United States Department of Agriculture
Soil Conservation Service

Northeast NTC
Chester, PA 19013

Subject: Ground-Penetrating Radar (GPR) Electromagnetic Induction (EM) Field Assistance- Fort Robinson State Park, Nebraska

Date: 28 September 1992

To: Ronald E. Morehead
State Conservationist
USDA-Soil Conservation Service
Federal Building, Room 152
100 Centennial Mall North
Lincoln, NE 68508-3866

Purpose:
To use geophysical techniques to assist archaeologist locate sites and structures associated with the historic Red Cloud Agency at Fort Robinson, Nebraska.

Principal Participants:
Jim Doolittle, Soil Specialist, SSQAS, SCS, Chester, PA
Kim Doolittle, Earth Team Volunteer, SCS, Chester, PA
Terry Steinacher, SHPO, Ft. Robinson Museum, Crawford, NE
Richard Torpin, Cultural Resource Coordinator, SCSA, Lincoln, NR
Mark Willoughby, Soil Party Leader, SCS, Chadron, NE
Phil Young, Soil Scientist, SCS, Chadron, NE

Activities:
The equipment and operators arrived at Ft. Robinson on the afternoon of 24 August. After a brief meeting with Terry Steinacher, a GPR survey was conducted within the grid over the suspected site of the fort's washery (laundry facility). On 25 August, electromagnetic induction surveys were completed over each of the three grid sites (washery, suspected site of a mass grave along Soldier Creek, and suspected site of Yate's Trading Post at the Red Cloud Agency). In addition, a GPR survey was also completed at the suspected site of Yate's Trading Post.

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, power distribution unit, transmission cable (30 m), and the model 3110 (120 MHz) antenna. The system was powered by a 12-volt battery.

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

The electromagnetic induction equipment used in this investigation were the EM38 and EM31 ground conductivity meters manufactured by GEONICS Limited [1]. Measurements of conductivity are expressed as milliSiemen per meter (mS/m).

Discussion:

Washery Site -

The grid covered an irregularly-shaped 36 by 62 meter area. The grid interval was 4 meters. This provided 116 grid intersects or observation points. At each intersect, measurement were taken with the EM31 meter in both the horizontal and vertical modes (Figures 1 and 2, respectively). Transects were conducted with the GPR along parallel, east-west trending grid lines.

Several point anomalies were detected with GPR. In Figures 1 and 2, subsurface anomalies suspected of representing cultural features have been identified with point symbols. While these anomalies were distributed across the survey area, they were concentrated in the extreme south-central portion.

Interpretation of the EM data are based on the identification of spatial patterns within the data set. Throughout most of the survey area, values of apparent conductivity were relatively invariable. However, along the southern portion of the survey area (left-hand portion of figures 1 and 2), isolines were closely spaced and values of apparent conductivity ranged from 20 to greater than 190 mS/m. This area was suspected of being disturbed and the most likely site of the Fort's washery.

An exploratory probe was conducted near the location of the best expressed point anomaly in the zone of higher apparent conductivity values in the south central portion of the survey area. The excavation revealed the suspected burnt residue of the washeries floor.

Soldier Creek Site -

The grid covered an irregularly-shaped 29 by 30 meter area. The grid interval was 4 meters. This provided 59 grid intersects or observation points. At each intersect, measurement were taken with the EM38 and EM31 meters in both the horizontal and vertical modes. The results of the EM31 survey are simulated in Figures 3 and 4. Dense vegetation and dissected terrain restricted the use of GPR at this site.

The site appeared to be both naturally and artifically disturbed. Patterns evident in figures 3 and 4 appear to represent an abandoned stream channel containing finer textured soil materials (lower left-hand corner of figures 3 and 4), and several anomalous areas (upper right-hand corner) believed to be underlain by buried metallic objects. These suspected cultural features are believe to post-date the Cheyenne Outbreak of 1879. The site does not appear

to have any feature indicative of a buried trench to a former saw mill.

Red Cloud Agency - Site of Yate's Trading Post-
The grid covered a 29 by 30 meter area. The grid interval was 4 meters. This provided 59 grid intersects or observation points. At each intersect, measurement were taken with the EM38 in the vertical mode and the EM31 meters in both the horizontal and vertical modes. The results of these surveys are simulated in Figures 5, 6, and 7. Generally values of apparent conductivity increase with soil depth. The irregular patterns evident in these figure are believed to indicate a site having a complex history of use and disturbance.

In figures 5, 6 and 7, two conspicuous anomalies are evident in the center right-hand portion of the survey area. The area enclosed by the the box (labelled "A") becomes more conspicuous with increasing soil depth (compare Figure 7 with Figure 6). The inference is a deep zone of disturbance, possibly a buried cellar to a former structure. Immediately to the south of this feature is an anomalous zone which is best expressed at shallow depths (compare Figure 5 with Figures 6 and 7). Here, highly contrasting, shallowly buried cultural features are suspected (later confirmed by exploratory probings).

Transects were conducted with the GPR along parallel, east-west trending grid lines. This survey was highly successful, identifying the location of several point anomalies (see Figure 8, between observation points 32 and 36) and a cellar to a former structure (see Figure 8, between observation points 44 and 48). The point anomalies identified in Figure 8 were probed. Excavations revealed a horse shoe, several metal bands and cartridges (dating back to the time of the Agency).

Additional radar transects were conducted to better define the boundaries of the suspected cellar. In Figures 6 and 7, the location of all point anomalies and the suspected cellar (area enclosed in box labeled "A") have been identified.

Results:
This was a brief but most successful survey. Results from this survey will be used to preserve selected areas and to reduce future expenditures of resources. Non-contacting geophysical techniques were used to locate two buried structural features (possible Washery and Yate's Trading Post) and to assess the archaeological significance of another site along Soldier Creek.

All participants recieved field training on the use of the EM38 and EM31 meters.

Activities such as this helps to demonstrates SCS's commitment to historical preservation and conservation, and provides an

opportunity to work cooperatively with Historic Preservation Officers of Nebraska.

I thank you for this opportunity to work in your state.

With kind regards.

James A. Doolittle

cc:
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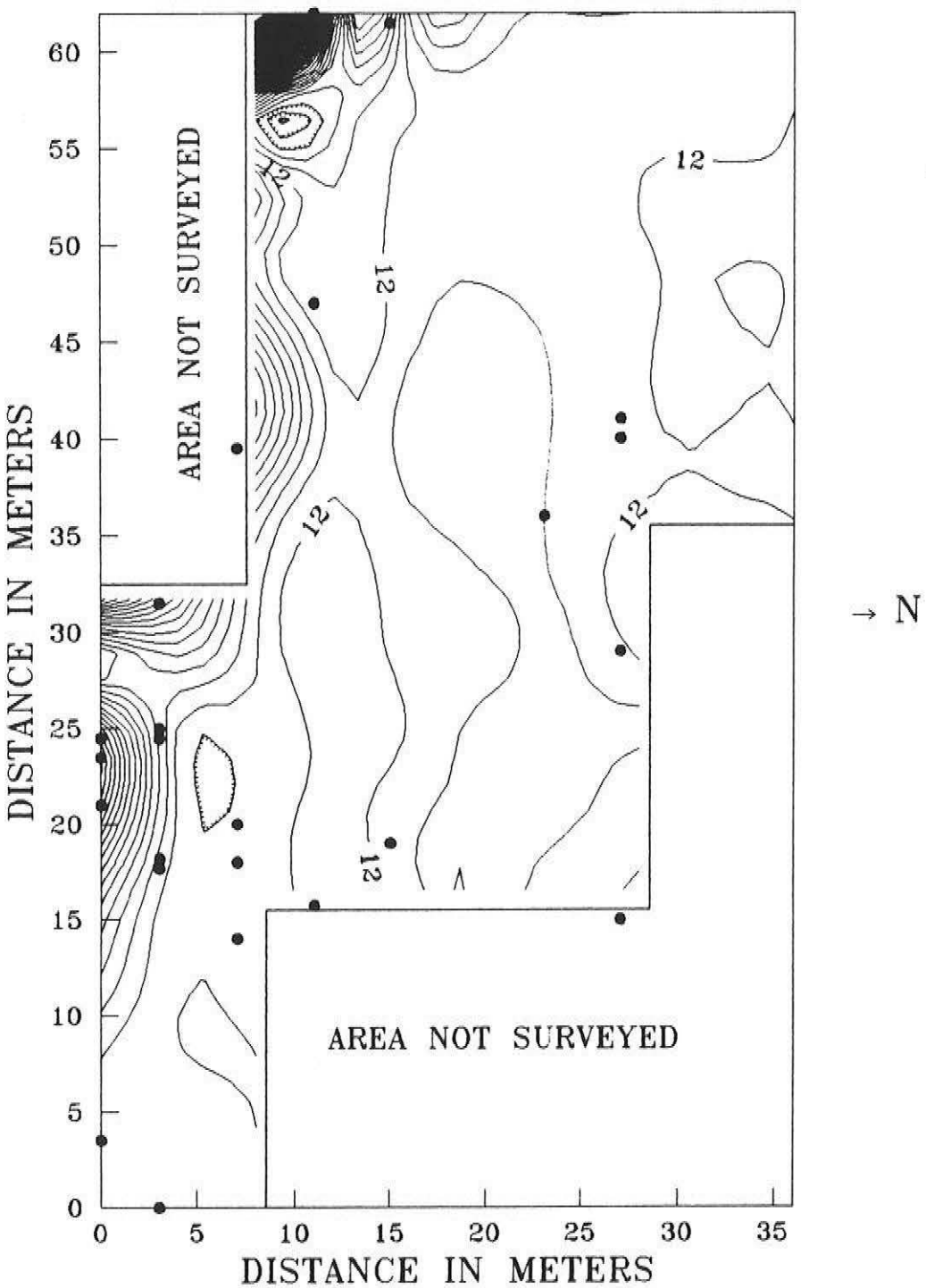
FIGURE 1

FORT ROBINSON, NEBRASKA

SITE OF WASHERY
EM31 SURVEY
HORIZONTAL DIPOLE



FORT ROBINSON, NEBRASKA

SITE OF WASHERY
EM31 SURVEY
VERTICAL DIPOLE

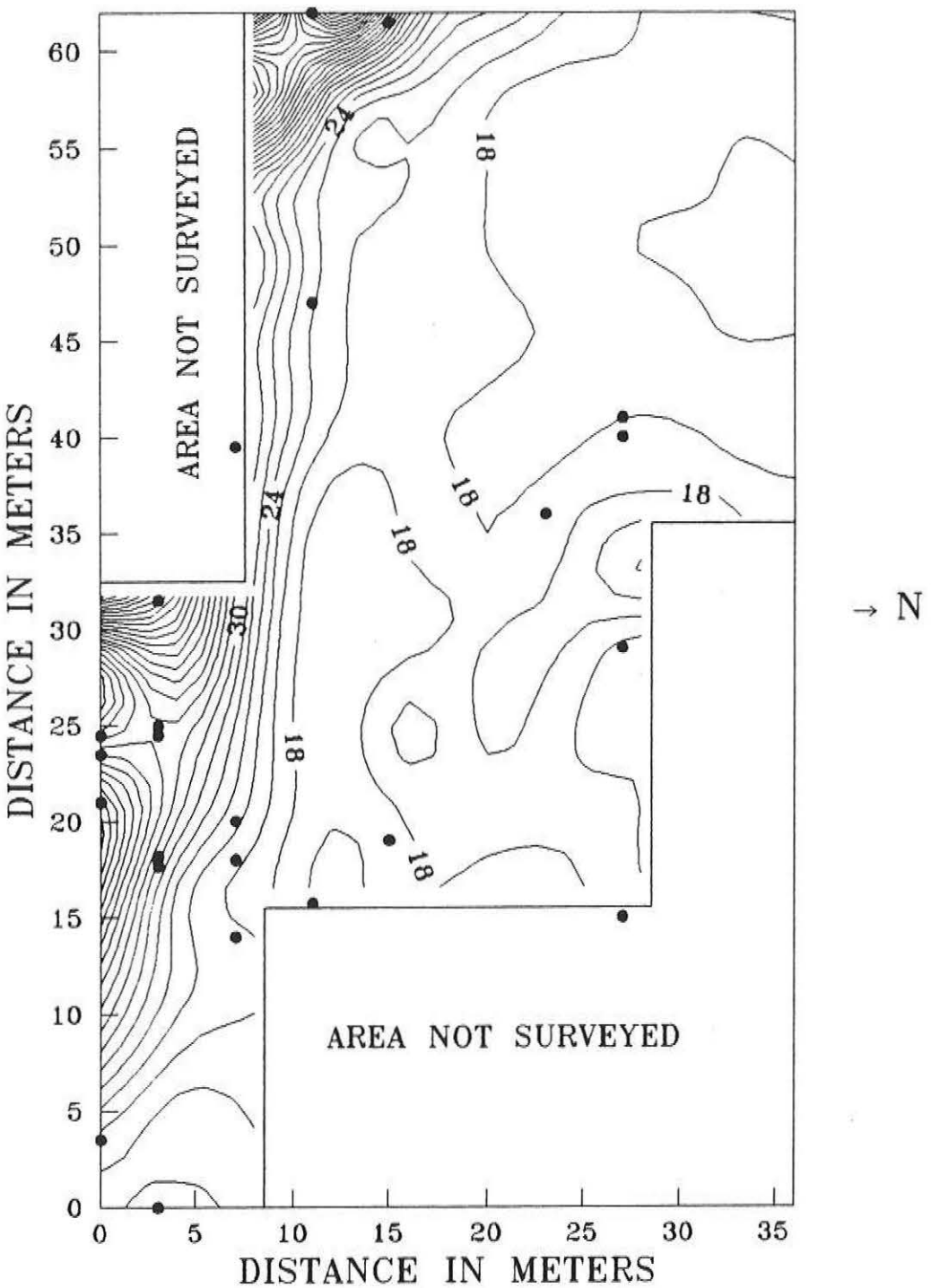


FIGURE 3

FORT ROBINSON, NEBRASKA

SOLDIER CREEK SITE
EM31 SURVEY
HORIZONTAL DIPOLE

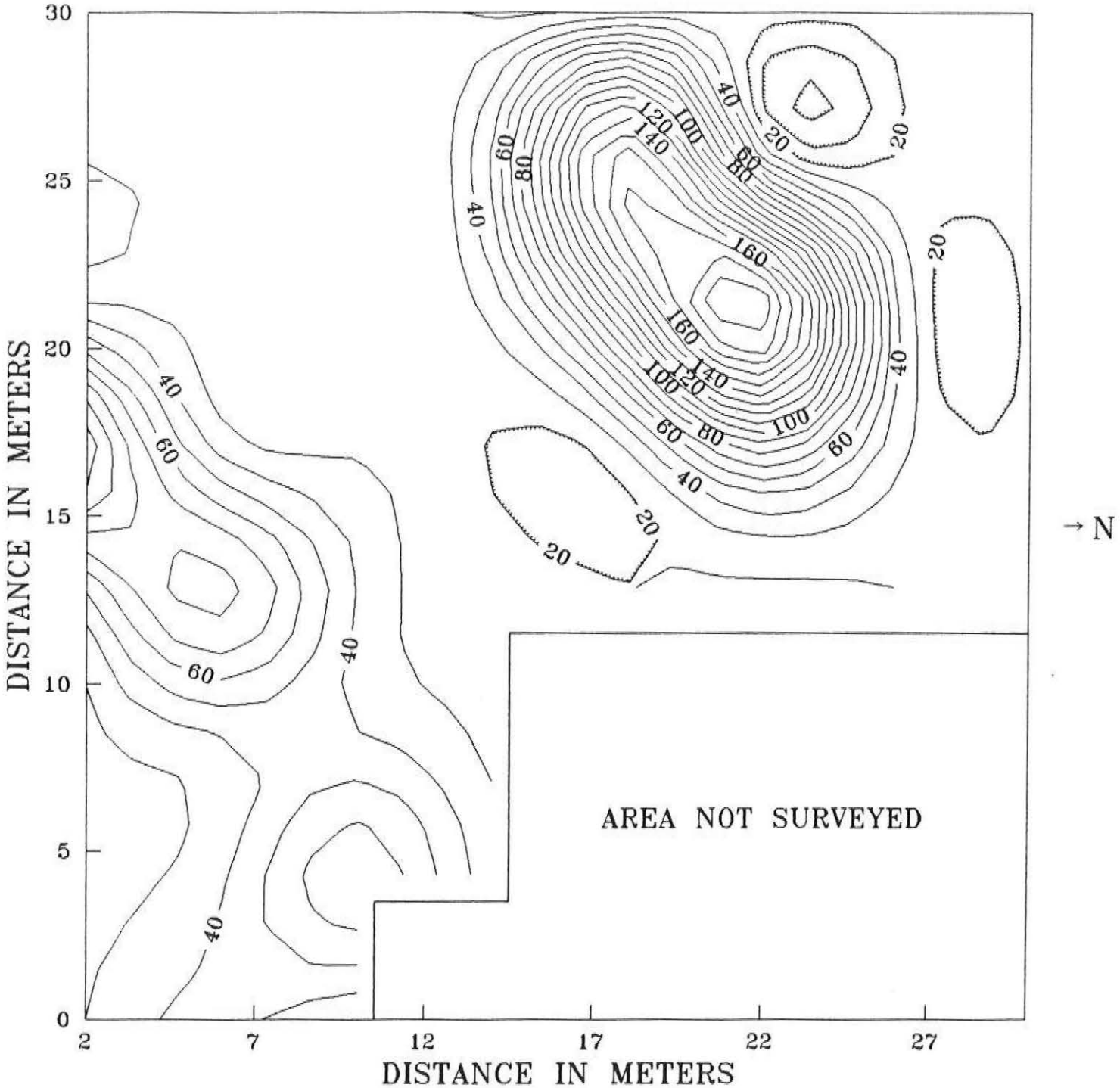
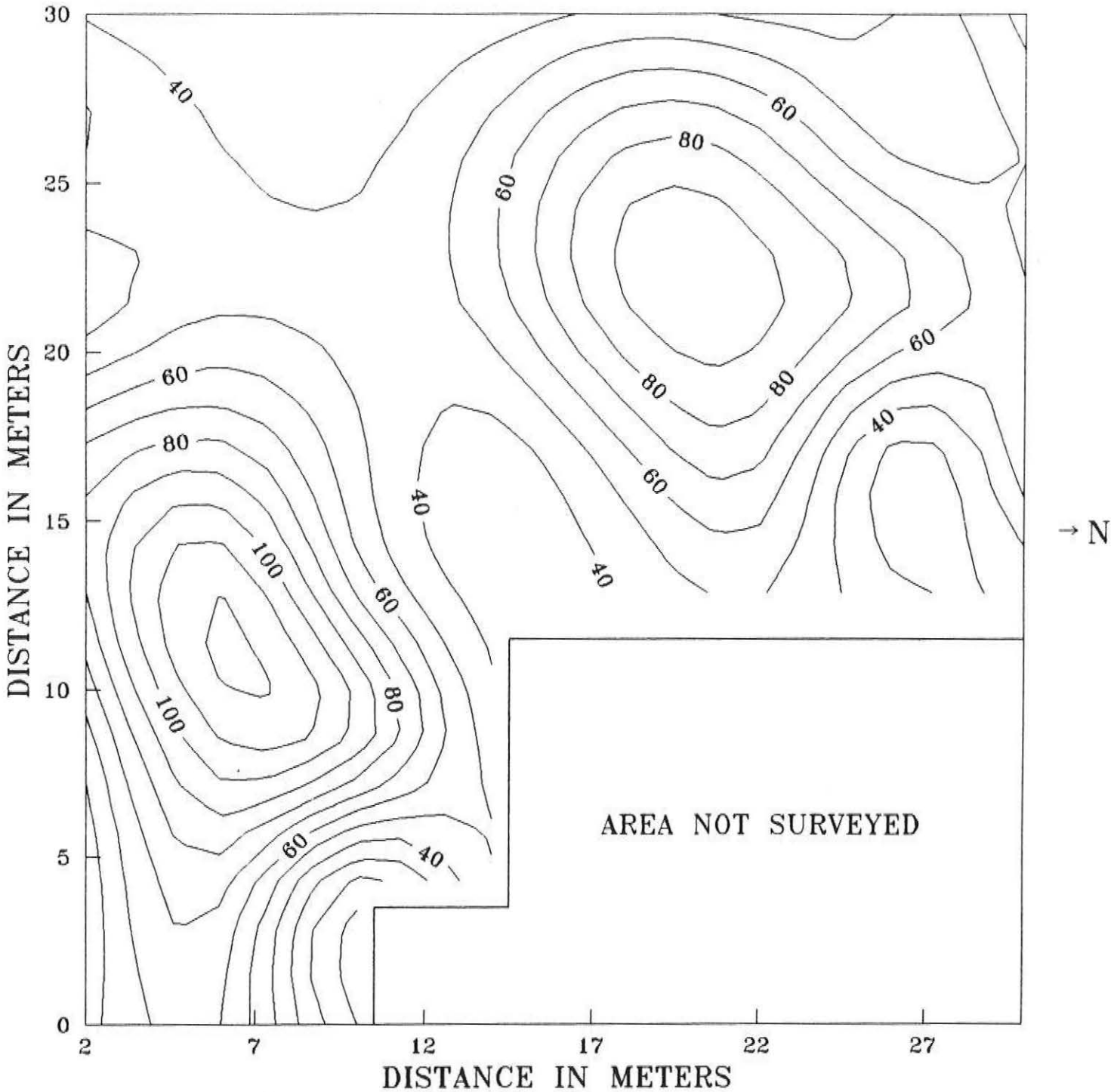


FIGURE 4

FORT ROBINSON, NEBRASKA

SOLDIER CREEK SITE
EM31 SURVEY
VERTICAL DIPOLE



FORT ROBINSON, NEBRASKA

SITE OF YATE'S TRADING POST
EM38 SURVEY
VERTICAL DIPOLE

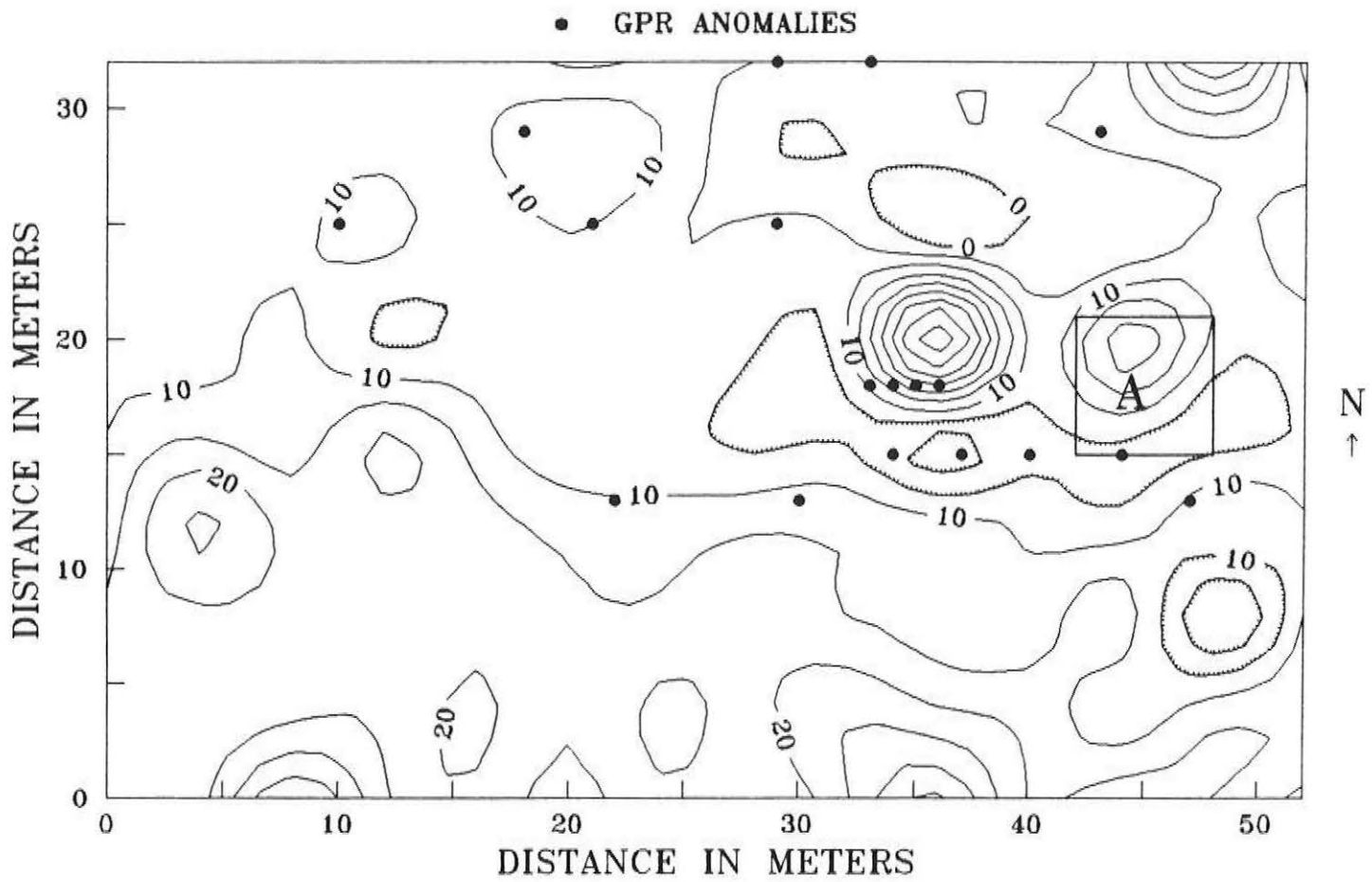


FIGURE 6

FORT ROBINSON, NEBRASKA

SITE OF YATE'S TRADING POST
EM31 SURVEY
HORIZONTAL DIPOLE

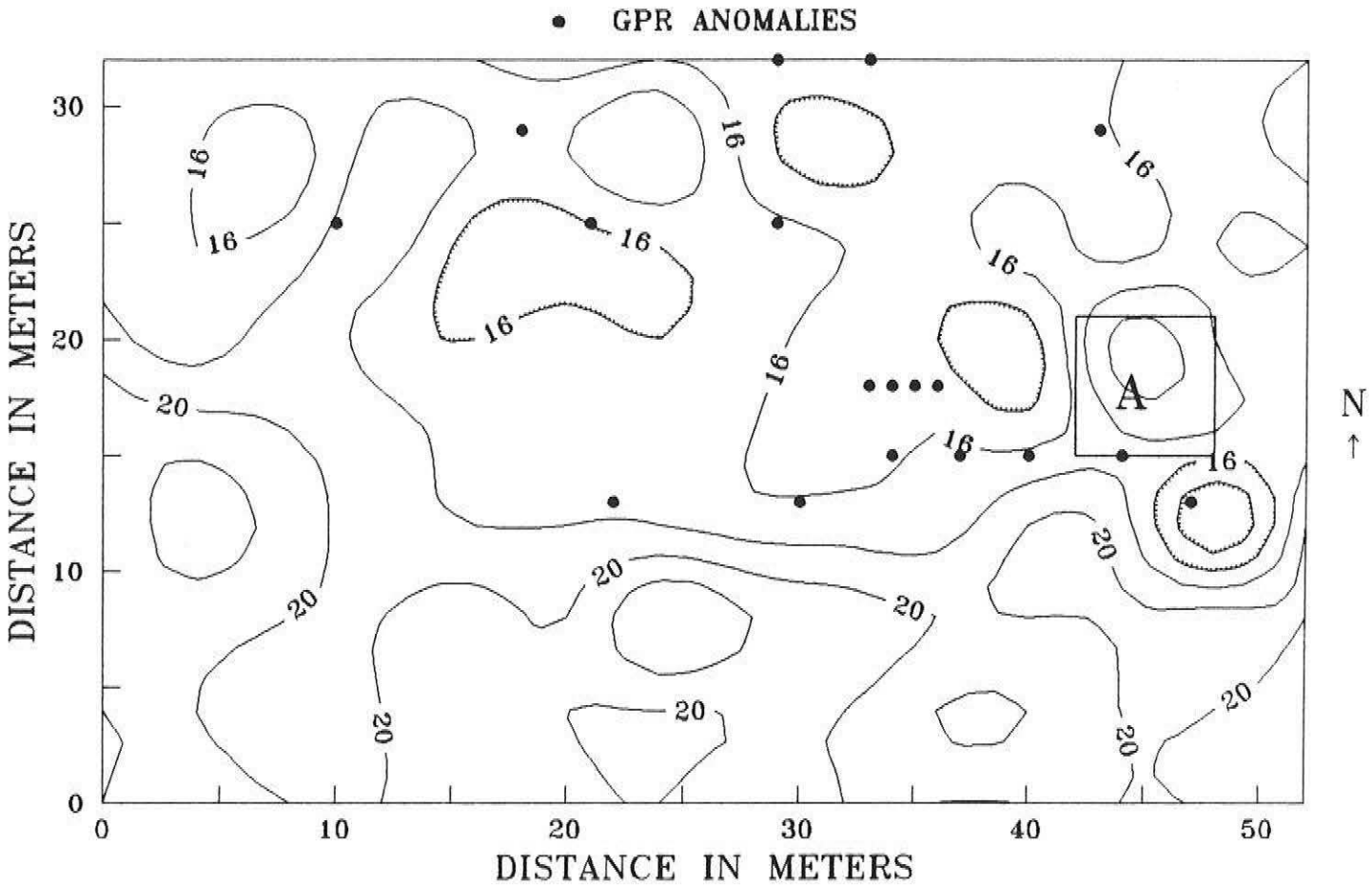


FIGURE 7

FORT ROBINSON, NEBRASKA

SITE OF YATE'S TRADING POST
EM31 SURVEY
VERTICAL DIPOLE

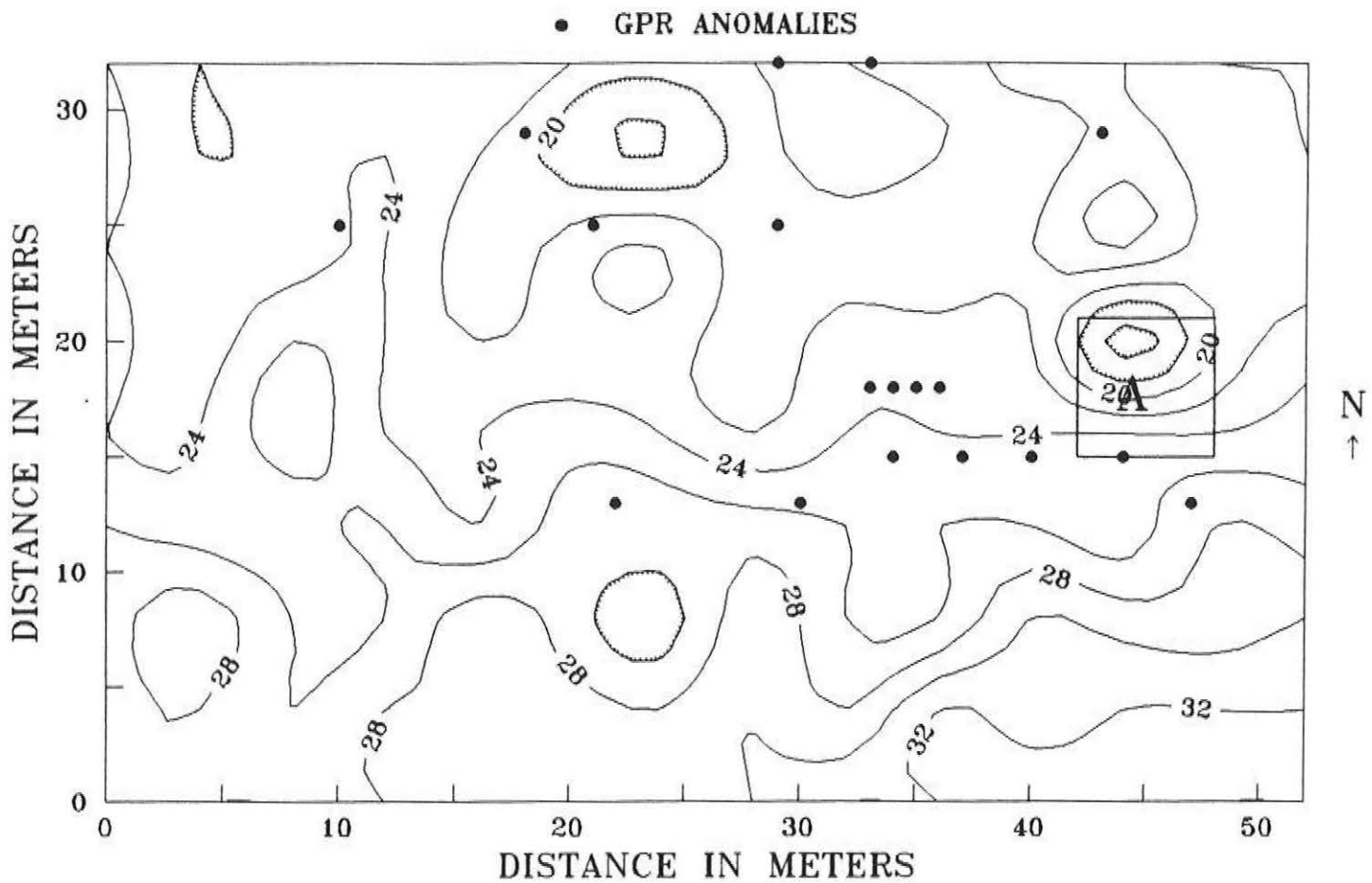
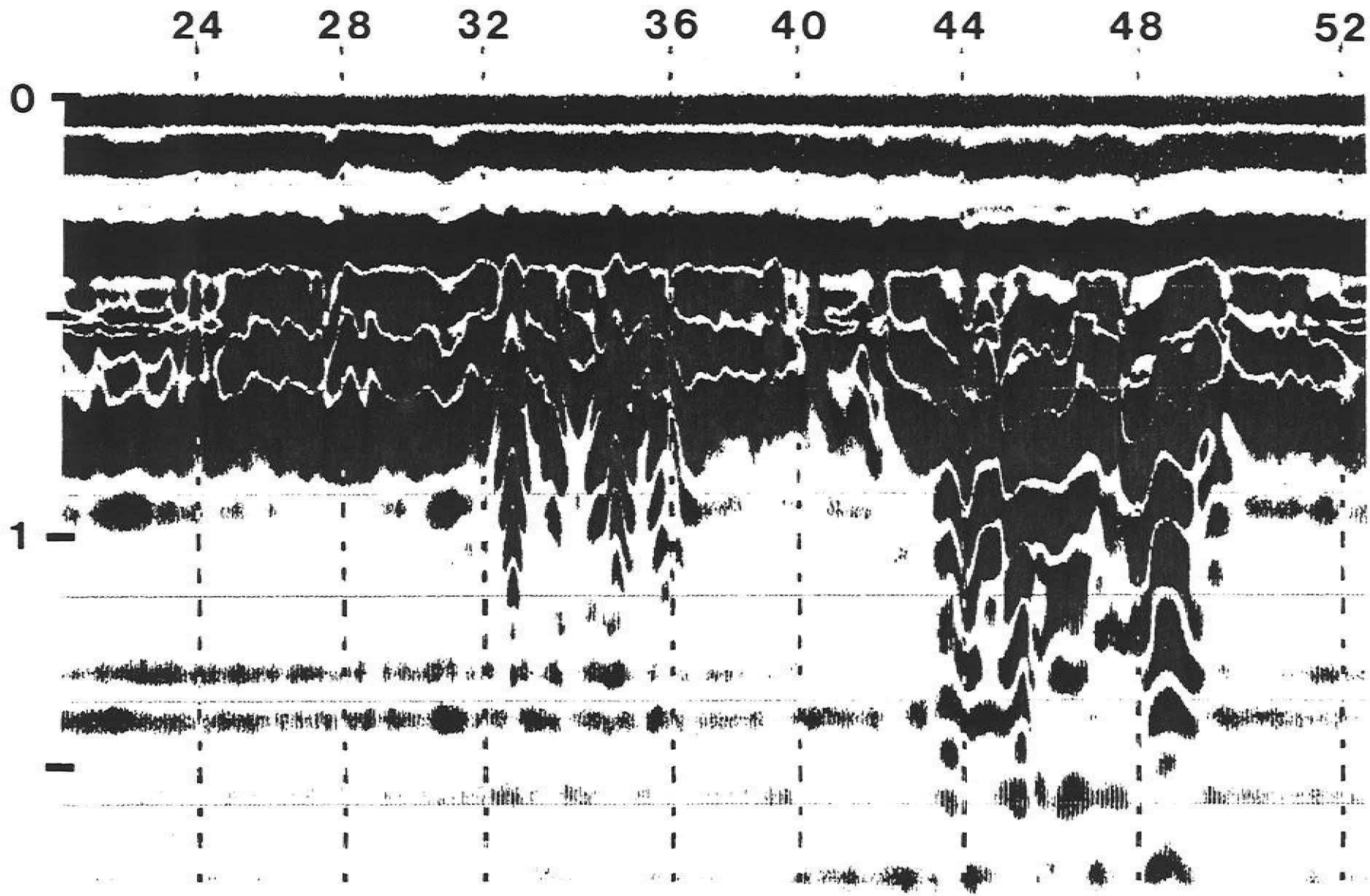


FIGURE 8



SITE OF YATE'S TRADING POST