**United States Department of Agriculture**
**Soil Conservation Service** **Chester, PA 19013**

**Subject:** Ground-Penetrating Radar (GPR) study of depth to paleosols in Reno County, Kansas; 20 to 30 June 1994. **Date:** 28 July 1994

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**Purpose:**
To use GPR and EM techniques to characterize depths to water table, lamellae and paleosols, and salt contents of selected soils and map units in Reno County, Kansas.

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**Activities:**
During this field study, about 24 miles of continuous radar data were collected. Traverses were completed with GPR in areas of Carwile (fine, mixed, thermic Typic Argiaquoll), Dillwyn (mixed, thermic Aquic Ustipsamment), Pratt (sandy, mixed, thermic Psammentic Haplustalf), and Tivoli (mixed, thermic Typic Ustipsamment) soils. Traverses were also conducted in areas of the proposed Dillhut (sandy over loamy, mixed, thermic Aquic Ustorthent), Hayes (coarse-loamy, mixed, thermic Udic Haplustalf) Langdon (mixed, thermic Argic Ustipsamment), Plev (sandy, mixed, thermic Mollic Endoaqualf), and Solvay (fine-loamy, mixed, thermic Aquic Haplustalf) soils. These traverses were conducted principally in the northeast and west portions of Reno County.

A detailed GPR and EM site investigation was completed in an area of Langdon-Tivoli fine sands, 0 to 15 percent slopes. Several transects and a detailed grid were completed with the EM38 meter in areas of Tabler (fine, montmorillonitic, thermic Udertic Argiustoll) and the proposed Punkin (fine, mixed, thermic Aquic Natrustoll) soils.

**Equipment:**
The radar unit used in this study was the Subsurface Interface Radar (SIR) System-8 manufactured by Geophysical Survey Systems, Inc+. The system was powered by a 12-volt vehicular battery. The model 3110 (120 mHz) antenna with model 705DA transceiver was used in the investigation.

The electromagnetic induction meter was the EM38, manufactured by Geonics Limited+. The meter is portable and requires only one person to operate. The depth of penetration is dependent upon the intercoil spacing, transmission frequency, and coil orientation relative to the ground surface. The EM38 meter integrates values of apparent conductivity over the upper 0.75 m in the horizontal dipole orientation, and over the upper 1.5 m in the vertical dipole orientation.

**Discussion:**
**Ground-Penetrating Radar Transects:**
Field Procedures:
All transects were conducted in areas that had been preselected by the survey party. Transects were confined to delineated areas of recognized soil map units. A 100 foot interval (paced) was used between observation points. Though GPR provides a continuous record of the subsurface, estimates of the depths to paleosols were restricted to the observation points.

Calibration trials consisted of multiple traverses conducted across site 1A (see Table 1). A scanning time of 80 nanoseconds (ns) was used. As part of the calibration trials, a metallic reflector was buried at a depth of 17 inches (43 cm). Based on the scaled depth to this reflector, the calculated dielectric constant was 9.9. The velocity of propagation was 0.312 ft/ns (0.095 m/ns). With a scanning time of 80 ns, the observation depth was about 12.5 feet (3.81 m).

The depth of observation ranged from about 17 to 150 inches. Because of the strong reflected signal from the soil surface, features within a depth of 17 inches of the soil surface were poorly or not resolved with the 120 mHz antenna. Because of the restricted scanning time, features at depths greater than 150 inches were beyond the maximum observation depth.

During the course of this study, at twenty-six observation sites, a soil auger was used to determine the depth to paleosol. This information was used to verify interpretations and to scale the radar profiles. The correlation between auger observations and scaled radar depths was exceptionally high. Based on 26 observations, the coefficient of determination ($r^2$) between the observed auger and the interpreted radar depths to the paleosol was 0.9593 (see Figure 1). The average difference in the depth to paleosol measurements between soil auger and radar measurements was 2.62 inches (with a range of 0 to 8 inches).

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+ Trade names have been used to provide specific information. Their mention does not constitute endorsement.

Ground-penetrating radar techniques are not appropriate for soil investigations in many areas of Reno County. This study was restricted to map units with components of coarse and moderately-coarse textured soils. However, in these units, depths of penetration were often restricted by thick bands of lamellae or layers of coarse-loamy or finer textured soil materials. In most areas of coarse-textured soil materials, GPR was a suitable investigation and research tool and provided adequate depths of penetration and good resolution of subsurface interfaces. However, in areas of coarse-textured materials, while the depth of observation and the resolution of subsurface features were good, the number and segmented nature of the subsurface layers plagued interpretations. To properly identify each layer, a prohibitive number of auger observations would have been required. One layer, the "paleosol", was distinct and recognizable in many areas and across most radar profiles.

The "paleosol" was defined as the lowest layer which limited the observation depth of the radar. Generally, this layer consisted of sandy loam or finer textured materials. Below this layer, no imagery was observed because of the high rates of signal attenuation. The paleosol appeared continuous on most radar profiles. However, in some areas, this layer was discontinuous. In addition, auger observations taken along the same transect line, confirmed that the texture of this layer can grade laterally.

The radar profiles contained numerous, segmented layers above the paleosols. These layers were assumed to represent stratified sand layers, buried A horizons, lamellae, or the water table. However, as ground-truth auger observations were limited, the identity of most of these layers could not be confirmed.

The map units, transect lengths, and locations are listed in Table 1. Ground-penetrating radar data were collected along eighty-five transect lines which ranged in length from 100 to 5400 feet. Several transects were omitted from this study because of limited profiling depths or the poor resolution of subsurface interfaces.

Results:

Transects were completed with the following map units: Ax - Hayes-Solvay complex, 0 to 5 percent slopes; Dp - Dillhut-Plev complex, 0 to 2 percent slopes; Ds - Dillhut-Solvay complex, 0 to 3 percent slopes; Dt - Dillwyn-Tivoli fine sands, 0 to 15 percent slopes; Pr - Pratt loamy fine sand, 1 to 5 percent slopes; Pt - Turon-Solvay-Carwile complex, 0 to 5 percent slopes; Px - Langdon-Tivoli fine sands, 0 to 15 percent slopes; and Tf - Tivoli fine sand 10 to 30 percent slopes. Table 2 summarizes the transect data for each map unit. Data from each transect are listed in the Addendum to this report.

Table 2 conveys comparative information but the use of averages and ranges is statistically inappropriate. The use of these statistics is incorrect as the minimum and maximum observation depths were 17 and 150 inches, respectively. Regardless of actual depths, because of the limitations of the equipment and the constraints of the survey, paleosols occurring at depths of less than 17 inches or greater than 150 inches were recorded as 17 and 150 inches, respectively.

In areas of the Hayes-Solvay complex, 0 to 5 percent slopes (map unit Ax), the average depth to the paleosol was 38.7 inches. One-half the observations had depths to paleosol between 33 and 42 inches. In the transected area of this map unit, depths to the paleosol were shallow

**Table 1**

**LOCATION OF GPR TRANSECTS**

| Number | Symbol | Length (feet) | Location |
|---|---|---|---|
| 1A | DT | 900 | SW1/4 SEC 11, T. 22 S., R. 6 W. |
| 1 | DP | 1700 | SW1/4 SEC 11, T. 22 S., R. 6 W. |
| 2 | DT | 1100 | S 1/2 SEC 11, T. 22 S., R. 6 W. |
| 3 | DT | 1200 | S 1/2 SEC 11, T. 22 S., R. 6 W. |
| 4 | TF | 300 | SE1/4 SEC 11, T. 22 S., R. 6 W. |
| 5 | DT | 600 | SE1/4 SEC 11, T. 22 S., R. 6 W. |
| 6 | DP | 600 | SE1/4 SEC 11, T. 22 S., R. 6 W. |
| 7 | DP | 2400 | SE1/4 SEC 5, T. 22 S., R. 5 W. |
| 8 | PR | 100 | SE1/4 SEC 5, T. 22 S., R. 5 W. |
| 9 | DP | 2600 | SE1/4 SEC 5, T. 22 S., R. 5 W. |
| 10 | DT | 2500 | NW1/4 SEC 5, T. 22 S., R. 5 W. |
| 11 | DS | 2600 | SW1/4 SEC 10, T. 22 S., R. 6 W. |
| 12 | PR | 2500 | S 1/2 SEC 15, T. 22 S., R. 5 W. |
| 13 | DT | 2600 | NW1/4 SEC 14, T. 22 S., R. 5 W. |
| 14 | DT | 2100 | SW1/4 SEC 13, T. 22 S., R. 5 W. |
| 15 | DT | 2800 | S 1/2 SEC 13, T. 22 S., R. 5 W. |
| 16 | PR | 800 | NW1/4 SEC 19, T. 22 S., R. 5 W. |
| 17 | DT | 1900 | NW1/4 SEC 19, T. 22 S., R. 5 W. |
| 18 | DT | 3100 | NE1/4 SEC 19, T. 22 S., R. 5 W. |
| 19 | TF | 200 | SW1/4 SEC 21, T. 22 S., R. 5 W. |
| 20 | DT | 1000 | SW1/4 SEC 21, T. 22 S., R. 5 W. |
| 21 | DP | 1200 | SW1/4 SEC 21, T. 22 S., R. 5 W. |
| 22 | DT | 700 | SW1/4 SEC 21, T. 22 S., R. 5 W. |
| 23 | DP | 400 | NE1/4 SEC 21, T. 22 S., R. 5 W. |
| 24 | TF | 400 | NE1/4 SEC 21, T. 22 S., R. 5 W. |
| 25 | DT | 300 | SW1/4 SEC 22, T. 22 S., R. 5 W. |
| 26 | DS | 1000 | SE1/4 SEC 22, T. 22 S., R. 5 W. |
| 27 | DT | 900 | SE1/4 SEC 22, T. 22 S., R. 5 W. |
| 28 | TF | 300 | SE1/4 SEC 22, T. 22 S., R. 5 W. |
| 29 | DS | 200 | SE1/4 SEC 22, T. 22 S., R. 5 W. |
| 30 | TF | 100 | SE1/4 SEC 22, T. 22 S., R. 5 W. |
| 31 | DS | 100 | SE1/4 SEC 22, T. 22 S., R. 5 W. |
| 32 | DP | 1300 | SW1/4 SEC 19, T. 22 S., R. 4 W. |
| 33 | PR | 300 | SW1/4 SEC 19, T. 22 S., R. 4 W. |
| 34 | DS | 400 | SW1/4 SEC 19, T. 22 S., R. 4 W. |
| 35 | DS | 1100 | SE1/4 SEC 24, T. 22 S., R. 5 W. |
| 36 | DT | 1200 | SE1/4 SEC 24, T. 22 S., R. 5 W. |
| 37 | DS* | 1600 | SW1/4 SEC 24, T. 22 S., R. 5 W. |
| 38 | DS | 1200 | SW1/4 SEC 30, T. 22 S., R. 4 W. |
| 39 | PT | 2000 | SE1/4 SEC 30, T. 22 S., R. 4 W. |
| 40 | DS | 1100 | SW1/4 SEC 28, T. 22 S., R. 4 W. |
| 41 | DS | 1200 | NW1/4 SEC 1, T. 23 S., R. 4 W. |

* May contain more than one map unit.

**Table 1 (continued)**

**LOCATION OF GPR TRANSECTS**

| Number | Symbol | Length (feet) | Location |
|---|---|---|---|
| 42 | DT | 1100 | NW1/4 SEC 1, T. 23 S., R. 4 W. |
| 43 | DS | 1700 | NE1/4 SEC 1, T. 23 S., R. 4 W. |
| 44 | DS | 1500 | NE1/4 SEC 11, T. 23 S., R. 4 W. |
| 45 | DT | 4800 | S 1/2 SEC 11, T. 23 S., R. 4 W. |
| 46 | DS | 1500 | NE1/4 SEC 14, T. 23 S., R. 4 W. |
| 47 | DS | 2300 | NE1/4 SEC 13, T. 23 S., R. 4 W. |
| 48 | DT | 3600 | N 1/2 SEC 7, T. 23 S., R. 4 W. |
| 49 | DT | 800 | SW1/4 SEC 1, T. 23 S., R. 5 W. |
| 50 | DS | 900 | SW1/4 SEC 1, T. 23 S., R. 5 W. |
| 51 | DT | 1600 | SW1/4 SEC 1, T. 23 S., R. 5 W. |
| 52 | TF | 1400 | SW1/4 SEC 1, T. 23 S., R. 5 W. |
| 53 | DS | 1000 | NW1/4 SEC 4, T. 23 S., R. 4 W. |
| 54 | DT | 1300 | NE1/4 SEC 4, T. 23 S., R. 4 W. |
| 55 | DT | 1500 | SW1/4 SEC 9, T. 23 S., R. 4 W. |
| 56 | TF | 800 | SW1/4 SEC 9, T. 23 S., R. 4 W. |
| 57 | DT | 1100 | SW1/4 SEC 9, T. 23 S., R. 4 W. |
| 58 | DS | 2700 | NE1/4 SEC 17, T. 23 S., R. 4 W. |
| 59 | DS | 1700 | SW1/4 SEC 17, T. 23 S., R. 4 W. |
| 60 | DS | 3400 | SE1/4 SEC 18, T. 23 S., R. 4 W. |
| 61 | DS* | 3900 | S 1/2 SEC 20, T. 22 S., R. 10 W. |
| 62 | DT | 5400 | S 1/2 SEC 21, T. 22 S., R. 10 W. |
| 63 | DT | 1600 | SW1/4 SEC 8, T. 22 S., R. 10 W. |
| 64 | DS | 1200 | SE1/4 SEC 8, T. 22 S., R. 10 W. |
| 65 | TF | 1500 | SE1/4 SEC 8, T. 22 S., R. 10 W. |
| 66 | DS | 1400 | SW1/4 SEC 5, T. 22 S., R. 10 W. |
| 67 | DT | 500 | SW1/4 SEC 5, T. 22 S., R. 10 W. |
| 68 | DT | 1400 | NE1/4 SEC 5, T. 22 S., R. 10 W. |
| 69 | TF | 500 | NE1/4 SEC 5, T. 22 S., R. 10 W. |
| 70 | DS | 1000 | NE1/4 SEC 5, T. 22 S., R. 10 W. |
| 71 | DT | 800 | NE1/4 SEC 5, T. 22 S., R. 10 W. |
| 72 | DS | 300 | NE1/4 SEC 5, T. 22 S., R. 10 W. |
| 73 | DT | 1300 | NE1/4 SEC 5, T. 22 S., R. 10 W. |
| 74 | PX | 3900 | N 1/2 SEC 8, T. 24 S., R. 10 W. |
| 75 | PR | 500 | NW1/4 SEC 8, T. 24 S., R. 10 W. |
| 76 | PX | 300 | NE1/4 SEC 3, T. 24 S., R. 9 W. |
| 77 | PT | 1100 | NE1/4 SEC 3, T. 24 S., R. 9 W. |
| 78 | PX | 600 | NE1/4 SEC 3, T. 24 S., R. 9 W. |
| 79 | PT | 1200 | N 1/2 SEC 3, T. 24 S., R. 9 W. |
| 80 | AX | 1400 | NW1/4 SEC 3, T. 24 S., R. 9 W. |
| 81 | PX | 2400 | NW1/4 SEC 11, T. 24 S., R. 9 W. |
| 82 | PX | 2100 | N 1/2 SEC 7, T. 25 S., R. 9 W. |
| 83 | PX | 1900 | NE1/4 SEC 13, T. 25 S., R. 9 W. |
| 84 | PX | 3400 | N 1/2 SEC 13, T. 25 S., R. 10 W. |
| 85 | PX | 1200 | SW1/4 SEC 10, T. 25 S., R. 10 W. |

at 7 percent, moderately deep at 67 percent, deep at 20 percent, and very deep at 6 percent of the observation points (see Figure 2, upper).

In areas of the Dillhut-Plev complex, 0 to 2 percent slopes (map unit Dp), the average depth to the paleosol was 28.9 inches. One-half the observations had depths to paleosol between 17 and 34 inches. In the transected area of this map unit, depths to the paleosol were shallow at 52 percent, moderately deep at 30 percent, deep at 11 percent, and very deep at 7 percent of the observation points (see Figure 2, lower).

**Table 2**

**GPR TRANSECTS**

| | | | | Depth to Paleosol (in inches) | | |
|---|---|---|---|---|---|---|
| **Map Unit** | **Number** | **Observations** | **Length(ft)** | **Min.** | **Max.** | **Avg.** |
| Ax | 1 | 15 | 1400 | 17 | 91 | 38.7 |
| Dp | 6 | 102 | 9600 | 13 | 136 | 28.9 |
| Ds | 24 | 374 | 35000 | 17 | 150 | 45.3 |
| Dt | 30 | 531 | 49000 | 17 | 150 | 64.3 |
| Pr | 5 | 47 | 4200 | 15 | 76 | 38.9 |
| Pt | 3 | 46 | 4300 | 17 | 65 | 31.0 |
| Px | 8 | 165 | 15700 | 17 | 150 | 49.8 |
| Tf | 7 | 57 | 5000 | 17 | 150 | 87.5 |

In areas of the Dillhut-Solvay complex, 0 to 3 percent slopes (map unit Ds), the average depth to the paleosol was 45.3 inches. One-half the observations had depths to paleosol between 22 and 62 inches. In the transected area of this map unit, depths to the paleosol were shallow at 21 percent, moderately deep at 37 percent, deep at 16 percent, and very deep at 26 percent of the observation points (see Figure 3, upper).

In areas of the Dillwyn-Tivoli fine sands, 0 to 15 percent slopes (map unit Dt), the average depth to the paleosol was 64.3 inches. One-half the observations had depths to paleosol between 29 and 86 inches. In the transected area of this map unit, depths to paleosol were shallow at 14 percent, moderately deep at 23 percent, deep at 17 percent, and very deep at 46 percent of the observation points (see Figure 3, lower).

In areas of Pratt loamy fine sand, 1 to 5 percent slopes (map unit Pr), the average depth to the paleosol was 38.9 inches. One-half the observations had depths to paleosol between 26 and 51 inches. In the transected area of this map unit, depths to paleosol were shallow at 17 percent, moderately deep at 43 percent, deep at 26 percent, and very deep at 14 percent of the observation points (see Figure 4, upper).

In areas of the Turon-Solvay-Carwile complex, 0 to 5 percent slopes (map unit Pt), the average depth to the paleosol was 31.0 inches. One-half the observations had depths to paleosol between 17 and 38 inches. In the transected area of this map unit, depths to paleosol were shallow at 33 percent, moderately deep at 43 percent, deep at 20 percent, and very deep at 4 percent of the observation points (see Figure 4, lower).

In areas of Langdon-Tivoli fine sands, 0 to 15 percent slopes (map unit Px), the average depth to the paleosol was 49.8 inches. One-half the observations had depths to paleosol between 17 and 64 inches. In the transected area of this map unit, depths to paleosol were shallow at 27 percent, moderately deep at 22 percent, deep at 22 percent, and very deep at 29 percent of the observation points (see Figure 5, upper).

In areas of the Tivoli fine sand, 10 to 30 percent slopes (map unit Tf), the average depth to the paleosol was 87.5 inches. One-half the observations had depths to paleosol between 55 and 123 inches. In the transected area of this map unit, depths to paleosol were shallow at 2 percent, moderately deep at 12 percent, deep at 14 percent, and very deep at 72 percent of the observation points (see Figure 5, lower).

## Systematic Sampling with EM Techniques

Introduction:

One of the most common uses for electromagnetic induction (EM) techniques has been to assess soil salinity (2, 3, 4, 5, 16, 17, 19) and sodicity (1). These techniques, however, have also been used to map bedrock surfaces (21), glacial deposits (20, 15), and permafrost (18, 9); estimate thicknesses of clays (14) or sand and gravel deposits (13); measure soil water content (11); and evaluate edaphic properties important to forest site productivity (12). These studies have documented some of the advantages of using EM interpretations and its applications over broad areas and soil types.

Electromagnetic induction techniques are a non-invasive geophysical method in which electromagnetic energy is used to measure the apparent conductivity of earthen materials. Apparent conductivity is the weighted average conductivity measurement for a column of earthen materials to a specified investigation depth (6). The averages are weighted according to the depth response function of the meter (19). Values of apparent conductivity are expressed in milliSiemens per meter (mS/m).

Apparent conductivity values are seldom diagnostic in themselves. However, lateral and vertical variations in these measurements can be used to infer changes in soils and soil properties. Electromagnetic responses are dependent on soil properties. Variations in electromagnetic responses are produced by changes in soil moisture, salt content, texture, and mineralogy (2). In nonsaline areas, soil texture, mineralogy, and moisture are the principal factors determining apparent conductivity (11). Each of these factors will affect the apparent conductivity of soils.

Soils and soil map units can be differentiated by characteristic ranges of apparent conductivity (7, 8). As EM measurements integrate several soil properties, responses can be correlated within geographic areas to soil types. Generally, in geophysical research, the term "soil type" has been used to refer to the particle-size class of unconsolidated sediments. Zalasiewicz and Mathers (20) used

EM techniques to map glacial sediments and distinguish areas of bouldery clays from arenaceous deposits. Sartorelli and French (18) defined grouping of the Unified Soil Classification System based on characteristic apparent conductivity values. Kingston (10) used EM techniques to distinguish and map soil and geologic deposits and strata. In these studies different "soil types" and lithologies induced distinct and characteristic EM responses.

Electromagnetic induction is an imperfect geophysical tool and is not equally suitable for use in all soil investigations. The success of an EM survey depends on the nature and variability of soil properties. This method has been most effective in areas where subsurface soil properties are fairly homogeneous, the effects of one factor dominants over the others, and variations in the EM response can be related to changes in a single factor (e.g. volumetric moisture, soluble salt content, clay content, soil depth, or mineralogy).

Each soil will have a characteristic EM response. For a particular soil, the EM response will constitute a range of values which will be influenced by temporal variations in soil moisture and temperature. Furthermore, cultural and natural features can be expected to influence these ranges. Similar soils will have a similar range in EM responses. Within a given geographic area, the conductivities of some soils will overlap. Soil properties and types can be inferred with EM techniques provided one is cognizant of changes in parent materials, drainage, topography, and vegetation.

*Area of Langdon-Tivoli fine sands, 0 to 15 percent slopes.*

Study Area:

The study site consisted of 3.2 acres of rangeland in southwestern Reno County, Kansas. Relief was about 10.6 feet. The area consists of several low mounds and ridges of windblown sands. Most areas are nearly level to rolling. The study site was bounded on the south by a fence line and road.

The topography of study site has been simulated in Figures 6 and 7. Figure 6 is a two-dimensional contour plot and Figure 7 is a three-dimensional surface net diagram of the ground surface. In Figure 6, the contour interval is 1.0 foot. The line of spot symbols appearing in Figure 6 represents the location of a radar traverse. In Figure 7, the vertical exaggeration is 10.

The study sites contains an intricate pattern of soils. Soils identified within the study site include Langdon (mixed, thermic Argic Ustipsamment), Tivoli (mixed, thermic Typic Ustipsamment), and Turon (sandy, mixed, thermic Psammentic Haplustalf).

Within the study site, at the time of this investigation, it was presumed that variations in the electromagnetic response would be directly related to changes in the depth to paleosol or lamellae. It was assumed that EM responses would be lower in areas of Tivoli and Langdon soils than in areas of Turon soil. In areas of soils with similar particle-size distributions, variations in the EM response would be highly influenced by differences in the volumetric moisture contents, and the presence, thickness, and arrangement of lamellae and soil horizons.

Field Methods:
A 400 by 350 foot rectangular grid was established across the study site. Survey flags were inserted in the ground at 50 foot intervals. At each of the 72 grid intersections, measurements were obtained with an EM38 meter in both the horizontal and vertical dipole orientations.

A transit was used to establish grid lines and determine the surface elevation of each grid intersection. Elevations were not tied to a benchmark; the lowest recorded surface point was chosen as the 0.0 foot datum.

Results:
Electromagnetic induction methods focuses on the rate and magnitude of change in EM response from place to place. Isarithmic maps prepared from EM data provide a graphic description of variations in soils and/or soil properties within a survey site.

Figures 8 and 9 represent two-dimensional isarithmic maps prepared from data collected with the EM38 meter in the horizontal and the vertical dipole orientations, respectively. The horizontal measurements integrates electromagnetic conductivity within the 0 to 0.75 m; the vertical measurements integrates values within the 0 to 1.5 m. At all observation points, values of apparent conductivity increased with increasing depth (horizontal dipole measurements < vertical dipole orientation). This relationship was believed to reflect increasing clay and volumetric moisture content with increasing soil depth.

Values of apparent conductivity were highest in the swales. These areas were inferred to have soils with higher clay contents (shallower depths to paleosol) and/or greater volumetric moisture contents. Values of apparent conductivity were lowest on the summits of dunes were the clay and volumetric moisture contents were lower. Intermediate values occurred on sideslopes.

A preliminary assessment of EM values was made in the field for the purpose of locating sampling sites. Based on this assessment, 5 observation points were selected and described. Table 3 list the soils and their averaged apparent conductivity values. Some soils can be differentiated by a characteristic range of apparent conductivity values. In Table 3, each soil appears to have a fairly unique EM response.

**Table 3**

**EM38 TRANSECT DATA**
**AVERAGE APPARENT CONDUCTIVITY**
(in mS/m)

| Soil | # Observations | EMH | EMV |
|---|---|---|---|
| Langdon | 1 | 4.0 | 7.0 |
| Tivoli | 2 | 2.0 | 5.0 |
| Turon | 2 | 7.5 | 15.0 |

Using EM responses, the distribution of soils described at the five observation points was extended to other portions of the survey site.

Measurements taken with the EM38 meter in the vertical dipole orientation were used to prepare a soil map (Figure 10). Observation points with low (< 6 mS/m), intermediate (6 to 11 mS/m), and high (>11 mS/m) EM responses were identified as Tivoli, Langdon, and Turon soils, respectively.

A radar traverse was completed along the grid line identified by the spot symbols in figures 6, 8, and 9. The enclosed radar profile is from this grid line. It has been processed through RADAN software. The profile has been normalized, terrain corrected, and the color tables and values have been transformed.

The numbers appearing at the top of the radar profile represent distances (in feet) and grid intersections. A paleosol (P) is evident beneath the dune in the left-hand portion of the radar profile. This layer varies in depth from about 3.0 feet in a swale near the 400 foot mark to about 7.5 feet on the summit of the dune near the 300 foot mark. Depths to this interface are moderately deep between the 150 and 50 foot marks. The strong and reverberated signals beneath "M" in the left-hand portion of the radar profile were produced by a buried metallic object.

*Area of Tabler-Punkin complex.*

Survey Area:
The study site consisted of about 3.6 acres of cropland in northeastern Reno County, Kansas. Relief was about 1.4 feet. The study site was bounded on the north by a road. Tabler is a member of the fine, montmorillonitic, thermic Udertic Argiustoll family. The proposed Punkin soil is a member of the fine, mixed, thermic Aquic Natrustoll family.

Field Methods:
A 350 by 450 foot rectangular grid was established across the study site. Survey flags were inserted in the ground at 50 foot intervals. At each of the 80 grid intersections, measurements were obtained with an EM38 meter in both the horizontal and vertical dipole orientations.

A transit was used to establish grid lines and determine surface elevations at each grid intersect. Elevations were not tied to a benchmark; the lowest recorded surface point was chosen as the 0.0 foot datum.

Results:
The topography of study site has been simulated in Figures 11 and 12. Figure 11 is a two-dimensional contour plot and Figure 12 is a three-dimensional surface net diagram of the ground surface. In Figure 11, the contour interval is 0.2 foot. In Figure 12, the vertical exaggeration is 20. This scale and vertical exaggeration were needed to express an old field-boundary line in the south-central portion of the study area.

Figures 13 and 14 represent two dimensional plots of apparent conductivity values collected in the horizontal and vertical dipole orientations, respectively. In each figure, the interval is 10 mS/m.

For all but five observation points, EM response increased with increasing soil depth (response in the vertical greater than in the conductive materials (i.e. greater clay, soluble salt, and/or water contents) with increasing soil depth. The reverse relationship at several observation points was attributed to high concentrations of soluble salts near the soil surface.

In both plots, EM responses appear to be highly variable across the site. Responses decreased toward the right-hand margin of each plot indicating a probable reduction in the amount of soluble salts and a change in soil type. In addition, in both plots, a noticeable linear pattern extends across the site from the northwest to the southeast corners. This feature may reflect a buried fluvial feature which exerts control over the soils.

Electromagnetic responses were relatively high across this site. Based on 80 observations, the average apparent conductivity was 103 mS/m, with a range of 27 to 180 mS/m in the horizontal mode. One-half of the observations collected in the horizontal dipole orientation had apparent conductivity values between 72 and 129 mS/m. The average apparent conductivity was 127 mS/m, with a range of 42 to 211 mS/m in the vertical mode. One-half of the observations collected in the vertical dipole orientation had apparent conductivity values between 96 and 158 mS/m.

**Conclusions:**

1. Ground-penetrating radar techniques are not appropriate for use in many soils of Reno County. Depths of penetration were restricted by thick bands of lamellae or layers of coarse-loamy or finer textured soil materials. In areas of coarse-textured soil materials, GPR was a suitable tool and provided adequate depths of penetration and good resolution of subsurface interfaces. However, in many areas of coarse-textured materials, while the depth of observation and resolution of GPR was good, the large number and segmented nature of subsurface layers plagued interpretations. To properly identify each layer, a prohibitive number of auger observations would have been required. One layer, the "paleosol", was distinct and recognizable across most radar profiles. Ground-penetrating radar techniques were used to characterize the depth to "paleosols" across extensive areas and several map units.

2. Continuous or discrete sampling with EM meters along transect lines can be used to detect variations in soils and soil properties. This tool can be used to provide objective description of soils, evaluate "modal" soil conditions, locate some map unit boundaries, and identify sites for more detailed observations. In Reno County, the EM38 meter appears to be a useful tool for assessing sodium-affected soils and map units. All participants received training and exposure to the uses of the EM38 meter. The NSSC has loaned an EM38 meter (serial number 8906008) to the survey party for the period of 1 August to 1 November 1994.

3. Isarithmic maps prepared from EM data can provide a graphic description of variations in soils and/or soil properties within selected map units. I encourage the soil survey party to avail themselves to these techniques.

It was my pleasure to work with and assist the soil scientists of Reno County.

With kind regards

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## ADDENDUM

**Transect data on the depth to paleosol collected with GPR in Reno County, Kansas:**

**TRANSECT 1A**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 79" |
| 100 | 79 |
| 200 | 74 |
| 300 | 68 |
| 400 | 56 |
| 500 | 57 |
| 600 | 28 |
| 700 | 29 |
| 800 | 28 |
| 900 | 29 |

**TRANSECT 1**
**MU: DP**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 54" |
| 100 | 58 |
| 200 | 57 |
| 300 | 44 |
| 400 | 62 |
| 500 | 57 |
| 600 | 40 |
| 700 | 37 |
| 800 | 46 |
| 900 | 36 |
| 1000 | 37 |
| 1100 | 31 |
| 1200 | 32 |
| 1300 | 35 |
| 1400 | 17 |
| 1500 | 27 |
| 1600 | 29 |
| 1700 | 34 |

**TRANSECT 2**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 36" |
| 100 | 34 |
| 200 | 32 |
| 300 | 33 |
| 400 | 34 |
| 500 | 74 |
| 600 | 36 |
| 700 | 34 |
| 800 | 40 |
| 900 | 83 |
| 1000 | 19 |
| 1100 | 96 |

**TRANSECT 3**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 45" |
| 100 | 54 |
| 200 | 45 |
| 300 | 27 |
| 400 | 45 |
| 500 | 17 |
| 600 | 17 |
| 700 | 40 |
| 800 | 45 |
| 900 | 31 |
| 1000 | 17 |
| 1100 | 24 |
| 1200 | 17 |

**TRANSECT 4**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 26" |
| 100 | 92 |
| 200 | 106 |
| 300 | 70 |

**TRANSECT 5**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 80" |
| 100 | 27 |
| 200 | 34 |
| 300 | 17 |
| 400 | 17 |
| 500 | 28 |
| 600 | 62 |

**TRANSECT 6**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0' | 23" |
| 100 | 17 |
| 200 | 17 |
| 300 | 17 |
| 400 | 17 |
| 500 | 17 |
| 600 | 35 |

**TRANSECT 7**
**MU: DP**

| DISTANCE | DEPTH |
|---|---|
| 0' | 34" |
| 100 | 33 |
| 200 | 17 |
| 300 | 17 |
| 400 | 17 |
| 500 | 17 |
| 600 | 25 |
| 700 | 24 |
| 800 | 25 |
| 900 | 26 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 17 |
| 1400 | 17 |
| 1500 | 17 |
| 1600 | 17 |
| 1700 | 17 |
| 1800 | 17 |
| 1900 | 17 |
| 2000 | 17 |
| 2100 | 17 |
| 2200 | 41 |
| 2300 | 25 |
| 2400 | 13 |

**TRANSECT 8**
**MU: PR**

| DISTANCE | DEPTH |
|---|---|
| 0' | 26" |
| 100 | 15 |

**TRANSECT 9**
**MU: DP**

| DISTANCE | DEPTH |
|---|---|
| 0' | 17" |
| 100 | 17 |
| 200 | 17 |
| 300 | 17 |
| 400 | 17 |
| 500 | 17 |
| 600 | 17 |
| 700 | 17 |
| 800 | 56 |
| 900 | 73 |
| 1000 | 49 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 17 |
| 1400 | 17 |
| 1500 | 17 |
| 1600 | 17 |
| 1700 | 17 |
| 1800 | 17 |
| 1900 | 17 |
| 2000 | 41 |
| 2100 | 29 |
| 2200 | 34 |
| 2300 | 25 |
| 2400 | 17 |
| 2500 | 17 |
| 2600 | 17 |

**TRANSECT 10**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0' | 25" |
| 100 | 54 |
| 200 | 54 |
| 300 | 32 |
| 400 | 19 |
| 500 | 31 |
| 600 | 28 |
| 700 | 17 |
| 800 | 17 |
| 900 | 17 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 20 |
| 1400 | 49 |
| 1500 | 25 |
| 1600 | 19 |
| 1700 | 29 |
| 1800 | 32 |
| 1900 | 17 |
| 2000 | 17 |
| 2100 | 35 |
| 2200 | 17 |
| 2300 | 27 |
| 2400 | 27 |
| 2500 | 34 |

**TRANSECT 11**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 17" |
| 100 | 17 |
| 200 | 17 |
| 300 | 17 |
| 400 | 17 |
| 500 | 17 |
| 600 | 17 |
| 700 | 17 |
| 800 | 17 |
| 900 | 17 |
| 1000 | 19 |
| 1100 | 37 |
| 1200 | 68 |
| 1300 | 118 |
| 1400 | 35 |
| 1500 | 34 |
| 1600 | 18 |
| 1700 | 69 |
| 1800 | 32 |
| 1900 | 31 |
| 2000 | 45 |
| 2100 | 17 |
| 2200 | 17 |
| 2300 | 17 |
| 2400 | 17 |
| 2500 | 36 |
| 2600 | 35 |

| TRANSECT 12 | | TRANSECT 13 | | TRANSECT 14 | |
|---|---|---|---|---|---|
| MU: PR | | MU: DT | | MU: DT | |
| DISTANCE | DEPTH | DISTANCE | DEPTH | DISTANCE | DEPTH |
| 0' | 17" | 0' | 28" | 0' | 17" |
| 100 | 17 | 100 | 37 | 100 | 25 |
| 200 | 37 | 200 | 28 | 200 | 35 |
| 300 | 59 | 300 | 37 | 300 | 23 |
| 400 | 75 | 400 | 37 | 400 | 34 |
| 500 | 65 | 500 | 33 | 500 | 52 |
| 600 | 76 | 600 | 17 | 600 | 71 |
| 700 | 70 | 700 | 31 | 700 | 53 |
| 800 | 42 | 800 | 17 | 800 | 29 |
| 900 | 45 | 900 | 17 | 900 | 17 |
| 1000 | 49 | 1000 | 37 | 1000 | 17 |
| 1100 | 28 | 1100 | 43 | 1100 | 17 |
| 1200 | 62 | 1200 | 17 | 1200 | 51 |
| 1300 | 51 | 1300 | 17 | 1300 | 62 |
| 1400 | 31 | 1400 | 80 | 1400 | 51 |
| 1500 | 32 | 1500 | 80 | 1500 | 52 |
| 1600 | 17 | 1600 | 80 | 1600 | 45 |
| 1700 | 37 | 1700 | 80 | 1700 | 34 |
| 1800 | 40 | 1800 | 80 | 1800 | 38 |
| 1900 | 17 | 1900 | 84 | 1900 | 39 |
| 2000 | 27 | 2000 | 52 | 2000 | 45 |
| 2100 | 23 | 2100 | 41 | 2100 | 67 |
| 2200 | 17 | 2200 | 41 | | |
| 2300 | 34 | 2300 | 28 | | |
| 2400 | 32 | 2400 | 34 | | |
| 2500 | 32 | 2500 | 52 | | |
| | | 2600 | 68 | | |

**TRANSECT 15**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 37" |
| 100 | 28 |
| 200 | 26 |
| 300 | 34 |
| 400 | 17 |
| 500 | 36 |
| 600 | 56 |
| 700 | 77 |
| 800 | 95 |
| 900 | 69 |
| 1000 | 60 |
| 1100 | 56 |
| 1200 | 51 |
| 1300 | 46 |
| 1400 | 41 |
| 1500 | 49 |
| 1600 | 69 |
| 1700 | 40 |
| 1800 | 34 |
| 1900 | 27 |
| 2000 | 24 |
| 2100 | 31 |
| 2200 | 17 |
| 2300 | 17 |
| 2400 | 17 |
| 2500 | 26 |
| 2600 | 17 |
| 2700 | 72 |
| 2800 | 45 |

**TRANSECT 16**
**MU: PR**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 32" |
| 100 | 25 |
| 200 | 29 |
| 300 | 18 |
| 400 | 23 |
| 500 | 33 |
| 600 | 51 |
| 700 | 61 |
| 800 | 58 |

**TRANSECT 17**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 71" |
| 100 | 91 |
| 200 | 90 |
| 300 | 42 |
| 400 | 43 |
| 500 | 77 |
| 600 | 34 |
| 700 | 50 |
| 800 | 28 |
| 900 | 17 |
| 1000 | 100 |
| 1100 | 121 |
| 1200 | 72 |
| 1300 | 67 |
| 1400 | 127 |
| 1500 | 104 |
| 1600 | 51 |
| 1700 | 91 |
| 1800 | 82 |
| 1900 | 40 |

| TRANSECT 18<br>MU: DT<br>DISTANCE | DEPTH | TRANSECT 19<br>MU: TF<br>DISTANCE | DEPTH | TRANSECT 20<br>MU: DT<br>DISTANCE | DEPTH |
|---|---|---|---|---|---|
| 0′ | 54" | 0′ | 34" | 0′ | 33" |
| 100 | 85 | 100 | 79 | 100 | 18 |
| 200 | 73 | 200 | 48 | 200 | 17 |
| 300 | 68 | | | 300 | 75 |
| 400 | 50 | | | 400 | 36 |
| 500 | 68 | | | 500 | 29 |
| 600 | 60 | | | 600 | 17 |
| 700 | 57 | | | 700 | 17 |
| 800 | 72 | | | 800 | 17 |
| 900 | 79 | | | 900 | 17 |
| 1000 | 34 | | | 1000 | 17 |
| 1100 | 20 | | | | |
| 1200 | 56 | | | | |
| 1300 | 99 | | | | |
| 1400 | 17 | | | | |
| 1500 | 43 | | | | |
| 1600 | 91 | | | | |
| 1700 | 29 | | | | |
| 1800 | 17 | | | | |
| 1900 | 63 | | | | |
| 2000 | 134 | | | | |
| 2100 | 85 | | | | |
| 2200 | 17 | | | | |
| 2300 | 105 | | | | |
| 2400 | 100 | | | | |
| 2500 | 38 | | | | |
| 2600 | 150 | | | | |
| 2700 | 150 | | | | |
| 2800 | 150 | | | | |
| 2900 | 150 | | | | |
| 3000 | 150 | | | | |
| 3100 | 77 | | | | |

**TRANSECT 21**
**MU: DP**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 23" |
| 100 | 29 |
| 200 | 21 |
| 300 | 29 |
| 400 | 17 |
| 500 | 17 |
| 600 | 17 |
| 700 | 18 |
| 800 | 26 |
| 900 | 34 |
| 1000 | 32 |
| 1100 | 31 |
| 1200 | 63 |

**TRANSECT 22**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 65" |
| 100 | 120 |
| 200 | 150 |
| 300 | 150 |
| 400 | 150 |
| 500 | 150 |
| 600 | 88 |
| 700 | 116 |

**TRANSECT 23**
**MU: DP**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 57" |
| 100 | 76 |
| 200 | 69 |
| 300 | 136 |
| 400 | 85 |

**TRANSECT 24**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 68" |
| 100 | 87 |
| 200 | 150 |
| 300 | 150 |
| 400 | 104 |

**TRANSECT 25**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 28" |
| 100 | 37 |
| 200 | 93 |
| 300 | 94 |

**TRANSECT 26**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 84" |
| 100 | 85 |
| 200 | 83 |
| 300 | 48 |
| 400 | 70 |
| 500 | 54 |
| 600 | 36 |
| 700 | 36 |
| 800 | 37 |
| 900 | 32 |
| 1000 | 63 |

**TRANSECT 27**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 46" |
| 100 | 93 |
| 200 | 127 |
| 300 | 150 |
| 400 | 150 |
| 500 | 150 |
| 600 | 150 |
| 700 | 136 |
| 800 | 150 |
| 900 | 88 |

**TRANSECT 28**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 120" |
| 100 | 150 |
| 200 | 138 |
| 300 | 130 |

**TRANSECT 29**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 150" |
| 100 | 150 |
| 200 | 150 |

**TRANSECT 27**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 46" |
| 100 | 93 |
| 200 | 127 |
| 300 | 150 |
| 400 | 150 |
| 500 | 150 |
| 600 | 150 |
| 700 | 136 |
| 800 | 150 |
| 900 | 88 |

**TRANSECT 28**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 120" |
| 100 | 150 |
| 200 | 138 |
| 300 | 130 |

**TRANSECT 29**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 150" |
| 100 | 150 |
| 200 | 150 |

**TRANSECT 30**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 84" |
| 100 | 119 |

**TRANSECT 31**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 135" |
| 100 | 123 |

**TRANSECT 32**
**MU: DP**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 17" |
| 100 | 29 |
| 200 | 18 |
| 300 | 29 |
| 400 | 25 |
| 500 | 17 |
| 600 | 17 |
| 700 | 17 |
| 800 | 17 |
| 900 | 17 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 17 |

**TRANSECT 33**
**MU: PR**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 48" |
| 100 | 52 |
| 200 | 61 |
| 300 | 41 |

**TRANSECT 34**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 33" |
| 100 | 20 |
| 200 | 18 |
| 300 | 21 |
| 400 | 32 |

**TRANSECT 35**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 26" |
| 100 | 17 |
| 200 | 17 |
| 300 | 17 |
| 400 | 17 |
| 500 | 17 |
| 600 | 17 |
| 700 | 17 |
| 800 | 21 |
| 900 | 25 |
| 1000 | 28 |
| 1100 | 32 |

**TRANSECT 36**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 44" |
| 100 | 57 |
| 200 | 24 |
| 300 | 29 |
| 400 | 29 |
| 500 | 41 |
| 600 | 49 |
| 700 | 91 |
| 800 | 37 |
| 900 | 79 |
| 1000 | 49 |
| 1100 | 117 |
| 1200 | 43 |

**TRANSECT 37**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 25" |
| 100 | 36 |
| 200 | 23 |
| 300 | 18 |
| 400 | 17 |
| 500 | 17 |
| 600 | 44 |
| 700 | 17 |
| 800 | 41 |
| 900 | 57 |
| 1000 | 28 |
| 1100 | 40 |
| 1200 | 43 |
| 1300 | 33 |
| 1400 | 57 |
| 1500 | 85 |
| 1600 | 87 |

**TRANSECT 38**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 23" |
| 100 | 20 |
| 200 | 17 |
| 300 | 23 |
| 400 | 28 |
| 500 | 43 |
| 600 | 17 |
| 700 | 17 |
| 800 | 17 |
| 900 | 23 |
| 1000 | 54 |
| 1100 | 54 |
| 1200 | 37 |

**TRANSECT 39**
**MU: PT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 42" |
| 100 | 50 |
| 200 | 42 |
| 300 | 39 |
| 400 | 17 |
| 500 | 17 |
| 600 | 17 |
| 700 | 37 |
| 800 | 17 |
| 900 | 17 |
| 1000 | 17 |
| 1100 | 22 |
| 1200 | 29 |
| 1300 | 28 |
| 1400 | 34 |
| 1500 | 36 |
| 1600 | 27 |
| 1700 | 43 |
| 1800 | 36 |
| 1900 | 33 |
| 2000 | 48 |

**TRANSECT 40**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 24" |
| 100 | 23 |
| 200 | 25 |
| 300 | 23 |
| 400 | 25 |
| 500 | 23 |
| 600 | 22 |
| 700 | 24 |
| 800 | 29 |
| 900 | 28 |
| 1000 | 32 |
| 1100 | 25 |

**TRANSECT 41**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 53" |
| 100 | 58 |
| 200 | 62 |
| 300 | 31 |
| 400 | 17 |
| 500 | 31 |
| 600 | 31 |
| 700 | 57 |
| 800 | 44 |
| 900 | 56 |
| 1000 | 76 |
| 1100 | 76 |
| 1200 | 44 |

**TRANSECT 42**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 34" |
| 100 | 29 |
| 200 | 29 |
| 300 | 62 |
| 400 | 85 |
| 500 | 75 |
| 600 | 28 |
| 700 | 28 |
| 800 | 28 |
| 900 | 28 |
| 1000 | 34 |
| 1100 | 36 |

**TRANSECT 43**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 45" |
| 100 | 48 |
| 200 | 42 |
| 300 | 59 |
| 400 | 61 |
| 500 | 77 |
| 600 | 91 |
| 700 | 75 |
| 800 | 71 |
| 900 | 84 |
| 1000 | 52 |
| 1100 | 83 |
| 1200 | 91 |
| 1300 | 85 |
| 1400 | 74 |
| 1500 | 73 |
| 1600 | 94 |
| 1700 | 110 |

**TRANSECT 44**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 78" |
| 100 | 51 |
| 200 | 53 |
| 300 | 37 |
| 400 | 74 |
| 500 | 57 |
| 600 | 75 |
| 700 | 61 |
| 800 | 48 |
| 900 | 52 |
| 1000 | 62 |
| 1100 | 53 |
| 1200 | 48 |
| 1300 | 50 |
| 1400 | 28 |
| 1500 | 17 |

**TRANSECT 45**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0' | 150" |
| 100 | 150 |
| 200 | 125 |
| 300 | 77 |
| 400 | 84 |
| 500 | 126 |
| 600 | 68 |
| 700 | 79 |
| 800 | 62 |
| 900 | 125 |
| 1000 | 119 |
| 1100 | 84 |
| 1200 | 74 |
| 1300 | 113 |
| 1400 | 91 |
| 1500 | 125 |
| 1600 | 136 |
| 1700 | 96 |
| 1800 | 35 |
| 1900 | 150 |
| 2000 | 51 |
| 2100 | 42 |
| 2200 | 150 |
| 2300 | 51 |
| 2400 | 42 |
| 2500 | 33 |
| 2600 | 39 |
| 2700 | 36 |
| 2800 | 62 |
| 2900 | 65 |
| 3000 | 108 |
| 3100 | 75 |
| 3200 | 113 |
| 3300 | 99 |
| 3400 | 49 |
| 3500 | 82 |
| 3600 | 84 |
| 3700 | 74 |
| 3800 | 65 |
| 3900 | 31 |
| 4000 | 57 |
| 4100 | 108 |
| 4200 | 82 |
| 4300 | 123 |
| 4400 | 150 |
| 4500 | 150 |
| 4600 | 86 |
| 4700 | 150 |
| 4800 | 150 |

**TRANSECT 46**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 53" |
| 100 | 32 |
| 200 | 34 |
| 300 | 28 |
| 400 | 35 |
| 500 | 32 |
| 600 | 28 |
| 700 | 49 |
| 800 | 92 |
| 900 | 49 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 47 |
| 1400 | 57 |
| 1500 | 70 |

**TRANSECT 47**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 18" |
| 100 | 23 |
| 200 | 21 |
| 300 | 21 |
| 400 | 24 |
| 500 | 23 |
| 600 | 22 |
| 700 | 26 |
| 800 | 20 |
| 900 | 42 |
| 1000 | 65 |
| 1100 | 36 |
| 1200 | 35 |
| 1300 | 21 |
| 1400 | 23 |
| 1500 | 32 |
| 1600 | 26 |
| 1700 | 24 |
| 1800 | 21 |
| 1900 | 22 |
| 2000 | 24 |
| 2100 | 23 |
| 2200 | 22 |
| 2300 | 22 |

**TRANSECT 48**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0' | 67" |
| 100 | 96 |
| 200 | 66 |
| 300 | 77 |
| 400 | 46 |
| 500 | 53 |
| 600 | 49 |
| 700 | 37 |
| 800 | 45 |
| 900 | 45 |
| 1000 | 69 |
| 1100 | 96 |
| 1200 | 86 |
| 1300 | 113 |
| 1400 | 100 |
| 1500 | 87 |
| 1600 | 126 |
| 1700 | 62 |
| 1800 | 60 |
| 1900 | 150 |
| 2000 | 83 |
| 2100 | 70 |
| 2200 | 49 |
| 2300 | 74 |
| 2400 | 87 |
| 2500 | 59 |
| 2600 | 29 |
| 2700 | 37 |
| 2800 | 137 |
| 2900 | 57 |
| 3000 | 133 |
| 3100 | 85 |
| 3200 | 97 |
| 3300 | 150 |
| 3400 | 150 |
| 3500 | 150 |
| 3600 | 150 |

**TRANSECT 49**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0' | 23" |
| 100 | 79 |
| 200 | 45 |
| 300 | 61 |
| 400 | 86 |
| 500 | 24 |
| 600 | 25 |
| 700 | 26 |
| 800 | 25 |

**TRANSECT 50**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 25" |
| 100 | 24 |
| 200 | 26 |
| 300 | 40 |
| 400 | 19 |
| 500 | 22 |
| 600 | 23 |
| 700 | 24 |
| 800 | 17 |
| 900 | 17 |

**TRANSECT 51**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 29" |
| 100 | 23 |
| 200 | 27 |
| 300 | 17 |
| 400 | 17 |
| 500 | 17 |
| 600 | 61 |
| 700 | 150 |
| 800 | 48 |
| 900 | 17 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 17 |
| 1400 | 17 |
| 1500 | 17 |
| 1600 | 20 |

**TRANSECT 52**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 26" |
| 100 | 65 |
| 200 | 108 |
| 300 | 134 |
| 400 | 86 |
| 500 | 82 |
| 600 | 59 |
| 700 | 25 |
| 800 | 71 |
| 900 | 147 |
| 1000 | 150 |
| 1100 | 150 |
| 1200 | 150 |
| 1300 | 150 |

**TRANSECT 53**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 54" |
| 100 | 37 |
| 200 | 49 |
| 300 | 150 |
| 400 | 150 |
| 500 | 150 |
| 600 | 91 |
| 700 | 64 |
| 800 | 91 |
| 900 | 46 |
| 1000 | 26 |

**TRANSECT 54**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 40" |
| 100 | 31 |
| 200 | 71 |
| 300 | 62 |
| 400 | 76 |
| 500 | 68 |
| 600 | 105 |
| 700 | 150 |
| 800 | 150 |
| 900 | 150 |
| 1000 | 130 |
| 1100 | 97 |
| 1200 | 113 |
| 1300 | 117 |

**TRANSECT 55**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 54" |
| 100 | 79 |
| 200 | 52 |
| 300 | 43 |
| 400 | 68 |
| 500 | 150 |
| 600 | 122 |
| 700 | 102 |
| 800 | 43 |
| 900 | 35 |
| 1000 | 26 |
| 1100 | 37 |
| 1200 | 49 |
| 1300 | 41 |
| 1400 | 102 |
| 1500 | 76 |

**TRANSECT 56**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 74" |
| 100 | 94 |
| 200 | 65 |
| 300 | 43 |
| 400 | 74 |
| 500 | 86 |
| 600 | 150 |
| 700 | 150 |
| 800 | 95 |

**TRANSECT 57**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0' | 130" |
| 100 | 128 |
| 200 | 103 |
| 300 | 82 |
| 400 | 76 |
| 500 | 85 |
| 600 | 41 |
| 700 | 45 |
| 800 | 68 |
| 900 | 77 |
| 1000 | 45 |
| 1100 | 84 |

**TRANSECT 58**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 36" |
| 100 | 40 |
| 200 | 25 |
| 300 | 32 |
| 400 | 27 |
| 500 | 29 |
| 600 | 29 |
| 700 | 34 |
| 800 | 79 |
| 900 | 24 |
| 1000 | 26 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 17 |
| 1400 | 17 |
| 1500 | 17 |
| 1600 | 17 |
| 1700 | 51 |
| 1800 | 27 |
| 1900 | 26 |
| 2000 | 23 |
| 2100 | 22 |
| 2200 | 66 |
| 2300 | 31 |
| 2400 | 17 |
| 2500 | 37 |
| 2600 | 17 |
| 2700 | 17 |

**TRANSECT 59**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 40" |
| 100 | 17 |
| 200 | 17 |
| 300 | 33 |
| 400 | 24 |
| 500 | 17 |
| 600 | 24 |
| 700 | 38 |
| 800 | 17 |
| 900 | 53 |
| 1000 | 27 |
| 1100 | 25 |
| 1200 | 63 |
| 1300 | 114 |
| 1400 | 78 |
| 1500 | 76 |
| 1600 | 128 |
| 1700 | 150 |

**TRANSECT 60**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 68" |
| 100 | 73 |
| 200 | 67 |
| 300 | 80 |
| 400 | 74 |
| 500 | 63 |
| 600 | 57 |
| 700 | 77 |
| 800 | 88 |
| 900 | 69 |
| 1000 | 67 |
| 1100 | 94 |
| 1200 | 88 |
| 1300 | 97 |
| 1400 | 93 |
| 1500 | 78 |
| 1600 | 71 |
| 1700 | 60 |
| 1800 | 67 |
| 1900 | 96 |
| 2000 | 150 |
| 2100 | 150 |
| 2200 | 77 |
| 2300 | 63 |
| 2400 | 31 |
| 2500 | 25 |
| 2600 | 26 |
| 2700 | 28 |
| 2800 | 17 |
| 2900 | 17 |
| 3000 | 17 |
| 3100 | 17 |
| 3200 | 17 |
| 3300 | 27 |
| 3400 | 32 |

**TRANSECT 61**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0' | 44" |
| 100 | 22 |
| 200 | 31 |
| 300 | 23 |
| 400 | 17 |
| 500 | 17 |
| 600 | 74 |
| 700 | 42 |
| 800 | 21 |
| 900 | 36 |
| 1000 | 38 |
| 1100 | 83 |
| 1200 | 78 |
| 1300 | 80 |
| 1400 | 41 |
| 1500 | 33 |
| 1600 | 20 |
| 1700 | 28 |
| 1800 | 62 |
| 1900 | 40 |
| 2000 | 17 |
| 2100 | 26 |
| 2200 | 19 |
| 2300 | 32 |
| 2400 | 41 |
| 2500 | 28 |
| 2600 | 17 |
| 2700 | 17 |
| 2800 | 50 |
| 2900 | 17 |
| 3000 | 49 |
| 3100 | 48 |
| 3200 | 53 |
| 3300 | 85 |
| 3400 | 27 |
| 3500 | 68 |
| 3600 | 45 |
| 3700 | 62 |
| 3800 | 51 |
| 3900 | 65 |

**TRANSECT 62**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0' | 85" |
| 100 | 65 |
| 200 | 68 |
| 300 | 56 |
| 400 | 108 |
| 500 | 150 |
| 600 | 150 |
| 700 | 150 |
| 800 | 150 |
| 900 | 150 |
| 1000 | 150 |
| 1100 | 150 |
| 1200 | 150 |
| 1300 | 150 |
| 1400 | 104 |
| 1500 | 59 |
| 1600 | 17 |
| 1700 | 31 |
| 1800 | 17 |
| 1900 | 42 |
| 2000 | 114 |
| 2100 | 150 |
| 2200 | 150 |
| 2300 | 129 |
| 2400 | 118 |
| 2500 | 82 |
| 2600 | 78 |
| 2700 | 26 |
| 2800 | 17 |
| 2900 | 28 |
| 3000 | 17 |
| 3100 | 17 |
| 3200 | 40 |
| 3300 | 29 |
| 3400 | 51 |
| 3500 | 17 |
| 3600 | 26 |
| 3700 | 32 |
| 3800 | 17 |
| 3900 | 17 |
| 4000 | 54 |
| 4100 | 58 |
| 4200 | 83 |
| 4300 | 47 |
| 4400 | 57 |
| 4500 | 42 |
| 4600 | 17 |
| 4700 | 17 |
| 4800 | 17 |
| 4900 | 62 |
| 5000 | 84 |
| 5100 | 93 |
| 5200 | 76 |
| 5300 | 150 |
| 5400 | 62 |

**TRANSECT 63**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 121" |
| 100 | 66 |
| 200 | 51 |
| 300 | 79 |
| 400 | 72 |
| 500 | 84 |
| 600 | 100 |
| 700 | 39 |
| 800 | 50 |
| 900 | 57 |
| 1000 | 96 |
| 1100 | 101 |
| 1200 | 103 |
| 1300 | 78 |
| 1400 | 88 |
| 1500 | 87 |
| 1600 | 72 |

**TRANSECT 64**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 25" |
| 100 | 17 |
| 200 | 27 |
| 300 | 29 |
| 400 | 29 |
| 500 | 17 |
| 600 | 17 |
| 700 | 17 |
| 800 | 32 |
| 900 | 17 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 17 |

**TRANSECT 65**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 68" |
| 100 | 68 |
| 200 | 150 |
| 300 | 103 |
| 400 | 53 |
| 500 | 50 |
| 600 | 127 |
| 700 | 70 |
| 800 | 17 |
| 900 | 25 |
| 1000 | 113 |
| 1100 | 50 |
| 1200 | 80 |
| 1300 | 68 |
| 1400 | 110 |
| 1500 | 150 |

**TRANSECT 66**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 46" |
| 100 | 28 |
| 200 | 56 |
| 300 | 51 |
| 400 | 50 |
| 500 | 50 |
| 600 | 34 |
| 700 | 34 |
| 800 | 109 |
| 900 | 104 |
| 1000 | 126 |
| 1100 | 97 |
| 1200 | 126 |
| 1300 | 88 |
| 1400 | 117 |

**TRANSECT 67**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 150" |
| 100 | 91 |
| 200 | 78 |
| 300 | 97 |
| 400 | 70 |
| 500 | 87 |

**TRANSECT 68**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 40" |
| 100 | 17 |
| 200 | 27 |
| 300 | 26 |
| 400 | 31 |
| 500 | 28 |
| 600 | 88 |
| 700 | 105 |
| 800 | 59 |
| 900 | 74 |
| 1000 | 70 |

**TRANSECT 69**
**MU: TF**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 28" |
| 100 | 131 |
| 200 | 48 |
| 300 | 60 |
| 400 | 61 |
| 500 | 150 |

**TRANSECT 70**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 108" |
| 100 | 70 |
| 200 | 27 |
| 300 | 24 |
| 400 | 34 |
| 500 | 58 |
| 600 | 71 |
| 700 | 72 |
| 800 | 34 |
| 900 | 73 |
| 1000 | 101 |

**TRANSECT 71**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 82" |
| 100 | 103 |
| 200 | 86 |
| 300 | 75 |
| 400 | 61 |
| 500 | 74 |
| 600 | 104 |
| 700 | 46 |
| 800 | 71 |

**TRANSECT 72**
**MU: DS**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 51" |
| 100 | 34 |
| 200 | 17 |
| 300 | 54 |

**TRANSECT 73**
**MU: DT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 59" |
| 100 | 150 |
| 200 | 102 |
| 300 | 150 |
| 400 | 150 |
| 500 | 150 |
| 600 | 73 |
| 700 | 29 |
| 800 | 66 |
| 900 | 150 |
| 1000 | 28 |
| 1100 | 51 |
| 1200 | 17 |
| 1300 | 36 |

**TRANSECT 74**
**MU: PX**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 17" |
| 100 | 31 |
| 200 | 17 |
| 300 | 17 |
| 400 | 23 |
| 500 | 32 |
| 600 | 17 |
| 700 | 41 |
| 800 | 80 |
| 900 | 80 |
| 1000 | 80 |
| 1100 | 36 |
| 1200 | 60 |
| 1300 | 40 |
| 1400 | 42 |
| 1500 | 31 |
| 1600 | 44 |
| 1700 | 31 |
| 1800 | 108 |
| 1900 | 27 |
| 2000 | 77 |
| 2100 | 17 |
| 2200 | 17 |
| 2300 | 20 |
| 2400 | 17 |
| 2500 | 34 |
| 2600 | 34 |
| 2700 | 17 |
| 2800 | 17 |
| 2900 | 33 |
| 3000 | 38 |
| 3100 | 17 |
| 3200 | 17 |
| 3300 | 41 |
| 3400 | 26 |
| 3500 | 88 |
| 3600 | 17 |
| 3700 | 38 |
| 3800 | 40 |
| 3900 | 26 |

**TRANSECT 75**
**MU: PR**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 52" |
| 100 | 35 |
| 200 | 17 |
| 300 | 52 |
| 400 | 37 |
| 500 | 31 |

**TRANSECT 76**
**MU: PX**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 100" |
| 100 | 94 |
| 200 | 82 |
| 300 | 48 |

**TRANSECT 77**
**MU: PT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 49" |
| 100 | 51 |
| 200 | 23 |
| 300 | 17 |
| 400 | 28 |
| 500 | 27 |
| 600 | 20 |
| 700 | 57 |
| 800 | 28 |
| 900 | 34 |
| 1000 | 65 |
| 1100 | 23 |

**TRANSECT 78**
**MU: PX**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 42" |
| 100 | 79 |
| 200 | 42 |
| 300 | 35 |
| 400 | 99 |
| 500 | 54 |
| 600 | 31 |

**TRANSECT 79**
**MU: PT**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 31" |
| 100 | 44 |
| 200 | 17 |
| 300 | 17 |
| 400 | 26 |
| 500 | 17 |
| 600 | 34 |
| 700 | 35 |
| 800 | 17 |
| 900 | 17 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 65 |

**TRANSECT 80**
**MU: AX**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 36" |
| 100 | 22 |
| 200 | 17 |
| 300 | 45 |
| 400 | 47 |
| 500 | 36 |
| 600 | 91 |
| 700 | 32 |
| 800 | 40 |
| 900 | 36 |
| 1000 | 34 |
| 1100 | 34 |
| 1200 | 34 |
| 1300 | 34 |
| 1400 | 43 |

**TRANSECT 81**
**MU: PX**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 40" |
| 100 | 47 |
| 200 | 17 |
| 300 | 66 |
| 400 | 22 |
| 500 | 24 |
| 600 | 150 |
| 700 | 150 |
| 800 | 104 |
| 900 | 33 |
| 1000 | 61 |
| 1100 | 34 |
| 1200 | 28 |
| 1300 | 27 |
| 1400 | 27 |
| 1500 | 27 |
| 1600 | 44 |
| 1700 | 76 |
| 1800 | 54 |
| 1900 | 45 |
| 2000 | 17 |
| 2100 | 35 |
| 2200 | 17 |
| 2300 | 36 |
| 2400 | 35 |

**TRANSECT 82**
**MU: TX**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 150" |
| 100 | 95 |
| 200 | 37 |
| 300 | 91 |
| 400 | 44 |
| 500 | 47 |
| 600 | 53 |
| 700 | 17 |
| 800 | 17 |
| 900 | 63 |
| 1000 | 17 |
| 1100 | 17 |
| 1200 | 17 |
| 1300 | 17 |
| 1400 | 17 |
| 1500 | 43 |
| 1600 | 61 |
| 1700 | 58 |
| 1800 | 17 |
| 1900 | 76 |
| 2000 | 69 |
| 2100 | 26 |

**TRANSECT 83**
**MU: PX**

| DISTANCE | DEPTH |
|---|---|
| 0′ | 17" |
| 100 | 34 |
| 200 | 110 |
| 300 | 17 |
| 400 | 53 |
| 500 | 150 |
| 600 | 84 |
| 700 | 17 |
| 800 | 69 |
| 900 | 76 |
| 1000 | 17 |
| 1100 | 42 |
| 1200 | 150 |
| 1300 | 133 |
| 1400 | 26 |
| 1500 | 50 |
| 1600 | 71 |
| 1700 | 117 |
| 1800 | 150 |
| 1900 | 88 |

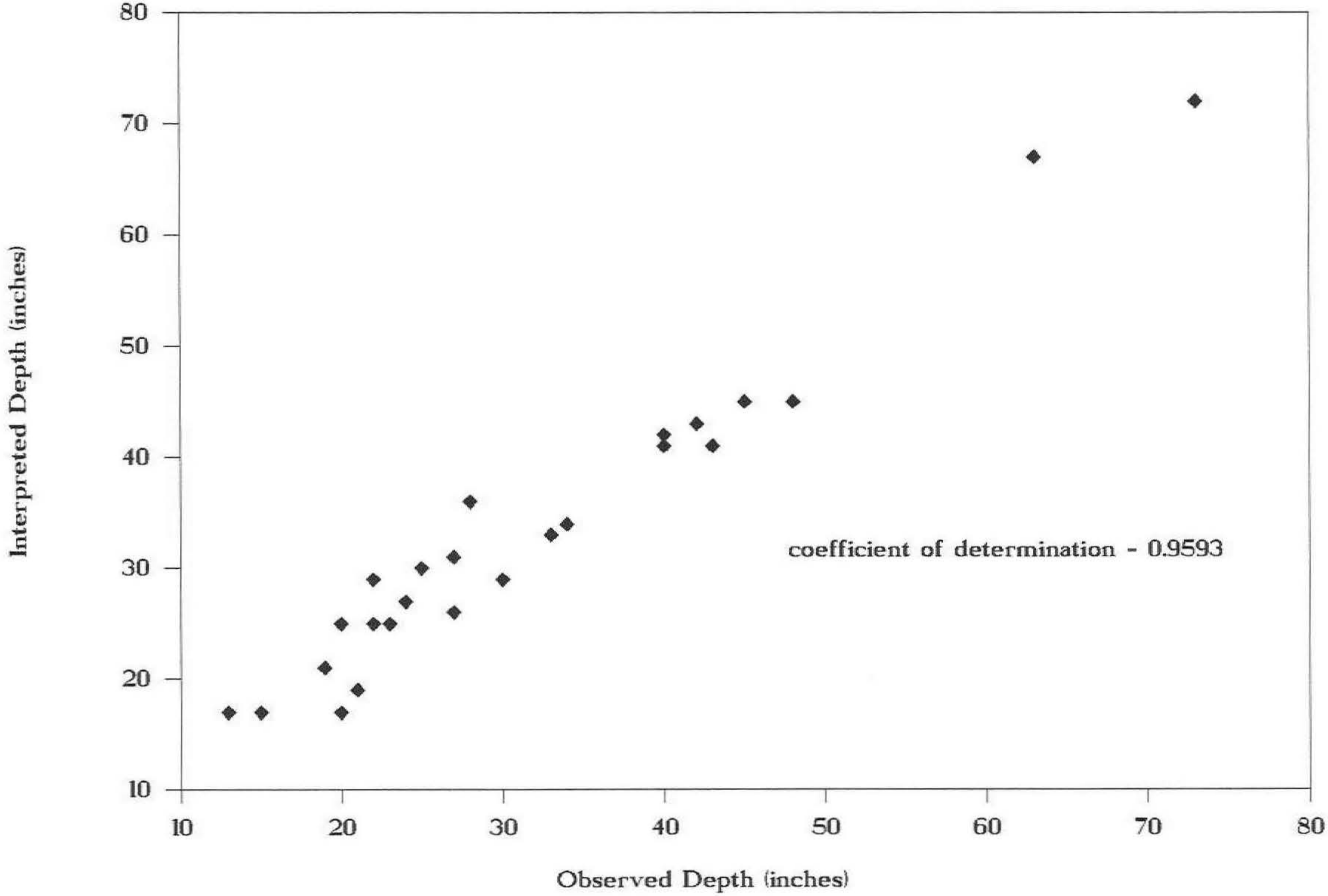
**TRANSECT 84**
**MU: PX**

| DISTANCE | DEPTH |
|---|---|
| 0' | 44" |
| 100 | 17 |
| 200 | 26 |
| 300 | 41 |
| 400 | 83 |
| 500 | 99 |
| 600 | 33 |
| 700 | 52 |
| 800 | 17 |
| 900 | 57 |
| 1000 | 49 |
| 1100 | 17 |
| 1200 | 60 |
| 1300 | 60 |
| 1400 | 37 |
| 1500 | 17 |
| 1600 | 17 |
| 1700 | 17 |
| 1800 | 17 |
| 1900 | 45 |
| 2000 | 17 |
| 2100 | 59 |
| 2200 | 43 |
| 2300 | 57 |
| 2400 | 17 |
| 2500 | 136 |
| 2600 | 62 |
| 2700 | 17 |
| 2800 | 74 |
| 2900 | 50 |
| 3000 | 68 |
| 3100 | 118 |
| 3200 | 127 |
| 3300 | 57 |

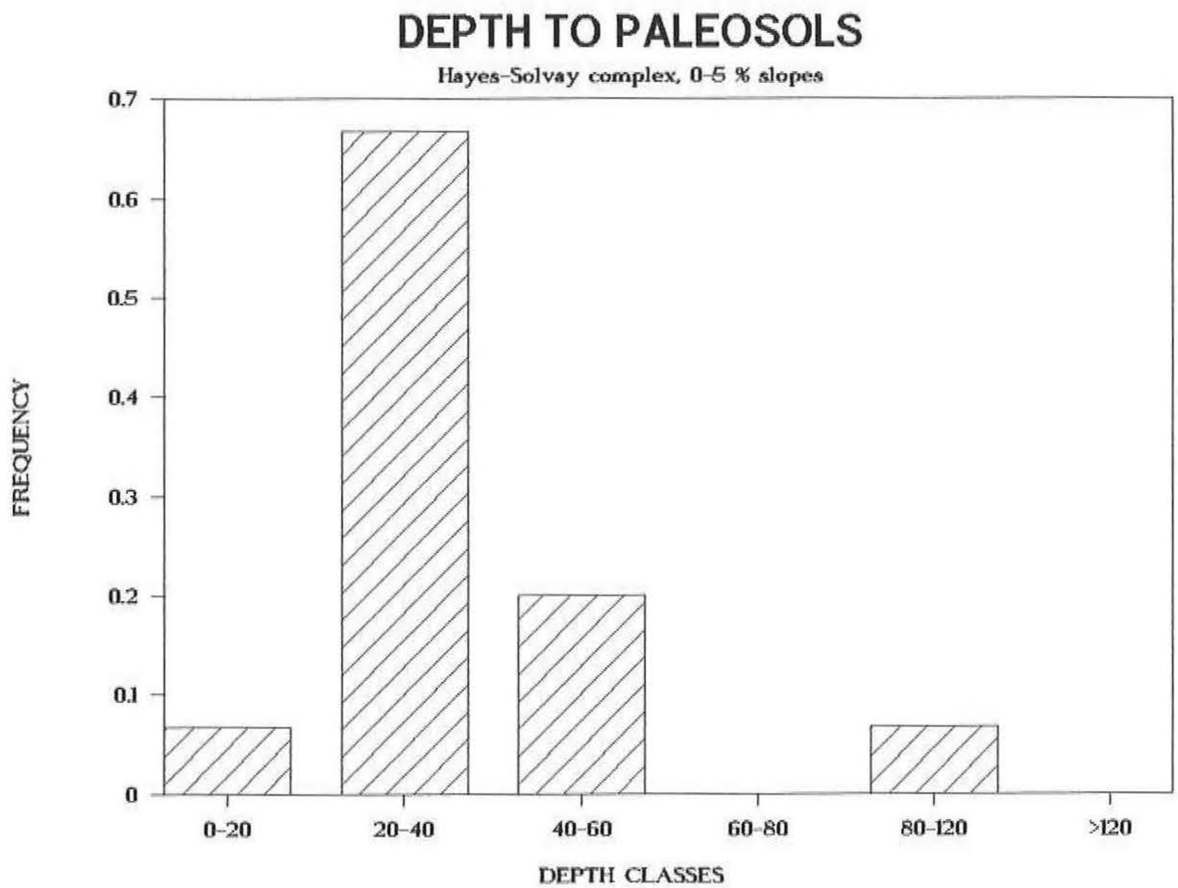
**TRANSECT 85**
**MU: PX**

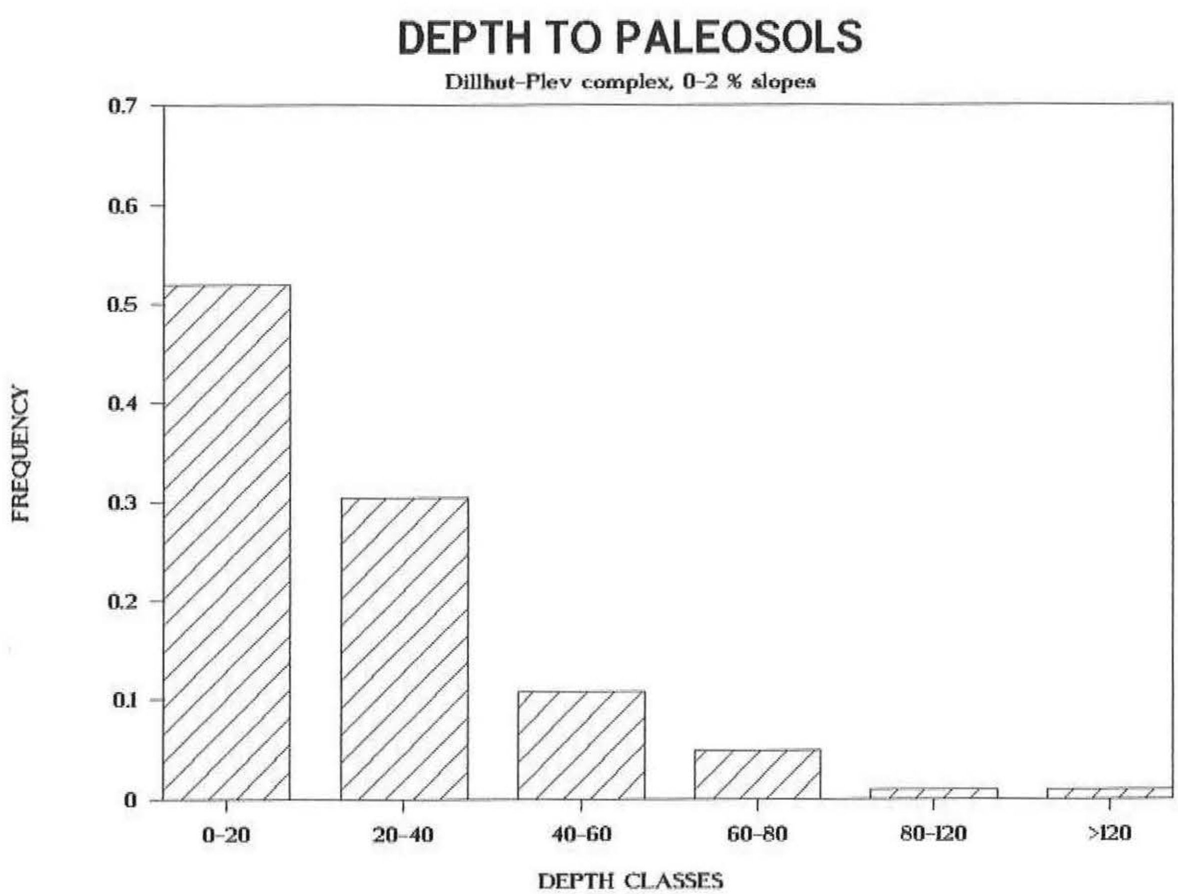
| DISTANCE | DEPTH |
|---|---|
| 0' | 17" |
| 100 | 54 |
| 200 | 150 |
| 300 | 94 |
| 400 | 42 |
| 500 | 17 |
| 600 | 49 |
| 700 | 17 |
| 800 | 17 |
| 900 | 17 |
| 1000 | 68 |
| 1100 | 17 |
| 1200 | 19 |

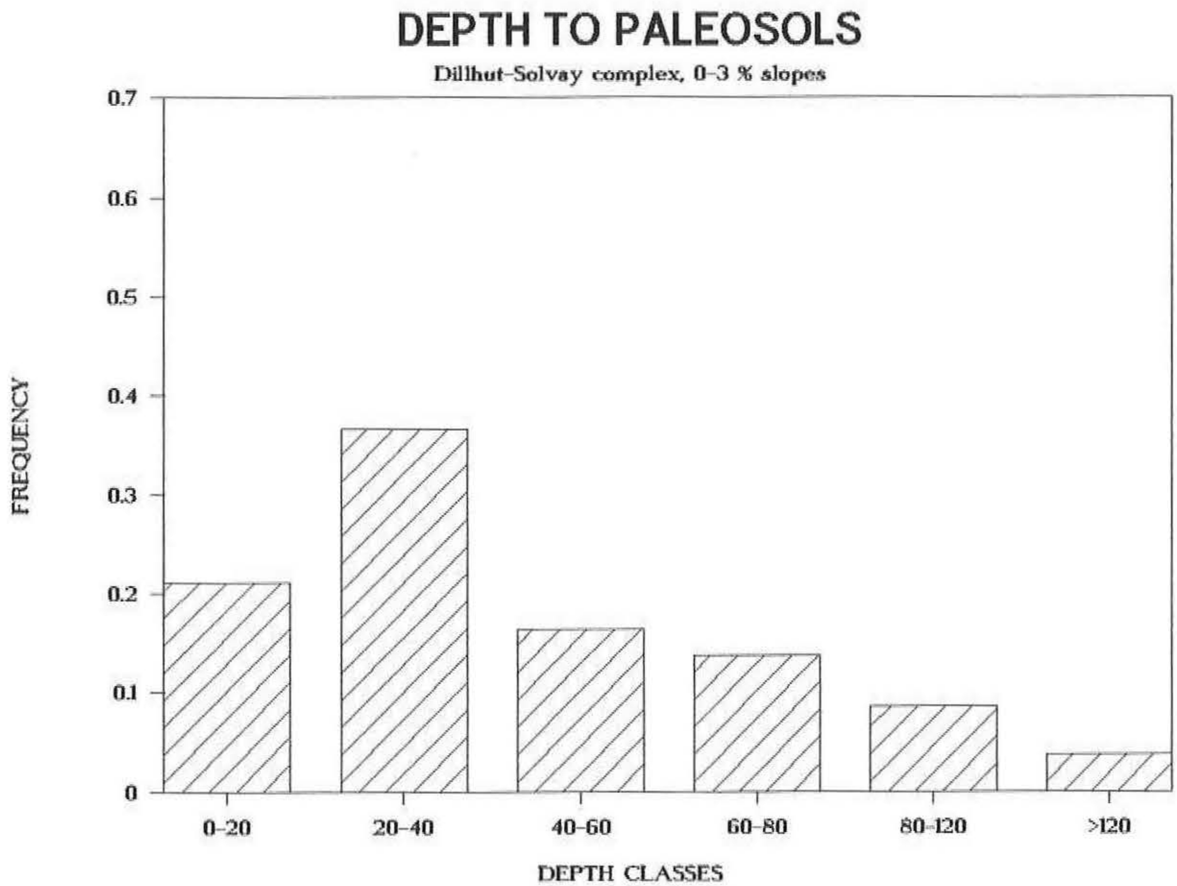
# FIGURE 1

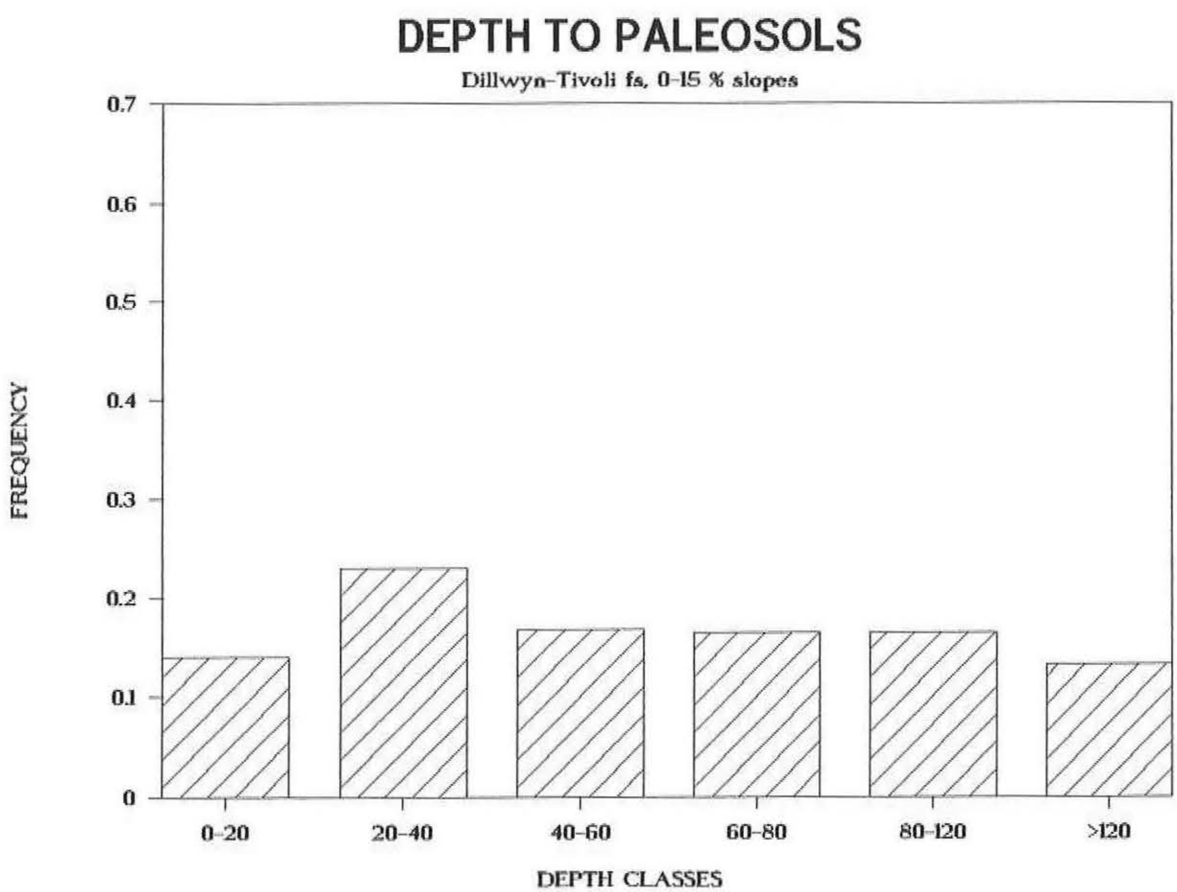


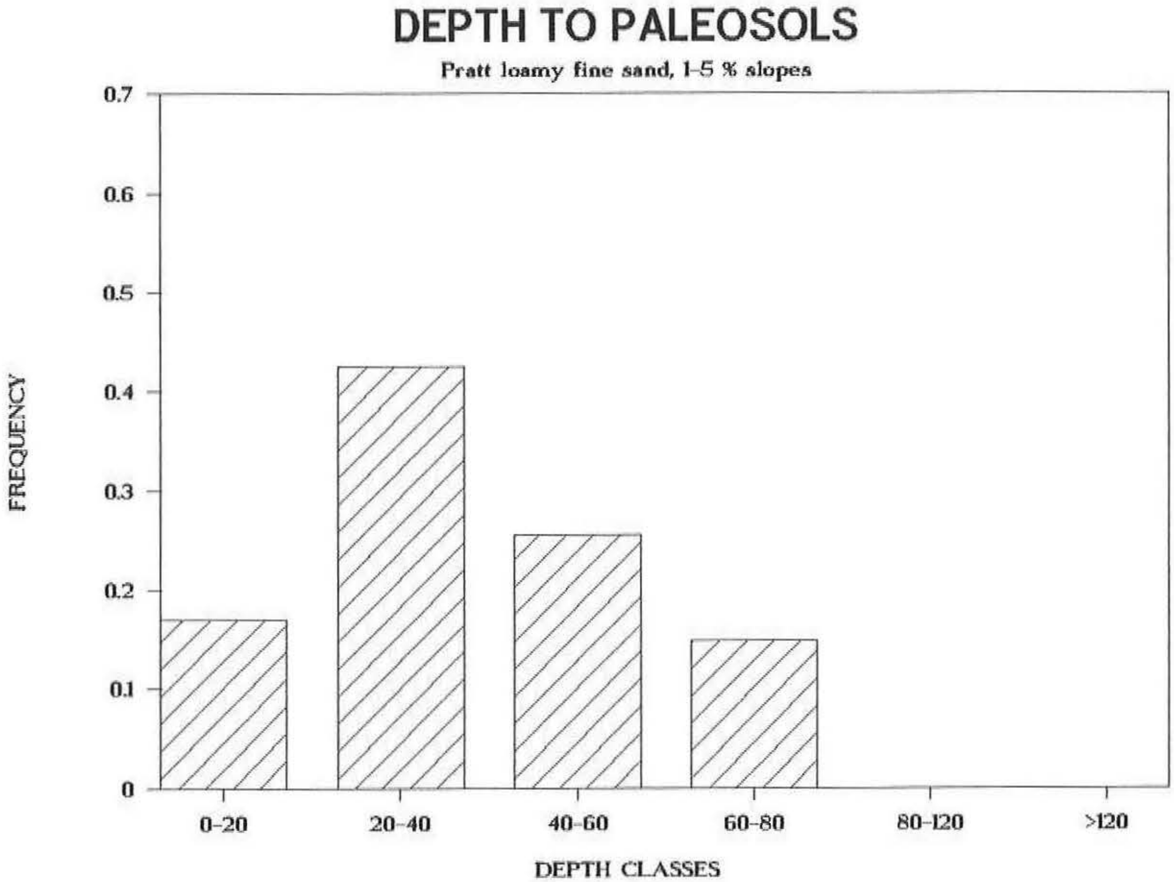
80
70
60
50
40
30
20
10
Interpreted Depth (inches)
coefficient of determination - 0.9593
10
20
30
40
50
60
70
80
Observed Depth (inches)

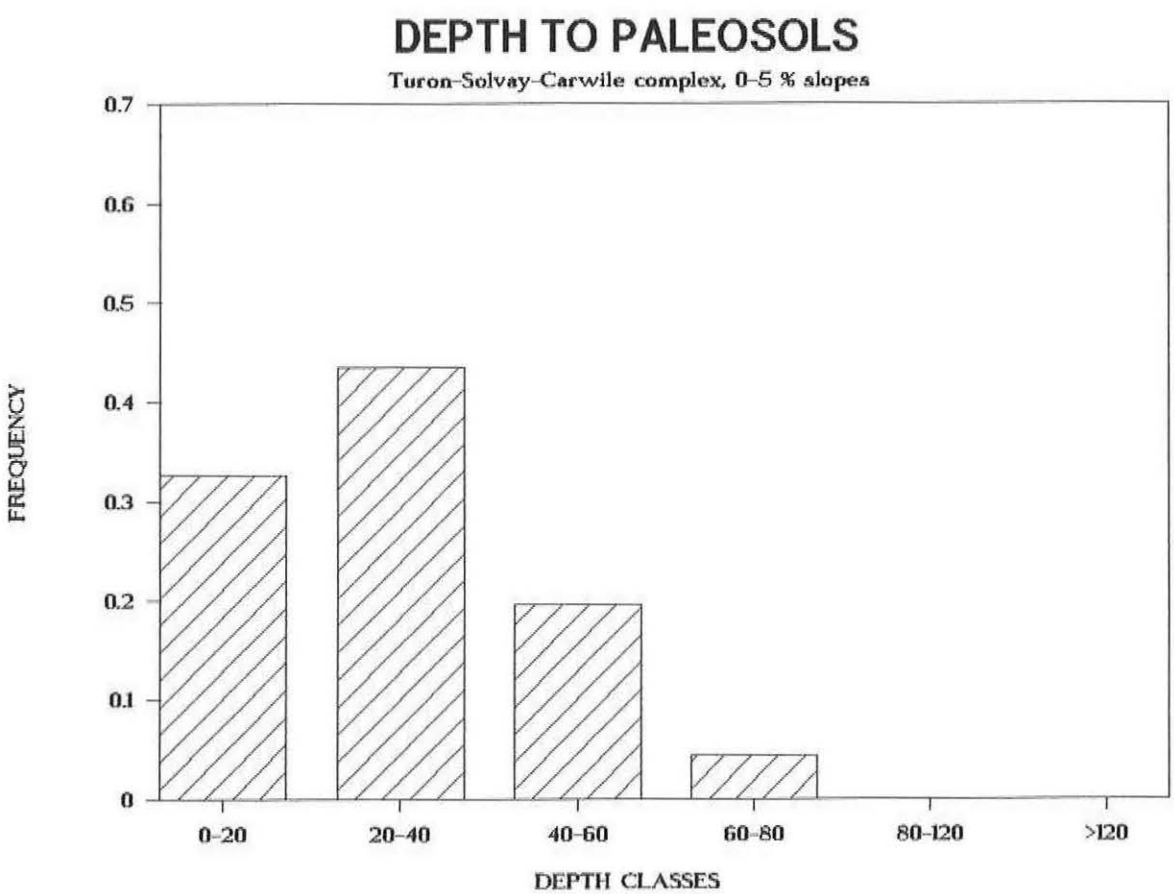

DEPTH TO PALEOSOLS
Hayes-Solvay complex, 0-5 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES

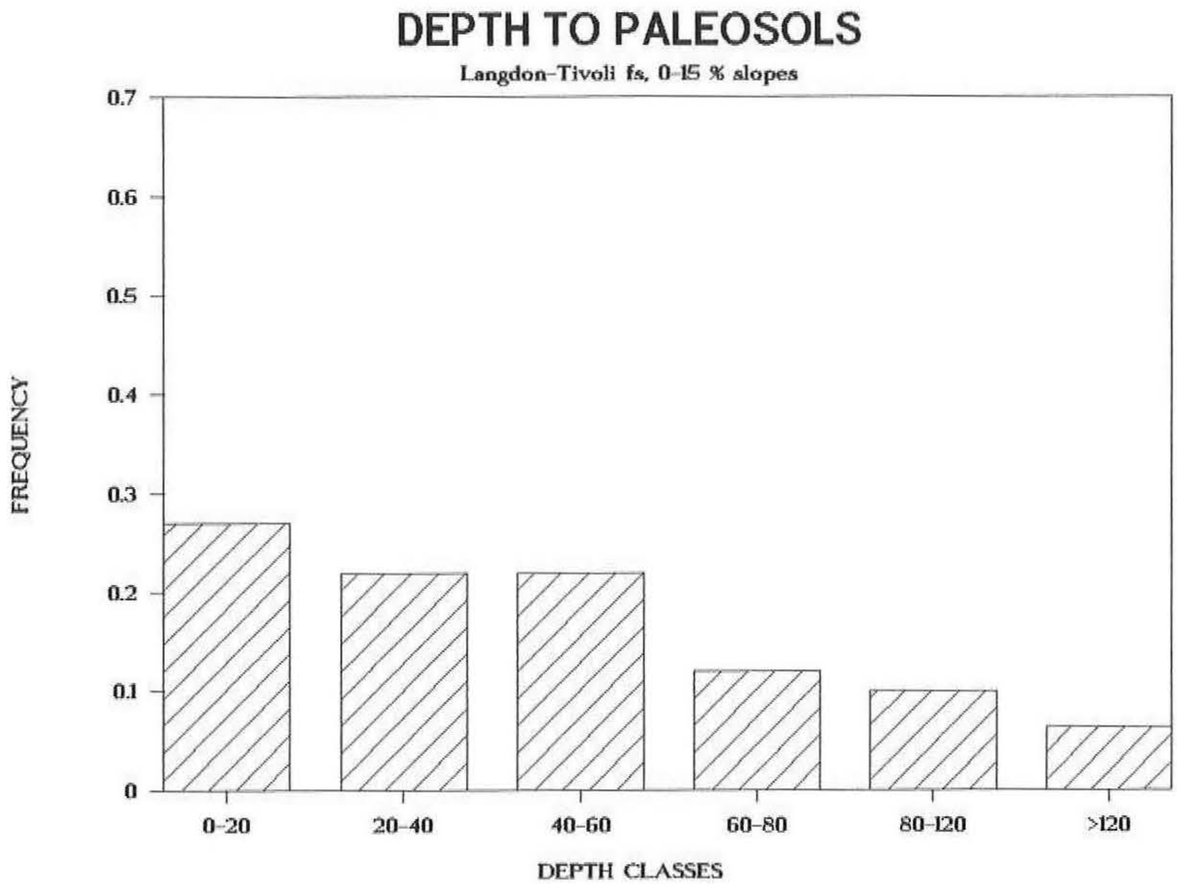

DEPTH TO PALEOSOLS
Dillhut-Plev complex, 0-2 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES

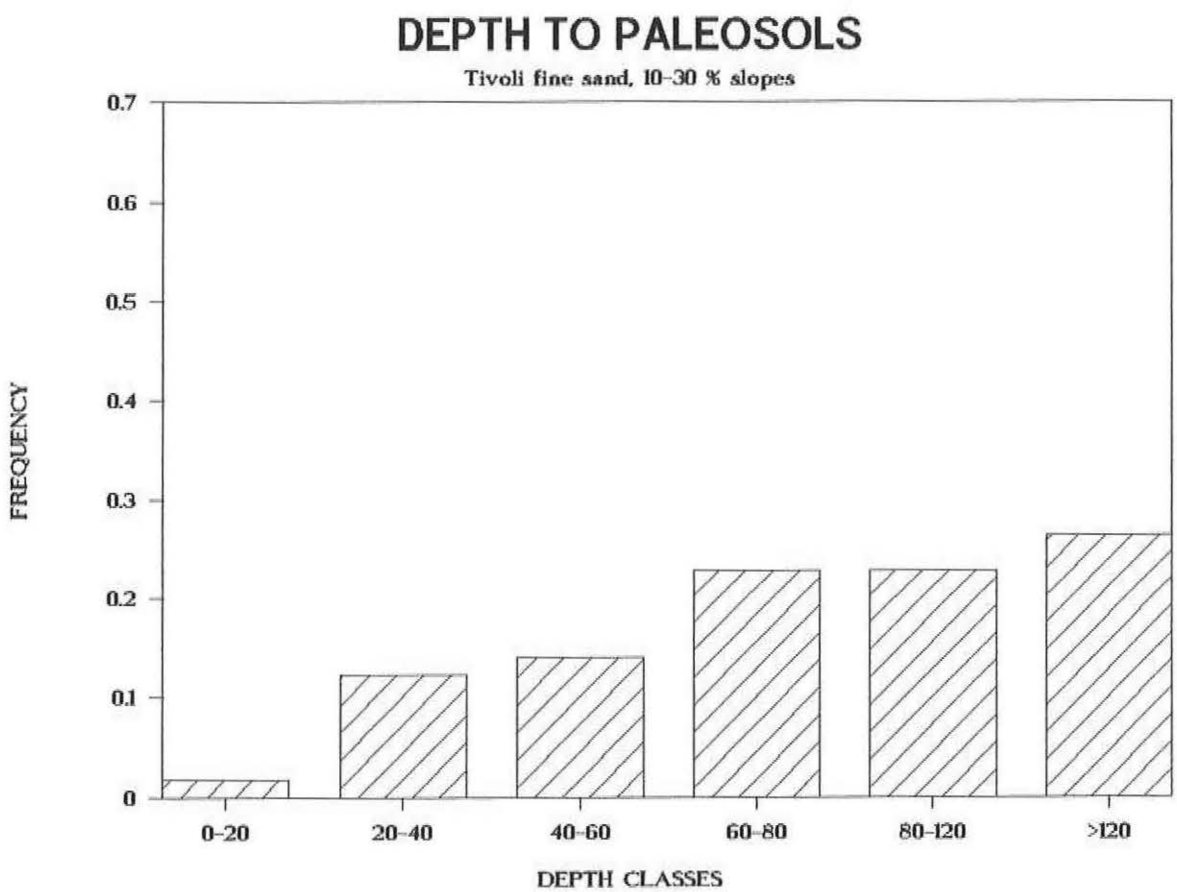

DEPTH TO PALEOSOLS
Dillhut-Solvay complex, 0-3 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES

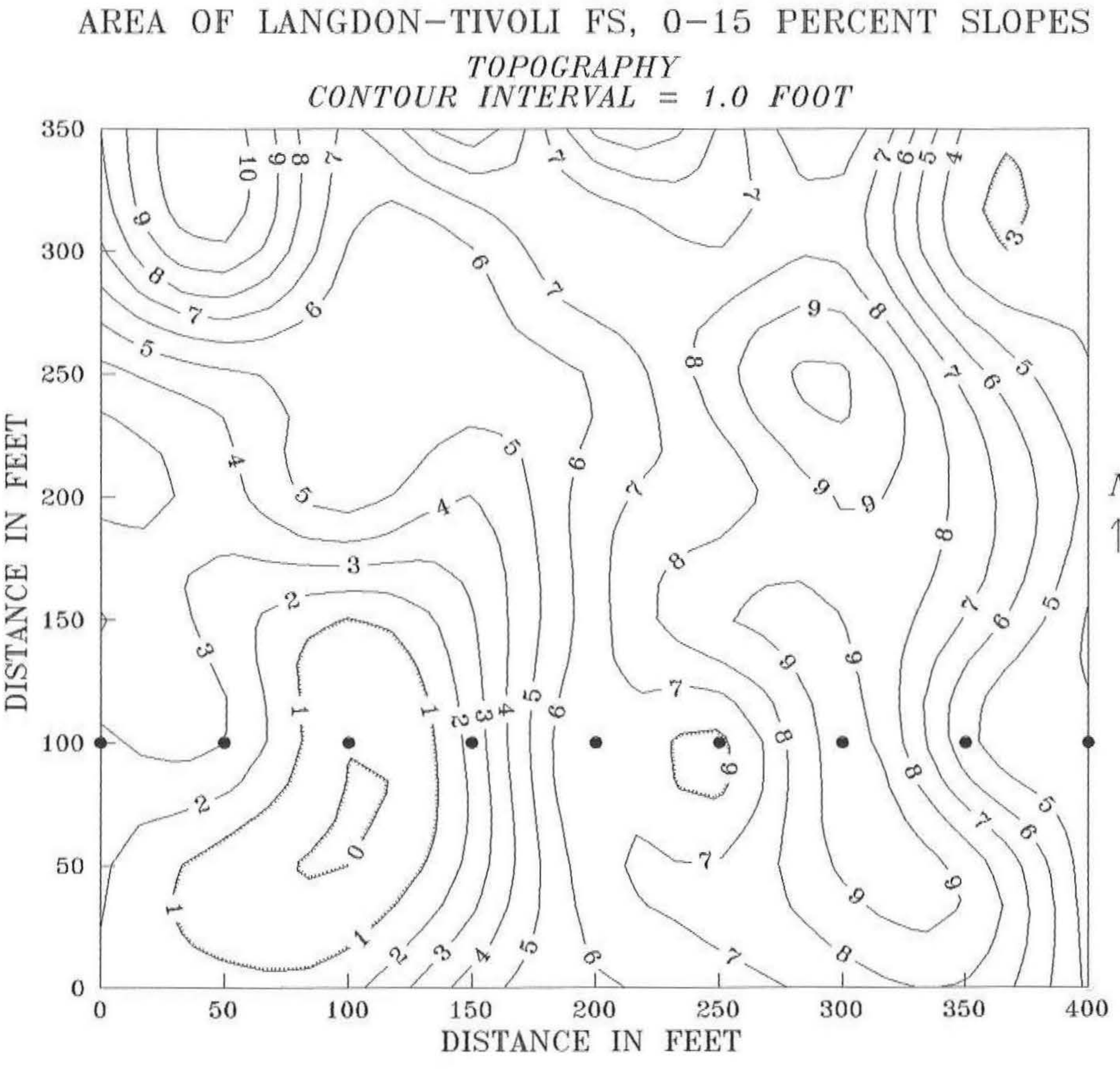

DEPTH TO PALEOSOLS
Dillwyn-Tivoli fs, 0-15 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES


DEPTH TO PALEOSOLS
Pratt loamy fine sand, 1-5 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES

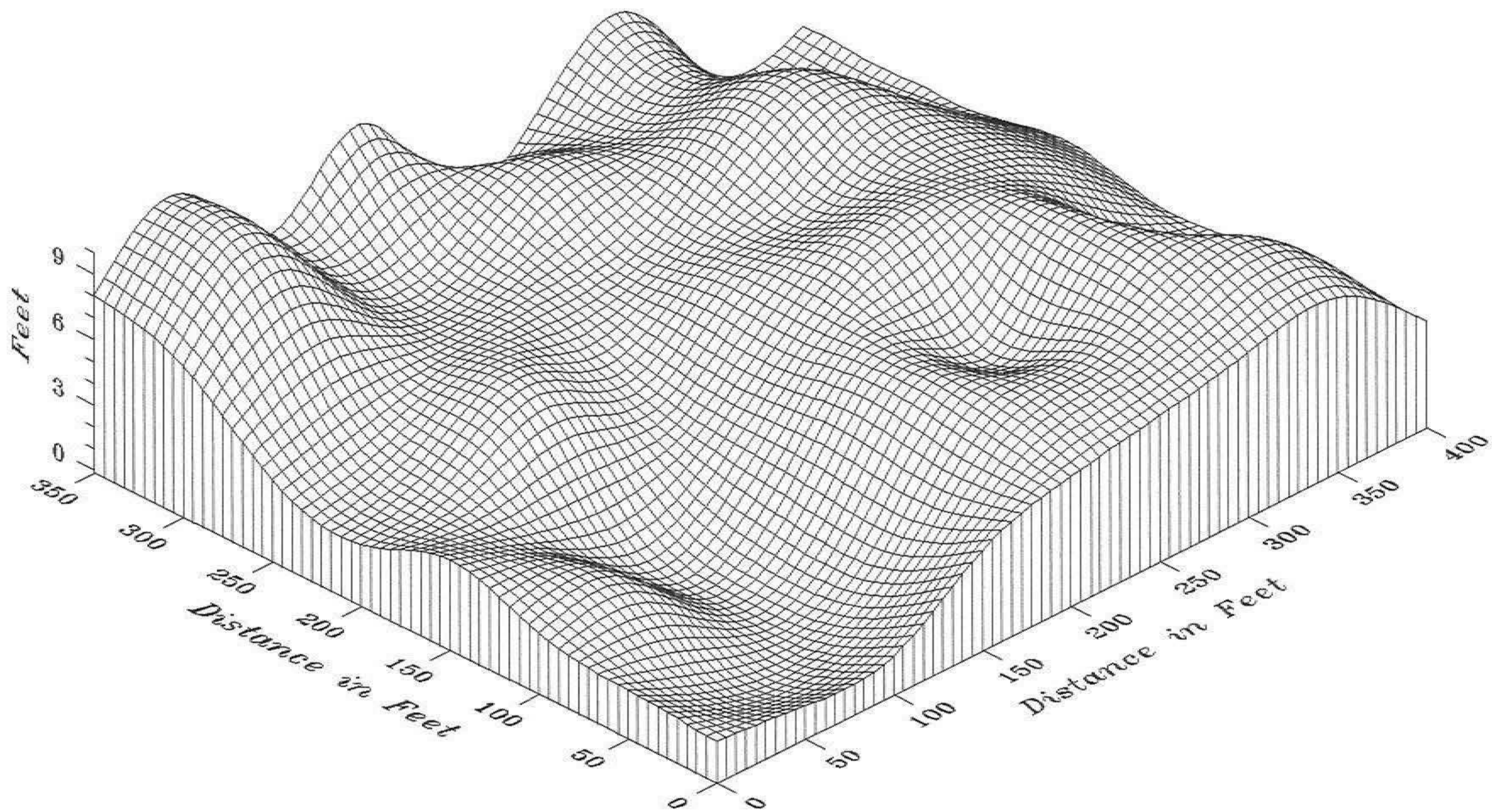

DEPTH TO PALEOSOLS
Turon-Solvay-Carwile complex, 0-5 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES

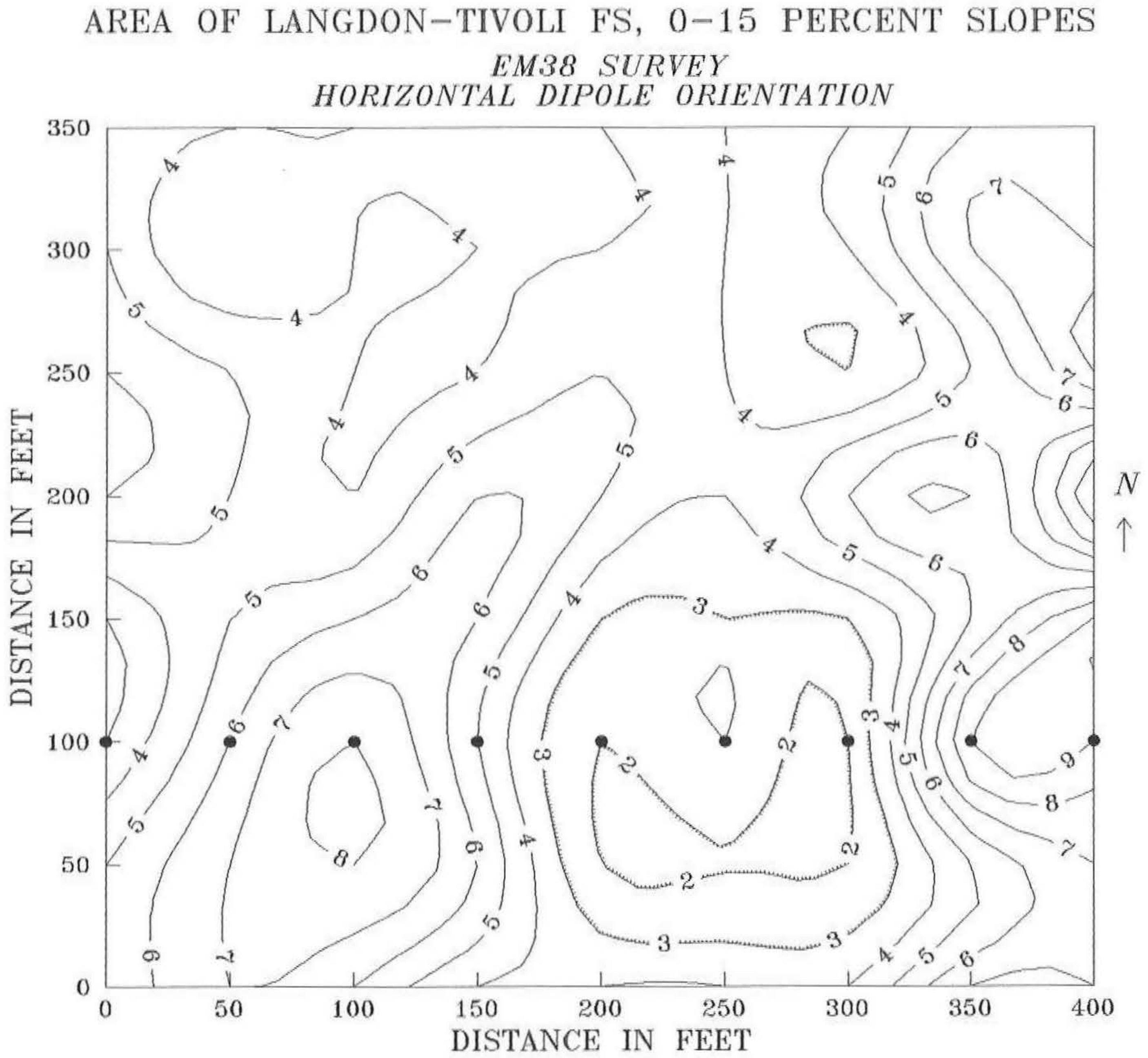

DEPTH TO PALEOSOLS
Langdon-Tivoli fs, 0-15 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES

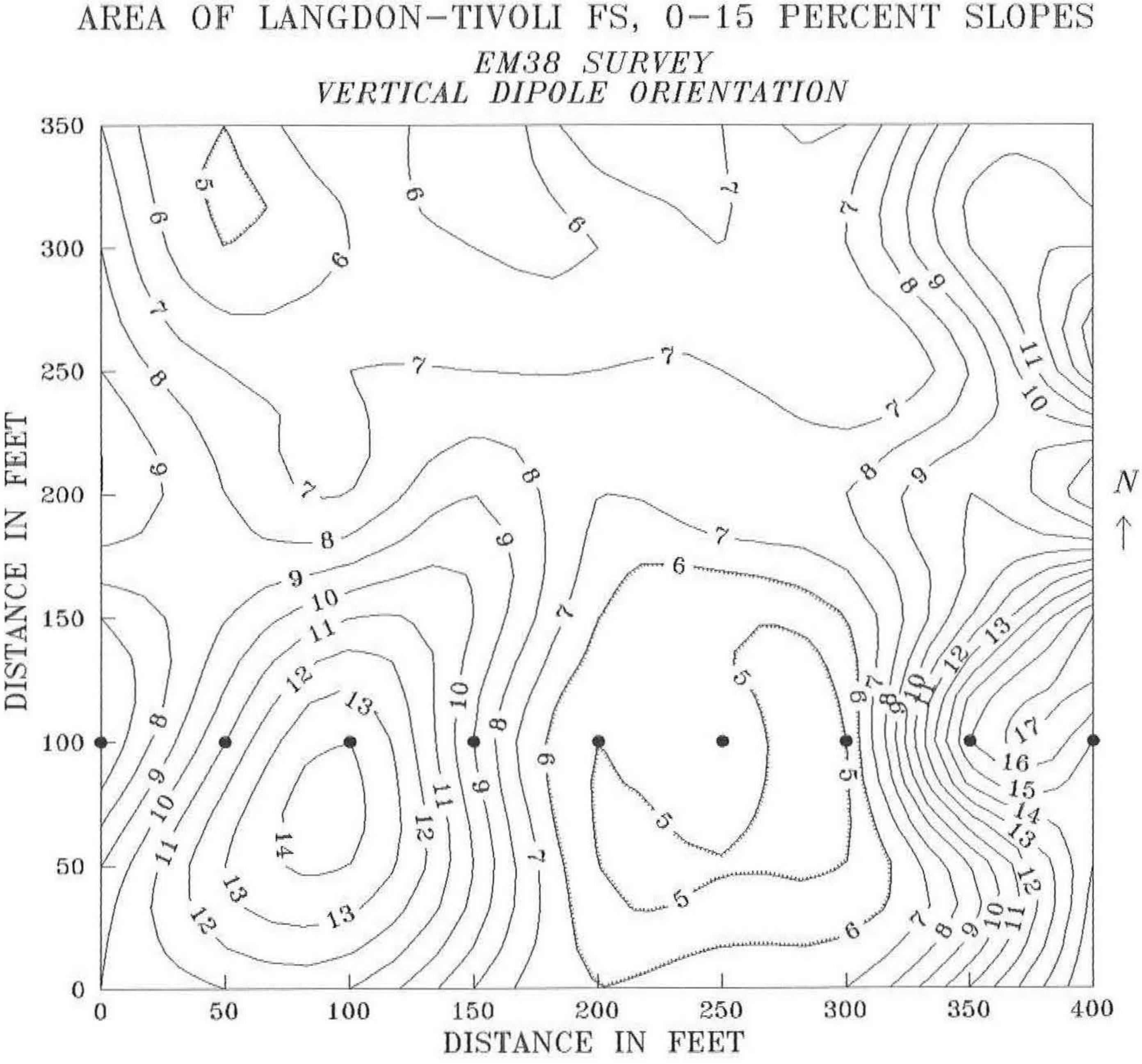

DEPTH TO PALEOSOLS
Tivoli fine sand, 10-30 % slopes
FREQUENCY
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0-20
20-40
40-60
60-80
80-120
>120
DEPTH CLASSES

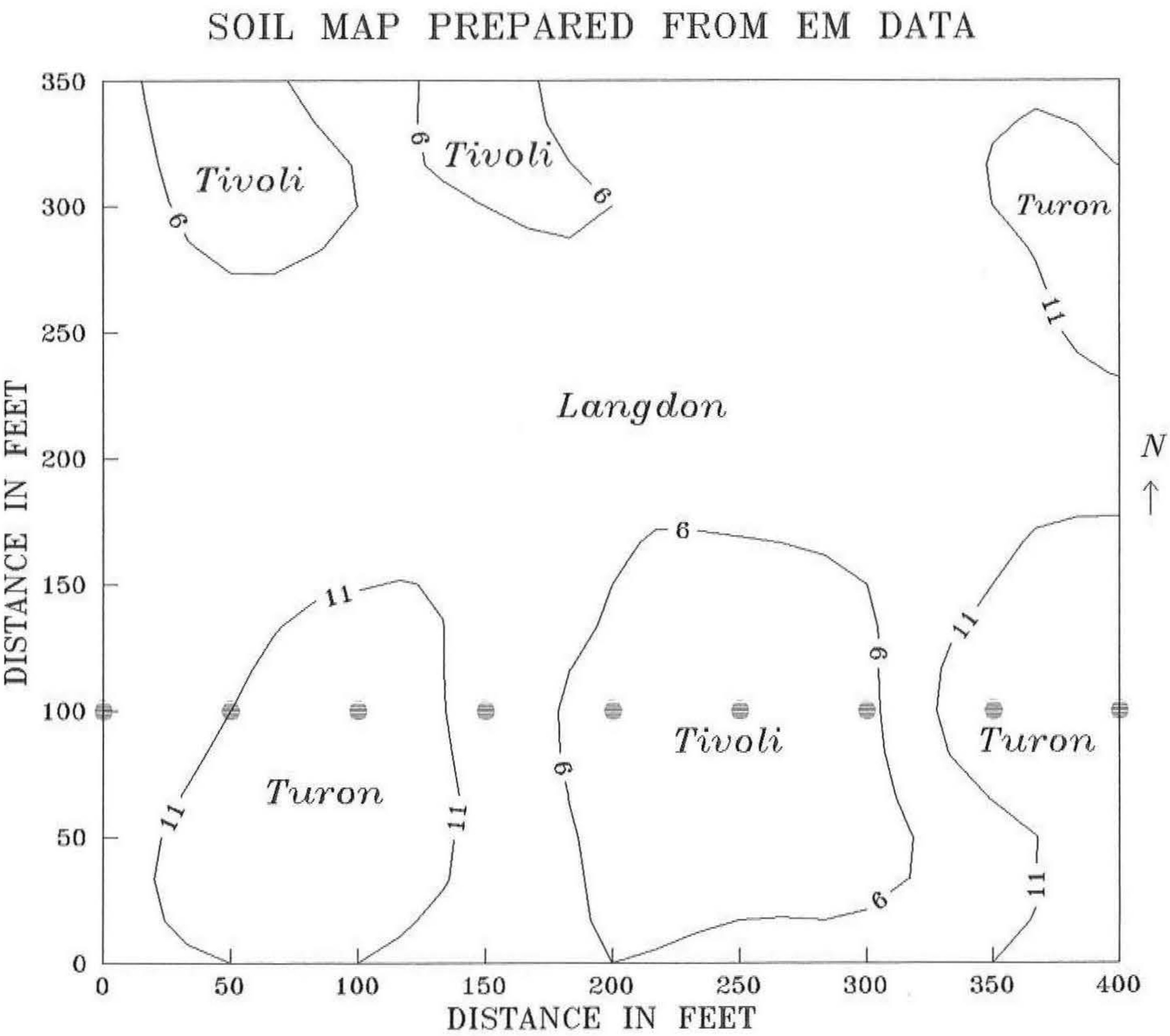

AREA OF LANGDON-TIVOLI FS, 0-15 PERCENT SLOPES
TOPOGRAPHY
CONTOUR INTERVAL = 1.0 FOOT
DISTANCE IN FEET
DISTANCE IN FEET
N
0
50
100
150
200
250
300
350
400

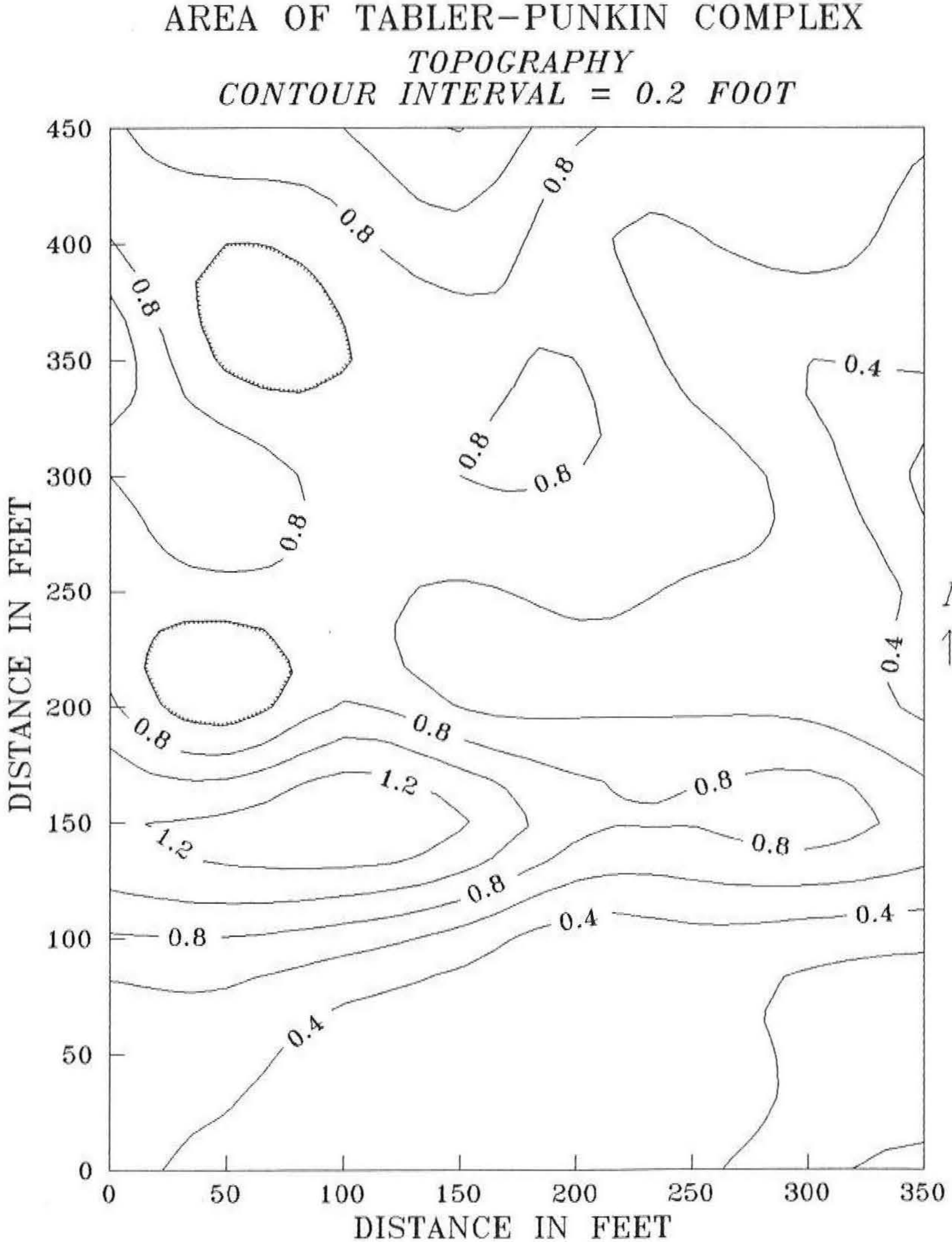
AREA OF LANGDON-TIVOLI FINE SANDS, 0-15 PERCENT SLOPES



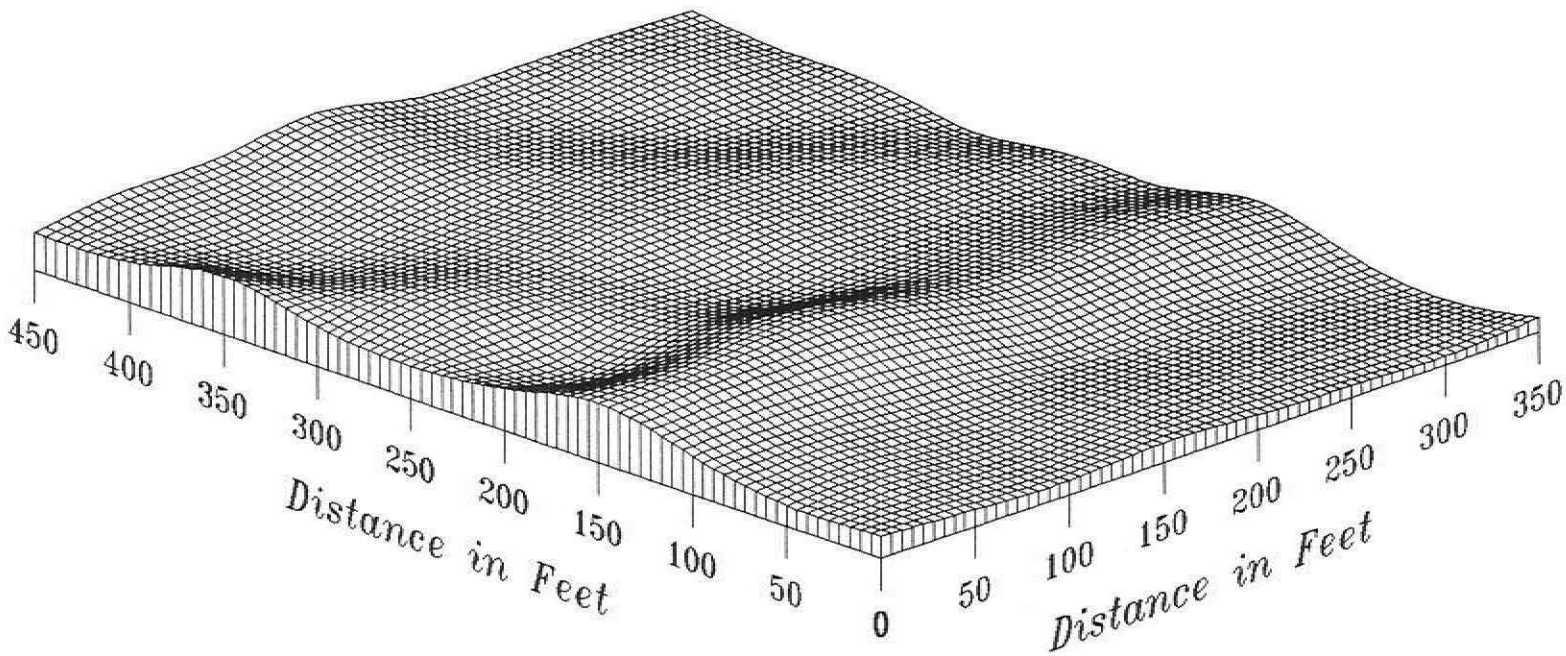

AREA OF LANGDON-TIVOLI FS, 0-15 PERCENT SLOPES
EM38 SURVEY
HORIZONTAL DIPOLE ORIENTATION
DISTANCE IN FEET
DISTANCE IN FEET
N

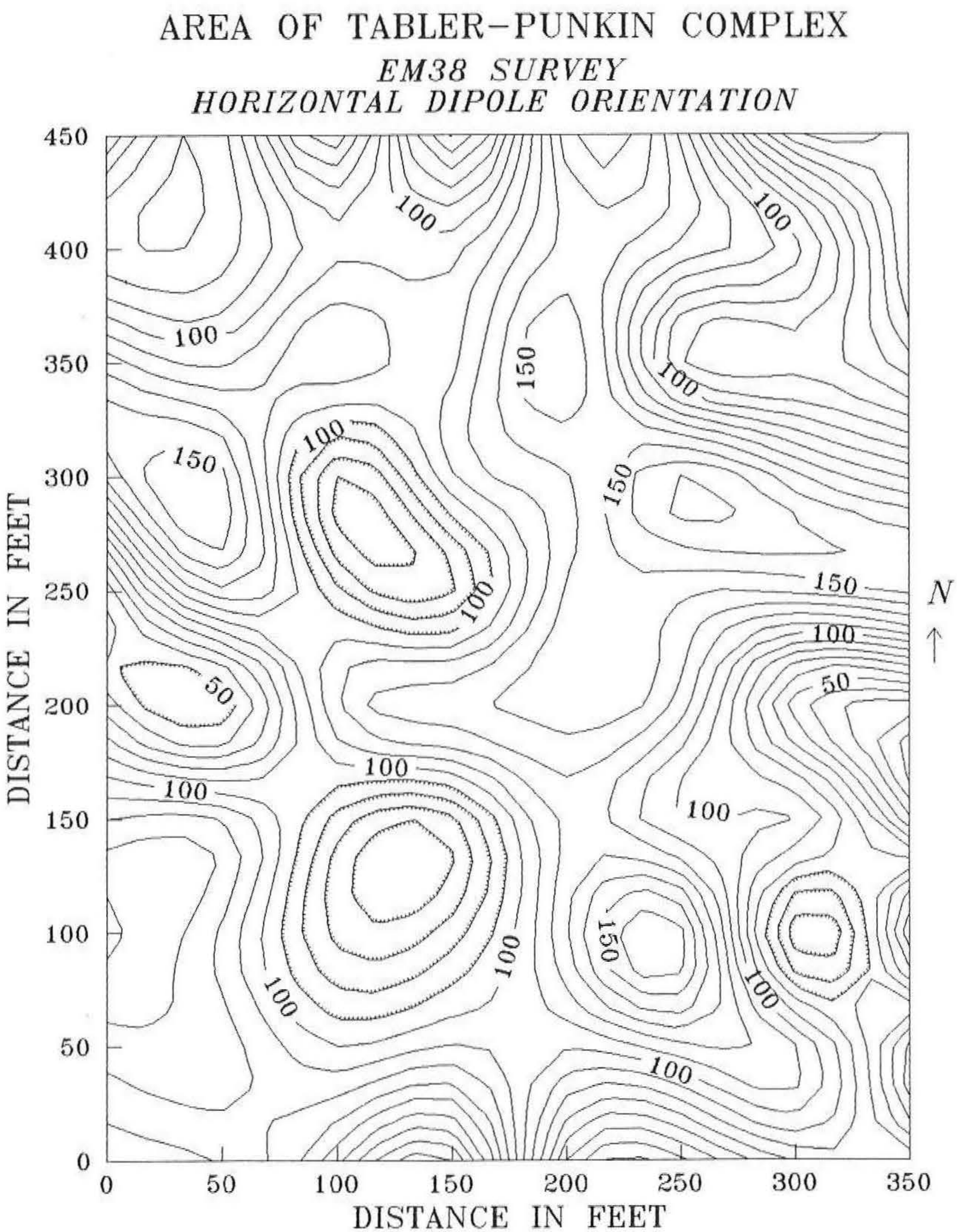

AREA OF LANGDON-TIVOLI FS, 0-15 PERCENT SLOPES
EM38 SURVEY
VERTICAL DIPOLE ORIENTATION
DISTANCE IN FEET
DISTANCE IN FEET
N

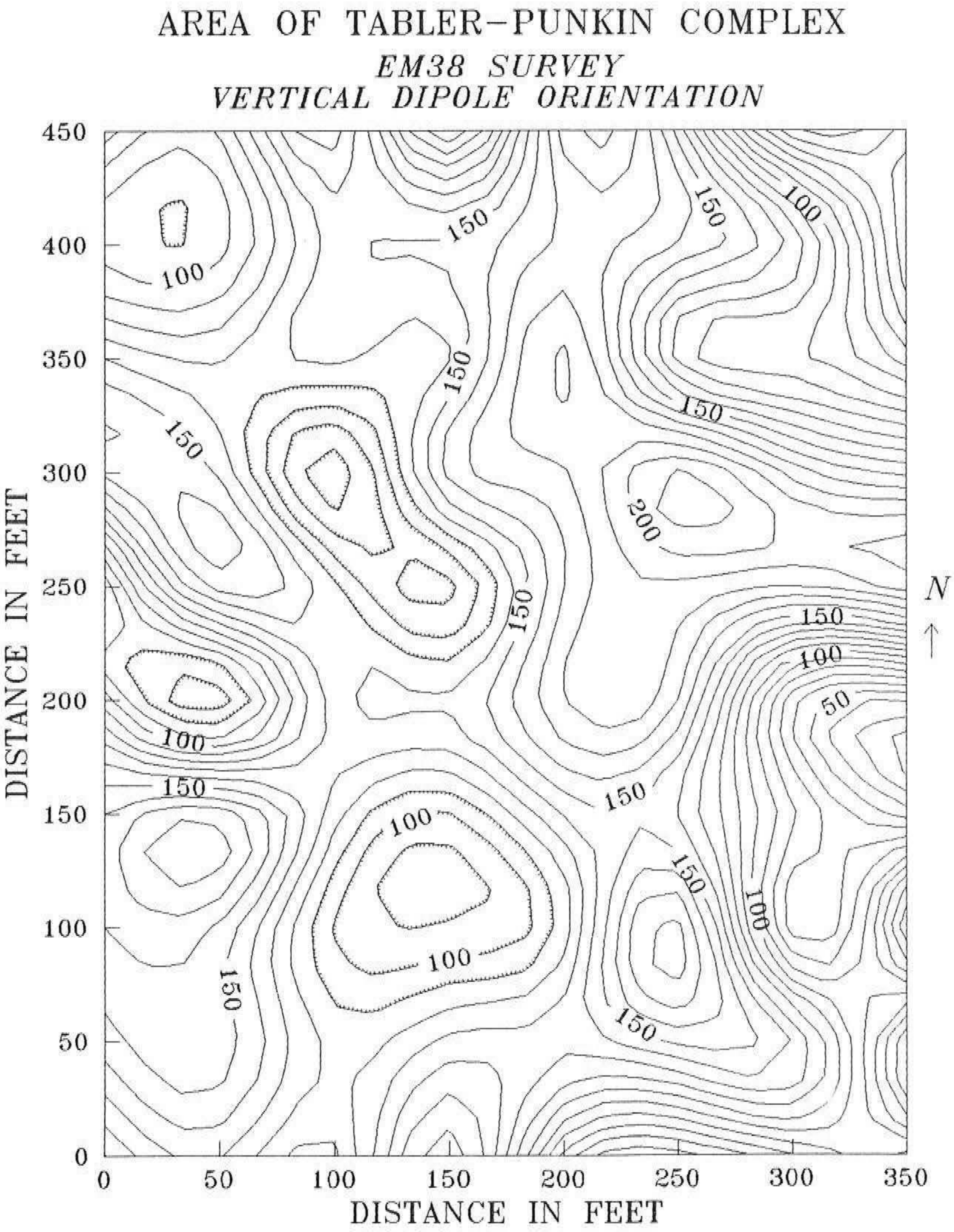

SOIL MAP PREPARED FROM EM DATA
Tivoli
Tivoli
Turon
Langdon
N
Turon
Tivoli
Turon
6
6
6
11
6
11
11
11
6
6
11
11
DISTANCE IN FEET
DISTANCE IN FEET
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400


AREA OF TABLER-PUNKIN COMPLEX
TOPOGRAPHY
CONTOUR INTERVAL = 0.2 FOOT
DISTANCE IN FEET
DISTANCE IN FEET
N
0.8
0.8
0.8
0.8
0.8
0.8
0.8
0.8
0.8
0.8
0.8
0.8
0.8
1.2
1.2
0.4
0.4
0.4
0.4
0.4
0
50
100
150
200
250
300
350
400
450

AREA OF TABLER–PUNKIN COMPLEX




AREA OF TABLER-PUNKIN COMPLEX
EM38 SURVEY
HORIZONTAL DIPOLE ORIENTATION
DISTANCE IN FEET
DISTANCE IN FEET
0
50
100
150
200
250
300
350
400
450
0
50
100
150
200
250
300
350
N
100
150
50


AREA OF TABLER-PUNKIN COMPLEX
EM38 SURVEY
VERTICAL DIPOLE ORIENTATION
DISTANCE IN FEET
DISTANCE IN FEET
0
50
100
150
200
250
300
350
400
450
0
50
100
150
200
250
300
350
100
150
200
50
N