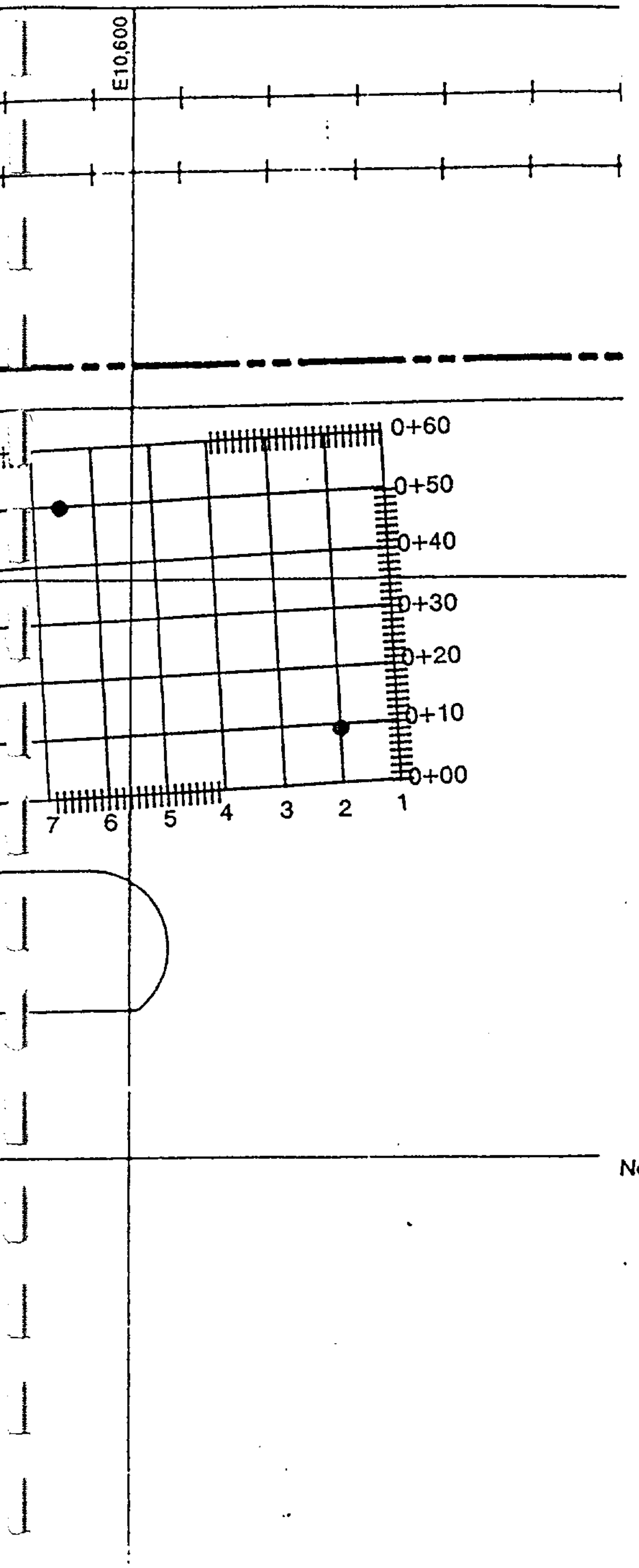
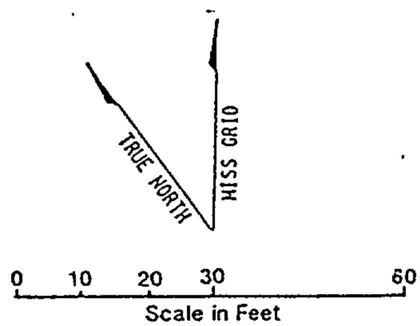


EXPLANATION

- Area of GPR coverage
- Surveyed point
- Point target
- Possible numerous buried objects

Note: Basemap source Stepan Co. Property Ground Penetrating Radar Survey Site and Vicinity Plan, D.O.E. Contract No. DE-AC05-810820722, Prepared by Bechtel National Inc., Oak Ridge, Tennessee.



prepared by	GROUND PENETRATING RADAR SURVEY STEPAN CHEMICAL CO. SITES MAYWOOD, NEW JERSEY prepared for BECHTEL NATIONAL INC.	GPR Survey Coverage and Anomaly Map Stepan Chemical Co. Area 2	
checked by MB		Weston Geophysical	Fig. 4
reviewed by			

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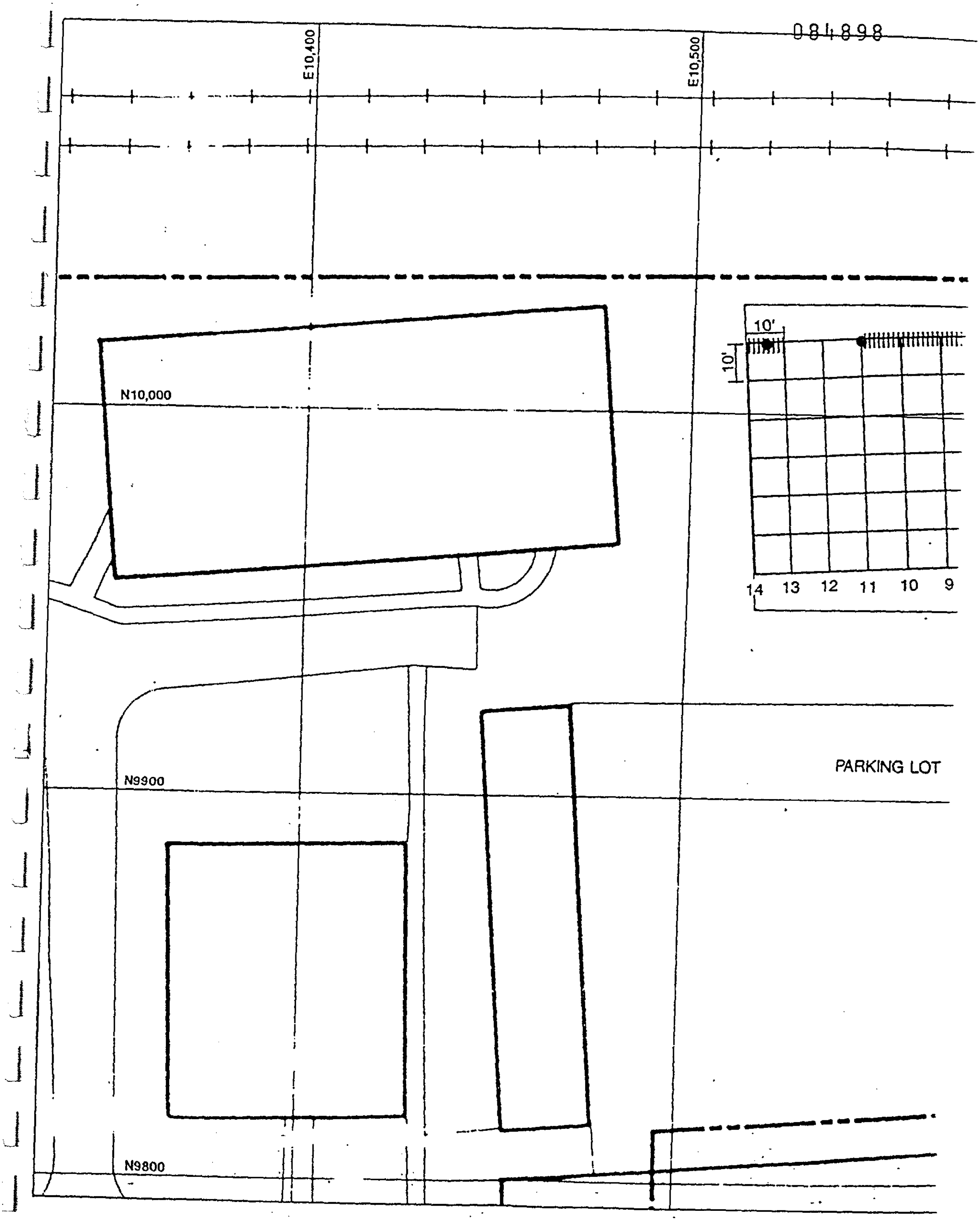

E10,400
E10,500
10'
10'
14
13
12
11
10
9
N10,000
PARKING LOT
N9900
N9800

APPENDIX A

GROUND PENETRATING RADAR
METHOD OF INVESTIGATION

GENERAL CONSIDERATIONS

Ground penetrating radar is an electromagnetic survey technique that reveals a graphic cross-sectional view of earth stratigraphy and point targets (i.e., drums, pipelines, utilities, boulders, etc.) below the ground surface. It is a reflection technique similar to the single-trace seismic reflection method commonly used in marine subbottom profiling. The two techniques differ in that the acoustic method uses audio frequency sound waves, while the radar method uses electromagnetic waves at frequencies of 80 to 1,000 megahertz (MHz).

In a radar system (Figure 1), high-frequency impulses of electromagnetic energy are generated by a transmitter in the antenna. Each impulse propagates downward through the ground surface and into the material below. At interfaces, part of the signal is reflected while part is transmitted still deeper to be reflected by other layers or isolated bodies. After transmitting the outgoing pulse, the antenna instantly switches from a transmitting mode to a receiving mode in order to detect the reflected signals.

During data acquisition, a graphic recorder provides an immediate view of the data. Radar impulses are transmitted in sync with a swept-stylus type graphic recorder. The graphic recorder stylus sweeps across the paper at a uniform speed and reflected signals above a user-selected threshold cause the paper to be darkened at points proportional to the amplitude of the reflection. Because the antenna is being pulled forward slowly, each pass of the stylus represents a slightly different antenna position. As the recorder paper advances, a continuous cross-section of reflections from subsurface stratigraphy and point targets is generated.

Data are recorded as a function of distance along the traverse versus time. Detected reflections are represented as the two way travel time to the reflector at a specific station location. Data enhancement is possible if the data are recorded on magnetic tape or diskette for later computer processing.

DATA INTERPRETATION

Figure 2 shows a GPR record of a buried river channel from a Weston Geophysical project in the northeastern United States. The dipping reflectors are indicative of the bedrock surface, while the nearly horizontal reflectors are from the overlying stratified fine sands.

Data is plotted as a function of antenna position versus time. Accurate determination of the depth to any layer requires calibration of the radar system. Calibration is performed by moving the antenna over a metal target with a known depth, such as a buried metal plate or pipe. Metallic objects typically are depicted by a characteristic hyperbolic anomaly. Figure 3 shows a GPR record over three buried fuel tanks. The time scale can then be converted to a depth scale by determining the location of the known reflector on the GPR record. If the depth to an observed reflector is not known, a borehole can be drilled or an excavation conducted to establish its depth. This is a more costly procedure, but it provides an exact depth calibration.

An approximation of the depth to a reflector can be made by estimating the velocity of the medium and by directly reading the travel times of the radar signals on the GPR recording. Velocity can be estimated by the equation:

$$V_m \approx C/\sqrt{K'}$$

where

V_m is the velocity of the radar signals through the medium
C is the speed of light (2.998×10^8 m/s)

and K' is the dielectric constant (the real term at the relative dielectric permittivity). The values of the dielectric constant (electrical properties) for earth materials vary considerably and are affected by such conditions as porosity, degree of saturation, mineral composition, etc.

Depth of penetration in a given material is limited by attenuation of the signal. Attenuation is controlled by the amount of water and clay present in a material, the conductivity of the material and saturation fluids, and the degree of scattering of the electromagnetic signals. Penetration of up to 75 feet has been reported for water-saturated sands in a Massachusetts glacial delta. Signal penetration in saturated clays, however, is less than a few feet; signal penetration in sea water is less than one foot. It is important to note that in a layered material a single, highly reflective layer alone can limit penetration by preventing the propagation of energy past it. In this case, apparent loss of energy is caused by reflection rather than by signal attenuation.

Ground penetrating radar can be used to locate underground pipes and tanks, foundations, voids, sand, gravel, peat, and archeological artifacts. Layered structures in soils and hard rock can be charted accurately in continuous profiles. The effectiveness and speed with which modern systems can be used makes ground penetrating radar a logical choice where rapid and accurate shallow surveys are required.

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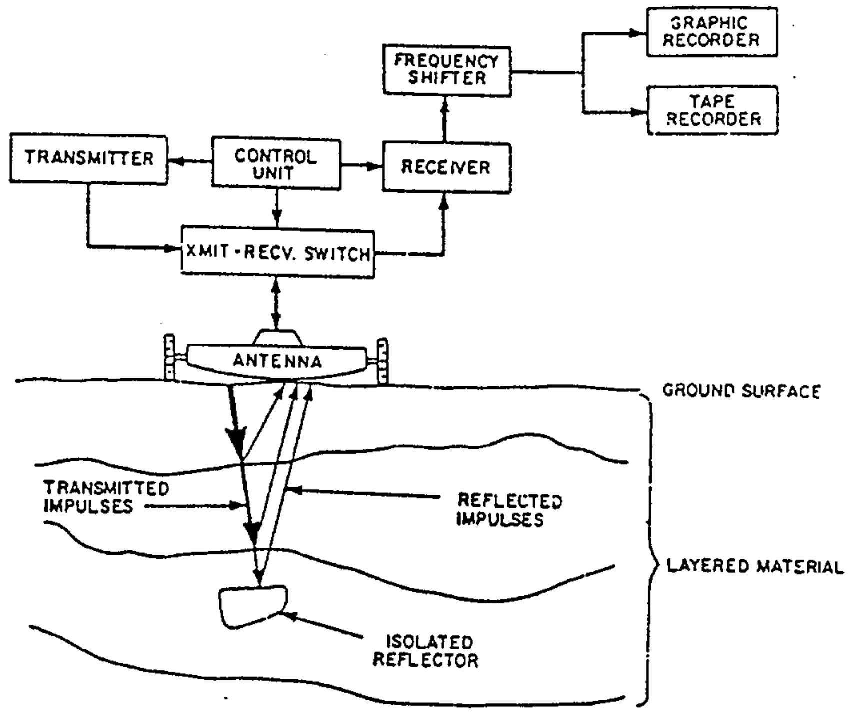
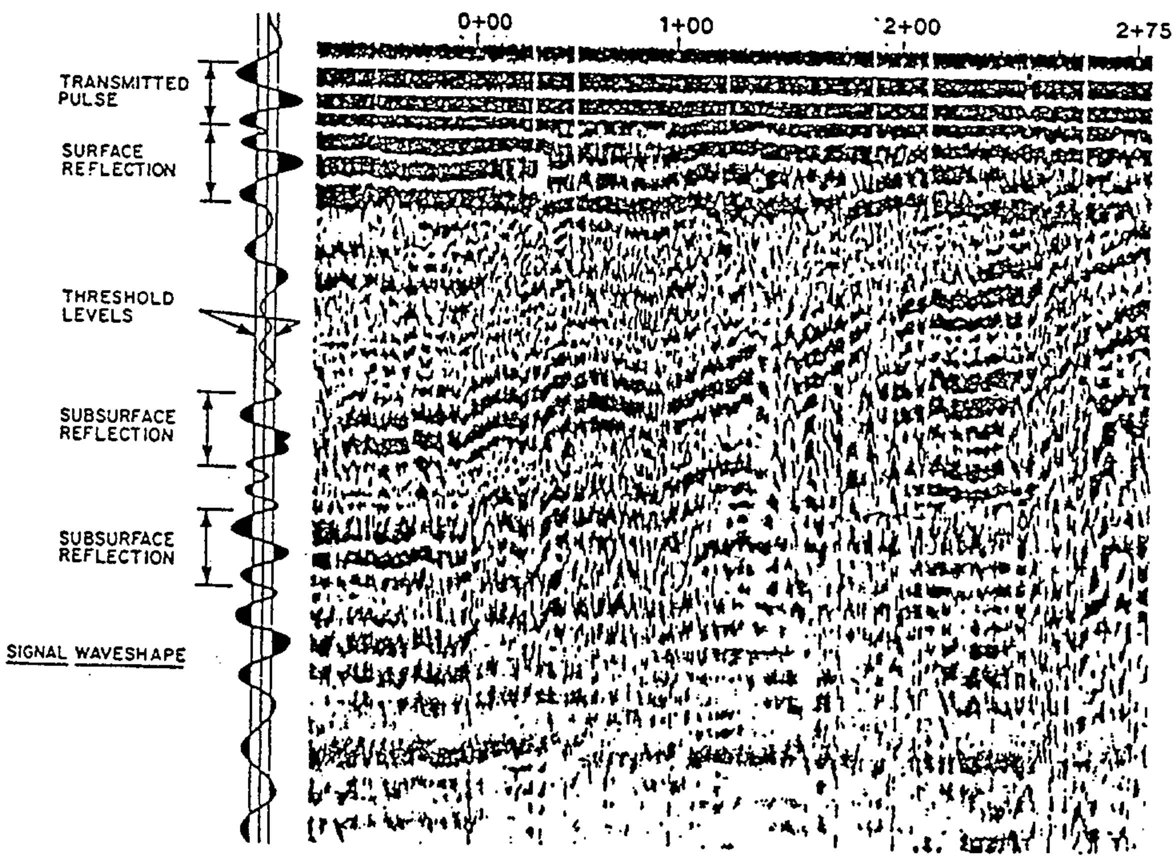


RADAR SYSTEM BLOCK DIAGRAM



TYPICAL RADAR RECORD

GROUND PENETRATING RADAR SET-UP

FIGURE 1

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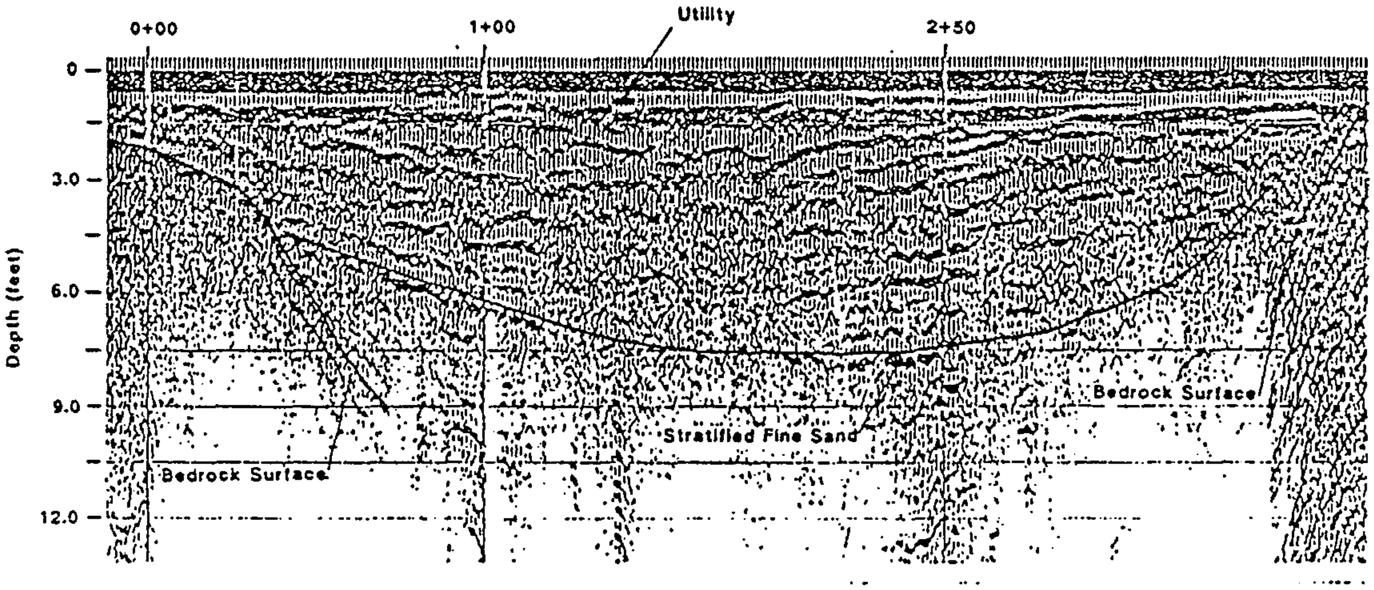

GROUND PENETRATING RADAR RECORD OF A BURIED RIVER CHANNEL

FIGURE 2

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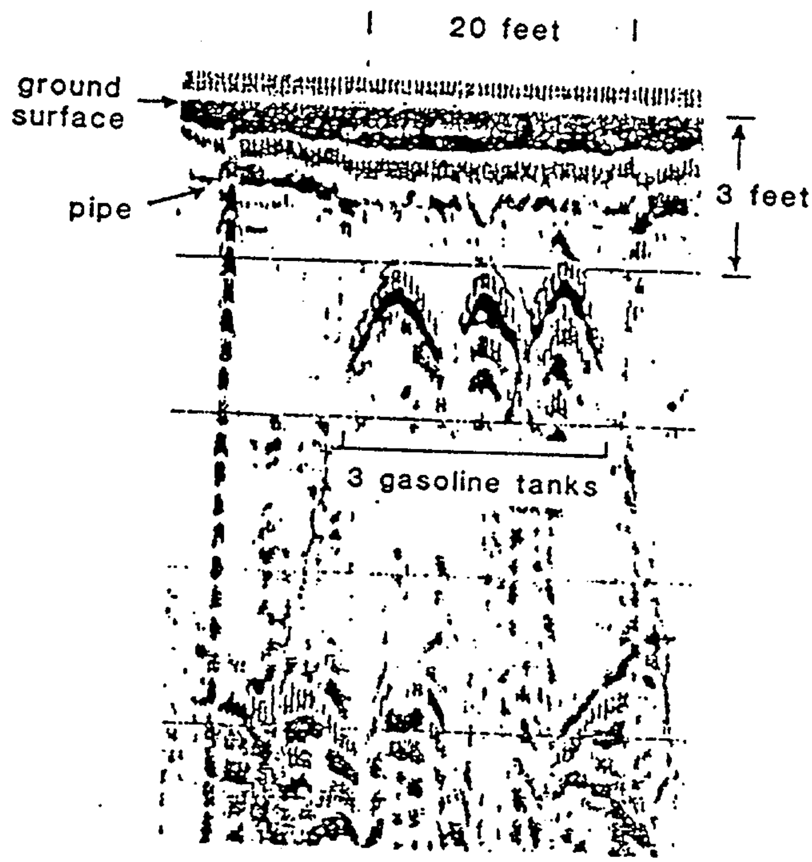

GROUND PENETRATING RADAR RECORD OF BURIED FUEL TANKS

FIGURE 3