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Iowa Department of Natural Resources

A report on joint agreement number 68-6114-5-2048 between
the United States Department of Agriculture-Soil Conservation Service
and the Iowa Department of Natural Resources-Geological Survey Bureau

Iowa Quaternary Studies Group Contribution Number 14

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ACKNOWLEDGEMENTS

The combined effort of several individuals made this project possible. Dean Thompson, USDA-SCS, Des Moines, initiated the project with his preliminary studies in the watershed. His hard work and excellent salesmanship led to the cooperative agreement that culminated in this report. His enthusiasm and concern for the State's archaeological record has been a constant source of inspiration. Other members of the Planning Staff at the SCS office in Des Moines were very helpful during the project. Roger Schnoor, coordinator of the watershed project, provided much assistance in obtaining maps, landowner information, and did an excellent job of coordinating GSB's activities in the watershed with those of the SCS. Gerald Walker and his crew surveyed all the hole locations and provided GSB with other topographic information. Conversations and a field review with Stan Riggle, Archaeologist at the SCS Midwest Technical Center, Lincoln, NE helped focus the project on issues of concern to both the SCS and the Midwestern archaeological community. John Tandarich, University of Illinois at Urbana-Champaign Agronomy Department spent a few hot days in the field and nearly became part of the Holocene alluvial record of Soap Creek. His assistance with some of the descriptions and thoughtful discussions are greatly appreciated. The report was significantly improved as a result of reviews by Tim Kemmis and Bernie Hoyer of the GSB. Illustrations were prepared by Kay Irelan who was very patient in the face of a rushed deadline. The manuscript was typed by Mary Pat Heitman. Thanks are also due to all landowners who provided access to the study areas.

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ABSTRACT

Soap Creek Watershed drains approximately 65,590 hectares (162,000 acres) of the Des Moines River Basin in the Southern Iowa Drift Plain landform region of southeastern Iowa. Detailed investigations of the late Wisconsinan and Holocene alluvial stratigraphic record in portions of the watershed were conducted in order to develop a landscape evolution model for the area. The purpose of the model was to assist archaeologists and planners in developing effective means for locating and evaluating the archaeological record preserved in the valley landscape. The present valley landscape is a mosaic of surfaces and underlying deposits of varying age and origin. Holocene-age alluvial fills in the watershed were grouped into four formal lithostratigraphic units. These were assigned member status in the DeForest Formation, which encompasses all Holocene-age alluvium in Iowa. The four members have distinct lithologic properties, and consistent landscape positions and stratigraphic relationships throughout the study area. Radiocarbon dates on organic material contained within the alluvial fills indicates that each lithostratigraphic unit was deposited during discrete intervals of the Holocene.

Maps of the distribution of the DeForest Formation members in portions of the watershed are presented. These provide the basis for formulating sampling strategies necessary to evaluate the archaeological resource of the area. The sequence of deposits and their chronology in Soap Creek Watershed is compared to those identified elsewhere in Iowa. Factors responsible for the behavior of the fluvial system are discussed in order to provide a region-wide framework for evaluating the role of fluvial processes in shaping the archaeological record.

INTRODUCTION

Recently, planners, archaeologists, and others involved in cultural resource management have become aware that traditional methods for evaluating the cultural resource potential of an area, such as pedestrian survey and shallow test pitting, do not adequately sample the three dimensions of the landscape. This inadequate sampling has led to significant gaps in the record of known cultural resources as well as erroneous conclusions concerning some aspects of regional cultural history (Bettis and Thompson, 1982; Benn, 1986a). In order to overcome some of these inadequacies in traditional evaluation techniques and to better avoid unanticipated cultural resource discovery during project construction the USDA-Soil Conservation Service (SCS) sponsored a series of geologic investigations in western Iowa watersheds in 1979 and 1980 as part of the cultural resource assessment of those watersheds (Bettis and Thompson, 1982). These studies demonstrated that most of the existing record of prehistoric cultures was buried and not detectable using traditional techniques. It was concluded that only by evaluating the age of the deposits making up the present landscape, and mapping the landforms and deposits underlying them, could an adequate plan for sampling the existing cultural resources be devised (Bettis and Thompson, 1981; Thompson and Bettis, 1981). Benn (1986b) incorporated this approach into an overview of western Iowa archaeology and made recommendations concerning implementation of the Resource Protection and Planning Process in the area (Henning, 1985).

Similar studies sponsored by the U.S. Army Corps of Engineers in the Coralville and Saylorville Lake areas along the Iowa and Des Moines Rivers respectively, came to similar conclusions concerning the visibility of the archaeological record to traditional site locating techniques (Anderson and Overstreet, 1986; Benn, 1986a; Bettis and Hoyer, 1986). These investigations further demonstrated the necessity of understanding the age and distribution of the deposits making up the landscape in order to adequately sample the landscape for archaeological resources.

It was within this framework that the SCS entered into a cooperative agreement with the Iowa Department of Natural Resources, Energy and Geological Resources Division, Geological Survey Bureau (GSB; formerly the Iowa Geological Survey) to study the relationship between alluvial stratigraphy and prehistoric archaeological deposits in portions of Soap Creek Watershed in Appanoose, Davis, Monroe, and Wapello counties of south-central Iowa (Fig. 1). The primary goal of the agreement was to develop a model of late Wisconsinan and Holocene landscape development in order to better identify the context and content of the archaeological record. This model will help archaeologists develop appropriate and effective means of investigating and protecting the archaeological record in the State of Iowa. This report details the results of these investigations and makes recommendations for future archaeological and geomorphological studies in the watershed.

METHODS

Methods used in this investigation are similar to those employed in similar studies conducted by the GSB (Bettis and Hoyer, 1986) and by the Iowa

State University Agronomy Department in cooperation with the SCS (Bettis and Thompson, 1982; Thompson and Bettis, 1980a). After examination of USGS 7.5 minute and 1:2,400 scale topographic maps supplied by the SCS, as well as published soil survey reports of Appanoose (Lockridge, 1977), Monroe (Oelmann, 1984), and Wapello counties (Seaholm, 1981) three proposed structure site areas were selected for detailed investigations. The areas selected were representative of the proposed structure sites in the watershed--in the upper part of the drainage network and in the western two-thirds of Soap Creek Basin. The detailed investigations involved drilling several transects of 7.6 cm (3 in) diameter borings across the valleys in order to examine the deposits beneath the valley surface. All borings were taken as continuous, intact core and described in the field using standard USDA nomenclature (Soil Survey Staff, 1975). Soil horizon terminology follows that proposed in Soil Survey Staff, 1981 (see also Bettis, 1984a). All descriptions are presented in Appendix A. Hole numbers at individual sites follow the "AB" designation in Appendix A (e.g., 68AB7 is hole number 7 at site 68-66). Locations and elevations of borings were determined by SCS transit survey. In most cases borings extended into pre-Wisconsinan-age deposits. Cross-sections were constructed from these data. Organic material encountered in the borings and in stream bank exposures was collected and submitted to Beta Analytic Inc., Coral Gables, Florida for radiocarbon dating. A total of twelve radiocarbon dates were obtained during the project. Deposits from selected borings were collected and processed for particle-size distribution, pH, clay mineralogy, and organic carbon content at the GSB's Quaternary Materials Laboratory. Particle-size distribution was determined by the pipette method as described by Walter et al., (1978). Sediment pH was determined by emersing a combination electrode attached to a Fisher Acument 800 pH meter in the supernatant liquid of a 1:1 sediment:distilled water mixture after allowing the mixture to equilibriate for 30 minutes. Organic carbon content of the samples was determined using a modification of the Walkley-Black wet combustion method (Andrew Manu, Agronomy Department, Iowa State University, Ames, personal communication, 1985). Laboratory data for selected profiles are presented in Appendix C. Clay mineralogy of selected glacial till samples was evaluated using the "semi-quantitative" method of Glass (Hallberg et al., 1978a). These analyses were performed on a Phillips APD 3500 Automated Powder Diffractometer.

Stream banks were examined and the exposed deposits described in some portions of the watershed where subsurface borings were not taken. Organic materials were collected and submitted for radiocarbon analysis from some of these exposures.

Prior to the GSB investigation, personnel from the SCS took borings and made preliminary geomorphological observations in several areas within the watershed (Thompson, 1983a). Data from these studies are incorporated into this report.

PROJECT LOCATION

Soap Creek is a right-bank tributary of the Des Moines River valley (Fig. 1). It joins with the Des Moines Valley near the town of Eldon in southeastern Wapello County, downstream of Ottumwa. Soap Creek drains approximately 65,590 ha (162,000 ac) of the Southern Iowa Drift Plain landform region

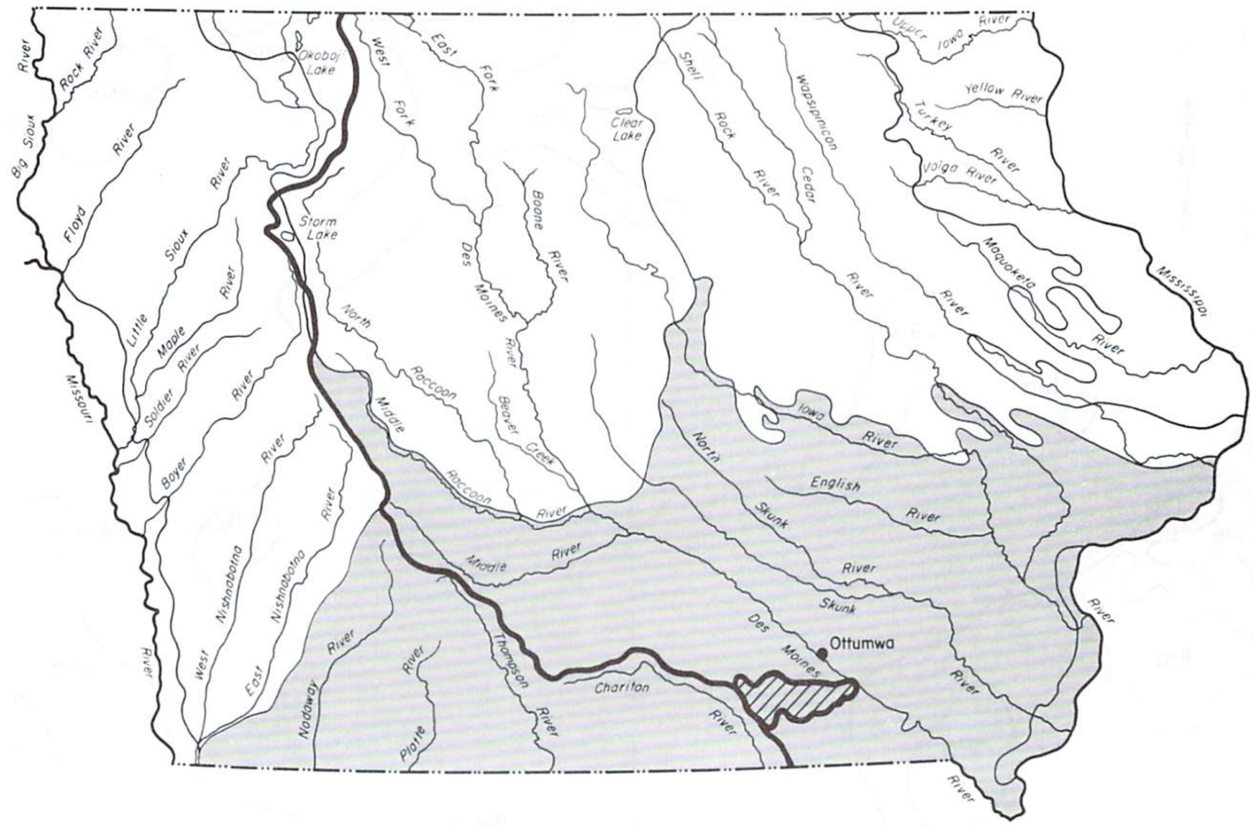


Figure 1. Location of Soap Creek Watershed (crosshatched outline) within the Southern Iowa Drift Plain (gray pattern).

(Fig. 1). Soap Creek has five major tributaries: Little Soap Creek (10,880 ha, 26,880 ac), Brush Creek (4,560 ha, 11,264 ac) Bear Creek (4,094 ha, 10,112 ac), South Fork (10,882 ha, 26,880 ac), and North Fork (25,134 ha, 62,080 ac). Soap Creek Basin is long and relatively narrow (approximately 2.4 times longer than its widest portion) and drains from west to east. The western boundary of the watershed is located along the Des Moines-Chariton (Mississippi-Missouri) basin divide.

BEDROCK GEOLOGY

The uppermost bedrock in the four county area drained by Soap Creek is siltstone, shale, sandstone, coal, and limestone of the Marmaton and Cherokee

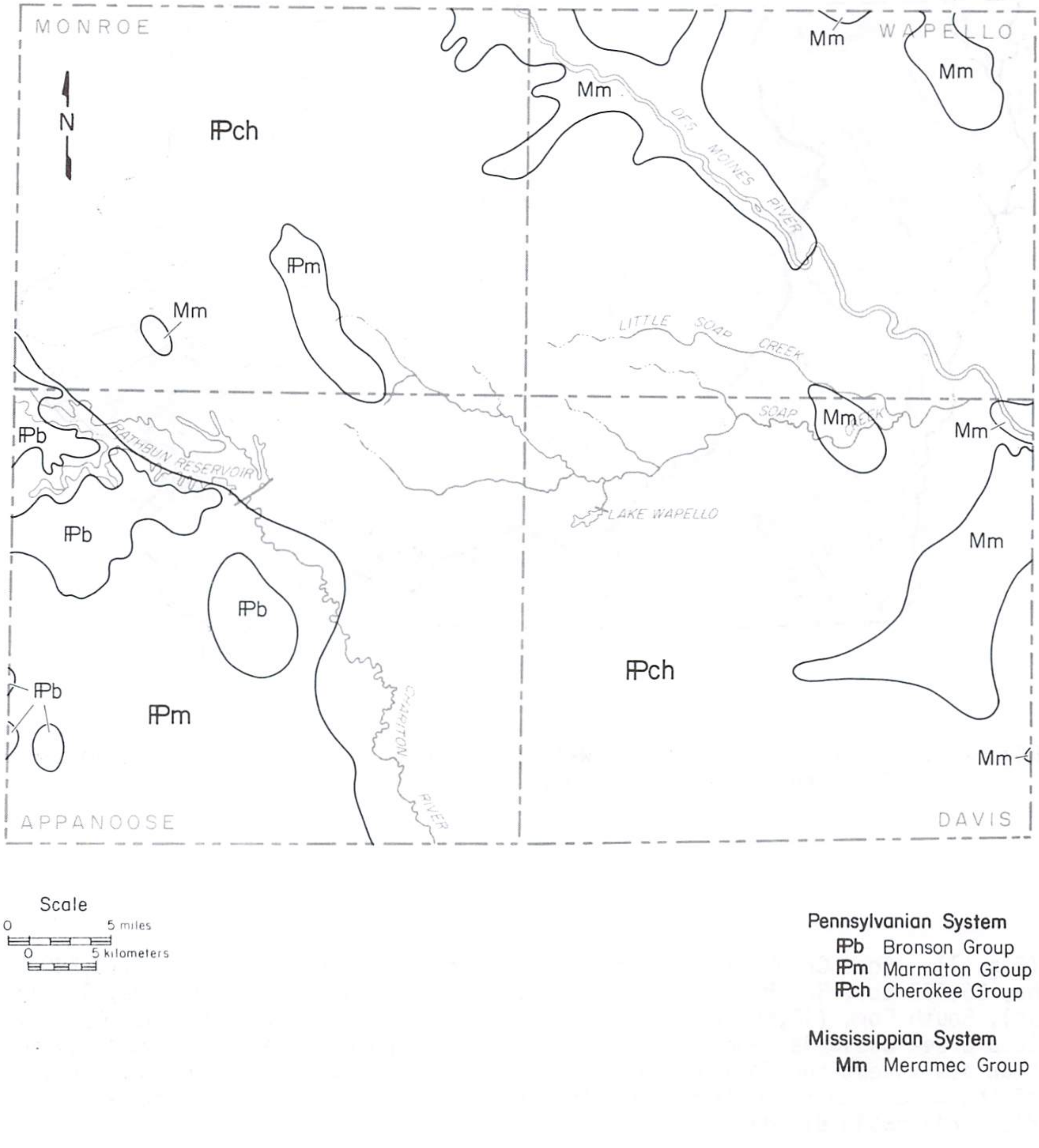


Figure 2. Map of the bedrock geology in Appanoose, Davis, Monroe, and Wapello counties with an overlay of the present drainage system of Soap Creek Watershed.

groups of the Pennsylvanian System (Fig. 2). These rocks were deposited in fluvial, deltaic, and marine settings during numerous transgressions and regressions of the Transcontinental Sea (Heckel, 1977; Ravn et al., 1984). Heckel (1977, 1980) has suggested that fluctuations in sea level during the Pennsylvanian were glacio-eustatic in origin. The lowermost Pennsylvanian rocks were deposited on an erosion surface developed on Mississippian System carbonates. Mississippian carbonates outcrop in the eastern part of Soap Creek Watershed around the confluence of Soap Creek and Little Soap Creek. In this report lithotypes are described, but formal stratigraphic designations of the Pennsylvanian rocks do not go below the Supergroup level.

QUATERNARY GEOLOGY

Pennsylvanian rocks are unconformably overlain by Early and Middle Pleistocene-age glacial tills (diamictons), associated outwash, and interglacial alluvium, colluvium, and loess. The extent of individual depositional units and the relationships among many of these units are poorly understood at this time. Extensive erosion, both glacial and subaerial, has obliterated most of the deposits originally present, and created a complex mosaic of laterally discontinuous deposits varying in age and origin. Subsurface investigations by Hallberg and Boellstorff (1978; Boellstorff, 1978; Hallberg, 1980; 1986) demonstrated that the classic model of two Pre-Illinoian glaciations (Kansan and Nebraskan) was grossly oversimplified and had led to numerous miscorrelations of glacial and interglacial deposits across the Midcontinent. Hallberg (1980) grouped all Pre-Illinoian deposits into two formal lithostratigraphic units, the Alburnett Formation and the overlying Wolf Creek Formation, on the basis of the mineralogy of their clay fraction. The Wolf Creek Formation was subdivided into members on the basis of particle-size and combined particle-size and matrix-carbonate data. Fission-track ages and geochemical correlation of volcanic ashes interbedded in the Pre-Illinoian till sequence of western Iowa suggest that the youngest Pre-Illinoian till in southern and eastern Iowa is about 500,000 years old, while the oldest till, stratigraphically below Alburnett Formation deposits, is in excess of 2.2 million years old (Hallberg et al., 1984; Hallberg, 1986; Bettis et al., 1986).

Over 30 samples of Pre-Illinoian till from Soap Creek Watershed were analyzed for particle-size distribution and clay mineralogy as part of this study. The analyses indicate that the tills in this area have clay-mineral assemblages closely related to local bedrock source materials and unlike those typical of the Wolf Creek and Alburnett formations in eastern Iowa. The Soap Creek samples contain higher percentages of kaolinite + chlorite, and lower percentages of expandable clay minerals than are typical regionally for the Wolf Creek and Alburnett formations (Fig. 3). These differences can be attributed to the local incorporation of underlying Pennsylvanian-age bedrock whose clay-mineral assemblage is high in kaolinite + chlorite and very low in expandables. The Pre-Illinoian till sequence is relatively thin in this area and the underlying shales, siltstones, and coals are not very resistant to glacial erosion. The result is that large quantities of local rock were incorporated into the tills and altered their mineralogy. This phenomena is obvious in Figure 3; the clay mineralogy of the Soap Creek Watershed samples is intermediate between the average values of Pre-Illinoian tills in eastern

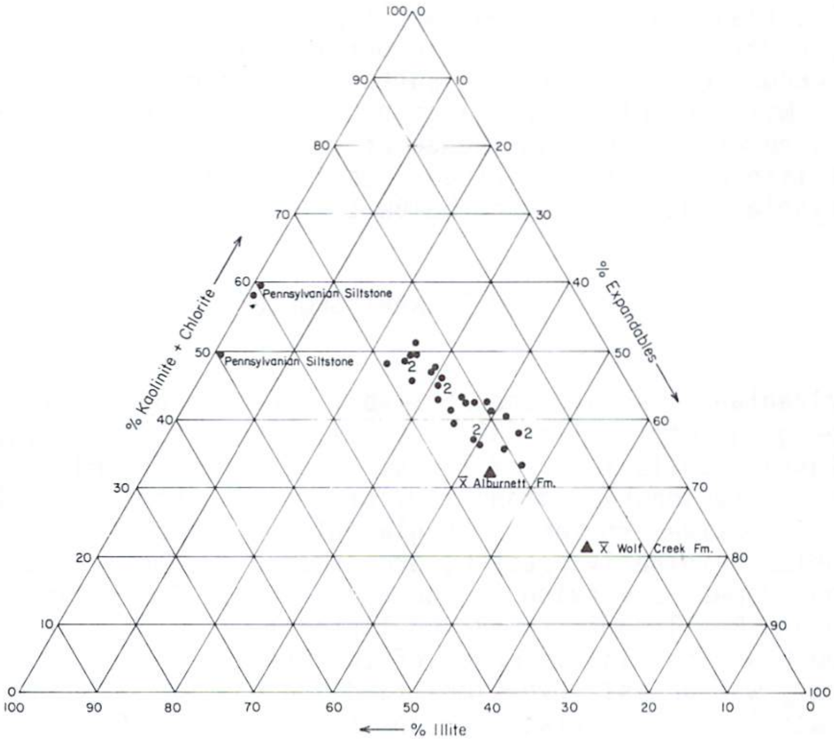


Figure 3. Ternary plot of the clay-mineral assemblages of Pre-Illinoian-age tills and Pennsylvanian-age rocks collected from Soap Creek Watershed. Note that the tills in the area have clay-mineral assemblages intermediate between the regional averages of eastern Iowa Pre-Illinoian-age tills (Hallberg, 1980) and the local substrate of Pennsylvanian-age rocks.

Iowa and values determined from samples of the bedrock in the watershed. Alteration of lithic properties of tills by incorporation of local substrate materials has also been documented in the southern part of the late Wisconsinan-age Des Moines Lobe in north-central Iowa (Bettis et al., 1985; Kemmis and Lutenegger, unpublished data; see also Hallberg, 1985).

Several large valleys buried by Pre-Illinoian till are cut into the bedrock surface throughout Iowa. These valleys do not contain the oldest Pre-Illinoian tills, but do contain Alburnett and Wolf Creek Formation tills (George Hallberg, GSB, personal communication). These relationships suggest that the valleys developed during the Pleistocene and are not pre-glacial in age. The Des Moines Valley crosscuts one of these buried bedrock valleys and

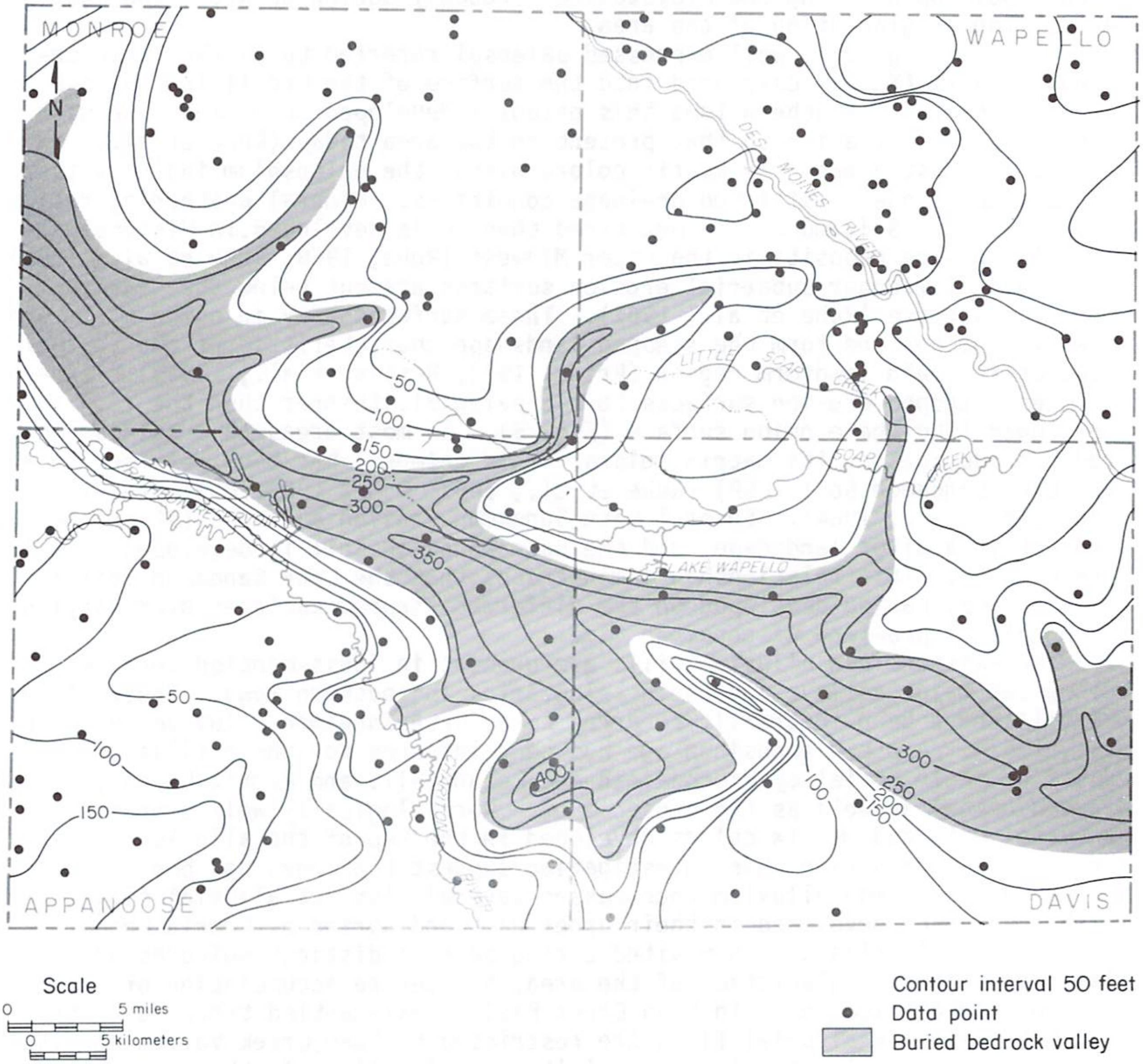


Figure 4. Map showing the thickness of Quaternary materials and the location of a large buried bedrock valley (density pattern) in Appanoose, Davis, Monroe, and Wapello counties. Note that the present locations of the Des Moines and Soap Creek valleys do not conform to the trend of the buried valley. The present drainage system is unrelated to the buried valley system. Dots are well locations used to construct the map. Well logs are on file at GSB.

therefore postdates the buried valley (Fig. 4). This indicates that this reach of the Des Moines Valley, as well as its major tributaries such as Soap Creek, developed during the Pleistocene, probably during or after the last Pre-Illinoian glaciation of the area.

A morphologically well expressed paleosol referred to as the Yarmouth-Sangamon Soil (YS) is developed into the surface of the Pre-Illinoian deposits (Ruhe, 1969). In southern Iowa this paleosol developed on a landscape with subdued relief relative to that present in the area today (Ruhe et al., 1967). In most areas gray matrix colors within the paleosolum indicate that it developed under restricted drainage conditions. Mineral weathering ratios show that the YS is much more weathered than soils developed in Wisconsinan- or Holocene-age deposits in the upper Midwest (Ruhe, 1969; Ruhe et al., 1967).

Several younger subaerial erosion surfaces are cut below the Yarmouth-Sangamon surface (Ruhe et al., 1967). These surfaces vary in number from one area to another and form the stepped landscape characteristic of the Southern Iowa Drift Plain landform region (Prior, 1976; Bettis et al., 1984b). Several of these stepped erosion surfaces have a paleosol, thinner than the YS, developed into the erosion surface (Fig. 5). In most areas this paleosol has red hues dominating its matrix colors. This paleosol has been referred to as the Late Sangamon Soil (LSP) (Ruhe et al., 1967; Ruhe, 1969; Hallberg, 1980; Canfield et al., 1984). Several Late Sangamon erosion surfaces (steps) may be present in a given landscape, and the Late Sangamon Soil is developed on all these steps. This relationship demonstrates that the Late Sangamon Soil is diachronous, having developed on the different stepped surfaces over varying intervals of pre-late Wisconsinan time.

Pre-Wisconsinan alluvial fills are present in loess-mantled terraces along the major valleys and their tributaries in southern Iowa. These alluvial fills have been informally referred to as Late Sangamon alluvium (Ruhe et al., 1967). A pre-Wisconsinan age has been inferred for these fills on the basis of their burial by Wisconsinan-age Roxana Silt and Peoria Loess (discussed below) as well as the presence of a morphologically well expressed paleosol with red matrix colors developed in the top of the alluvium. Observations made during this investigation suggest that what has been referred to as Late Sangamon alluvium encompasses several distinct alluvial fills, each with a paleosol developed in their upper part and buried by Peoria Loess. These alluvial fills were deposited during several distinct episodes after the last Pre-Illinoian glaciation of the area, but before accumulation of Wisconsinan-age loesses. In Soap Creek Basin loess-mantled terraces containing Late Sangamon alluvial fills are restricted to Soap Creek Valley and its major tributary valleys. In the vicinity of Unionville, in the central portion of the watershed, the terraces are approximately 18 m (60 ft) above the modern floodplain. In this area about 1.9 m of Wisconsinan-age loess (Peoria and Roxana) buries a paleosol developed in the terrace deposits (see description 04AB1 in Appendix A). These terraces decrease in elevation up-valley relative to the modern floodplain. Higher level, loess-mantled alluvial fills with paleosols developed in their upper part are also present within the watershed. These fills are present beneath dissected terrace or bench levels 20 to 30 m above the present valley floor. The alluvium comprising these fills is coarser than that described in the lower loess-mantled terrace (see description of site 04SC-D in Appendix A).

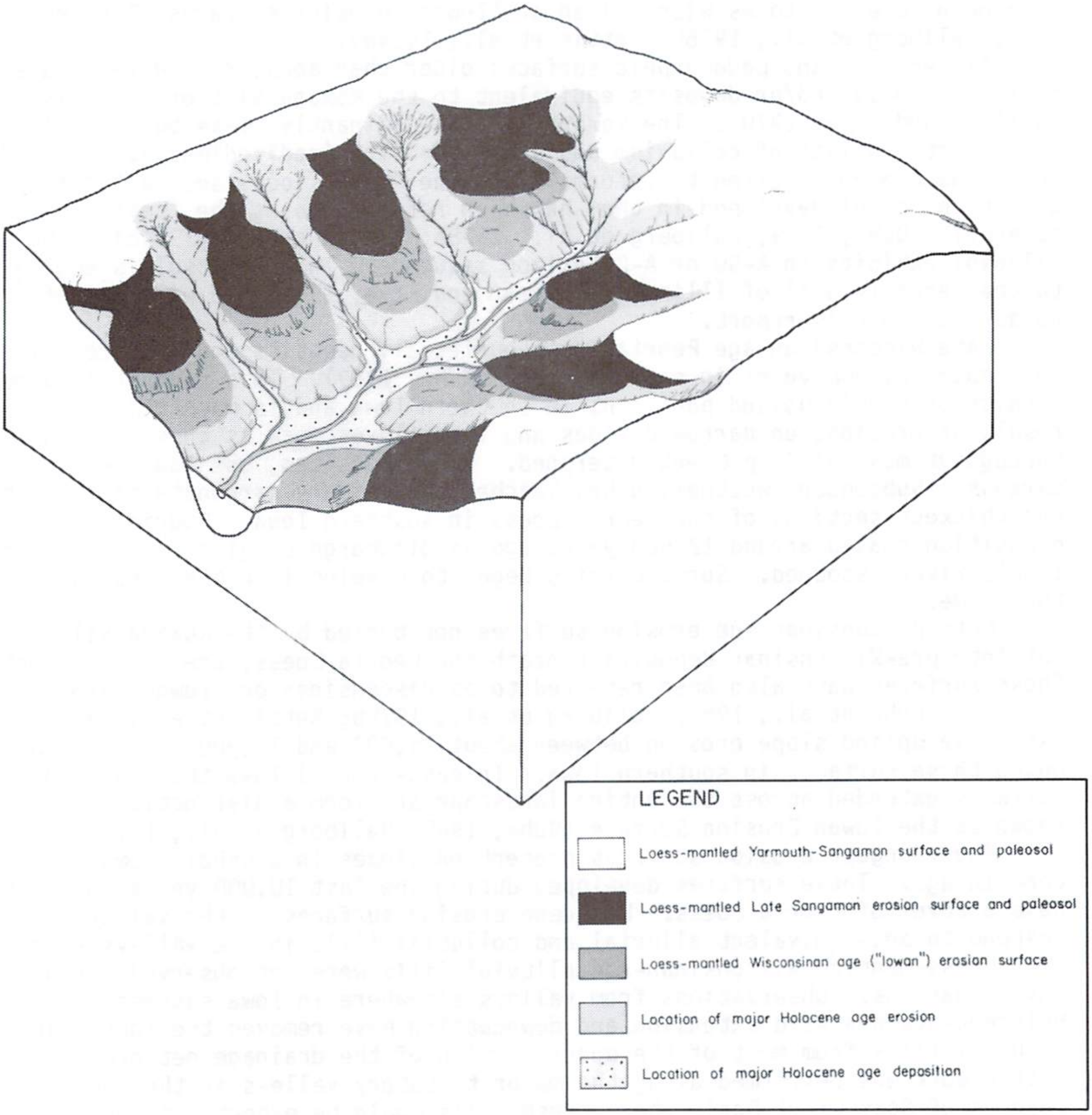


Figure 5. Schematic diagram of stepped erosion surfaces in an idealized low-order drainageway in Southern Iowa.

Younger, late Wisconsinan-age erosion surfaces are cut below the Late Sangamon erosion surfaces and alluvial fills. No paleosol is developed into the deposits beneath the erosion surface on these lower steps. These surfaces have been referred to as Wisconsinan or "Iowan" erosion surfaces (Ruhe et al., 1967; Hallberg et al., 1978b; Bettis et al., 1984b).

All erosion and pedomorphic surfaces older than about 30,000 years are buried by loess and/or deposits equivalent to the Roxana Silt of Illinois (Willman and Frye, 1970). The Roxana Silt is dominantly loess but usually its basal part consists of colluvium and slope deposits (pedisediment). These deposits have been referred to informally as the "basal loess sediments" in Iowa, and the paleosol developed in them has been referred to as the "basal loess paleosol" (Ruhe, 1969; Hallberg et al., 1978b; Bettis et al., 1984b). The paleosol exhibits an A-Bw or A-C horizon sequence. This paleosol is equivalent to the Farmdale Soil of Illinois (Willman and Frye, 1970) and will be referred to as such in this report.

Late Wisconsinan-age Peoria Loess buries all deposits and surfaces older than about 21,000 years in southern Iowa (Ruhe, 1969). This deposit is about 5 m thick on stable upland positions in southern Iowa and is much thinner, as a result of erosion, on narrow divides and interfluves such as those present throughout most of Soap Creek Watershed. When deposited, the loess was calcareous. Subsequent weathering has leached the primary carbonate from all but the thickest sections of the Peoria Loess in southern Iowa. Peoria Loess deposition ceased around 12,500 years ago as discharge of glacial outwash into Iowa's rivers stopped. Surface soils began to develop into the loess after that time.

Late Wisconsinan-age erosion surfaces not buried by the Roxana Silt and cut into pre-Wisconsinan deposits beneath the Peoria Loess, are also present. These surfaces have also been referred to as Wisconsinan or "Iowan" erosion surfaces (Ruhe et al., 1967; Hallberg et al., 1978b; Bettis et al., 1984b). Extensive upland slope erosion between about 25,000 and 17,000 years ago produced these surfaces in southern Iowa. In east-central Iowa these erosion surfaces extended across the entire landscape and form a distinctive landscape known as the Iowan Erosion Surface (Ruhe, 1969; Hallberg et al., 1978b).

The youngest erosion surfaces present on slopes in southern Iowa are Holocene in age. These surfaces developed during the last 10,000 years and do not have a cover of Peoria Loess. Holocene erosion surfaces on the valley slopes descend to age-equivalent alluvial and colluvial fills in the valleys (Fig. 5).

Loess-mantled Wisconsinan-age alluvial fills were not observed during our investigations. Observations from valleys elsewhere in Iowa suggest that Holocene-age headward extension and downcutting have removed the loess-mantled alluvial fills from most of the upper portion of the drainage network. Very little work was performed along the major tributary valleys in the lower reaches of Soap Creek Basin where these fills would be expected to occur.

Wisconsinan- and Holocene-age fluvial deposits in the state are grouped into two formations, the Noah Creek and DeForest. All Wisconsinan-age alluvial units are included in the Noah Creek Formation (Bettis and Kemmis, in preparation). The dominant grain size in this formation is usually larger than medium sand (0.5 mm). Relatively thin, coarse, in-channel deposits genetically related to Holocene-age fine-grained overbank sequences of the DeForest Formation are not included in the Noah Creek Formation. At this time the Noah Creek Formation has not been subdivided into members.

The DeForest Formation contains all the fine-grained Holocene-age alluvium in the state. This formation has been studied in great detail in western Iowa where it has been divided into six members on the basis of lithologic differences (Daniels et al., 1963; Bettis and Thompson, 1982; Bettis and Thompson, in preparation). Throughout the remainder of the state, DeForest Formation deposits tend to be thinner and less silty than in western Iowa. Holocene alluvium in western Iowa occurs in stacked gully fills deposited after headward extension of gullies (Bettis and Thompson, 1985). In the remainder of the state, streams are usually not confined to gullies and the alluvial fills occur as thinner, horizontally distributed units. Two different members, the Gunder and Roberts Creek members, have been defined in the DeForest Formation outside of western Iowa because of lithologic differences. The Turton, Mullenix, Hatcher, and Watkins members are restricted to western Iowa. The Camp Creek and Corrington members are mapped throughout the state.

The Camp Creek Member is oxidized to unoxidized silty, loamy, and sandy loam stratified alluvium found throughout the valley landscape. It is derived from both overbank flooding and slope wash, and can bury all other members of the DeForest Formation. It is Historic in age and has been informally referred to as "postsettlement alluvium" in many studies.

The Corrington Member is oxidized silty and loamy alluvium and colluvium making up alluvial fans. The Corrington Member consists of several fining-upward sequences representing episodic accumulation of deposits on the fans (Hoyer, 1980; Bettis and Hoyer, 1986). Paleosols are developed in the upper part of the fining-upward sequences and represent periods of relative stability separating the sedimentation episodes. Regionally, the Corrington Member accumulated primarily during the early and middle Holocene.

Two new members, Gunder and Roberts Creek, are mapped in all areas of the state except western Iowa. The Gunder Member is oxidized, silty to loamy alluvium and colluvium usually found beneath terraces in third-order and larger valleys, and beneath much of the valley floor in first-and second-order drainageways. This unit often interfingers with the Corrington Member and is either truncated or buried by the Roberts Creek Member in the present floodplain area. The Gunder Member accumulated during the latest Wisconsinan and into the late middle Holocene. The landscape occurrence and lithologic properties of the Gunder Member are similar to the Watkins and Hatcher members of the DeForest Formation in western Iowa.

The Roberts Creek Member is a dark-colored, loamy unit commonly found beneath present floodplains and low terraces. This unit truncates the Gunder and Corrington members in the floodplain area. The Roberts Creek Member accumulated during the late Holocene. The landscape occurrence and lithologic properties of the Roberts Creek Member are similar to the Mullenix and Turton members of western Iowa. Table 1 presents generalized descriptions for the members of the DeForest Formation in Soap Creek Watershed.

STRATIGRAPHY OF SELECTED STUDY SITES

Three structure site areas and several other localities lower in the drainage network were studied in detail by GSB personnel. The structure site areas studied include 68-66 and 68-55 located in the northwestern part of the watershed in southeastern Monroe County, and site 90-109 located in the west-

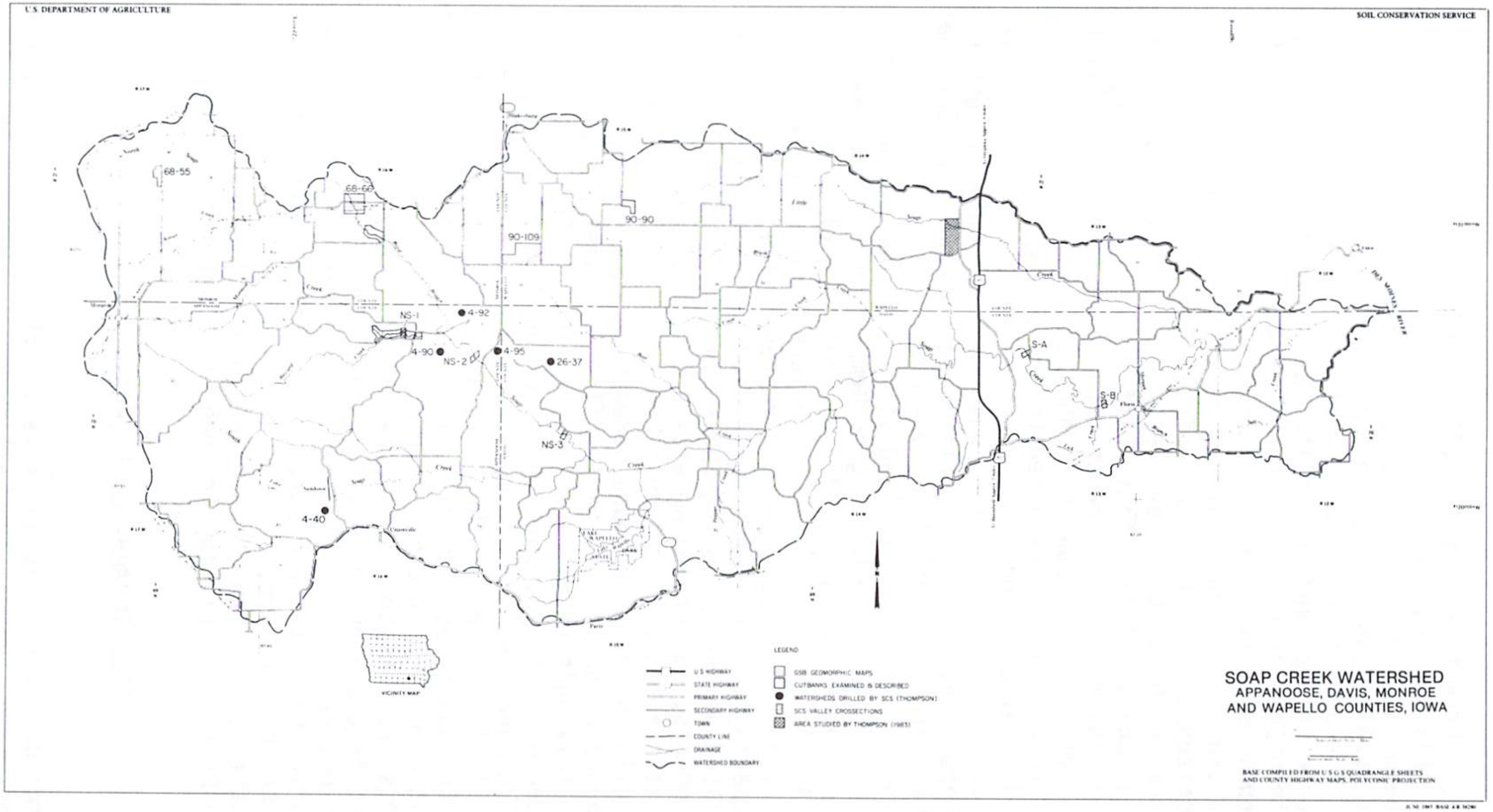


Figure 6. Map of Soap Creek Basin showing the location of areas discussed in the text. Base map courtesy of the SCS.

Table 1. Generalized description of Soap Creek Watershed Holocene alluvial units (DeForest Formation)

CAMP CREEK MEMBER
(informally referred to as postsettlement alluvium in many reports)

Very dark grayish brown to yellowish brown (10YR3/2-5/4) silt loam to loam; can be sandy loam texture if source materials are sandy; noneffervescent; unit is usually horizontally stratified where it exceeds 0.75 m in thickness; base of unit usually overlies buried A horizon of the presettlement soil; thickest in the floodplain area (where it buries the Roberts Creek Member) and at the base of steep slopes where row-cropped fields are upslope; ranges in age from as old as 400 BP at base to modern at top.

ROBERTS CREEK MEMBER

Very dark gray to dark gray (2.5Y3/0, 10YR3/1-4/1) silt loam, loam, or sandy loam; noneffervescent; thick sections are horizontally stratified at depth; unit has relatively thick A-C soil profile developed into its upper part; found within the present low floodplain, usually roughly paralleling the modern channel; a 1-4 meter high scarp usually separates this fill from older, higher Holocene terrace and alluvial fan levels; in some cases this fill may overlie older Holocene alluvium and it often cuts into the Corrington Member in fan-head trenches; unit ranges in age from about 3000 to 500 BP.

GUNDER MEMBER

Brown to yellowish brown (10YR4/3-5/4) silt loam to loam; poorly drained and/or reduced sections are darker colored (2.5Y4/4-4/2); noneffervescent; thick, morphologically well expressed, moderately well to somewhat poorly drained Mollisols and Alfisols are developed in upper part of unit; these soils usually have an argillic horizon (show evidence of clay translocation); C horizons usually contain brown mottles; lower part of unit may be horizontally stratified and sandy; unit forms prominent terrace in valleys; terrace margin merges with sideslopes in a smooth concave profile; 20 to 40 cm of Camp Creek Member often buries the surface of this unit; unit ranges in age from about 10,500 BP at its base to about 3000 BP at the top of the unit.

CORRINGTON MEMBER

Brown to dark grayish brown, and olive brown (10YR4/3-4/2, 2.5Y4/2-4/4) silty clay loam with sandy loam and pebbly loam interbeds; noneffervescent; upper part of unit has thick, morphologically well expressed, moderately well drained Mollisols and Alfisols developed into it; these soils usually have an argillic horizon; at least one and sometimes several paleosols within unit; C horizons usually contain brown mottles; unit consists of several fining-upward sequences with a paleosol usually developed at the top of each sequence; unit encompasses alluvial fans located at the junction of first- and second-order valleys with larger valleys; thin increments of Camp Creek Member often bury the surface of this unit and thicker Camp Creek sections are found in fan-head trenches; unit ranges in age from about 10,000 to 3,500 BP.

central part of the watershed in extreme southwestern Wapello County. The location of other areas examined by the GSB as well as areas investigated by SCS personnel are shown on Figure 6.

Site 68-66

Site 68-66 is located along a third-order (Strahler, 1964, system), southeasterly trending valley in the headwaters of Boyd Branch (secs. 21, 20, 17, and 16, T71N, R16W; Fig. 6). Drainage area above the structure site is 287 ha (710 ac). Local relief within this area is approximately 30 m (100 ft). Valley margins are asymmetric with southwest-facing slopes being gentler and consisting of more "steps" than opposing slopes.

Different soil series occur in certain positions on the landscape about site 68-66 (Oelmann, 1984; sheet 55). Belinda and Pershing Series soils are mapped on the uplands where Peoria Loess is thicker than 1 m. Soils of the Belinda Series are found on nearly level portions of the upland and are silty and poorly drained. These soils have prominent light-colored subsurface horizons where clay and iron compounds have been removed (E horizons) and underlying B horizons where these materials have accumulated (Bt horizons). Because of the poor drainage and high seasonal water table, the B horizons of the Belinda Series are gleyed and exibit gray colors. These soils formed under mixed grasses and deciduous trees. The Belinda Series is classified as a Mollic Albaqualf. Pershing Series soils are located on gently sloping margins of the upland and narrow interfluves. These soils are silty and somewhat poorly to moderately well drained. They have subsurface B horizons with evidence of significant clay translocation, and developed under mixed grass and tree vegetation. The Pershing Series is classified as an Aquollic Hapludalf. Armstrong Series soils are mapped downslope of the Pershing Series on moderately sloping convex slopes where loess thins and the surface soil is developed in the loess and underlying pedisediment and paleosol (usually a LSP). This series is moderately well or somewhat poorly drained and can be seepy. The surface horizon of this series is loam in texture and subsurface horizons, developed into the paleosol , are usually clay loam texture. The B horizon of the Armstrong Series has significant accumulations of translocated clay. Native vegetation on these soils was mixed prairie grasses and deciduous trees. The Armstrong Series is classified as an Aquollic Hapludalf. The Gara and Lindley Series are mapped on most of the steeply sloping valley margins where Pre-Illinoian glacial till and/or till-derived pedisediment are the surficial materials. The Gara Series is moderately well to well drained and loam to clay loam in texture. Significant accumulation of translocated clay has occurred in the B horizon of these soils. The Gara Series has a darker-colored Ap horizon or a thicker, dark-colored A1 horizon than the Lindley Series. Gara Series soils developed under mixed grass and deciduous trees while the Lindley Series developed under deciduous forest vegetation. The Gara Series is classified as a Mollic Hapludalf and the Lindley Series as a Typic Hapludalf. The Olmitz, Colo, and Vesser Series are mapped as a complex on the Holocene-age alluvium in the valley. The Olmitz and Vesser Series are found on the footslopes, alluvial fans, and low terrace. These series are well drained (Olmitz) and somewhat poorly or poorly drained (Vesser). The Vesser Series exhibits significant accumulations of translocated clay in its B horizon and has an overlying E horizon from which the clay and iron compounds have been leached. This series is classified as an Argiaquic Argialboll. The Olmitz Series does not have significant subsurface accumulations of clay and has a thicker, dark-colored A horizon than the Vesser Series. The Olmitz Series is classified as a Cumulic Hapludoll. The Colo Series is found in the floodplain area. This series is poorly drained and consists of a relatively thick, dark-colored A-C soil profile. The Colo Series is classified as a Cumulic Haplaquoll.

Conversations with the landowner indicate that the 68-66 valley has been channelized (Jack Wilson, personal communication, 1986). Our investigations support this and suggest the area of disturbance indicated on Figure 7.

Thirteen borings were made in this study area (Fig. 7). These were all drilled in valley alluvium, mostly in the area mapped Olmitz-Colo-Vesser Complex in the Soil Survey of Monroe County (Oelmann, 1984; sheet 55). All alluvium examined in this valley was noncalcareous. Three surfaces make up the valley landscape in this area: alluvial fans located at the junction of small valleys with the mainstem; a 1-2 m high terrace to which the valley wall slopes descend; and the present floodplain through which the modern stream flows. Each of these surfaces are underlain by distinct assemblages of deposits belonging to the DeForest Formation.

Two cross-sections show typical stratigraphic relationships for this drainageway (Fig. 8). Cross-section A-A' runs from southwest to northeast down a small tributary valley, across the mainstem, and to the eastern valley wall (see Figs. 7 and 8). The east-trending tributary valley is U-shaped in cross-section and does not contain an incised channel, although a discontinuous rill is present about midway down the drainageway. Valley slopes descend to the alluvial valley floor in a smooth concave profile. Reduced and oxidized loamy Gunder Member alluvium is the only prehistoric alluvial fill present in this tributary. This unit becomes increasingly reduced toward the head of the drainageway. The Gunder Member ranges from 1.8 to about 4 m in thickness in this valley. Up to 0.4 m of Camp Creek Member buries the Gunder Member in the central portion of the tributary. Surface soils developed into the Gunder Member in this drainageway are relatively thick, poorly to somewhat poorly drained, and have dark-colored surface horizons and subsurface horizons with significant accumulations of translocated clay (Bt horizons). These soils are classified as Haplaquolls and have morphologic properties intermediate between the Olmitz and Vesser Series.

A low-angle alluvial fan is present where this tributary enters the mainstem. Holes 12 and 13 were drilled on the fan. Fan deposits are the Corrington Member of the DeForest Formation. This unit consists of oxidized loamy alluvium containing two paleosols and three vertically stacked fining-upward sequences. The paleosols are morphologically less well expressed than the surface soil and are each developed in the top of a fining-upward sequence. Thickness of the Corrington Member ranges from 3.65 to greater than 5.4 m in these borings. Gunder Member alluvium in the tributary above the fan grades into the Corrington Member in the fan, indicating that the two units are time-equivalent. The Corrington Member at this location overlies unoxidized, unleached Pre-Illinoian-age till. A fluvial erosion surface, produced by downcutting prior to accumulation of the Corrington Member, is developed on the till surface.

A short, approximately 1 m high scarp separates the higher and older alluvial fan from the lower-lying floodplain to the east (Figs. 7 and 8). Hole

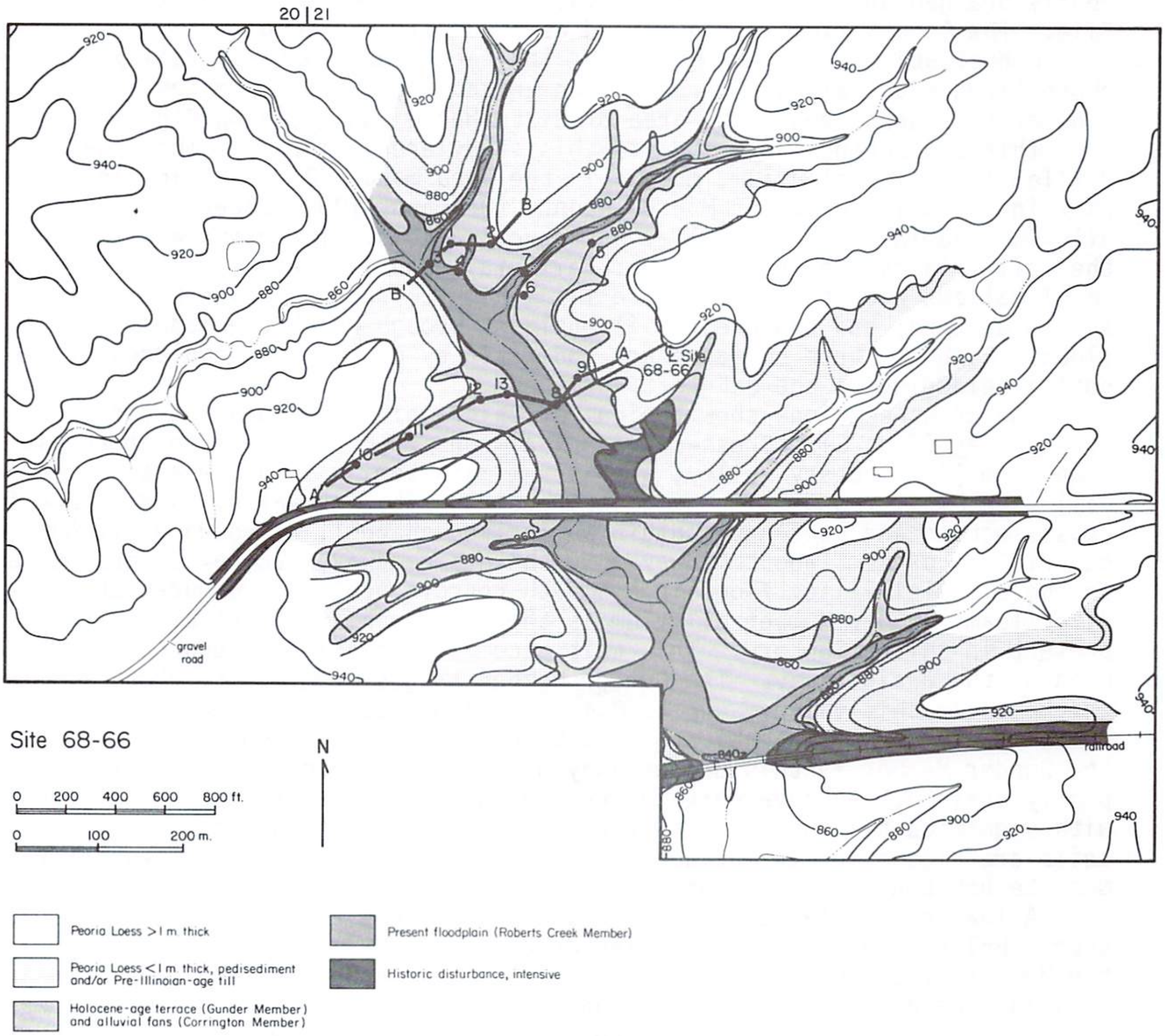


Figure 7. Map of site 68-66 area showing topography, location of borings, and generalized distribution of Quaternary materials.

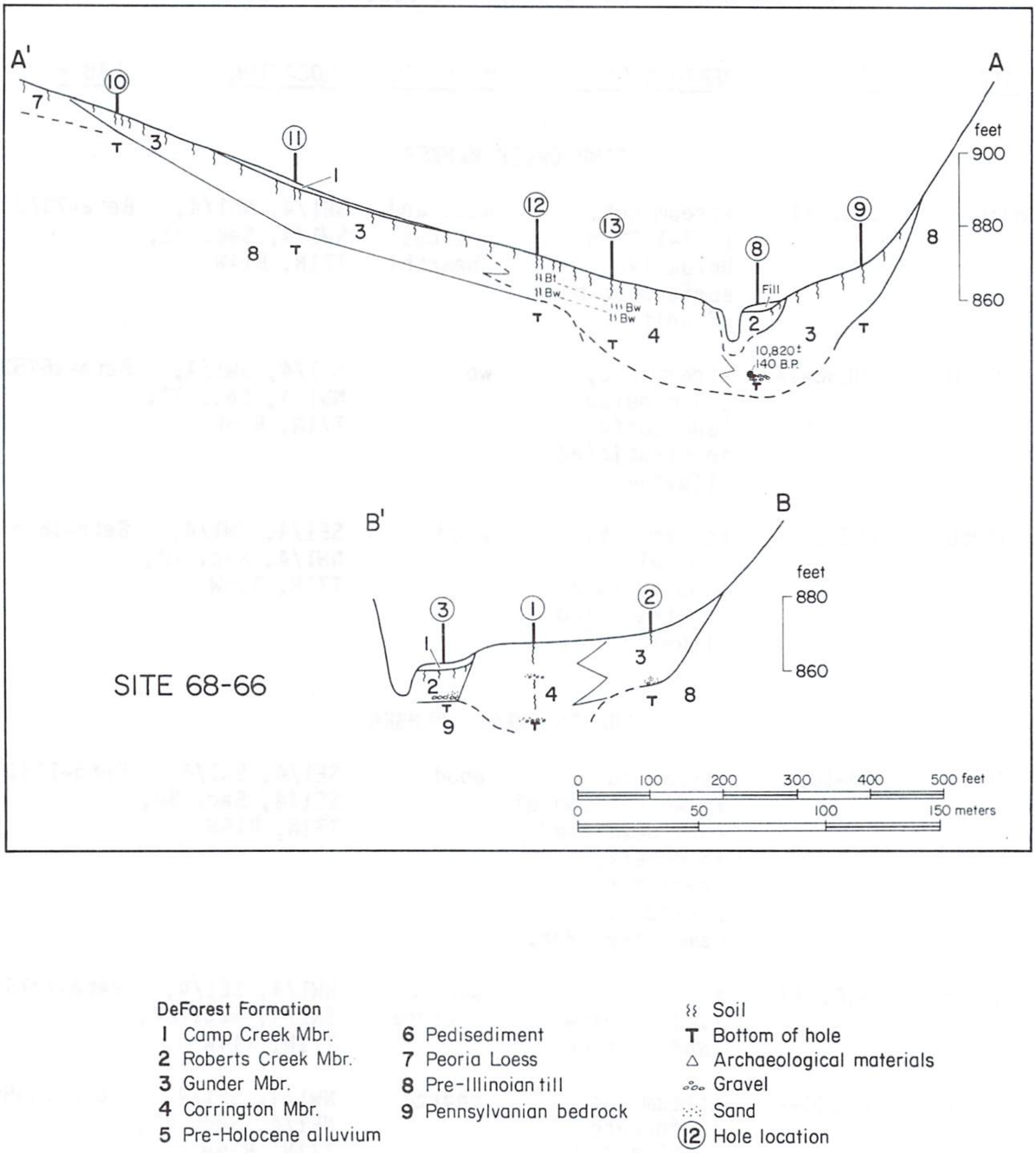


Figure 8. Cross-sections showing stratigraphic relationships among Quaternary materials in the 68-66 area. The locations of the cross-sections are shown on Figure 7.

Table 2. Radiocarbon dates from DeForest Fm. deposits: Soap Creek Watershed

DATE	SITE	DEPTH/STRAT.	MATERIAL	LOCATION	LAB #
		CAMP CREEK MEMBER			
Modern	S.C. #1	stream cut, 1.37-1.52 m below land surface at base of unit	wood and charcoal (hearth)	SE1/4, NE1/4, SW1/4, Sec. 22, T71N, R14W	Beta-7373
210 ±60	90LSC-1A	stream cut, 2.5 m below land surface in stratified alluvium	wood	SE1/4, SW1/4, NW1/4, Sec. 22, T71N, R15W	Beta-16753
360 ±60	LSC 1	stream cut, 3 m below land surface in stratified alluvium	wood	SE1/4, SW1/4, NW1/4, Sec. 22, T71N, R15W	Beta-16754
		ROBERTS CREEK MEMBER			
70 ±50	90-109A	stream cut, in Ab horizon of soil developed in Roberts Creek Mbr., buried by Camp Creek Mbr.	wood	SE1/4, SW1/4, SE1/4, Sec. 30, T71N, R15W	Beta-17318
1910 ±100	S.C. #2	stream cut, 1.22 m below land surface	wood and charcoal	NW1/4, SE1/4, SW1/4, Sec. 22, T71N, R14W	Beta-7374
2690 ±70	68LSC-2	stream cut, in feature (pit) 2.7 m below land surface	charcoal	NW1/4, SE1/4, NE1/4, Sec. 28, T71N, R16W	Beta-16359
		GUNDER MEMBER			
3300 ±110	S.C. #3	stream cut, 2.74-3.65 m below land surface	wood and charcoal	SE1/4, NE1/4, SW1/4, Sec. 22, T71N, R14W	Beta-7375

Table 2. (Continued)

DATE	SITE	DEPTH/STRAT.	MATERIAL	LOCATION	LAB #
3320 ±60	04SC-C	stream cut, 1.25 m below land surface, hearth in BC horizon of surface soil	charcoal	SW1/4, NE1/4, SE1/4, Sec. 4, T70N, R16W	Beta-17317
3530 ±70	04SC-X	stream cut, 4.57 m below land surface in channel fill	wood	SE1/4, NW1/4, SW1/4, Sec. 3, T70N, R16W	Beta-16751
3620 ±80	04SC-Y	stream cut, 3.66 m below land surface in channel fill	wood	SE1/4, NW1/4, SW1/4, Sec. 3, T70N, R16W	Beta-16752
8680 ±140	90AB16	soil core, 4.27 m below land surface	wood	SW1/4, SE1/4, Sec. 30, T71N, R15W	Beta-17319
10350 ±290	68AB19	soil core, 3 m below land surface	organics	SE1/4, SE1/4, SW1/4, Sec. 15, T71N, R17W	Beta-16324
10820 ±140	68AB8	soil core, 5.55-5.6 m below land surface	organics	SE1/4, SW1/4, NW1/4, Sec. 21, T71N, R16W	Beta-16323
		CORRINGTON MEMBER			
4420 ±100	04SC-A2	stream cut, from 2Ab horizon of 2nd paleosol	charcoal	center, SW1/4, Sec. 3, T70N, R16W	Beta-17316
7650 ±120	68AB6	soil core, 5.35-5.4 m below land surface	organics	NE1/4, SW1/4, NW1/4, Sec. 21, T71N, R16W	Beta-16322

8 along transect A-A' was drilled on the east side of the present stream in the floodplain. At that location 0.6 m of recent fill material buries dark-colored, loamy Roberts Creek Member alluvium. The recent fill may have been bulldozed to this location during the channel straightening. The Roberts Creek Member is 1.76 m thick at that location and is separated from the underlying Gunder Member by a disconformity (fluvial erosion surface). The Gunder Member is greater than 3.64 m thick at this location and consists of oxidized loamy alluvium grading downward to sandy and gravelly alluvium. Wood collected within the Gunder Member between 5.55 and 5.6 m below the land surface yielded a radiocarbon date of 10,820±140 B.P. (Beta-16323; Table 2).

A short scarp separates the floodplain from a higher, older terrace along the eastern side of the valley. Elevation of this terrace is about equal to that of the medial portion of the alluvial fan across the valley. The valley wall slope descends to this terrace in a smooth, concave profile. Hole 9, the easternmost along transect A-A', was drilled in the footslope position on the eastern side of the terrace (Figs. 7 and 8). At that location 3.88 m of oxidized, loamy Gunder Member alluvium/colluvium buries oxidized and unleached Pre-Illinoian till. A disconformity separates the Gunder Member from the underlying till. The surface soil on this footslope is moderately well to somewhat poorly drained, has a thick, dark-colored surface horizon and a brown structural subsurface Bw horizon. This type of B horizon, in which there is no evidence of significant clay accumulation, is also referred to as a cambic B horizon (Soil Survey Staff, 1981). This soil is classified as a Hapludoll.

Transect B-B', located upvalley of A-A', runs from the floodplain area diagonally across a low-angle alluvial fan at the junction of a south-trending tributary valley with Boyd Branch (Figs. 7 and 8). Stratigraphic relationships along this transect are similar to those along transect A-A'. Hole 3 was drilled into the floodplain on the east side of the creek. At that location the Roberts Creek Member, with a relatively thick A-C soil profile (Entisol) developed into its surface, is buried by 0.54 m of Camp Creek Member alluvium. The Roberts Creek Member is 2.46 m thick here and fines upward from gravel at the base to silt loam in the upper part of the unit. A buried A-C soil profile (Entisol) is present between 1.47 and 1.87 m below the land surface within the Roberts Creek Member at this location. The presence of this paleosol indicates an interval of floodplain stability during the period of Roberts Creek Member accumulation. The Roberts Creek Member is separated from underlying Pennsylvanian-age siltstone by a disconformity in this area.

A 1.5 m high scarp separates the present floodplain from the adjacent alluvial fan. Hole 1 was drilled in the midfan position. The fan is composed of more than 6.2 m of oxidized, loamy Corrington Member deposits and has a well to moderately well drained surface soil with a dark-colored surface horizon and a subsurface Bt horizon with significant accumulations of clay developed into it. This soil is classified as an Argiudoll. Two paleosols, both morphologically less well expressed than the surface soil, are present within the Corrington Member here. The former surface horizons of these paleosols are evident as peaks and bulges in the organic carbon profile of 68AB1 in Appendix C.

Hole 2 was drilled off the edge of the alluvial fan on the footslope descending from the valley wall. Oxidized Gunder Member grading downward from silt loam to sandy loam was encountered at this location. The lower sandy portion of the Gunder Member, as well as portions of the overlying silt loam interval, are pedisediment derived from erosion of Pre-Illinoian-age till and Wisconsinan loess making up the steep slope to the east. The Gunder Member deposits grade into the Corrington Member making up the adjacent alluvial fan, and the two units are time-equivalent. The surface soil on the footslope has a relatively thick structural and color subsurface Bw horizon (cambic B horizon) overlain by a thick plow layer (Ap horizon). This profile derives many of its properties, such as thick, weakly expressed soil horizons, from the episodic deposition on the soil surface of material eroded from upslope. In this situation, horizons become thicker as new material is deposited on the soil surface. This soil is classified as a Dystrochrept. The Gunder Member buries mottled, oxidized and leached Pre-Illinoian-age till at this location. A fluvial erosion surface (disconformity) separates these units.

A small, partially filled, abandoned channel of the tributary stream crosses the alluvial fan between holes 1 and 2 (Fig. 7). Hole 4 was drilled in this drainageway and encountered 6.8 m of Roberts Creek Member with a dark-colored A-Bw-C soil profile developed in the upper 0.87 m. The Roberts Creek Member buries Pennsylvanian-age siltstone at this location.

Three other holes were drilled in this structure site area. Hole 5 was located on the upstream margin of a small alluvial fan located about half way up a southwest-trending tributary of Boyd Branch (Fig. 7). Here 6.4 m of loamy Corrington Member buries unoxidized, unleached Pre-Illinoian-age till. The surface soil on this fan is poorly drained and has a thick, dark-colored surface horizon and a subsurface Bt horizon. This soil is classified as an Argiaquoll. One paleosol is present within the Corrington Member at this location. The paleosol is morphologically less well expressed than the surface soil and has a cambic B horizon.

Hole 6 was drilled downstream of hole 5 on a low-angle alluvial fan at the junction of this tributary with Boyd Branch (Fig. 7). Over 6 m of loamy Corrington Member is present at this location. One paleosol is present within the Corrington Member in hole 6. This paleosol has properties similar to those of the paleosol present in the alluvial fan hole 5 was drilled into. Wood collected from within the Corrington Member 5.35 to 5.4 m below the land surface in boring 6 was radiocarbon dated at 7,650±120 B.P. (Beta-16322; Table 2). A short, steep scarp separates the fan surface from the adjacent, lower lying floodplain.

Hole 7 was drilled in the floodplain area and encountered 4.7 m of dark-colored sandy and loamy Roberts Creek Member. A dark-colored A-C soil profile (Entisol) is developed in the upper 1.6 m of the Roberts Creek Member at this location. From 1.6 m to the base of the hole at 4.7 m below the land surface, the Roberts Creek Member consists of a series of stacked fining-upward sequences. These consist of about 1 m of pebbly coarse sand fining upward to organic loam. Contacts between each fining-upward sequence are abrupt and the entire sequence appears to be part of a channel fill.

Downvalley along Boyd Branch the alluvial fills are topographically more distinct than they are upvalley. Just upstream of the north-south gravel road crossing the stream between sections 27 and 28 (T71N, R16W) three distinct alluvial surfaces are evident on the valley floor (Fig. 6). The incised channel of Boyd Branch was walked and cutbanks were examined and described in this area. The lowest valley surface here is the floodplain. Shallow swales marking abandoned channels are evident in the floodplain area. The present channel of Boyd Branch is incised approximately four meters into the floodplain surface. Exposures along the incised channel of the present stream show that the abandoned channel areas are underlain by stratified Camp Creek Member deposits containing abundant wood and iron-stained sand beds. Surface soils in the abandoned channel areas have thin A-C soil profiles and are Entisols.

Outside the abandoned channel areas the floodplain is composed of two dark, loamy Roberts Creek Member alluvial fills. These are cut out or buried by the Camp Creek Member in the abandoned channel areas. The younger of the two dark, loamy Roberts Creek Member alluvial fills is loam in texture and has a surface soil with a dark brown (10YR3/3) Bw horizon developed in its upper part. This Roberts Creek Member fill truncates an older, dark, loamy Roberts Creek Member alluvial fill which is also within the floodplain area. These two fills have about the same surface elevation. The older alluvial fill is heavy loam in texture and has several superposed A-C soil profiles (Entisols) developed in it. These Entisols developed during short periods of stability on the floodplain.

Site 68LSC-2 was described in this older Roberts Creek Member fill exposed on the north side of the incised channel (Appendix A). At that location the Roberts Creek Member is buried by 0.3 m of Camp Creek Member deposits. The Roberts Creek Member is greater than 3.2 m thick here and consists of dark, loamy, noncalcareous alluvium with common gray mottles and secondary iron and manganese accumulations. Several superposed A-C soil profiles are present. Some of these are middens and contain charcoal, burned earth, and artifacts. A grit-tempered pottery fragment (body sherd) was collected approximately 2.2 m below the land surface. Charcoal collected from a 2.5 m long lenticular layer of iron-cemented coarse sand 2.7 m below the present land surface was radiocarbon dated at 2,690±70B.P. (Beta-16359; Table 2). The sand partially fills a shallow basin-shaped depression (pit) associated with one of the A-C soil profiles in the Roberts Creek Member.

A higher level terrace and alluvial fan complex borders the floodplain area underlain by the Camp Creek and Roberts Creek members. Exposures along the creek show that the Gunder and Corrington members underlie this upper valley surface. The Gunder Member underlies the terrace and is an oxidized silt loam with common gray and yellowish brown mottles. The surface soil developed in the upper part of the Gunder Member here is a poorly to somewhat poorly drained, dark-colored soil with a Bt horizon (Haplaquoll). The Corrington Member is poorly exposed along this reach. It is exposed where the incised channel of Boyd Branch cuts into a small, low-angle alluvial fan on the south side of the stream. In this outcrop the Corrington Member is oxidized loam with interbedded thin sandy and pebbly sand zones. No paleosols were recognized in this outcrop, but the exposure was poor and the deposits extend below the creek level. The surface soil developed into the Corrington Member in this area is very similar to that developed into the Gunder Member.

Stratigraphic relationships among the DeForest Formation members are similar thoughout the 68-66 area. The Gunder and Corrington members are the oldest Holocene-age alluvial fills in the valley and are separated from older, underlying units by a fluvial erosion surface. The Gunder Member underlies a terrace rising above the floodplain in this valley. The valley wall slope descends to the terrace in a smooth concave profile. The Corrington Member encompasses deposits making up the alluvial fans. Gunder and Corrington members interfinger where alluvial fans grade into the terrace and colluvial slopes. The Roberts Creek Member is incised into the Gunder and Corrington members in the lower lying floodplain area. The Camp Creek Member is found at the base of steep slopes and in the floodplain area where it buries older members of the DeForest Formation.

A map showing the surficial distribution of the various deposits comprising the landscape in the 68-66 area is shown in Figure 7. More than 1 m of Peoria Loess is present on the interfluves bordering the valley. The Peoria Loess has been eroded from the valley wall slopes which consist primarily of eroded Pre-Illinoian-age till and pedisediment derived from erosion of the till. Footslopes, toeslopes, the Holocene-age terrace and alluvial fans are grouped together. These surfaces are underlain by the Gunder and Corrington members which accumulated at about the same time. The lowest alluvial surface is the floodplain which is underlain by the Roberts Creek Member.

Site 68-55

Site 68-55 is located along a northeast-to-east-trending fourth-order valley in the headwaters of North Soap Creek Valley (secs. 15, 22, 21, and 16, T71N, R17W; Fig. 6). Two third-order valleys of approximately equal drainage area join just above the proposed structure site (Fig. 9). Total drainage area at the structure site is 289ha (715ac). Valley margins in this area are noticeably asymmetric; south-facing slopes are longer, gentler, and composed of more stepped surfaces than are north-facing slopes (Fig. 9). Local relief in this study area is about 30 m (100ft).

The soil series mapped in this area are similar to those mapped in the 68-66 area (Oelmann, 1984; sheet 54). The Belinda and Pershing Series are mapped on the upland and gentle upper valley slopes where Peoria Loess is greater than 1 m thick. The Armstrong Series is present on nose slopes where the loess thins and lower parts of the surface soil are developed into pedisediment and Pre-Illinoian till. A gray-colored paleosol (YS) outcrops on the upper slopes in the 68-55 area. The Rinda Series is mapped where the surface soil is developed into this paleosol. The Rinda Series is poorly drained and silty clay loam to silty clay texture. It developed under mixed grass and deciduous tree vegetation and has a Bt horizon which is developed in the YS Soil. Seeps are very common in this soil mapping unit because downward percolating soil water moves laterally across the slowly permeable B horizon of these soils. The Rinda Series is classified as a Mollic Ochraqualf. The Gara Series is present on most of the steep valley slopes where Pre-Illinoian-age till and till-derived pedisediment are the surficial materials. Just as at site 68-66, Holocene-age alluvium in the valley has a complex of Olmitz-Colo-Vesser Series mapped on it.

Three landforms make up the valley floor in this area. The valley slopes descend to a low terrace which merges with adjacent, low-angle alluvial fans. These two landforms are separated from the lower lying present floodplain by a short, steep, approximately 1 m high scarp. The floodplain roughly parallels the present stream.

Eleven cores were taken from this structure site area (Fig. 9). Two transects show representative stratigraphic cross-sections for this area (Fig. 10).

Transect C-C' extends from valley wall to valley wall below the junction of the two tributary valleys. Hole 14 was drilled in the valley footslope position at the northern margin of the terrace (Fig. 9). At that location 0.45 m of Camp Creek Member buries a soil developed into oxidized, loamy Gunder Member deposits. This soil has a thin, dark-colored A horizon, an underlying E horizon from which clay and iron compounds have been removed, and a Bt horizon with gray mottles where clay and iron compounds removed from the overlying E horizon have accumulated. This soil is classified as a Hapludalf. The Gunder Member is 1.15 m thick at this location and abruptly overlies more than 1.2 m of stratified, oxidized, calcareous pre-Holocene pedisediment. We interpret this pedisediment to be pre-Holocene in age because it has violent effervescence whereas all Holocene-age alluvium in the Soap Creek area is non-effervescent.

At hole 15, located in the mid-terrace position, a soil developed in the upper part of the Gunder Member is buried by 0.25 m of oxidized loamy Camp Creek Member. The soil is thick and dark colored, and has a subsurface Bt horizon where translocated clay has accumulated. The dark grayish brown color of the Bt horizon indicates that this soil is poorly to somewhat poorly drained. This soil is classified as a Haplaqualf. The Gunder Member here is oxidized loam which extends to 3.88 m below the land surface. The Gunder Member buries weathered Pennsylvanian-age shale at this location. A fluvial erosion surface (disconformity) is developed on the shale surface.

At hole 16, located near the terrace scarp, over 6.9 m of Gunder Member deposits were encountered. This hole was terminated in stratified, coarse, in-channel deposits of the Gunder Member. The surface soil here has a thick, dark-colored A horizon and a subsurface Bt horizon where translocated clay has accumulated. This soil has morphologic properties intermediate between the Colo and Vesser Series and is classified as an Argiaquoll. Two paleosols were encountered within the Gunder Member at this location. The lower of these, at 4 m below the land surface, has an A-C profile and developed during a short period of little or no sedimentation on the valley floor. The upper paleosol, at 2.24 m below the land surface, is truncated and only the Bt horizon remains. This paleosol developed during a period of floodplain stability longer than that during which the lower paleosol developed. Subsequent migration of the stream truncated the solum and shortly thereafter the upper portion of the Gunder Member began to accumulate.

A short, steep scarp separates the terrace underlain by the Gunder Member from the present floodplain. Hole 19 was drilled in the floodplain on the north side of the stream. Deposits of the Roberts Creek Member are the uppermost unit at this location, and include 1.94 m of dark-colored, loamy alluvium. This unit fines upward and has a thick sequence of stacked A-C soil profiles (Entisols) developed in its upper part. These soils developed during relatively short intervals of floodplain stability followed by periods of Roberts Creek Member alluviation. The Roberts Creek Member buries a fluvial erosion surface developed on the Gunder Member. At this location the Gunder Member consists of stratified silty and loamy, oxidized grading downward to reduced alluvium. Wood collected 3 m below the land surface within a silty interval in the Gunder Member was radiocarbon dated at 10,350±290 B.P. (Beta-16324; Table 2). This date is comparable to one obtained from wood collected from the Gunder Member buried beneath the Roberts Creek Member in the present floodplain area of the 68-66 study area (core 68AB8). Hole 19 terminated at a depth of 5.8 m in stratified loamy, sandy, and gravelly in-channel deposits of the Gunder Member.

Holes 17 and 18 were drilled east of transect C-C' on a small low-angle

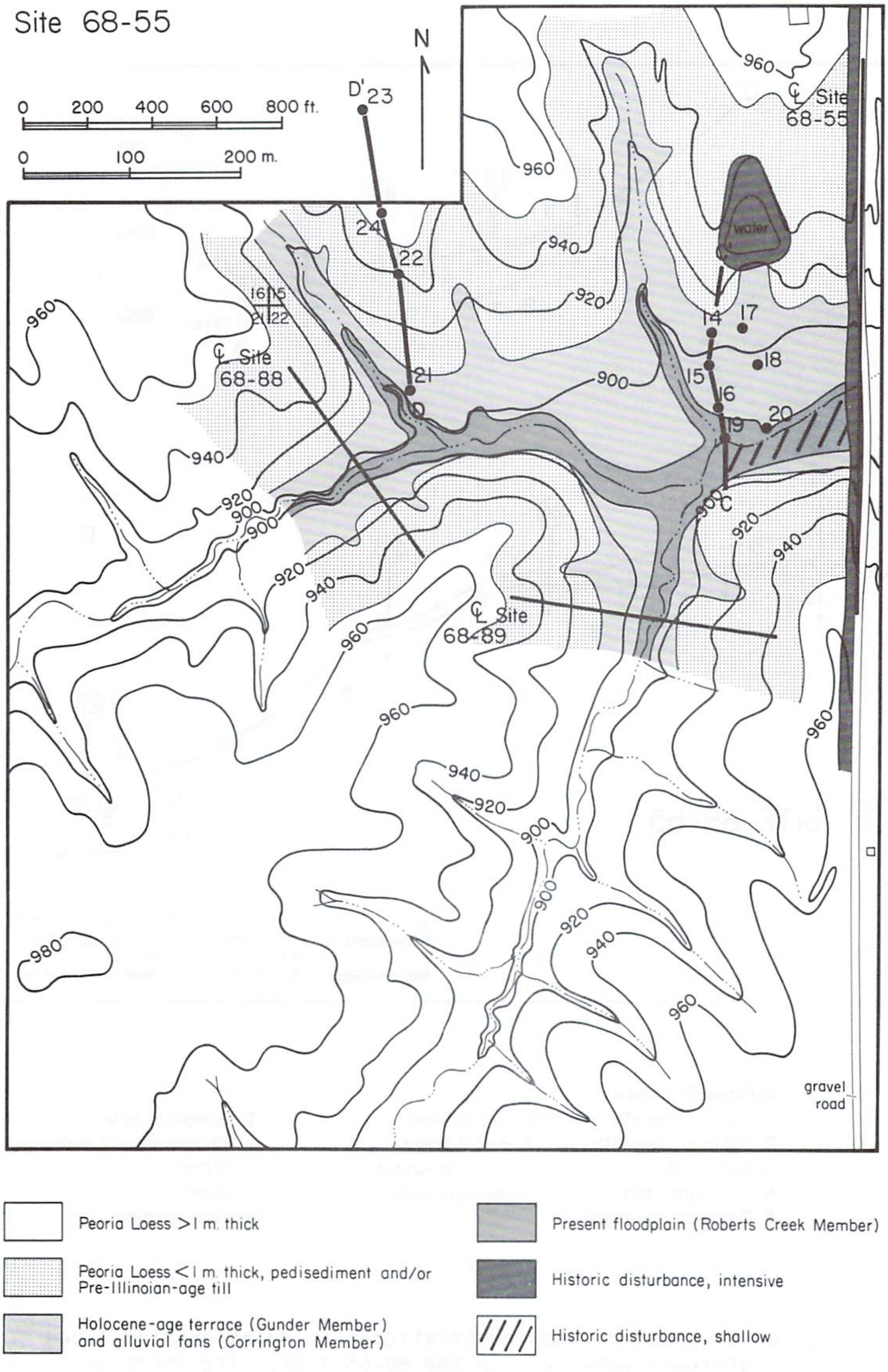
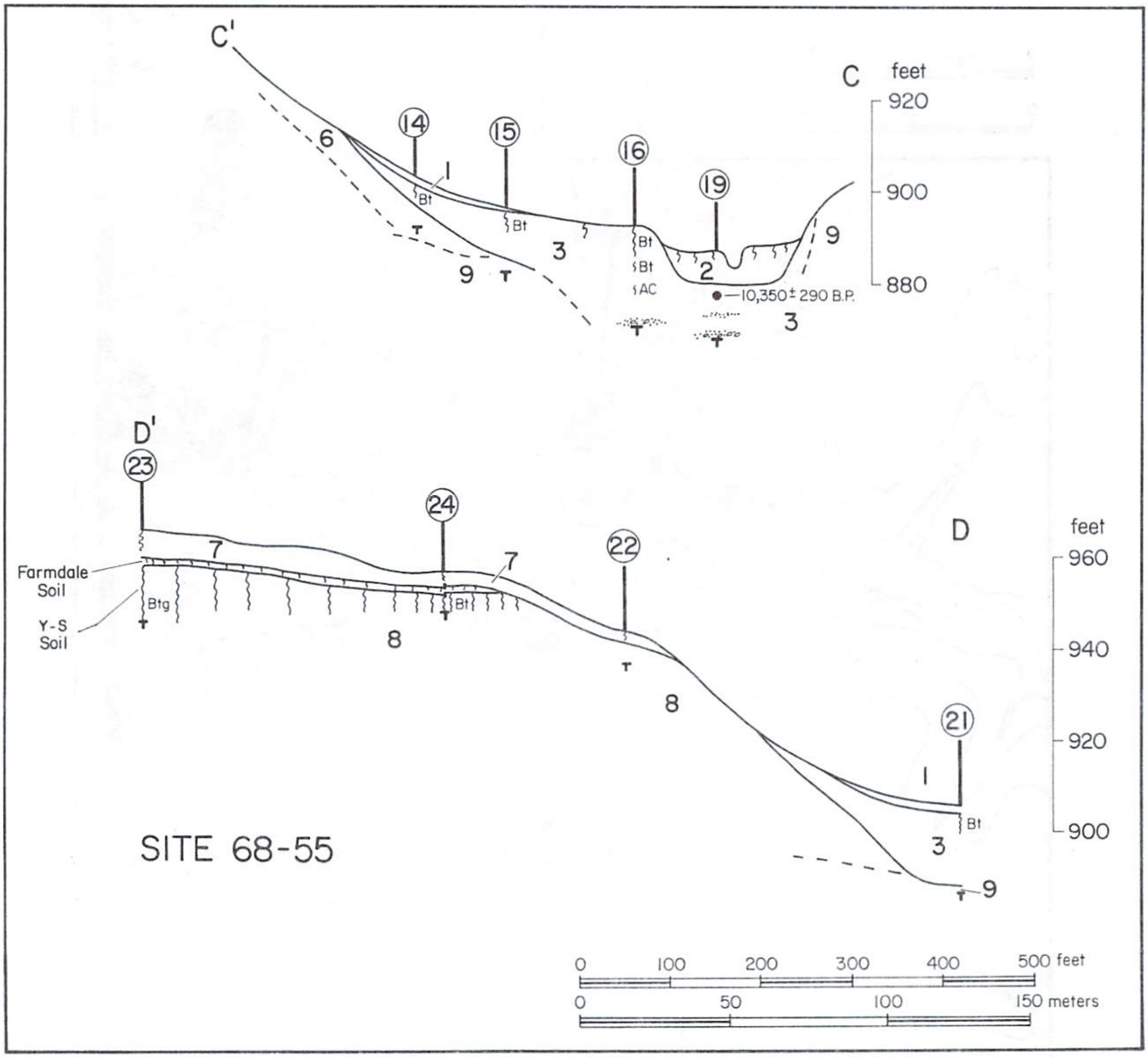


Figure 9. Map of the site 68-55 area showing topography, location of borings, and generalized distribution of Quaternary materials.



DeForest Formation
1 Camp Creek Mbr.
2 Roberts Creek Mbr.
3 Gunder Mbr.
4 Corrington Mbr.
5 Pre-Holocene alluvium

6 Pedisediment
7 Peoria Loess
8 Pre-Illinoian till
9 Pennsylvanian bedrock

Soil
T Bottom of hole
△ Archaeological materials
Gravel
Sand
(12) Hole location

Figure 10. Cross-sections showing stratigraphic relationships among Quaternary materials in the 68-55 area. The location of the cross-sections are shown on Figure 9.

alluvial fan on the north side of the valley (Fig. 9). Both these borings encountered Corrington Member deposits buried beneath oxidized, loamy Camp Creek Member deposits. The Corrington Member in this area consists of oxidized, loamy alluvium and colluvium with a paleosol exhibiting an A-Bw horizon sequence (Inceptisol) in the sequence. This paleosol is developed in the upper part of a fining-upward sequence just as the buried soils in the 68-66 area were. The Corrington Member deposits grade down-fan into Gunder Member deposits. The Corrington Member buries a fluvial erosion surface developed on weathered Pennsylvanian-age shale 5.5 to 6 m below the land surface in this area.

Transect D-D' is located upvalley of transect C-C' and extends from the upland to the Holocene-age terrace in the valley (Figs. 9 and 10). Core 23 was drilled on the upland margin on the north side of the valley. This tabular upland forms the divide between the Chariton and Des Moines River basins. A stratigraphic sequence typical for broad uplands in southern Iowa was encountered at 68AB23. Leached Peoria Loess (1.82 m thick) buries the Farmdale Soil developed in 0.33 m of Roxana Silt. A thick, gray-colored paleosol (YS) is developed in pre-Wisconsinan deposits buried beneath the Roxana Silt. This paleosol extends below the core depth.

Hole 24 was drilled on a stepped surface downslope from number 23 (Fig. 9). At that location 1.04 m of leached Peoria Loess buries the Farmdale Soil developed in Roxana Silt. The Pershing Series is mapped as the surface soil in this area. A complex 2-story paleosol, developed in both pedisediment and underlying Pre-Illinoian till, is buried by the loess and silt. This paleosol has morphologic properties associated with what has been called the "Late-Sangamon Paleosol" (LSP) (Ruhe et al., 1967; Hallberg et al., 1978b; Bettis et al., 1984b). These properties include: a stone line at the top of or within the paleosolum, reddish brown matrix colors, moderate to strong grade soil structure, an argillic horizon where significant accumulation of translocated clay has occurred, a zone of manganese oxide accumulation in the Bt horizon, and leaching of primary carbonate minerals from the solum. At this location on the slope, the YS soil originally present was completely truncated by pre-Wisconsinan slope erosion. This was followed by a period of pedogenesis during which the portion of the LSP in the Pre-Illinoian till began to develop. A later, possibly Wisconsinan-age episode of slope erosion partially truncated this younger paleosol. This was followed by deposition of the pedisediment overlying that portion of the paleosol developed in the Pre-Illinoian till. A final episode of pedogenesis, during which the portion of the paleosol in the pedisediment developed, occurred prior to accumulation of the Roxana Silt.

Boring 22 was located on the lowest stepped surface on this valley wall. The surface soil here is developed in 0.7 m of loamy pedisediment. This soil is brown to dark brown, has a very thin, dark-colored A horizon, and has an eroded subsurface B horizon with significant accumulation of translocated clay. This area is mapped as the Armstrong Series. A stone line, marking an erosion surface, separates the pedisediment from mottled, jointed, oxidized and leached Pre-Illinoian-age till. Since no Peoria Loess, Roxana Silt, or underlying paleosol are present, this erosion surface developed, at least in part, during the Holocene. Similar stratigraphic situations in other parts of the state have been referred to as "Iowan" erosion surfaces (Ruhe et al., 1968; Hallberg et al., 1978b; Bettis et al., 1984b).

Hole 21 was drilled on the Holocene-age terrace on the north side of the valley. At this location the Gunder Member is buried by 0.41 m of oxidized, loamy Camp Creek Member (Fig. 10). Here the Gunder Member is reduced and consists of a fining-upward sequence grading from loam and sandy loam at the base to loam and clay loam higher in the unit. The surface soil developed in the upper part of the Gunder Member is dark-colored, loamy, poorly drained, and has an A-Bt horizon sequence. This soil is classified as a Haplaquoll. The Gunder Member overlies a fluvial erosion surface developed on Pennsylvanian-age siltstone at a depth of 5.54 m.

Site 90-109

Site 90-109 is located in extreme southwestern Wapello County along a east-northeast trending fourth-order valley in the headwaters area of Little Soap Creek (Fig. 6). Two third-order valleys join to form the mainstem above the proposed structure site. Drainage area above the structure site is 320 ha (790 ac). Valley slopes are asymmetric in this area; south-facing slopes are longer and more gentle than north-facing slopes (Fig. 11). Numerous short, steep first-order drainages join the mainstem along this reach. The upland here is very low relief and is a classic example of a southern Iowa tabular divide. Local relief is approximately 23 m (76 ft).

The valley floor landscape in this area is made up of three types of landforms. Small, low-angle alluvial fans are present where first- and second-order tributaries join the mainstem. Most of these have been entrenched by their feeder streams. A relatively high (2-4 m) terrace, to which the alluvial fans grade, is evident in the upvalley part of this study area. Valley slopes descend to the terrace in a smooth, concave profile. This terrace decreases in elevation downvalley relative to the present floodplain. The floodplain is entrenched into the terrace above the junction of the two third-order streams. Below the junction the floodplain is separated from the terrace by a subtle scarp.

Soil series mapped in this area are similar to those in the previously discussed study areas (Seaholm, 1981; sheet 57). The Edina Series is mapped on very flat to concave areas of the upland where Peoria Loess is over 1.5 m thick. The Edina Series is poorly drained, has a thick, dark-colored A horizon, an underlying lighter-colored E horizon where clay and iron compounds have been removed, and a subsurface Bt horizon where clay and iron leached from the overlying E horizon has accumulated. Native vegetation under which this series developed was prairie. This series is classified as a Typic Argialboll. The Pershing and Grundy Series are mapped on the upland margins where Peoria Loess is greater than 1 m thick. The Pershing Series has an A-E-Bt horizon sequence and has a much thinner A horizon than does the Edina Series. The Grundy Series is somewhat poorly drained, has a thick, dark-colored A horizon and an underlying Bt horizon where clay translocated from overlying horizons is present. This series is classified as an Aquic Argiudoll. The Arispie Series is mapped in the heads of drainages in the western part of the study area where Peoria Loess is more than 1 m thick. This series is moderately well or somewhat poorly drained, and has an A-Bt horizon sequence similar to that present in the Grundy Series. The Arispie Series, however, has less clay in the Bt horizon than the Grundy Series. The Arispie Series is classified as an Aquic Argiudoll. A gray colored, sub-loess

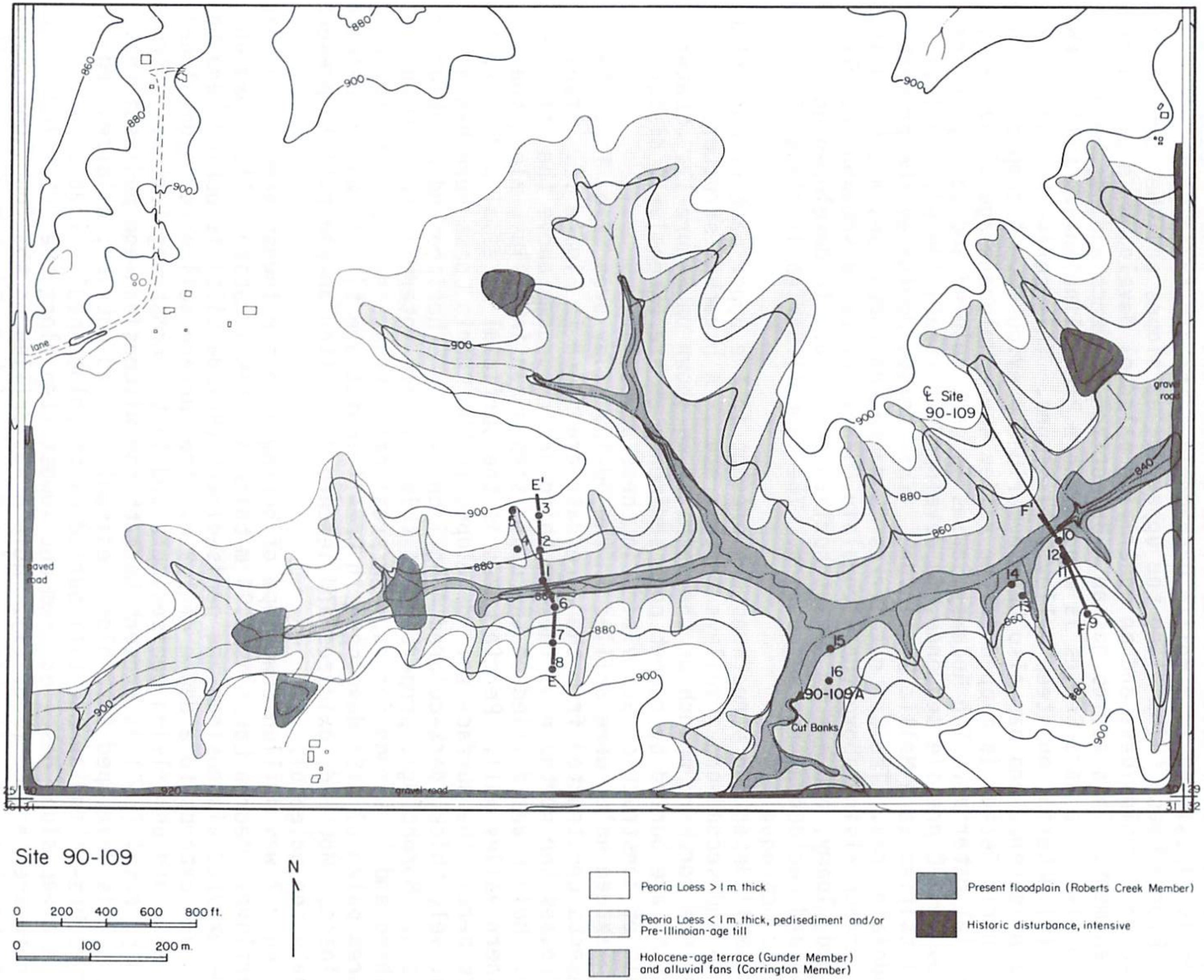


Figure 11. Map of the 90-109 area showing topography, location of borings and cut banks, and generalized distribution of Quaternary materials.

paleosol (YS) outcrops in drainage heads in the western part of the 90-109 area. The Rinda Series is mapped on this paleosol outcrop. This series is poorly to somewhat poorly drained, silty clay texture, and has an A-Bt horizon sequence. Native vegetation was mixed grasses and deciduous trees. The Rinda Series is classified as a Mollic Ochraqualf. The Armstrong Series is mapped where Peoria Loess thins along the upper valley slopes and the surface soil is developed in thin loess and an underlying paleosol developed in till-derived pedisediment. This series has an A-Bt horizon sequence and has been discussed previously. The Gara Series is mapped where Pre-Illinoian-age till is the surficial material on steep valley wall slopes. This series has an A-E-Bt horizon sequence and has also been described previously. A complex of Nodaway and Cantril Series is mapped in the valley where Holocene-age alluvium is the surficial material. The Nodaway Series is dark colored and poorly drained. It has an A-C profile sequence, is developed in stratified silty alluvium, and is classified as a Mollic Udifluvent. This series dominates the present floodplain area. The Cantril Series is mapped on footslopes and the Holocene-age terrace rising above the floodplain. This series is somewhat poorly drained, loamy, and has an A-E-Bt horizon sequence. It developed under mixed grass and deciduous tree vegetation. The Cantril Series is classified as a Udollic Ochraqualf.

Small detention structures are present in the upper part of many of the first- and second-order valleys in this area. A breached structure is present along the northern branch of the mainstem as shown on Figure 11. Quaternary deposits are buried by recent pond sediments or are extensively disturbed as a result of construction activities in these areas.

Sixteen holes were drilled in the 90-109 study area (Fig. 11). Two transects constructed from the core data are shown in Figure 12. Transect E-E' crosses the northern of the two third-order streams above the structure site. Hole 8 was drilled on the upper step of an interfluve along the southern valley wall. Peoria Loess is the surficial material and is 1.07 m thick here. The surface soil developed in the Peoria Loess here has a relatively thick, dark-colored A horizon over an E horizon and a subsurface Bt horizon. Morphologic properties of this soil are intermediate between the Pershing and Armstrong Series. An erosionally truncated, 1.7 m thick, gray colored paleosol (YS) developed in Pre-Illinoian-age till is buried beneath the loess. Mottled, oxidized and leached Pre-Illinoian-age till is present beneath the paleosol.

Hole 7 was drilled downslope of boring 8 on the lowest step along this interfluve. Peoria Loess is 0.94 m thick at this location. Clay loam and loam-textured Wisconsinan-age pedisediment (Roxana Silt) is buried beneath the loess and extends to a depth of 1.9 m. The surface soil here is developed in the loess and underlying pedisediment and is the Armstrong Series. A truncated paleosol (LSP) is present beneath the Wisconsinan-age pedisediment. The paleosol is developed into older pedisediment and mottled, oxidized and unleached Pre-Illinoian-age till buried by the older pedisediment.

A steep slope descends from the lowest step along the interfluve to a Holocene-age terrace (Fig. 11). Hole 6 was drilled on the footslope descending to the terrace. At this location 0.25 m of Camp Creek Member bury the Gunder Member which has a thick, dark-colored, moderately well drained soil with a Bt subsurface horizon developed in its upper part. This soil is

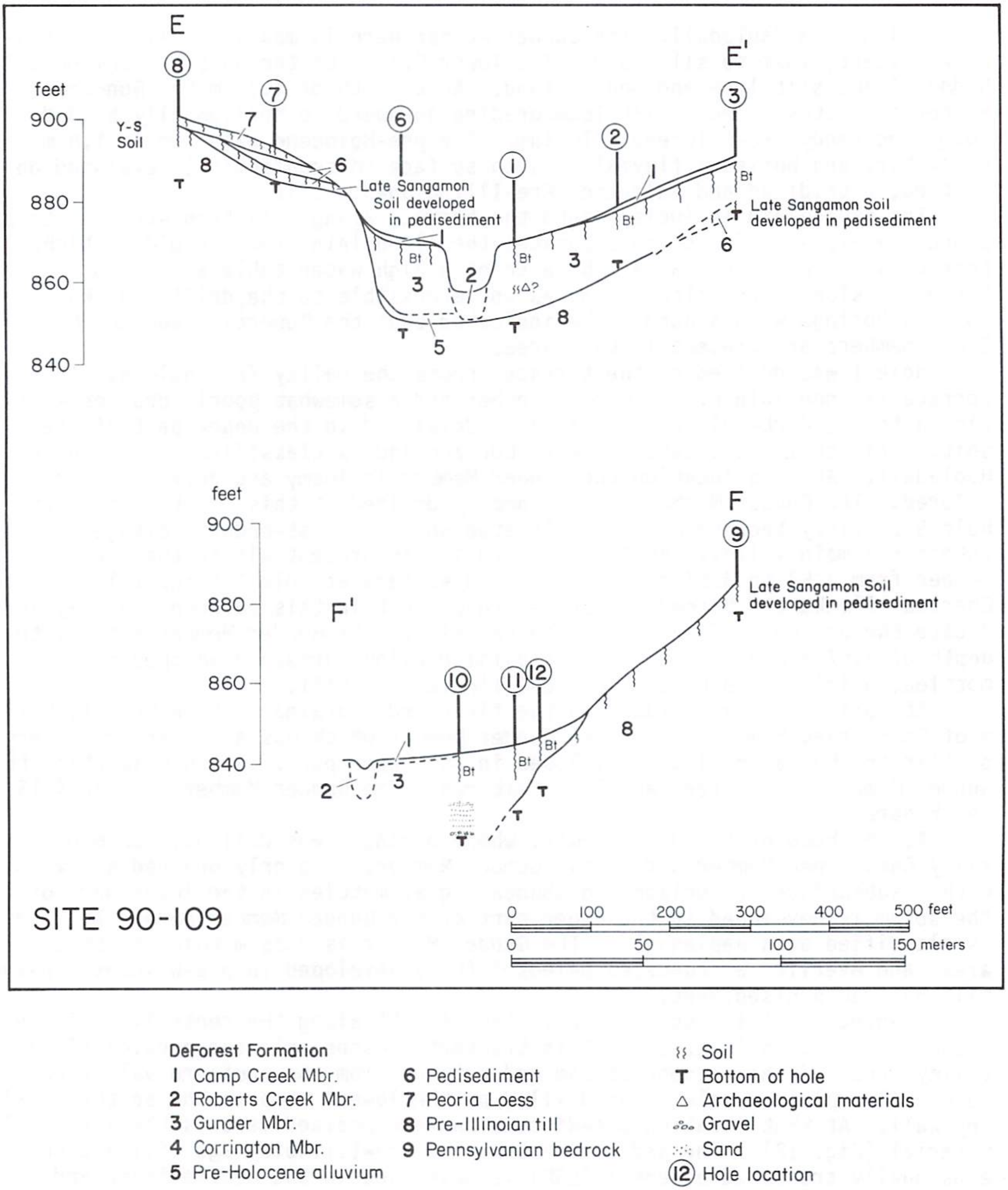


Figure 12. Cross-sections showing stratigraphic relationships among Quaternary materials in the 90-109 area. Note location of a possible buried archaeological site in core 1 along cross-section E-E'. The locations of the cross-sections are shown on Figure 11.

classified as a Hapludoll. The Gunder Member here is massive, oxidized, non-effervescent, loam to silt loam. The lower 0.28 m of the unit is horizontally bedded loam, silt loam and medium sand. At a depth of 4.37 m the Gunder Member truncates reduced silt loam grading downward to horizontally bedded loamy and sandy pre-Holocene alluvium. The pre-Holocene alluvium is 1.8 m thick here and buries a fluvial erosion surface (disconformity) developed on mottled, unoxidized and unleached Pre-Illinoian-age till.

The floodplain is incised into the terrace along this transect. A steep, approximately 4 m high scarp separates the floodplain from the older, higher terrace surface in this area. Because of a high water table and steep bordering slopes, the floodplain was not accessible to the drill rig, but shallow borings with a hand probe indicated that the Roberts Creek and Camp Creek members are present in this area.

Hole 1 was drilled on the terrace across the valley from hole 6. The terrace is underlain by the Gunder Member and a somewhat poorly drained soil with a thick, dark-colored A horizon is developed in the upper part of the unit. This soil has a subsurface Bt horizon and is classified as a Cumulic Hapludalf. At this location the Gunder Member is loamy and grayish brown colored. The Gunder Member is more poorly drained at this location than at hole 6 possibly because hole 1 is located where a first-order drainageway enters the main valley. An A-C soil profile is present within the Gunder Member from 3.53 to 3.67 m below the land surface at hole 1 (Fig. 12). Charcoal flecks and burned sandstone are present in this paleosol and may indicate the presence of an archaeological site. The Gunder Member extends to a depth of 5.57 m where it buries a fluvial erosion surface developed on mottled, oxidized and unleached Pre-Illinoian-age till.

At boring 2, about midway up the first-order drainage above hole 1, 0.19 m of Camp Creek Member buries the Gunder Member which has a surface soil very similar to that at boring 1 developed in its upper part. At this location the Gunder Member is oxidized and loam textured. The Gunder Member is over 4.15 m thick here.

At the head of the drainageway, where boring 3 was drilled, 0.2 m of silty Camp Creek Member buries the Gunder Member. A poorly drained silty soil with a subsurface Bt horizon and abundant gray mottles in the lower part of the solum is developed in the upper part of the Gunder Member here. This soil is classified as a Haplaquoll. The Gunder Member is 3.35 m thick in this area, and overlies a truncated paleosol (LSP) developed in pre-Wisconsinan-age till-derived pedisediment.

Transect F-F' is located downvalley of E-E' along the centerline of the proposed structure (Fig. 11). This transect crosses only the portion of the valley south of the present stream and extends from the southern valley wall to the floodplain. Hole 9 was drilled on the lowest step on the southern valley wall. At that location pre-Wisconsinan-age pedisediment is the surficial material (Fig. 12). The pedisediment buries Pre-Illinoian-age till and an erosionally truncated paleosol (LSP) is developed in the pedisediment and underlying till. The present surface soil, mapped as the Armstrong Series, is developed into the paleosol.

Holes 11 and 12 were drilled on the footslope descending to the floodplain. Oxidized sandy loam to clay loam Gunder Member is present at these locations. Relatively thick, moderately well to somewhat poorly drained surface soils with subsurface Bt horizons are developed in the upper part of the Gunder Member here. These soils are classified as Hapludalfs. The Gunder

Member thickens toward the valley center and buries a fluvial erosion surface developed on mottled, oxidized and unleached Pre-Illinoian-age till.

In this part of the valley, the prominent terrace present upvalley merges with the floodplain level. Hole 10 was drilled on the floodplain and encountered 0.2 m of dark-colored silty Camp Creek Member burying the Gunder Member (Fig. 12). The Gunder Member is poorly drained, and ranges from sand to silty clay loam texture at this location. The lowest 2.13 m of the unit consists of horizontally bedded, loamy, silty, sandy, and pebbly in-channel deposits. Over 6.4 m of Gunder Member are present here. A dark-colored, poorly drained soil with a subsurface Bt horizon is developed in the upper part of the Gunder Member at this location. This soil is classified as a Haplaqualf.

Upvalley of transect F-F' holes 13 and 14 were drilled at the mouth of a first-order drainageway on an alluvial fan-like landform elevated approximately 1 m above the adjacent floodplain (Fig. 11). This landform is made up of oxidized clay loam textured Gunder Member alluvium which buries a fluvial erosion surface developed on mottled, oxidized and leached Pre-Illinoian-age till. This landform is an erosionally modified equivalent of the Holocene-age terrace at cross-section E-E'. Surface soils developed in the upper part of the Gunder Member on this landform are moderately well to somewhat poorly drained, dark colored, loam to clay loam texture, and have E and Bt horizons. These soils are classified as Hapludalfs.

Hole 15 was drilled on the present floodplain at the junction of the two third-order streams above the proposed structure site (Fig. 11). In this area a subtle scarp separates the present floodplain from the terrace. At hole 15 0.58 m of stratified silt loam Camp Creek Member buries 1.68 m of dark-colored silt loam grading downward to loam textured Roberts Creek Member. The Roberts Creek Member buries a fluvial erosion surface developed on oxidized silt loam textured Gunder Member alluvium. The BC horizon of a truncated paleosol developed in the Gunder Member is present immediately below the erosion surface. The upper horizons of this paleosol were removed by stream erosion prior to accumulation of the overlying Roberts Creek Member. Oxidized Gunder Member alluvium extends to the base of the hole at 5.77 m.

Hole 16 was drilled southeast of boring 15 on the toeslope descending to the Holocene-age terrace (Fig. 11). At this location 0.11 m of silt loam textured Camp Creek Member buries the Gunder Member. The Gunder Member is 5.68 m thick here and grades downward from silt loam to horizontally bedded silt loam and medium to coarse sand and gravel. Wood collected 4.27 m below the land surface within the lower, bedded portion of the Gunder Member was radiocarbon dated at 8,680±140 B.P. (Beta-17319; Table 2). The surface soil developed in the upper part of the Gunder Member here is poorly drained and has a subsurface Bt horizon. This soil is classified as a Haplaquoll. The Gunder Member buries a fluvial erosion surface developed on unoxidized, unleached Pre-Illinoian-age till 5.79 m below the land surface.

Several small cut banks are present along the southern of the two third-order streams southwest of hole 16 (Fig. 11). The stream cuts into the present floodplain as well as the low Holocene-age terrace in this area and exposes Gunder, Roberts Creek, and Camp Creek Member fills. The northernmost of the exposures is in the present floodplain and exposes 1.2 m of Camp Creek Member alluvium burying a thick, dark-colored A-C soil profile developed in the upper part of the Roberts Creek Member. Wood collected in the upper 0.2 m of the buried soil was radiocarbon dated at 70±50 B.P. (Beta-17318; Table 2). This probably dates the approximate time of burial of the Roberts Creek Member by the Camp Creek Member deposits.

Site 90-90

Site 90-90 is located near the mouth of a north-trending fourth-order tributary of Little Soap Creek (Fig. 6). Drainage area above the proposed structure site is 219 ha (540 ac). Valley wall slopes are very steep along this drainageway and the Nodaway-Cantril Complex is mapped in the valley (Seaholm, 1981; sheet 50). Most of the valley floor and slopes are covered with timber, and drilling was not possible in this area. The stream course was walked and bank exposures examined in the lower one-third of the watershed.

The Gunder, Roberts Creek, and Camp Creek members are exposed in the cut-banks along this drainageway. Gunder Member deposits are present beneath a low Holocene-age terrace; Roberts Creek Member deposits underlie the present flood-plain area, which is inset into the terrace; Camp Creek Member deposits bury the Roberts Creek Member, and in other areas cut out the Roberts Creek and Gunder members in the present floodplain area. Properties of these fills are similar to those at the previously described sites. Two horizontally bedded silty, loamy, and sandy Camp Creek Member alluvial fills are present in the floodplain area along this drainageway. The lithologic properties of both fills are similar, but crosscutting relationships allow their differentiation. Beds containing abundant organic materials are present in the lower part of both Camp Creek Member fills. Wood collected from the older of the two Camp Creek Member fills was radiocarbon dated at 360±60 B.P. (Beta-16754; Table 2), while organics collected from the younger fill yielded a date of 210±60 B.P. (Beta-16753; Table 2). Both samples were collected approximately 3 m below the land surface.

SCS Study Areas

Prior to the GSB investigations, SCS personnel conducted subsurface investigations in four proposed structure site areas (4-95, 4-90, 4-92, and 26-37; see Fig. 6). GSB personnel visited site 4-95 during these investigations and logs of the borings and field notes for the other sites were provided by the SCS for this brief summary. The reader is referred to the notebook of Thompson (1983a) on file at the SCS office in Des Moines, IA, for field notes and descriptions of the cores removed during these investigations. Appendix B contains a copy of Thompson's descriptions and discussion of site 4-95. The SCS study areas have smaller drainage areas (26-210 ha) than the areas investigated by GSB. In addition, the SCS study areas are located farther down the drainage network in small tributaries which drain directly to Soap Creek or South Soap Creek.

The Camp Creek, Roberts Creek, Gunder, and Corrington members of the DeForest Formation were encountered in these valleys during the SCS investigations. In all these areas the valley landscape consists of alluvial fans, two Holocene-age terraces, and the lower lying present floodplain. These surfaces were separated by short, steep scarps, usually 1.5 to 2 m in height. Horizontally bedded Camp Creek Member alluvium was encountered in the floodplain area. T2 is the first terrace level above the floodplain. Dark-colored, loamy Roberts Creek Member deposits were encountered there. Lower portions of the Roberts Creek Member contain interbedded coarse sand and gravel in-channel deposits. Surface soils on T2 have A-C and A-Bw-C profiles. T1 is the highest alluvial surface in these valleys. Valley wall slopes descend to this level in a smooth concave profile. The Gunder Member underlies this terrace level and consists of oxidized loamy to silt loam alluvium overlying a fluvial erosion surface developed on Pre-Illinoian-age till. Surface soils on T2 have A-E-Bt or A-Bt horizon sequences.

On the basis of cutting relationships, Thompson hypothesized that alluvial fans were sometimes older than, and in other instances, younger than T1. GSB investigations suggest that the fans and the Gunder Member, which comprises T1, are equivalent in age. The topographic separation of the alluvial fills in the SCS study areas can be attributed to their proximity to the master streams (Soap Creek and South Soap Creek) and consequent steep gradients. This geographic situation promotes vertical entrenchment which produces topographic separation of alluvial fills, especially when the master stream is nearby.

Thompson (1983b) also investigated the alluvial stratigraphy and associated archaeological manifestations along a portion of Little Soap Creek and a second-order tributary in section 22 of Green Township (T71N, R14W; Fig. 6). He identified four alluvial fills exposed along a straightened reach of Little Soap Creek, and informally designated them SC-1 through SC-4. All these exposures were within the present floodplain of Little Soap Creek. SC-1 consists of intermittently exposed gravel at the base of the fill sequence. This may be a separate fill or the basal in-channel deposits of unit SC-2. SC-2 is oxidized and silt loam or loam texture. A moderately thick surface soil with an A-Bt horizon sequence is developed in its upper part. This fill is the Gunder Member. Unit SC-3 is cut into SC-2 and consists of slightly darker colored, loam to silt loam alluvium. The surface soil developed into this unit is thinner than that developed in unit SC-2 and has an A-Bw horizon sequence. This fill is also the Gunder Member. Disseminated charcoal collected 1 to 1.5 m above creek level from near the base of unit SC-2 was radiocarbon dated at 3,300±110 B.P. (Beta 7375; Table 2; Thompson, 1983b:4). Unit SC-4 is highly stratified and cuts out or buries older fills along this reach. This is the Camp Creek Member.

The second-order tributary examined by Thompson (1983b) trends southwest-to-northeast and has a drainage area of about 71 ha (176 ac). Three distinct alluvial fills, informally designated as LS-1, LS-2, and SC-4, were recognized in outcrop during a reconnaissance survey along this drainageway. Unit LS-1 is present along the modern floodplain and is dark-colored, loamy alluvium of the Roberts Creek Member. Wood collected from within this fill, 1.2 m below the land surface, was radiocarbon dated at 1,910±100 B.P. (Beta 7374; Table 2). At a nearby exposure cut into a low Holocene-age terrace, gray colored, massive, silty clay loam texture Gunder Member alluvium (LS-2) is truncated by lighter-colored, horizontally bedded Camp Creek Member (SC-4). Charcoal in an apparent prehistoric feature located at the contact between the Gunder and overlying Camp Creek members yielded a "modern" radiocarbon date (Beta-7373; Table 2). This discrepancy was not resolved.

Soap Creek Valley

A cursory examination of alluvial fills exposed along the entrenched channel of Soap Creek was made in section 3 and the eastern half of section 4

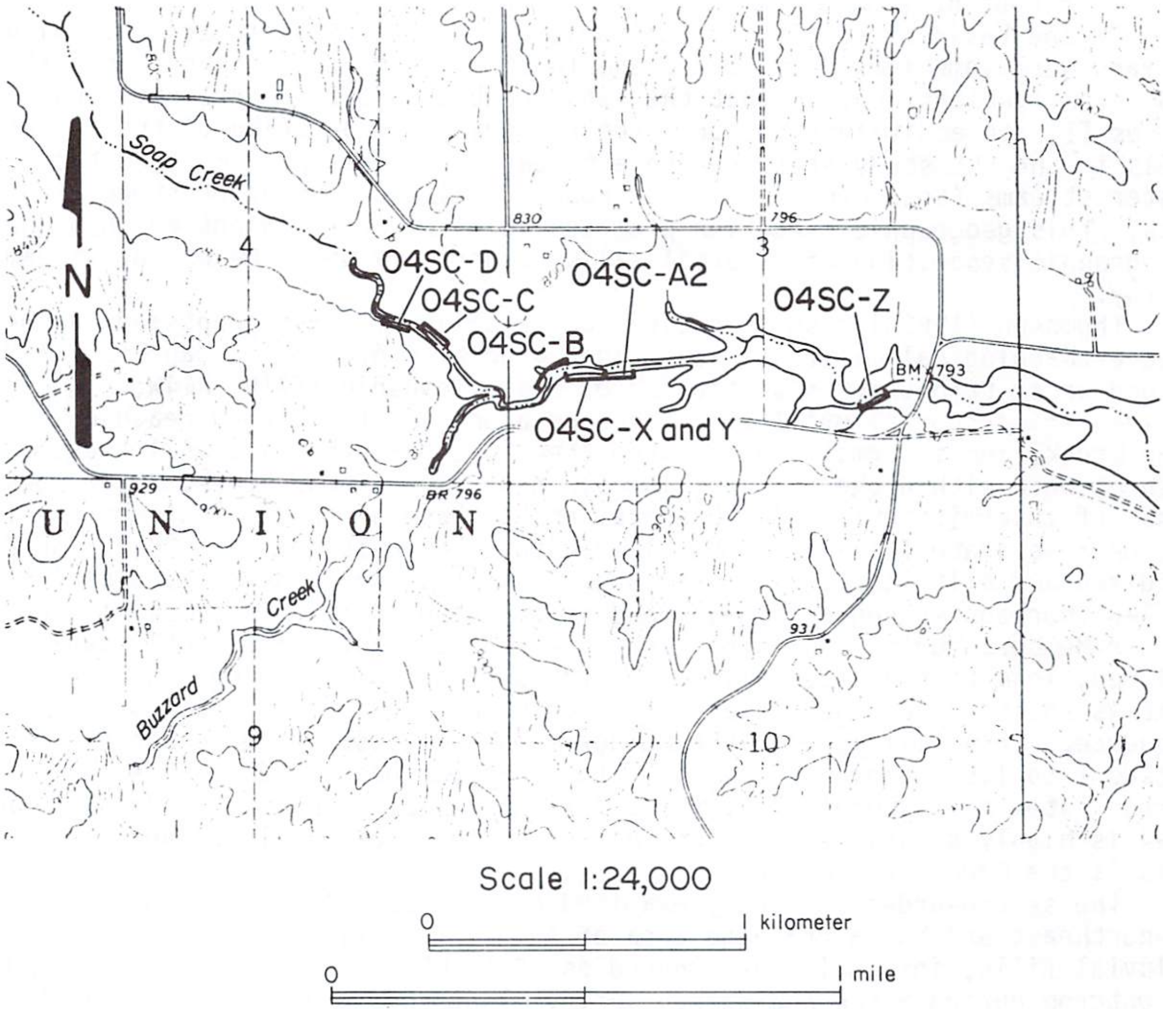


Figure 13. Portion of U.S.G.S. 7.5 minute Blakesburg, Iowa quadrangle showing the location of cutbanks along Soap Creek which are discussed in this report.

of Union Township (T70N, R16W) in northeastern Appanoose County (Fig. 6). All the exposures of Holocene-age alluvium are within the present floodplain in this area. The Gunder, Corrington, Roberts Creek, and Camp Creek members of the DeForest Formation, as well as several archaeological deposits contained within these fills, were recognized along this reach (Fig. 13).

Site 04SC-B encompasses a series of three alluvial fills exposed along the left (north) bank in a large bend in the creek just east of the line between sections 3 and 4. On the upstream end of the exposure dark-colored, loamy alluvium of the Roberts Creek Member is present. Moving downstream along the cut, the Roberts Creek Member is cut into oxidized, loamy Gunder Member alluvium. A surface soil with an A-Bt horizon sequence (a Hapludoll) is developed in the upper part of the Gunder Member where it is not cut out by the Roberts Creek Member. Farther downstream along the exposure, this Gunder Member fill is cut into and, in part, overlaps another Gunder Member fill which contains a prominent paleosol. The paleosol has a thick, dark-colored A horizon and a subsurface Bt horizon, and is classified as a Mollic Hapludalf. The modern surface soil developed into this part of the exposure has an A-Bt horizon sequence with an A horizon thinner than that of the paleosol. The Bt horizon of the surface soil is welded to the underlying paleosol. The older Gunder Member fill beneath the paleosol exhibits medium to coarse subangular blocky structure below the solum while the overlying younger Gunder Member fill tends to be massive below the solum. Burned rocks, indicating the presence of an archaeological site, were observed approximately 1.5 m below the land surface, above the buried paleosol and within the lower part of the younger Gunder Member alluvial fill in this exposure.

At 04SC-C, located upstream of 04SC-B in the eastern part of section 4, Gunder Member deposits are exposed along the left (north) bank of Soap Creek. Here 0.2 m of horizontally bedded, loamy Camp Creek Member deposits bury the Gunder Member. The Gunder Member alluvium exposed here exhibits coarse subangular blocky structure throughout and is morphologically very similar to the older Gunder Member fill exposed downstream at 04SC-B. The surface soil developed into the upper part of the Gunder Member at 04SC-C has an A-Bt horizon sequence and is classified as a Mollic Hapludalf. Charcoal collected from a prehistoric hearth 1.25 m below the land surface within the Bt horizon of the surface soil developed in the Gunder Member was radiocarbon dated at 3,320±60 B.P. (Beta-17317; Table 2). Several burned rocks were also observed eroding out of this exposure from about the same level. Dark-colored, loamy Roberts Creek Member cuts out the Gunder Member on the upstream end of this exposure.

Sites 04SC-X and 04SC-Y are located along the right (south) bank of Soap Creek downstream of site 04SC-B in section 3 (Fig. 13). A point-bar and channel-fill sequence within the Gunder Member is exposed here. The point-bar deposits consist of cross-bedded, iron-cemented sand and fine gravel dipping into a channel fill on the downstream end of the exposure. The channel deposits grade upward into oxidized, loamy Gunder Member deposits which are morphologically very similar to the younger Gunder Member deposits exposed at site 04SC-B. The surface soil is classified as a Cumulic Haplaquoll. Two radiocarbon dates, 3,530±70 and 3,620± 80 B.P. (Beta-16751 and 16752; Table 2) were obtained from organics interbedded with Gunder Member in-channel deposits in the lower part of this exposure. Oxidized, loamy Camp Creek Member deposits (0.25 -0.3 m thick) bury the Gunder Member at this exposure.

Site 04SC-A2 is located on the downstream end of the previously discussed exposure. This exposure is in the distal portion of a low-angle alluvial fan emanating from a small tributary to the south. The fan remnant (Corrington Member) is completely surrounded by younger alluvium (Gunder Member) deposited by Soap Creek. The fan remnant is evident as a low, few square decameter knob in the floodplain. Exposed Corrington Member deposits here consist of oxidized, loamy alluvium encompassing four fining-upward sequences. The Corrington Member deposits extend below creek level. Paleosols are developed in the upper part of each fining-upward sequence. Three paleosols are exposed here. The lowest two have thick, dark-colored A horizons and subsurface Bw horizons. These paleosols are classified as Mollisols and developed under prairie vegetation. The uppermost paleosol has a thinner A horizon, an E horizon and an underlying Bt horizon. This paleosol is classified as an Alfisol and developed under deciduous tree vegetation. The modern surface soil has a thick, dark-colored A horizon and an underlying Bt horizon which is welded to the buried Alfisol. This soil is classified as a Hapludoll and formed under prairie vegetation. Charcoal collected from the second paleosol below the present land surface, 0.9 m above creek level, yielded a radiocarbon date of 4,420 ±100 B.P. (Beta-17316; Table 2). A chert flake was collected from the lowest paleosol, at about creek level, and burned rocks were observed in the other paleosols in the exposure. The Gunder Member deposits immediately upstream at 04SC-X and Y truncate Corrington Member deposits exposed at 04SC-A2. During 1983 the SCS conducted a survey of floodplain damages within the watershed. Several areas were selected for evaluation, which included transects of drill holes and resurveying cross-sections originally surveyed in 1978. These investigations documented the nature and degree of change in the distribution of Camp Creek Member deposits along the major drainages in the watershed. Selected cross-sections and descriptions of borings taken during the survey are presented in Appendix B. The complete set of logs and surveyed cross-sections are available at the SCS office in Des Moines.

CORRELATIONS WITH OTHER STUDIES OF HOLOCENE-AGE ALLUVIUM IN IOWA

Introduction

Holocene-age alluvial fills in Soap Creek Watershed are lithologically similar to, and have distribution patterns similar to Holocene alluvium in eastern, central, and southern Iowa. All these alluvial fills are contained within the DeForest Formation (Bettis and Kemmis, in preparation), which is present throughout Iowa. This section of the report discusses previous studies of Holocene alluvial fills in eastern, central, and southern Iowa and suggests correlations with the fills identified in the Soap Creek Watershed study.

Individual Studies

In 1980 Thompson and Bettis studied the alluvial fills along a third-order tributary of Weldon Creek in southeastern Decatur County, Iowa (NE 1/4, NE 1/4, sec. 14, T68N, R24W). Drainage area at the study locality was 100 ha

(247 ac). The valley landscape in the area consisted of two small alluvial fans, a low terrace, and a floodplain area. Six alluvial fills, informally numbered 0-5, were distinguished during the investigations (Thompson and Bettis, 1980b:2). Unit 0 consisted of reduced, coarse-textured alluvium burying a fluvial erosion surface developed on unoxidized, unleached Pre-Illinoian-age till. Unit 0 was interpreted as Wisconsinan-age alluvium and is included in the Noah Creek Formation (Bettis and Kemmis, in preparation). Units 1 and 2 correlate with the Gunder Member. Unit 1 is oxidized to reduced, coarse-textured in-channel deposits, while unit 2 is the overlying, mottled, oxidized to reduced, finer textured overbank portion of the fining-upward sequence. Units 1 and 2 grade laterally into deposits making up alluvial fans which were also referred to as unit 2 by Thompson and Bettis (1980b). The fan deposits consisted of oxidized, loamy deposits with interbedded sand and gravel. Both fans contained several fining-upward sequences with a paleosol developed in the upper part of each sequence. These deposits correlate with the Corrington Member. Units 3 and 4 in the Decatur County study are dark-colored, loamy fills which are cut into unit 2 in the floodplain area. These two units correlate with the Roberts Creek Member. Just as in portions of the Soap Creek study area, individual DeForest Formation members may encompass more than one alluvial fill. Unit 5 of the Decatur County study corresponds to the Camp Creek Member. It is loamy, exhibits horizontal bedding, and buries all older fills. Topographic and stratigraphic relationships of the various DeForest Formation members are very similar in the Decatur County and Soap Creek areas. Alluvial fans composed of Corrington Member deposits are present at the junction of small valleys with larger trunk valleys. The Corrington Member deposits grade laterally into Gunder Member deposits making up a low terrace. Roberts Creek Member deposits are incised into or overlie the Gunder Member deposits in the floodplain area. Both the Roberts Creek and Gunder members encompass several, lithologically similar alluvial fills.

SCS-sponsored investigations were also undertaken in Mahaska County during 1980 (Thompson, 1983c). These investigations focused on the alluvial stratigraphy along a third-order tributary to Snyder Creek in east-central Mahaska County (sec. 28, T75N, R14W). Four Holocene-age alluvial fills, informally numbered 2-5, were identified in the area. Units 2 and 3 consisted of oxidized, loamy alluvial fills beneath a prominent Holocene-age terrace. These two alluvial fills correlate with the Gunder Member. Organics collected from the base of unit 2 yielded a radiocarbon date of 11,800±130 B.P. (Beta-3856). Unit 4 consists of dark-colored, loamy alluvium inset into units 2 and 3 in the floodplain area. This unit correlates with the Roberts Creek Member. Unit 5 includes stratified loamy alluvium burying unit 4 in the floodplain area. Unit 5 correlates with the Camp Creek Member. Topographic and stratigraphic relationships among the various units were similar to relationships in the Decatur County area and in Soap Creek Watershed.

Bettis and Hoyer (1984) studied the stratigraphy of the Michael's Creek Fan as part of a cultural resource study for a road realignment project in Louisa County in southeastern Iowa. The alluvial fan investigated emanated from a third-order tributary, Michael's Creek, along the western margin of the Mississippi River valley. These investigations documented an alluvial fan sequence with lithologic properties intermediate between the Gunder and Corrington members. This fan consisted of alluvium fining upward from oxidized, horizontally bedded sandy loam and silt loam to loam and silt loam. Two paleosols were developed into the upper part of the alluvial fan sequence.

Early Woodland ceramics (Black Sand Ware) found within the lowest of the paleosols, in conjunction with an absence of multiple fining-upward sequences, suggest that the Michael's Creek Fan accumulated during the late Holocene (after about 4000 B.P.). Several studies in the Upper Midwest have concluded that alluvial fans composed of Corrington Member and correlative deposits accumulated between approximately 8,500 and 2,500 B.P., during the early and middle Holocene (Bettis et al., 1984a). At the Michael's Creek Fan local factors (Mississippi River channel changes) caused the timing of the fan sedimentation to differ from the regional pattern.

Bettis (1984b) studied alluvial stratigraphy along Roberts Creek in northwestern Clayton County. This is the type area for the Roberts Creek and Gunder members (Bettis and Kemmis, in preparation). The alluvial fills in the valley were arranged into four informal lithologic units, A-D. Unit D in the Roberts Creek area has no recognized equivalent in the Soap Creek area. Unit D is oxidized and reduced, silty, loamy, and sandy Wisconsinan-age alluvium buried by Peoria Loess. It is probable that similar loess-mantled alluvium exists in the Soap Creek area, but it was not encountered in our investigations. Unit C in the Roberts Creek area is the Type Gunder Member. It consists of oxidized silty and loamy alluvium which usually exhibits brown mottles. Surface soils with A-Bt horizon sequences are developed in the upper part of the Gunder Member in this area. Extensive radiocarbon dating of alluvium in the Roberts Creek area indicates that the Gunder Member accumulated during the early and middle Holocene, just as it did in Soap Creek Watershed. In both areas the Gunder Member is present beneath a low terrace into which the present floodplain is incised. Unit B in the Roberts Creek area is the Type Roberts Creek Member. The Roberts Creek Member here is dark-colored,loamy alluvium, and has surface soils with A-Bw or A-C soil profiles developed in its upper part. This unit is found in the present floodplain area and accumulated during the late Holocene. Unit A of the Roberts Creek study is the Camp Creek Member. This unit consists of oxidized, horizontally bedded silty and loamy alluvium. As in other areas, this unit can bury or cut out all older alluvial fills and is Historic in age.

Brice, Petrides, and Associates (1985) conducted geomorphological investigations along a portion of the South Fork of Catfish Creek in Dubuque County as part of the Phase II investigations for a bridge crossing and road alignment. They identified the floodplain, a low terrace, and several small, steep alluvial fans in the area. Two alluvial fills were identified and informally referred to as Units I and II. Unit I buried all valley surfaces and had Entisols or no soil profile developed into it. This unit is equivalent to the Camp Creek Member. Unit II encompassed the remainder of the alluvium in the valley as well as that making up the alluvial fans. That unit has lithologic properties intermediate between the Roberts Creek and Gunder members. It was inferred from the poorly expressed morphology and weak horizonation of soils developed into Unit II that this fill accumulated during the late Holocene.

Investigations undertaken in the Saylorville Lake area, just upstream of the Des Moines Lobe terminus along the Des Moines River in central Iowa, documented alluvial fills which are correlative with those in the Soap Creek area (Bettis and Benn, 1984; Bettis and Hoyer, 1986; Benn, 1986b). The deposits beneath the High Terrace in the Saylorville Lake area are the Gunder Member. These deposits grade upward from oxidized sandy loam to oxidized loamy and silty alluvium. Brown mottles are common in the Gunder Member in this area.

Surface soils with thick A-Bt horizon sequences are developed in the upper part of the Gunder Member in the central Des Moines Valley. In this area the Gunder Member accumulated between about 11,000 and 4,000 B.P. Laterally, the Gunder Member deposits beneath the High Terrace grade into Corrington Member alluvial fan deposits. Corrington Member deposits in the central Des Moines Valley are oxidized, loamy alluvium and colluvium with interbedded sand and gravel. The fans are made up of several stacked fining-upward sequences with a paleosol developed in the upper part of each fining-upward sequence. Surface soils developed on the fans are as morphologically well expressed as those developed on the High Terrace underlain by the Gunder Member. Deposits making up the Intermediate Terrace along the central Des Moines Valley are the Roberts Creek Member. These deposits consist of dark-colored, loamy alluvium that has surface soils with A-Bw or A-C profiles developed in its upper part. Roberts Creek Member deposits are incised into Gunder and Corrington Member deposits in the present floodplain area. The Roberts Creek Member accumulated between 4,000 and about 750 years ago in the central Des Moines Valley. The youngest landform in the Saylorville Lake area, the Low Terrace, is composed of Camp Creek Member deposits. The Camp Creek Member also buries many older alluvial fills in the valley. This unit consists of in-channel deposits as well as horizontally bedded, oxidized, loamy and sandy alluvium that has little or no evidence of pedogenic alteration. Alluvium in tributary valleys was not intensively studied during the Saylorville Lake study, but cursory examination of cut banks along the tributary streams indicates that the Gunder, Roberts Creek, and Camp Creek members are present in the tributaries also.

A similar study of the Coralville Lake area along the Iowa River valley in eastern Iowa also documented alluvial fills correlative with DeForest Formation members elsewhere in Iowa (Anderson and Overstreet, 1986). Deposits making up the Intermediate terrace in Coralville Lake are the Gunder Member. In this area the Gunder Member consists of oxidized loamy and sandy alluvium. Alluvial fans composed of Corrington Member deposits grade laterally into Gunder Member deposits. Corrington Member deposits consist of oxidized, loamy alluvium and colluvium with interbedded sand and gravel. Several fining-upward sequences with a paleosol developed in the upper part of each sequence are present in the fans. Low terrace deposits, the Roberts Creek Member, are inset into the fans (Corrington Member) and the Intermediate terrace (Gunder Member). Low terrace deposits are dark-colored, loamy and sandy textured and exhibit more bedding than do the Gunder Member deposits making up the Intermediate terrace. Postsettlement alluvium, the Camp Creek Member, buries many Low terrace surfaces and is thickest adjacent to the pre-Coralville Lake Iowa River channel. This deposit is oxidized and exhibits prominent horizontal bedding. The High terrace in Coralville Lake is Wisconsinan in age and has no presently identified correlative in the Soap Creek area. Sand dunes and sheets are also very abundant in the Iowa Valley along Coralville Lake and are a product of winnowing of sandy late Wisconsinan-age alluvium in the valley, as well as movement of eolian sand from the Iowan Erosion Surface immediately north of the valley. This local abundance of sand makes the texture of most of the alluvial fills in the Coralville Lake area sandier than the regional norm for DeForest Formation alluvium. Most of the other lithologic properties, such as degree of oxidation, mottling, and nature of pedogenic alteration of the upper portion of the units are, however, consistent with the regional trends.

Investigations at three sites along the F-518 Corridor in southeastern Iowa encountered DeForest Formation alluvium in third-and fourth-order valleys (Lensink, 1986). Just downslope of the Sweeting site (13WS61), which is located on a narrow interfluve along a tributary to Davis Creek (SE 1/4, sec. 28, T77N, R6W), alluvium making up a small alluvial fan and a low terrace buried by the fan in a third-order valley has properties similar to the Roberts Creek Member. The fan and underlying terrace alluvium are dark colored and loamy. Two radiocarbon dates, 4,830±170 B.P. (Beta-12734) and 1,990±90 B.P. (Beta-12930), collected from the terrace deposits and overlying fan respectively, indicate that intermittent sedimentation occurred from the late middle Holocene into the late Holocene in this landscape position. Ages and properties of the deposits at this locality deviate from the regional pattern documented for the Roberts Creek Member. Local factors, such as a small spring in close proximity to the fan, may account for the deviation from the regional pattern.

Cores taken from two low, unpaired Holocene-age terraces across Davis Creek from site 13WS122, located approximately 0.8 km (0.5 mi) south of the Sweeting site, encountered three members of the DeForest Formation. The upper 1.06 m of deposit on the lowest terrace is the Camp Creek Member. This deposit consists of dark-colored, horizontally bedded silty alluvium. The Camp Creek Member buries dark-colored, loamy Roberts Creek Member alluvium. A buried paleosol with an A-Bg horizon sequence was developed in the upper part of the Roberts Creek Member buried by Camp Creek Member deposits at this locality. On the higher terrace, dark-colored, loamy Roberts Creek Member deposits bury Gunder Member deposits. The Gunder Member deposits at this location are deoxidized, but exhibit prominent mottles, suggesting former oxidizing conditions. A buried paleosol with an A-C soil profile is developed in the upper part of the Gunder Member here. Two backhoe trenches dug south of Davis Creek, on the margin of 13WS122, revealed loamy, horizontally bedded Camp Creek Member deposits beneath the floodplain adjacent to the site. These deposits extended to depths of greater than 3 m. A "modern" radiocarbon date (Beta-12466) was obtained on walnuts collected 2.75-2.9 m below the surface in this area.

The Goose Creek site (13WS126) was located on a low terrace on the south side of Goose Creek about 5 km (3 mi) south of 13WS122. Cores and a backhoe trench at this site indicate that alluvium making up this terrace is the Gunder Member. The alluvium consists of oxidized, stratified loamy deposits grading upward to more massive, oxidized, loamy alluvium exhibiting prominent brown mottles. The surface soil developed into the upper part of the Gunder Member on the terrace has an A-E-Bt horizon sequence. A radiocarbon date on charcoal associated with a Late Archaic or Early Woodland component 0.5 m below the terrace surface (2,520±70 B.P.; Beta-12686) indicates that the bulk of Gunder Member accumulation had occurred before the late Holocene on this landform.

REGIONAL CORRELATIONS AND CAUSAL MECHANISMS

Studies of Holocene-age alluvium indicate that changes in fluvial systems were roughly synchronous on a regional scale, but the direction and magnitude of the changes varied from area to area and within different parts of individual drainage basins (Knox, 1983; Bettis and Benn, 1984; Bettis and Hoyer, 1986; Bettis and Thompson, 1982). These changes produced valley landscapes which vary in detail but share an overall pattern of landform-sediment assemblages (Bettis and Hoyer, 1986). Deposits making up these assemblages are the members of the DeForest Formation. These members can be mapped throughout Iowa and form the basis for state-wide correlation of Holocene-age alluvial deposits. Indeed, they may be mappable throughout a large portion of the Upper Midwest, and can provide the framework for regional correlation of Holocene-age deposits.

The studies outlined above, and several others conducted in adjacent states, have shown that there are regional trends in the morphologic properties, distribution patterns, and chronology of Holocene-age valley fills (Bettis and Hoyer, 1986; Bettis et al., 1984a; Knox, 1983; Wiant et al., 1983). These trends are a product of adjustments of the Upper Midwestern fluvial system to both late-glacial increases in local relief and discharge fluctuations, and water table changes related to climatic change during the Holocene. Several investigations have shown that rivers and streams downcut during the terminal Wisconsinan in response to the cessation of glacial meltwater discharge into their headwater areas or the master streams to which they drained (Bettis and Hoyer, 1986; Hallberg et al., 1984; Bettis and Hallberg, 1985; Wiant et al., 1983). This terminal Wisconsinan downcutting also occurred in drainage systems not directly affected by glacial meltwater and may have been related to climate changes or internal adjustments in these fluvial systems (Knox, 1983; Brackenridge, 1981). The downcutting increased local relief and triggered a complex response of the fluvial system (Schumm, 1977; 1980). The complex response involved headward extension of tributary valleys, episodic accumulation of alluvial fans at the junction of those tributaries with larger valleys, and episodic aggradation in both the tributaries and large valleys. This response continued until about 4,000 B.P. in most areas.

Climatic reconstructions of the period from 10,500 to 4,000 B.P. indicate a drying and warming trend culminating about 6,500 to 5,000 B.P. (Van Zant, 1979; Baerreis, 1980). During this period water tables were lowered, flood frequency was reduced, but infrequent, high-magnitude floods became more prevalent (Knox et al., 1981). Prairies expanded over large portions of the landscape while forests decreased in areal extent. The net effect of these climatic trends was to promote episodic aggradation and favor oxidizing conditions in the valley environment.

The Gunder and Corrington members accumulated under these conditions during the early and middle Holocene. Both are dominated by oxidized deposits which often contain brown mottles. The mottles may have begun to develop during high water table conditions prior to about 8,000 B.P. and during intermittent high water table conditions in the overall dry middle Holocene.

Corrington Member deposits accumulated episodically in alluvial fans. These deposits were derived from erosion (headward extension, widening, and downcutting) in the basin above the fan, and therefore periods of sedimentation on the fan correspond to erosion episodes in the basin above the fan. At the beginning of a sedimentation episode relatively coarse deposits accumulated rapidly on the fan surface (Hoyer, 1980). These were buried by increasingly less frequent pulses of finer textured deposits as the sedimentation episode continued. Pedogenesis altered the upper part of each fining-upward sequence as sedimentation rates became negligible. Corrington Member alluvial fan deposits grade laterally into Gunder Member alluvium. The major period of Corrington Member alluvial fan accumulation in Iowa and adjacent states was between 8,500 and 2,500 B.P. (Bettis et al., 1984a).

Gunder Member deposits are present in both large and small valleys, and accumulated between about 11,000 and 4,000 B.P. in most areas. The Gunder Member is present beneath one or more Holocene-age terrace(s), or across most of the valley floor in unchanneled small valleys high in the drainage network. Lower portions of this member usually consist of coarse-grained, in-channel deposits. These grade upward into finer textured deposits which accumulated during overbank flooding. The Gunder Member also encompasses deposits beneath footslopes and toeslopes at the base of valley wall slopes. These Gunder Member deposits accumulated as slopewash and were derived from deposits upslope. Slopewash-derived Gunder Member deposits grade imperceptively into overbank-dominated Gunder Member deposits away from the valley wall slopes. Several investigations have shown that the Gunder Member encompasses several morphologically similar alluvial fills which have cutting, and in some cases, overlapping relationships (Bettis, 1984b; Bettis and Hoyer, 1986). Individual fills can be mapped in outcrop, backhoe trenches, and with detailed drilling. Formally grouping these morphologically similar fills into one member is practical for mapping purposes and for cultural resource evaluation and planning.

Modern soils exhibiting a similar degree of development are present on Corrington Member alluvial fans and on terraces underlain by the Gunder Member. These soils have moderate to strong grade structure, subsurface Bt horizons showing evidence of clay translocation, well expressed horizonation, brown mottles within the solum, and usually have oxidized (brown) C horizons. These soils are classified as Alfisols and Mollisols. In most cases, these soils consist of two or more superimposed soil profiles welded together. Numerous radiocarbon dates and associated time-diagnostic artifacts indicate that these soils developed during the late Holocene, from about 2,500 B.P. to the present.

Shortly after about 4,000 B.P. most streams in Iowa and adjacent states downcut and began to migrate laterally and construct new, lower-lying floodplains consisting of Roberts Creek Member deposits. At about the same time, or slightly later, alluvial fan accumulation ended as fan-head trenches developed (Bettis et al., 1984a). Reconstructions of the late Holocene (post-4,000 B.P.) climate suggest that conditions cooler and more moist than were characteristic of the middle Holocene prevailed during the late Holocene (Van Zant, 1979; Baker et al., 1987). These late Holocene climatic conditions promoted higher water tables, increased the frequency of low-magnitude floods, and allowed a more lush vegetation cover and expansion of deciduous forest (Knox et al., 1981). The net effect of these environmental conditions was to inhibit oxidizing conditions and promote accumulation of organic-rich Roberts Creek Member deposits in the floodplain area.

The Roberts Creek Member is present beneath low terraces and the present floodplain. In most areas Roberts Creek Member deposits are incised into older Gunder and Corrington Member deposits. Locally, the Roberts Creek Member overlaps the upper portions of the Gunder and Corrington members adjacent to the present floodplain. Roberts Creek Member deposits are usually absent in low-order, unchanneled tributary valleys high in the drainage network. Roberts Creek Member deposits accumulated during the late Holocene, after about 4,000 B.P. (Bettis, 1984b; Bettis and Hoyer, 1986). Lower portions of the unit consist of coarse-textured, in-channel deposits grading upward into finer textured overbank deposits. The fine-textured portion of the member is dark colored because much of the organic matter originally present in the deposit has not been oxidized. The Roberts Creek Member can also encompass several morphologically similar alluvial fills. Just as with the Gunder Member, individual fill units can be recognized by detailed study in local areas.

Modern soils developed into the Roberts Creek Member contrast sharply with modern soils developed into the Gunder and Corrington members. Soils developed into the Roberts Creek Member have A-Bw or A-C profiles, are dark colored, exhibit weak to moderate grade structure, do not have evidence of clay translocation in their B horizons, and have weak horizonation. These soils are classified as Inceptisols or Entisols. Radiocarbon dates and associated time-diagnostic artifacts suggest that these soils have been developing for 1000 years or less (Bettis and Hoyer, 1986; Benn and Harris, 1982; Benn, 1986a).

The Camp Creek Member is present throughout the state. The unit accumulated under Historic climatic and vegetation conditions. The Camp Creek Member encompasses in-channel and overbank deposits in the present channel belt and upper portions of the floodplain area. Camp Creek Member alluvium often buries the Roberts Creek Member in the floodplain area. Also included in the Camp Creek Member are recent slopewash deposits at the base of slopes. In this landscape position the Camp Creek Member deposits bury the Gunder and Corrington members. Camp Creek Member deposits are distinct from other members of the DeForest Formation in that they are always at the landsurface, usually have well preserved bedding throughout the vertical extent of the unit, and are usually not pedogenically altered. Radiocarbon dates and Historic artifacts buried within the Camp Creek Member indicate that it began accumulating as early as 450 years ago, and is still accumulating. Similar to the Gunder and Roberts Creek members, the Camp Creek Member can encompass several morphologically similar alluvial fills.

CONCLUSIONS AND RECOMMENDATIONS

Holocene-age valley landscapes and the deposits of which they are comprised can be consistently mapped in the Soap Creek Watershed area. Figures 7, 9, and 11 of this report present generalized maps of landforms underlain by groups of alluvial fills with similar ages. This mapping is possible because the various alluvial fills in the area can be grouped into the members of the DeForest Formation. Several radiocarbon dates from the Soap Creek area, in conjunction with a much larger body of dates from elsewhere in Iowa and surrounding states, provides the chronologic framework used for assigning temporal ranges for the DeForest Formation members in the study area.

These maps depict the physical landscape which is the framework within which the archaeological record is preserved. Since the archaeological record consists of cultural deposits, not cultures, the physical context of those deposits is extremely important in their interpretation. In addition, buried archaeological deposits, not detectable using traditional archaeological site detection techniques, are present within the alluvial fills in the valleys. Detecting and evaluating these sites is a frontier of archaeological methodology (Benn, 1986b). Investigation of the distribution and chronology of the alluvium in valleys provides information necessary to adequately assess the potential of the area for containing buried sites. Once this information is available, informed decisions about the survey methodologies to be used on the various portions of the valley landscape can be made.

Several recommendations for future archaeological and archaeological geology investigations in Soap Creek Watershed can be offered based on the results of this study and several others summarized in the previous sections.

1) Initial archaeological surveys in the watershed should concentrate on three structure site areas which have been studied and mapped by GSB (sites 68-66, 68-55, and 90-109). In these areas the valley landscape has been divided into temporally-equivalent landform areas. Members of the DeForest Formation have different potential for containing archaeological deposits from the various culture periods (Bettis and Benn, 1984; Bettis and Hoyer, 1986; Anderson and Overstreet, 1986). Inferred relationships are outlined in Table 3.

2) Traditional site locating techniques, such as pedestrian survey and shallow test pits can be employed in the areas where Peoria Loess and/or Pre-Illinoian-age till or till-derived pedisediment are the surficial materials. Shallowly buried archaeological deposits may be present in these areas.

3) Buried sites are very likely in the Corrington-Gunder Member complex areas (alluvial fans and Holocene-age terrace) and survey methodology should be geared to addressing this concern. Archaeological deposits buried in these areas will be associated with the Paleo-Indian, and Archaic culture periods.

4) Buried sites may also be found in the modern floodplain area where Roberts Creek Member deposits are present. Buried archaeological deposits in this area will be associated with the Late Archaic, Woodland, and possibly Oneota culture periods. Older in-situ archaeological deposits will not be found in the present floodplain area because the deposits there (Roberts Creek Member) are too young to contain these deposits.

5) Camp Creek Member deposits can bury all other members of the DeForest Formation. Compared to other areas in the state, such as western Iowa and larger river valleys, the Camp Creek Member is relatively thin in most structure site areas in Soap Creek Watershed. In most cases it can be penetrated in shallow test pits or with a hand probe. Either of these two methods should be used where pedestrian survey indicates an absence of surficial archaeological deposits. If archaeological survey is planned in larger valleys within the watershed, thick Camp Creek Member sections may be encountered. Thick Camp Creek Member deposits were documented during the SCS investigations along the major streams in the watershed (Appendix B, cross-sections). These areas must be identified prior to an archaeological survey of the area in order to avoid pedestrian surveys and shallow test pitting in areas where these methods are not effective.

6) The Roberts Creek Member needs to be more intensively dated in Soap Creek Watershed. This unit is inferred to be the context in which buried Woodland archaeological deposits will be found. That inference is based on only two radiocarbon dates from the area.

7) A detailed geologic study should be undertaken to physically trace deposits from a small tributary into the alluvium in one or more of the major valleys in Soap Creek Watershed. Cursory examination of cut banks along Soap Creek indicate that DeForest Formation members are present in the large valley, but the detailed physical and temporal relationships between the large-

Table 3. Preservation potentials for **buried** archaeological sites in Soap Creek Watershed. Archaeological deposits representing culture periods younger than the landform-sediment assemblages will occur on or near the surface in that area unless buried by Camp Creek Member deposits.

Culture Period	Corrington Member	Gunder Member	Roberts Creek Member	Camp Creek Member
Paleo-Indian	++	++	-	-
Early and Middle Archaic	++	++	-	-
Late Archaic	++	++	++	-
Woodland	+-	+	++	-
Oneota	-	-	++	+-
Historic	-	-	-	++

- not possible; +- low potential; + moderate potential; ++ high potential

and small-valley fills is not well understood. These relationships may have had a significant impact on prehistoric settlement patterns in the area. Because of the documented presence of radiocarbon datable material and archaeological deposits within the alluvial fills, the Soap Creek Watershed is an ideal area for addressing this issue.

8) When locating potential structure sites and borrow areas in the future, attempts should be made to avoid impacting alluvial fans. These are known to be the context for many Archaic Period archaeological sites in the Upper Midwest (Bettis and Hoyer, 1986; Wiant et al., 1983). Avoiding these areas at the planning stage should prove to be cost effective. If these areas cannot be avoided, monitoring during construction is recommended.

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APPENDIX A

Detailed core descriptions from GSB investigations

68AB1

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 867.5 ft
Landscape position: alluvial fan, midfan
Slope: 5-9%
Vegetation: cultivated field
Date described: 3/31/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CORRINGTON MEMBER
0-21	Ap	black to very dark gray (10YR2/1-3/1) silt loam, cloddy, friable, noneffervescent, abrupt lower boundary, common roots
21-43	A	black to very dark gray (10YR2/1-3/1) silty clay loam, moderate medium granular, friable, noneffervescent, gradual lower boundary, common medium to fine oxides, common roots
43-73	Bt1	very dark grayish brown (10YR3/2) silty clay loam, strong medium angular blocky, firm, noneffervescent, gradual lower boundary, common fine iron concretions, few thin discontinuous black (10YR2/1) cutans
73-108	Bt2	very dark grayish brown to dark grayish brown (10YR3/2-4/2) silty clay loam, moderate coarse columnar breaking to strong medium angular blocky, firm, noneffervescent, gradual lower boundary, common fine to medium iron concretions, few fine oxides, common thin almost con-

		tinuous very dark grayish brown (10YR3/2) cutans
108-135	Bt3	very dark grayish brown to dark grayish brown (10YR3/2-4/2) silty clay loam, strong medium angular blocky, friable, noneffervescent, clear lower boundary, iron concretions and oxides as above, few thin discontinuous very dark grayish brown (10YR3/2) cutans, thick continuous clay flows in root channels
135-173	BC	dark grayish brown (10YR4/2-2.5Y4/2) silty clay loam, moderate medium to coarse subangular blocky, friable, noneffervescent, clear lower boundary, common medium to fine yellowish brown (10YR5/6) mottles, common fine oxides, occasional fine pebbles
173-243	CB	dark grayish brown (2.5Y4/2) loam, weak coarse columnar, friable, noneffervescent, gradual lower boundary, abundant medium to coarse yellowish brown (10YR5/6) mottles, oxide accumulation along root channels
243-273	C	as above but contains more sand, fine pebbles at base, abrupt lower boundary
273-280	2Ab	very dark grayish brown (10YR3/2) silty clay loam, weak medium subangular blocky, friable, noneffervescent, gradual lower boundary, few medium dark grayish brown (2.5Y4/2) mottles, common fine oxides
280-331	2Bwb	dark gray to dark grayish brown (10YR4/1-4/2) silt loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual lower boundary, common medium olive brown (2.5Y4/4)

		mottles, common fine iron concretions and oxides
331-383	2Cb	dark grayish brown to olive brown (2.5Y4/2-4/4) silt loam to silty clay loam, very weak medium subangular blocky to massive, friable, noneffervescent, abrupt lower boundary, common medium olive brown to light olive brown (2.5Y4/4-5/4) mottles, iron concretions and oxides as above
383-410	3A1b	very dark gray to dark gray (10YR3/1-4/1) silt loam to silty clay loam, very weak medium subangular blocky to massive, friable, noneffervescent, gradual lower boundary, common coarse dark yellowish brown (10YR4/6) soft pipestems
410-441	3A2b	very dark gray (10YR3/1) silt loam, weak medium to fine subangular blocky, friable, noneffervescent, clear lower boundary, pipestems as above
441-450	3ABb	dark brown (10YR3/3) silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual lower boundary, few medium to fine yellowish brown (10YR5/6) mottles
450-474	3Bw1b	light olive brown to light yellowish brown (2.5Y5/4-6/4) silt loam, moderate to strong medium to fine angular blocky, friable, noneffervescent, gradual lower boundary, abundant fine yellowish brown (10YR5/6) mottles along root channels, common thin discontinuous olive brown (2.5Y4/4) cutans
474-488	3Bw2b	light olive brown to light yellowish brown (2.5Y5/4-6/4) silty clay loam, moderate coarse columnar breaking to strong

		medium angular blocky, friable, noneffervescent, gradual boundary, mottles and cutans as above
488-514	3BCb	dark grayish brown to olive brown (2.5Y4/2-4/4) silt loam, weak medium subangular blocky, friable, noneffervescent, clear lower boundary, common medium to coarse gray (2.5Y5/0) mottles, occasional iron accumulations along root channels
514-545	3C1b	dark grayish brown to olive brown (2.5Y4/2-4/4) silt loam, massive, friable, noneffervescent, clear lower boundary, common medium to coarse gray and light olive brown (2.5Y5/0 and 5/4) mottles
545-590	3C2b	gray (2.5Y5/0) loam to silt loam, massive, friable, noneffervescent, abrupt lower boundary, common coarse olive brown (2.5Y4/4) mottles
590-base (620)	4C	dark grayish brown to grayish brown (2.5Y4/2-5/2) medium to coarse loamy sand and fine gravel, single grain, loose, noneffervescent, auger rejected

68AB2

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 870.4 ft
Landscape position: footslope descending to alluvial fan
Slope: 9-14%
Vegetation: cultivated field
Date described: 4/1/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-40	Ap	very dark grayish brown (10YR3/2) loam, cloddy, friable, noneffervescent, abrupt lower boundary, common roots
40-75	Bw1	yellowish brown (10YR5/4-5/6) loam with occasional fine pebbles, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common medium dark yellowish brown (10YR4/6) mottles, few fine oxides and iron concretions, common roots
75-97	Bw2	brown (10YR4/3-5/3) loam with occasional fine to medium pebbles, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, abundant medium dark yellowish brown (10YR4/6) mottles, abundant medium iron concretions, common roots
97-113	Bw3	grayish brown to brown (10YR5/2-5/3) silt loam, moderate to strong medium columnar, friable, clear boundary, mottles and iron concretions as above, few roots

113-203	C1	dark grayish brown and yellowish brown (10YR4/2 and 5/6) silt loam, massive, friable, noneffervescent, gradual boundary, abundant fine to medium iron concretions, few fine oxides, clay flows in root channels
203-242	C2	brown (10YR5/3) silt loam with common fine to medium pebbles, massive, friable, noneffervescent, gradual boundary, abundant medium dark gray (10YR4/1) mottles, iron concretions as above
242-330	C3	dark yellowish brown (10YR4/6) silt loam to loam with common medium pebbles occuring in irregular spaced bands, massive, friable, noneffervescent, abrupt boundary, common medium dark gray (10YR4/1) mottles, common medium to coarse iron concretions
330-365	2C	yellowish brown (10YR5/6) fine sandy loam to loam, massive, friable, noneffervescent, abrupt boundary, common coarse light gray (10YR6/1) mottles in upper 10 cm
365-390	3C1	brown (7.5YR4/4) medium to coarse loamy sand, single grain, loose, noneffervescent, abrupt boundary
390-409	3C2	dark gray to dark grayish brown (10YR4/1-4/2) medium sand, single grain, loose, noneffervescent, clear boundary
409-424	3C3	dark brown to brown (7.5YR3/4-4/4) medium sand, single grain, loose, noneffervescent, abrupt boundary
		PRE-ILLINOIAN TILL
424-449	4C1 (MOL)	yellowish brown (10YR5/4-5/6) loam, massive, firm, noneffer-

		vescent, clear boundary, common olive brown (2.5Y4/6) streaks, common medium iron concretions
449-base (540)	4C2 (UU)	very dark gray to dark gray (10YR3/1-4/1) loam with common pebbles, massive, firm, violent effervescence

68AB3

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 862.0 ft
Landscape position: floodplain inset into alluvial fan
Slope: 0-2%
Vegetation: pasture
Date described: 4/1/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-54	+	very dark grayish brown (10YR3/2) silt loam, weak fine to medium subangular blocky, friable, non-effervescent, abrupt boundary, abundant roots, occasional burrows filled with brown (10YR4/3) loam
		ROBERTS CREEK MEMBER
54-76	A1	black to very dark gray (10YR2/1-3/1) silt loam, moderate medium granular, friable, noneffervescent, gradual boundary, common roots
76-106	A2	very dark gray to very dark grayish brown (10YR3/1-3/2) silt loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary, very few fine dark yellowish brown (10YR4/6) mottles, common roots
106-147	A3	very dark grayish brown (10YR3/2) loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, common medium dark grayish brown (10YR4/6) mottles, few fine oxides, common fine iron concretions

147-170	A1b	black to very dark gray (10YR2/1-3/1) loam, moderate fine to medium granular, friable, noneffervescent, gradual boundary, abundant fine dark yellowish brown (10YR4/6) mottles
170-187	A2b	very dark gray (10YR3/1) loam, weak fine subangular blocky, friable, noneffervescent, clear boundary, abundant fine to medium olive brown (2.5Y4/4) mottles, abundant fine iron concretions
187-213	Cb	very dark gray (2.5Y3/0) stratified loam and medium sand, massive and single grain, friable and loose, noneffervescent, abrupt boundary, mottles as above
213-262	2C1	dark grayish brown to olive brown (2.5Y4/2-4/4) sandy loam, massive, nonsticky nonplastic, noneffervescent, abrupt boundary, common coarse dark gray (2.5Y4/0) mottles, common medium iron concretions
262-300	2C2	dark grayish brown (2.5Y4/2) medium to coarse loamy sand and gravel (clasts up to 5cm in diameter), single grain, loose, noneffervescent, abrupt boundary
		PENNSYLVANIAN SYSTEM DES MOINES SUPERGROUP
300-base (350)	3CR	greenish gray (5GY6/1) siltstone, massive, very friable, noneffervescent, common bluish gray (5B6/1) and olive (5Y5/4) streaks

68AB4

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 863.3 ft
Landscape position: mouth of drainage inset into alluvial fan
Slope: 5-9%
Vegetation: cultivated field
Date described: 4/1/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION ROBERTS CREEK MEMBER
0-87	modern solum	modern solum (A-Bw-BC) developed in very dark gray to very dark grayish brown (10YR3/1-3/2) silty clay loam alluvium, noneffervescent, gradual boundary
87-143	C1	very dark gray to dark gray (10YR3/1-4/1) heavy loam, massive, friable, noneffervescent, abundant medium to coarse dark yellowish brown to yellowish brown (10YR4/4-5/6) mottles, clear boundary
143-190	C2	dark gray (10YR4/1) sandy loam to loam (coarsens with depth), single grain to massive, loose to friable, noneffervescent, abrupt boundary, occasional mottles
190-351	C3	dark grayish brown (2.5Y4/2) loam, massive, friable, noneffervescent, abundant coarse dark gray (2.5Y4/0) and common medium light olive brown (2.5Y5/6) mottles, clear boundary
351-427	C4	very dark gray (10YR3/1) loam grading to sandy loam, massive, friable, noneffervescent, few fine charcoal flecks at top of

		horizon, clear boundary
427-680	2C	dark grayish brown and olive brown (2.5Y4/2 and 4/4) medium to coarse sand and pebbles, single grain, loose, noneffervescent, abrupt boundary
		PENNSYLVANIAN SYSTEM DES MOINES SUPERGROUP
680-base (717)	R	greenish gray (5BG6/1) siltstone, massive, firm, noneffervescent

68AB5

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 875.4 ft
Landscape position: upstream margin of small alluvial fan
Slope: 5-9%
Vegetation: cultivated field
Date described: 4/1/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CORRINGTON MEMBER
0-133	modern solum	somewhat poorly drained mollisol with an argillic horizon (Argiaquoll), Bt horizon is silty clay loam, abrupt lower boundary
133-203	paleosol	Inceptisol witl 10cm thick Ab horizon over Bwb horizon, silty clay loam texture, clear lower boundary
203-250	2C1b	dark grayish brown to olive brown (2.5Y4/2-4/4) loam, massive, friable, noneffervescent, common coarse gray (2.5Y5/0) mottles, common medium soft iron accumulations, gradual boundary, lower portion of horizon contains coarse pebbles
250-510	2C2b	dark grayish brown (2.5Y4/2) loam, massive, friable, noneffervescent, common coarse gray (2.5Y5/0) mottles, gradual boundary, water table at 337cm
510-640	3C	dark grayish brown (2.5Y4/2) medium sand grading downward to fine gravel, single grain, loose, noneffervescent, occasional medium to coarse olive brown (2.5Y4/4) mottles, abrupt boundary
		PRE-ILLINOIAN TILL

640-base (670)	4C (UU)	very dark gray (10YR3/2) loam with common pebbles, massive, firm, violent effervescence

68AB6

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 863.3 ft
Landscape position: alluvial fan, midfan
Slope: 5-9%
Vegetation: pasture
Date described: 4/1/86
Described by: E.A. Bettis III
Remarks: C-14 date 535-540cm--7650±120 B.P. (Beta-16322)

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CORRINGTON MEMBER
0-167	modern solum	somewhat poorly drained Mollisol with an argillic horizon (Argiaquoll), developed in silty clay loam alluvium, abrupt lower boundary
167-220	paleosol	somewhat poorly drained Inceptisol developed in loamy alluvium, clear lower boundary
220-300	2C1b	olive brown (2.5Y4/4) loam, massive, friable, noneffervescent, abundant fine to medium gray mottles, clear boundary
300-516	2C2b	dark gray (2.5Y4/1) loam, massive, slightly sticky nonplastic, noneffervescent, occasional thin zones of iron mottles, water table at 303cm
516-base (600)	3C	dark grayish brown to olive brown (2.5Y4/2-4/4) sandy loam, single grain, loose, C-14 date on wood 535-540cm -- 7650±120 B.P. (Beta-16322), medium to coarse sand and gravel at base, auger rejected

68AB7

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 859.0 ft
Landscape position: floodplain inset into alluvial fan
Slope: 2-5%
Vegetation: pasture
Date described: 4/1/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION ROBERTS CREEK MEMBER
0-160	modern solum	Entisol developed in loamy alluvium
160-base (470)		this zone consists of a series of dark gray to dark grayish brown (2.5Y4/1-4/2) fining upward sequences, these consist of about 1m of pebbles and coarse sand grading upward to organic loam, contacts between the sequences are abrupt, all are noneffervescent, the whole package appears to be a channel fill sequence, auger rejected on coarse gravel

68AB8

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 858.8 ft
Landscape position: floodplain
Slope: 2-5%
Vegetation: pasture
Date described: 4/2/86
Described by: E.A. Bettis III
Remarks: C-14 date 555-560cm--10,820±140 B.P. (Beta-16323)

Depth (cm)	Soil Horizon (weathering zone)	Description
		RECENT FILL
0-60	+	brown (10YR4/3) loam, noneffervescent, massive to cloddy, this horizon appears to be fill buldozed into this location
		DEFOREST FORMATION ROBERTS CREEK MEMBER
60-236	C	black to very dark gray (10YR2/1-3/1) loamy alluvium with 10cm thick gravel layer at base, noneffervescent, common iron mottling, abrupt lower boundary
		GUNDER MEMBER
236-310	2C1	olive brown (2.5Y4/4) loamy alluvium, noneffervescent, abundant iron mottling, gradual lower boundary
310-488	2C2	black to dark gray (10YR2/1-5Y4/1) fine loamy sand alluvium, massive, noneffervescent, common olive (5Y4/3) mottles, clear boundary
488-512	2C3	olive brown (2.5Y4/4) coarse sand, single grain, loose, noneffervescent, abrupt boundary
512-560	2C4	dark gray (10YR4/1) loamy sand, single grain, loose, noneffer-

		vescent, abrupt boundary, C-14 date on wood 555-560cm-- 10,820±140 B.P. (Beta-16323)
560-587	2C5	dark yellowish brown (10YR4/4) coarse sand and gravel, single grain, loose, noneffervescent, abrupt boundary
587-base (600)	2C6	dark yellowish brown (10YR4/4) coarse sand and gravel, violent effervescence, auger rejected

68AB9

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 869.7 ft
Landscape position: footslope descending to terrace
Slope: 9-14%
Vegetation: cultivated field
Date described: 4/2/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-40	Ap	very dark grayish brown (10YR3/2) loam, cloddy, friable, noneffervescent, abrupt boundary
40-83	AB	very dark grayish brown to dark grayish brown (10YR3/2-4/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary
83-143	Bw	brown (10YR4/3) heavy loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary
143-260	C1	brown (10YR4/3) loam, massive, friable, noneffervescent, gradual boundary, abundant medium to coarse yellowish brown (10YR5/6) and common medium to coarse grayish brown (10YR5/2) mottles
260-388	C2	brown and grayish brown (10YR4/3 and 5/2) stratified loam and pebbly loam, massive separates along horizontal bedding planes, friable, noneffervescent, abrupt boundary, abundant streaks and mottles of opposite color, common fine oxides
		PRE-ILLINOIAN TILL

388-401	2C1 (OU)	dark grayish brown to brown (10YR4/2-4/3) loam with common fine pebbles, massive, firm, violent effervescence, clear boundary
401-base (480)	2C2 (UU)	dark gray (10YR4/1) loam with common pebbles, massive, firm, violent effervescence, common wood

68AB10

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 911.4 ft
Landscape position: near head of drainageway
Slope: 14-20%
Vegetation: pasture
Date described: 4/2/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Descriptiion
		DEFOREST FORMATION GUNDER MEMBER
0-145	modern solum	poorly drained mollisol with a Bt horizon developed in loamy alluvium, Bt is silty clay loam texture, A horizon is 70cm thick
		PRE-ILLINOIAN TILL
145-233	modern solum	dark gray (2.5Y4/1) 2Bt and 2BC horizons of modern soil developed in clay loam diamicton (till), common coarse olive brown (2.5Y4/4) mottles, noneffervescent
233-base (260)	(MOL)	clay loam diamicton (till) with occasional gravelly zones, noneffervescent

68AB11

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 892.0 ft
Landscape position: center of first order tributary
Slope: 9-14%
Vegetation: pasture
Date described: 4/2/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-38	+	very dark grayish brown (10YR3/2) loam, very weak fine granular to massive, friable, noneffervescent, abrupt boundary
		GUNDER MEMBER
38-330	modern solum	somewhat poorly drained mollisol with a thick minimally expressed Bt horizon, occasional pebbles, gradual boundary
330-396	C1	dark grayish brown to olive brown (2.5Y4/2-4/4) loamy alluvium with occasional fine pebbles, pebbles increase in abundance and size toward the base, lower 10cm is pebbly sandy loam, noneffervescent, occasional medium gray mottles, abrupt boundary
396-412	C2	mottled and oxidized loamy alluvium, noneffervescent, clear boundary
		PRE-ILLINOIAN TILL
412-base (520)	2C (MRU&UU)	loamy diamicton consisting of a series of 20cm thick graded beds, violent effervescence

68AB12

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 872.1 ft
Landscape position: apex of alluvial fan
Slope: 5-9%
Vegetation: pasture
Date described: 4/2/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CORRINGTON MEMBER
0-156	modern solum	very dark gray to very dark grayish brown (10YR3/1-3/2) Alfisol with minimally developed Bt horizon, developed in silty clay loam alluvium, common gray and olive brown mottles, abrupt boundary
156-253	paleosol	30cm Ab horizon overlying brown to dark yellowish brown (10YR4/3-4/4) Btb horizon, common fine gray mottles, abrupt boundary, this soil is developed into a fining upward sequence consisting of pebbly loam grading upward to heavy loam
253-319	paleosol	20cm thick Ab horizon overlying brown (10YR4/3) Bwb horizon developed in loamy alluvium, common medium to coarse gray mottles, noneffervescent, this soil is also developed into a fining upward sequence
319-365	Cb	brown (10YR4/3) loam, massive, friable, noneffervescent, common coarse gray mottles, noneffervescent, grades to pebbly loam at base
		PRE-ILLINOIAN TILL

365-457	2C1 (MOU)	mottled oxidized loamy diamicton, consists of a series of graded beds as at 68AB11, moderate to strong effervescence
457-base (482)	2C2 (UU)	unoxidized, unleached, loamy diamicton, very firm, auger rejected on cobble

68AB13

Location: site 68-66 SW1/4 NW1/4 sec.21 T71N R16W
Elevation: 865.7 ft
Landscape position: alluvial fan, midfan
Slope: 5-9%
Vegetation: cultivated field
Date described: 4/2/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CORRINGTON MEMBER
0-218	modern solum	very dark gray to dark gray (10YR3/1-4/1) somewhat poorly drained Mollisol developed in silty clay loam alluvium, common dark yellowish brown (10YR4/4) mottles, abrupt boundary
218-296	paleosol	10cm thick Ab horizon overlying 30cm thick olive brown (2.5Y4/4) Bwb horizon, abundant coarse gray mottles in Bwb horizon, clear boundary to olive brown (2.5Y4/4) Cb horizon, noneffervescent, clear lower boundary
296-350	paleosol	Ab-Bwb soil profile very similar to that developed in overlying zone, noneffervescent, gradual boundary
350-base (540)	Cb	dark gray to olive (5Y4/1-4/3) loam, massive, friable, common coarse mottles of opposite color, noneffervescent, auger rejected on coarse gravel

68AB14

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 903.3 ft
Landscape position: footslope
Slope: 9-14%
Vegetation: pasture
Date described: 4/7/86
Described by: E.A. Bettis III
Remarks: stones up to 30cm in diameter on surface

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-34	+	dark yellowish brown to yellowish brown (10YR4/4-5/4) loam to sandy loam, massive, friable, noneffervescent, abrupt boundary, common medium brown (7.5YR4/4) mottles
34-45	+	very dark grayish brown to dark brown (10YR3/2-3/3) loam, cloddy, friable, noneffervescent, common blobs of dark yellowish brown (10YR4/4) sandy loam, abrupt boundary
		GUNDER MEMBER
45-122	modern solum	Alfisol with 20cm thick very dark grayish brown (10YR3/2) loamy A horizon overlying a dark yellowish brown (10YR4/4) Bt horizon, common thin almost continuous cutans, common gray mottles in Bt horizon, gradual boundary
122-160	BC	yellowish brown (10YR5/6) loam, weak medium to coarse subangular blocky structure, friable, noneffervescent, abundant medium dark yellowish brown and grayish brown (10YR4/4-5/2) mottles, common subvertical joints with thin discontinuous cutans along

		the joint surfaces
		PRE-HOLOCENE ? PEDISEDIMENT
160-base (320)	2C	yellowish brown to brownish yellow (10YR5/6-6/6) stratified loam, sandy loam, and clay loam, massive but separates along horizontal bedding planes, friable, occasional pebbles, violent effervescence, common coarse very weathered secondary carbonate concretions, common coarse brown (7.5YR4/4) mottles, iron and oxide accumulations along subvertical joints

68AB15

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 896.7 ft
Landscape position: toeslope descending to terrace
Slope: 5-9%
Vegetation: pasture
Date described: 4/7/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-25	+	very dark grayish brown to dark brown (10YR3/2-3/3) loam with occasional fine pebbles, weak to moderate medium to fine subangular blocky, friable, noneffervescent, abrupt boundary, abundant roots
		GUNDER MEMBER
25-41	A	very dark gray (10YR3/1) silt loam, moderate fine granular, friable, clear boundary, abundant roots
41-55	AB	very dark gray (10YR3/1) silty clay loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots
55-78	Bt1	very dark gray (10YR3/1) silty clay loam, strong medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common fine iron concretions, common roots, abundant thin almost continuous black (10YR2/1) cutans
78-131	Bt2	dark grayish brown (10YR4/2) silty clay loam, strong coarse

		columnar breaking to strong medium angular blocky, friable, noneffervescent, gradual boundary, common medium to fine olive brown (2.5Y4/4) mottles, few fine iron concretions, common thin continuous very dark gray (10YR3/1) cutans
131-176	Bt3	dark grayish brown (10YR4/2) silty clay loam with occasional fine pebbles and coarse sand grains, strong medium to coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, clear boundary, abundant medium olive brown (2.5Y4/4) mottles, common fine iron concretions, common thin continuous very dark gray (10YR3/1) cutans
176-207	BC	brown to yellowish brown (10YR5/3-5/4) loam, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary, abundant medium yellowish brown and grayish brown (10YR5/8 and 5/2) mottles, abundant fine iron concretions, common thin continuous very dark gray (10YR3/1) cutans in root channels
207-216	C1	brown to yellowish brown (10YR5/3-5/4) loam with abundant fine pebbles, massive, friable, noneffervescent, abrupt boundary, mottles and iron concretions as above
216-312	C2	yellowish brown (10YR5/4) loam to silt loam, massive, friable, noneffervescent, abrupt boundary, common coarse grayish brown (2.5Y5/2) and common medium yellowish brown (10YR5/6) mottles, common fine iron concretions
312-339	C3	dark grayish brown (10YR4/2) loam

		which coarsens with depth with common fine pebbles at base, massive, friable, noneffervescent, clear boundary, common coarse grayish brown (2.5Y5/2) mottles along roots, few medium yellowish brown (10YR5/6) mottles, common fine oxides
339-388	C4	yellowish brown (10YR5/6) loam with occasional fine pebbles, massive, friable, noneffervescent, abrupt boundary, common medium to fine grayish brown (2.5Y5/2) mottles along roots
		PENNSYLVANIAN SYSTEM DES MOINES SUPERGROUP
388-base (400)	R	light greenish gray (5G5/1) shale, massive, very firm, noneffervescent

68AB16

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 892.7 ft
Landscape position: terrace adjacent to scarp leading to floodplain
Slope: 0-2%
Vegetation: pasture
Date described: 4/7/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-189	modern solum	cumulic Haplaquoll developed in silty clay loam alluvium, dark colored Bt horizon with abundant brown and gray mottles
189-224	C	yellowish brown (10YR5/4) loam with abundant brown and gray mottles, very coarse sand and fine pebbles common at base, abrupt boundary
224-310	2Btb	truncated Bt horizon developed in silty clay loam alluvium, gray with common brown mottles
310-400	2Cb	grayish brown to olive brown (2.5Y5/2-4/4) silt loam to silty clay alluvium, massive, abrupt boundary
400-471	3ACb	AC soil profile developed in silty alluvium
471-530	3C1b	grayish brown and olive brown (2.5Y5/2 and 4/4) silty alluvium, abundant brown mottles, gradual boundary
530-base (690)	3C2b	dark grayish brown to brown (10YR4/2-4/3) stratified medium to coarse sand with occasional fine pebbles and loamy interbeds, noneffervescent, hole collapsed

68AB17

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 903.4 ft
Landscape position: alluvial fan, upper midfan
Slope: 9-14%
Vegetation: pasture
Date described: 4/7/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-12	+	yellowish brown (10YR5/6) loam, massive, friable, moderate effervescence, abrupt boundary
12-41	+	very dark grayish brown to dark brown (10YR2/2-3/3) loam, moderate effervescence, abrupt boundary
		CORRINGTON MEMBER
41-160	Historic solum	15cm thick A horizon over Bt horizon developed in clay loam alluvium, common olive brown (2.5Y4/4) mottles, coarse sand at base, abrupt boundary, noneffervescent
160-312	paleosol	buried Inceptisol developed in loam to clay loam alluvium, Bw horizon is yellowish brown (10YR5/4-5/6), common gray mottles
312-474		brown to olive brown (10YR4/3-2.5Y4/4) loamy alluvium with abundant gray mottles and common iron and manganese accumulations
474-554		stratified pebbly sand and loam, 5cm diameter clast at base, noneffervescent, abrupt boundary

		PENNSYLVANIAN SYSTEM DES MOINES SUPERGROUP
554-base (560)	R	gray noneffervescent shale

68AB18

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 897.1 ft
Landscape position: alluvial fan, midfan
Slope: 5-9%
Vegetation: pasture
Date described: 4/8/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-26	C1	yellowish brown (10YR5/6) loam, massive, friable, noneffervescent, abrupt boundary, common roots
26-63	C2	very dark grayish brown to dark brown (10YR3/2-3/3) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots, common krotovina filled with sandy loam
		CORRINGTON MEMBER
63-88	Ab	dark brown (10YR3/3) silt loam, moderate medium granular, friable, noneffervescent, gradual boundary, few fine olive brown (2.5Y4/4) mottles, common roots
88-106	BAb	dark grayish brown (10YR4/2) silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, abundant fine olive brown (2.5Y4/4) mottles, few roots
106-128	Bt1b	grayish brown to brown (10YR4/2-4/3) silty clay loam, moderate coarse columnar breaking to strong medium angular blocky, friable, noneffervescenmt, gradual boundary, common fine to

		medium dark yellowish brown (10YR4/6) mottles, very few roots, common thin almost continuous very dark gray (10YR3/1) cutans
128-170	Bt2b	dark grayish brown to brown (10YR4/2-4/3) silty clay, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, mottles as above, common thick continuous very dark gray (10YR3/1) cutans
170-217	Bt3b	dark grayish brown (10YR4/2) silty clay loam, moderate medium angular blocky, friable, noneffervescent, gradual boundary, abundant medium dark yellowish brown (10YR4/6) mottles, abundant fine iron concretions, common thin discontinuous very dark gray (10YR3/1) cutans
217-250	BCb	dark grayish brown to brown (10YR4/2-4/3) clay loam, weak coarse subangular blocky, friable, noneffervescent, clear boundary, mottles as above, abundant medium iron concretions
250-352	Cb	yellowish brown (10YR5/4) loam to silty clay with occasional fine pebbles, massive, friable, noneffervescent, abrupt boundary, abundant medium grayish brown and yellowish brown (10YR5/2 and 5/6) mottles, abundant medium to fine iron concretions
352-393	2AC1b	dark grayish brown (10YR4/2) silty clay loam, weak fine subangular blocky, friable, noneffervescent, gradual boundary, abundant medium dark grayish brown (2.5Y4/2) mottles, common medium iron concretions
393-447	2AC2b	dark grayish brown (10YR4/2)

		silty clay loam, weak fine subangular blocky to massive, friable, noneffervescent, abrupt boundary, few medium dark grayish brown (2.5Y4/2) mottles, abundant fine to medium iron concretions
447-480	3BCb	yellowish brown (10YR5/4-5/6) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common medium grayish brown (10YR5/2) mottles, abundant medium iron concretions
480-565	3C1b	yellowish brown (10YR5/4) clay loam, massive, friable, noneffervescent, clear boundary, common coarse gray (2.5Y5/0) mottles, common medium oxides
565-590	3C2b	as above but with more coarse sand and occasional pebbles, abrupt boundary
		PENNSYLVANIAN SYSTEM DES MOINES SUPERGROUP
590-base (610)	R	yellowish brown (10YR5/6) weathered mudstone, common medium gray (2.5Y5/0) mottles, firm

68AB19

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 886.6 ft
Landscape position: floodplain
Slope: 0-2%
Vegetation: pasture
Date described: 4/8/86
Described by: E.A. Bettis III
Remarks: C-14 date 300cm--10,350±290 B.P. (Beta-16324); laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION ROBERTS CREEK MEMBER
0-84	AC	very dark grayish brown (10YR3/2) loam, weak medium to fine subangular blocky, friable, noneffervescent, clear boundary, abundant roots
84-98	Ab	black to very dark grayish brown (10YR2/1-3/2) loam, moderate medium granular, friable, noneffervescent, gradual boundary, common roots
98-134	ACb	very dark grayish brown (10YR3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, common fine brown (10YR4/3) mottles, few fine iron concretions
134-194	C1b	dark gray (10YR4/1) loam with common fine pebbles, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary, common medium yellowish brown (10YR5/6) mottles, abundant fine to medium iron concretions
194-222	C2b	dark yellowish brown (10YR3/4) coarse sandy loam and gravel, single grain, loose, nonefferves-

		cent, abrupt boundary, abundant iron staining on clasts
		GUNDER MEMBER
222-309	2C1	dark yellowish brown (10YR3/6) silt loam to loam, massive, friable, noneffervescent, gradual boundary, abundant medium to coarse dark gray (10YR4/1) mottles, common medium to coarse iron concretions, common wood, C-14 date on wood at 300cm --10,350±290 B.P. (Beta-16324)
309-373	2C2	dark grayish brown (2.5Y4/2) silt loam grading to coarse sand at base, massive, friable, noneffervescent, gradual boundary, common medium dark gray and yellowish brown (10YR4/1 and 5/6) mottles
373-460	3C	olive gray to olive (5Y4/4-4/3) silt loam, massive, slightly sticky, nonplastic, noneffervescent, abrupt boundary
460-base (580)	4C	olive gray to olive (5Y4/2-5/6) stratified loam, medium loamy sand and fine gravel, massive and single grain, friable and loose, noneffervescent, <u>Picea sp.</u> cone at 553cm, auger rejected on gravel

68AB20

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 886.9 ft
Landscape position: terrace above floodplain on which 68AB19 was drilled
Slope: 2-5%
Vegetation: pasture
Date described: 4/8/86
Described by: E.A. Bettis III
Remarks: this surface slopes toward the valley center

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-9	+	brown (10YR4/3) loam, massive, noneffervescent, abrupt boundary
		GUNDER MEMBER
9-210	modern solum	thick dark colored somewhat poorly drained solum developed into loam to clay loam alluvium,profile has an A-Bw sequence
210-base (300)	C	olive brown (2.5Y4/4) loam alluvium with abundant gray mottles and iron accumulations

68AB21

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 905.8 ft
Landscape position: toeslope descending to terrace
Slope: 5-9%
Vegetation: pasture
Date described: 4/8/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-41	+	brown (10YR4/3) loam, massive, noneffervescent, abrupt boundary
		GUNDER MEMBER
41-194	modern solum	dark colored somewhat poorly drained solum developed in loam to clay loam alluvium, solum has A-Bt sequence
194-424	C1	brown to olive brown (10YR4/3-2.5Y4/4) loam with occasional fine pebbles, occasional zones of coarse sand, common coarse gray mottles, noneffervescent
424-554	C2	dark gray to olive gray (5Y4/1-4/2) stratified loam to sandy loam with occasional zones of fine pebbles, coarse sand at base
		PENNSYLVANIAN SYSTEM DES MOINES SUPERGROUP
554-base (571)	R	siltstone with common hard carbonate concretions

68AB22

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 944.0 ft
Landscape position: lowest step on tertiary divide
Slope: 9-14%
Vegetation: cultivated field
Date described: 4/8/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		PEDISEDIMENT
0-20	Ap	dark brown (10YR3/3) loam, non-effervescent
20-60	Bt	loamy, eroded Bt horizon developed in pedisediment
60-70	2CB	loam to sandy loam with abundant pebbles, stone line
		PRE-ILLINOIAN TILL
70-173	3C1 (MJOL)	loamy diamicton
173-base (220)	3C3 (MJOU2)	loamy diamicton, thick continuous iron and manganese stains along joints, occasional coarse hard secondary carbonate concretions

68AB23

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 965.8 ft
Landscape position: tertiary divide two steps above level on which 68AB22 was drilled
Slope: 5-9%
Vegetation: cultivated field
Date described: 4/8/86
Described by: E.A. Bettis III
Remarks: the sequence below 215cm appears to be several paleosols welded togeather

Depth(cm)	Soil Horizon (weathering zone)	Description
		PEORIA LOESS
0-22	Ap	silt loam
22-147	modern solum	eroded Hapludalf, silt loam to heavy silt loam texture
147-182	C (MOL)	silt loam
		FARMDALE SOIL
182-195	2AEb	silt loam, weak to moderate structure
195-215	2Bwb	silt loam, noneffervescent, abrupt lower boundary
		LATE SANGAMON AND/OR YARMOUTH SANGAMON SOIL DEVELOPED IN TILL-DERIVED SEDIMENT
215-290	3Btb	grayish brown clay loam, strong medium angular blocky, firm, common red mottles, clear boundary
290-base (620)	3Btgb	gray clay loam, strong medium to coarse angular blocky, firm, quartz is the only recognizable mineral grain, yellowish brown (10YR5/6) mottles in the lower 30cm

68AB24

Location: site 68-55 SE1/4 SW1/4 sec.15 T71N R17W
Elevation: 956.4 ft
Landscape position: tertiary divide, step above that on which 68AB22 was drilled
Slope: 5-9%
Vegetation: cultivated field
Date described: 4/8/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		PEORIA LOESS
0-72	modern solum	eroded Hapludalf, silt loam
72-104	C (MOL)	silt loam
		FARMDALE SOIL DEVELOPED IN ROXANA-EQUIVALENT SILT
104-121	2EBb	silt loam, weak to moderate structure
121-137	2Bwb	silt loam, abrupt boundary
		LATE SANGAMON SOIL DEVELOPED IN PEDISEDIMENT
137-154	3Btb	
		LATE SANGAMON SOIL DEVELOPED IN PRE-ILLINOIAN TILL
154-base (260)	4Btb	Bt horizon developed in loam to clay loam diamicton, abundant gray mottles, thin continuous cutans, noneffervescent

90AB1

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 870.3 ft
Landscape position: terrace at mouth of 1st order tributary
Slope: 5-9%
Vegetation: pasture
Date described: 4/9/86
Described by: E.A. Bettis III
Remarks: possible archaeological site materials from 353-367cm

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-220	modern solum	somewhat poorly drained cumulic Hapludalf developed in loamy alluvium, abundant gray and brown mottles, noneffervescent
220-297	C1	olive brown (2.5Y4/4) heavy loam, massive, friable, abundant gray mottles and soft iron accumulations, clear boundary, noneffervescent
297-353	C2	grayish brown to dark gray (2.5Y5/2-4/1) loam, massive, friable, abundant coarse dark gray (2.5Y4/0) mottles, abrupt boundary
353-367	AC	very dark grayish brown (2.5Y3/2) heavy loam, massive, common charcoal flecks, burned sandstone fragments and fine pebbles, clear boundary
367-430	C3	dark grayish brown (2.5Y4/2) heavy loam with common pebbles, massive, common gray mottles, gradual boundary
430-532	C4	light olive brown (2.5Y5/4) loam with occasional fine pebbles, common gray mottles and soft iron accumulations, noneffervescent

532-557	C5	as above but with weak efferves-cence, abrupt boundary
		PRE-ILLINOIAN TILL
557-617	2C1 (MOU2)	clay loam diamicton
617-base (630)	2C2 (UU)	loam diamicton

90AB2

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 878.9 ft
Landscape position: aproximately midway up first order drainageway
Slope: 14-18%
Vegetation: pasture
Date described: 4/9/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-19	+	brown (10YR3/3) silt loam, non-effervescent, abrupt boundary
		GUNDER MEMBER
19-210	modern solum	solum developed in 64cm of silt loam alluvium overlying loam and clay loam alluvium, thick dark colored surface horizon overlying a Bt horizon, somewhat poorly drained, abundant gray and reddish brown mottles, noneffervescent, abundant coarse sand in matrix at base
210-270	2C	dark yellowish brown (10YR4/4) loam diamicton with abundant gray mottles, noneffervescent, abrupt boundary
270-330	3C	as above but contains no pebbles
330-base (434)	4C	gray loamy alluvium with abundant olive brown (2.5Y4/4) mottles, noneffervescent, auger rejected on coarse gravel

90AB3

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 891.1 ft
Landscape position: upper end of first order drainageway
Slope: 5-9%
Vegetation: pasture
Date described: 4/9/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weatering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-20	+	silt loam, noneffervescent
		GUNDER MEMBER
20-280	modern solum	solum developed in silt loam alluvium, Bt horizon is silty clay loam texture, somewhat poorly to moderately well drained, abundant gray mottles in lower part of solum, clear boundary, noneffervescent
280-335	C	grayish brown to olive brown (2.5Y5/2-4/4) loamy alluvium, abundant gray mottles, noneffervescent, abrupt boundary
		LATE SANGAMON SOIL DEVELOPED IN PEDISEDIMENT
335-420	2BCb	yellowish brown (10YR5/4-5/6) heavy loam, weak to moderate medium subangular blocky, friable, abundant medium gray mottles, lower 30cm is stratified loam, sandy loam, and pebbly loam, abrupt boundary, noneffervescent
420-base (440)	2Cb	pale brown to light yellowish brown (10YR6/3-6/4) sandy loam, violent effervescence, auger rejected on large rock

90AB4

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 887.1 ft
Landscape position: lowest step on landscape, west side of first order drainage
Slope: 5-9%
Vegetation: pasture
Date described: 4/9/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		PEDISEDIMENT
0-20	Ap	very dark grayish brown (10YR3/2) loam, cloddy, friable, noneffervescent, abrupt boundary
20-57	Bt	brown (10YR5/3) loam to clay loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, few fine grayish brown (10YR5/2) mottles, few fine iron concretions and oxides, common thin discontinuous brown (10YR4/3) cutans, common coarse sand and fine pebbles at base (stone line)
		PRE-ILLINOIAN TILL
57-104	2Bt	yellowish brown (10YR5/4) clay loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common medium grayish brown (10YR5/2) mottles, iron concretions and oxides as above, common thin discontinuous brown (10YR4/3) cutans
104-150	2BC	yellowish brown (10YR5/4) loam with occasional fine to medium pebbles, weak coarse subangular blocky, friable, noneffervescent, gradual boundary, common medium to coarse grayish brown (10YR5/2)

		mottles, abundant oxide stains on peds
150-base (178)	2C (MJOL-MJOU)	yellowish brown (10YR5/4) loam with occasional fine to medium pebbles, massive, friable, weak to moderate effervescence, common medium to coarse grayish brown (10YR5/2) mottles, oxide stains along subvertical joints, common thin almost continuous grayish brown (10YR5/2) coatings along joint faces

90AB5

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 897.3 ft
Landscape position: step above that on which 90AB4 was drilled
Slope: 5-9%
Vegetation: pasture
Date described: 4/9/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weatheriong zone)	Description
		PEORIA LOESS
0-146	modern solum	Mollic Hapludalf developed in silt loam, noneffervescent
		LATE SANGAMON SOIL DEVELOPED IN PEDISEDIMENT
146-175		poorly drained paleosol with Btb horizon, developed in clay loam sediment, abundant olive brown (2.5Y4/4) mottles, gray matrix, noneffervescent, abrupt boundary
		TRUNCATED YARMOUTH-SANGAMON SOIL
175-base (269)		gray (10YR5/2) clay loam, strong medium angular blocky, firm, occasional medium olive brown (2.5Y4/4) mottles, noneffervescent, occasional quartz pebbles, translocated clay peak near base of core

90AB6

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 870.1 ft
Landscape position: footslope decending to terrace
Slope: 5-9%
Vegetation: pasture
Date described: 7/28/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-25	A	very dark grayish brown (10YR3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, abundant roots
		GUNDER MEMBER
25-37	A1b	very dark gray to very dark grayish brown (10YR3/1-3/2) silty clay loam, weak medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, gradual boundary, abundant roots
37-64	A2b	very dark gray to very dark grayish brown (10YR3/1-3/2) silty clay loam, moderate fine granular, friable, noneffervescent, clear boundary, common roots
64-79	ABb	very dark grayish brown (10YR3/2) silty clay loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, few fine dark yellowish brown (10YR4/4) mottles, few roots
79-102	Bt1b	dark grayish brown (10YR4/2) silty clay loam, strong medium

		columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, abundant medium dark yellowish brown (10YR4/4) mottles, common medium iron concretions, common thin discontinuous very dark grayish brown (10YR3/2) cutans, few thin discontinuous silans
102-127	Bt2b	very dark grayish brown to dark gray (10YR3/2-4/1) loam with occasional coarse sand grains, strong coarse columnar, friable, noneffervescent, gradual boundary, common medium dark yellowish brown (10YR4/4) mottles, iron concretions as above, common thin discontinuous very dark grayish brown (10YR3/2) cutans, silans as above
127-185	Bt3b	very dark grayish brown (10YR3/2) silty clay loam with occasional coarse sand grains and few fine pebbles, strong coarse columnar, firm, noneffervescent, abrupt boundary, abundant medium yellowish brown (10YR5/6) mottles, common fine iron concretions, common thin almost continuous very dark gray to very dark grayish brown (10YR3/1-3/2) cutans
185-257	BCb	dark gray (10YR4/1) silty clay loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, abundant medium yellowish brown (10YR5/8) mottles, abundant medium iron concretions, common thin almost continuous cutans along subvertical joints
257-287	CBb	dark gray (10YR4/1) silt loam, very weak medium to fine subangular blocky, very friable, noneffervescent, clear boundary, common medium to coarse dark yellowish brown (10YR4/4)

		mottles, common fine iron concretions, very few thin discontinuous very dark grayish brown (10YR3/2) cutans along subvertical joints
287-320	C1b	dark grayish brown to brown (10YR4/2-4/3) silt loam, weak medium to fine subangular blocky to massive, friable, noneffervescent, gradual boundary, mottles and iron concretions as above
320-368	C2b	brown (10YR4/3) silt loam to loam, weak medium subangular blocky to massive, friable, noneffervescent, gradual boundary, abundant medium yellowish brown (10YR5/6) mottles, iron concretions as above
368-409	C3b	brown to grayish brown (10YR4/3-4/2) silt loam, massive, friable, noneffervescent, clear boundary, mottles as above, brown (7.5YR4/4) accumulations along root channels
409-437	C4b	brown and grayish brown (10YR4/3 and 4/2) stratified loam, silt loam and medium sand, massive and single grain, friable and loose, noneffervescent, abrupt boundary, common coarse dark yellowish brown (10YR4/4) mottles
		PRE-HOLOCENE ALLUVIUM
437-549	2C1	dark greenish gray (5GY4/1) silt loam to silty clay loam , weak medium subangular blocky to massive, friable, noneffervescent, clear boundary, abundant medium to coarse light olive brown (2.5Y5/4) mottles, occasional charcoal and coal flecks
549-602	2C2	greenish gray and olive (5G6/1 and 2.5Y5/4) stratified fine to

		coarse sand and loam with occasional pebbles, single grain, loose, noneffervescent, abrupt boundary, common coarse mottles of opposite color
602-617	2C3	olive brown (2.5Y4/4) silt loam, massive, friable, weak effervescence, abrupt boundary, common medium light olive brown (2.5Y5/6) mottles
		PRE-ILLINOIAN TILL
617-627	3C1 (MUU)	very dark grayish brown (2.5Y3/2) silt loam, massive, firm, weak to moderate effervescence, gradual boundary, common medium light olive brown (2.5Y5/4) mottles
627-base (678)	3C2 (UU)	dark gray (10YR4/1) loam with common medium to fine pebbles, massive, firm

90AB7

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 893.8 ft
Landscape position: lowest step on interfluve
Slope: 5-9%
Vegetation: pasture
Date described: 7/29/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		PEORIA LOESS
0-94	modern solum	moderately well drained Mollic Hapludalf developed in loess, common medium to fine red mottles in lower part of Bt horizon, Bt horizon is clay loam texture, abrupt boundary
		PEDISEDIMENT
94-150	2BC	yellowish brown (10YR5/4) clay loam, weak medium to fine subangular blocky, friable, noneffervescent, common coarse grayish brown (2.5Y5/2) mottles, gradual boundary
150-190	2Bt	yellowish brown (10YR5/4) loam, moderate medium subangular blocky, friable, noneffervescent, mottles as above, common thin discontinuous manganese coatings on ped faces, common thin almost continuous very dark gray (10YR3/1) cutans, abrupt boundary
		LATE SANGAMON SOIL DEVELOPED IN PEDISEDIMENT
190-264	3Btb	yellowish brown (10YR5/6) heavy loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common thin discontinuous very dark gray

		(10YR3/1) cutans, manganese coatings as above, few thin discontinuous brown (10YR5/3) silt coatings, clear boundary
		PRE-ILLINOIAN TILL
264-base (295)	4BC	yellowish brown (10YR5/6) loam, massive, firm, moderate to strong effervescence, common medium to coarse grayish brown (2.5Y5/2) mottles, common medium hard secondary carbonate concretions

90AB8

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 901.3 ft
Landscape position: second step up interfluve
Slope: 5-9%
Vegetation: pasture
Date described:7/29/86
Described by: E.A. Bettis III

Deptgh (cm)	Soil Horizon (weathering zone)	Description
		PEORIA LOESS
0-107	modern solum	Mollic Hapludalf with silty clay loam texture Bt horizon, abrupt boundary
		YARMOUTH SANGAMON SOIL DEVELOPED IN PRE-ILLINOIAN TILL
107-135	2Bt1b	brown (7.5YR4/4) clay loam, strong fine angular blocky, firm, noneffervescent, abundant medium to fine gray (10YR5/1) mottles, common thin almost continuous dark grayish brown (10YR4/2) cutans, clear boundary
135-170	2Bt2b	gray (10YR5/1) clay, strong medium to coarse angular blocky, firm, abundant medium to coarse brown (7.5YR4/4) mottles, common thin continuous dark grayish brown (10YR4/2) cutans, clear boundary
170-213	2Bt3b	grayish brown (2.5Y5/2) clay, strong medium to coarse angular blocky, firm, mottles and cutans as above, gradual boundary
213-259	2BC1b	yellowish brown (10YR5/6) loam, moderate medium to coarse subangular blocky, friable, mottles as above, few thin discontinuous very dark gray (10YR4/2) cutans

259-282	2BC2b	as above with thin almost continuous manganese coatings on peds
282-353	2C1b (MOL)	yellowish brown (10YR5/6) loam, massive, friable, common fine oxides, common fine iron concretions, abundant medium to coarse grayish brown (2.5Y5/2) mottles, noneffervescent, gradual boundary
353-417	2C2b (MJOL)	yellowish brown (10YR5/6) loam, massive, friable, common thin almost continuous manganese coatings and cutans along subvertical joints, gradual boundary
417-base (485)	2C3b (MJOU2)	as above with abundant hard secondary carbonate accumulation along joints

90AB9

Location: site 90-109 SE1/4 SW1/4 sec.30 T71N R15W
Elevation: 885.2 ft
Landscape position: lowest step on interfluve
Slope: 9-14%
Vegetation: pasture
Date described: 7/29/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		PEDISEDIMENT AND PRE-ILLINOIAN TILL
0-122	modern solum	solum developed in truncated Late-Sangamon Paleosol, horizon sequence is Ap-2Bt1-2Bt2-2Bt3-2BC, Ap horizon is silt loam texture, Bt horizon is yellowish brown (10YR5/6) clay loam with common thin discontinuous cutans and manganese accumulations, moderate medium subangular blocky soil structure in Bt horizon, abundant medium to coarse grayish brown (2.5Y5/2) mottles-in lower part of solum, 2 material is Pre-Illinoian till
122-165	2C1 (MOL)	yellowish brown (10YR5/4) loam, very weak medium to coarse subangular blocky, friable, common medium grayish brown (2.5Y5/4) mottles, organs in root channels, clear boundary
165-base (229)	2C2 (MJOU2)	yellowish brown (10YR5/4) loam, massive, friable, strong effervescence, common coarse hard secondary carbonate concretions which appear to be weathered, few fine grayish brown (2.5Y5/2) mottles, common thin discontinuous manganese accumulations along faint subvertical joints

90AB10

Location: site 90-109 SW1/4 SE1/4 sec.30 T71N R15W
Elevation: 843.6 ft
Landscape position: floodplain surface in toeslope position
Slope: 2-5%
Vegetation: pasture
Date described: 7/29/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-20	+	dark brown to brown (10YR3/3-4/3) silt loam, massive, noneffervescent, abrupt boundary
		GUNDER MEMBER
20-51	AE	very dark gray (10YR3/1) silty clay loam, moderate medium to fine subangular blocky, friable, noneffervescent, abundant thin almost continuous silans, clear boundary
51-163	Bt	very dark gray (10YR3/1) clay loam, subangular blocky structure with common thin almost continuous black (10YR2/1) cutans, common fine iron concretions, this zone consists of several Bt horizons
163-239	BC	dark gray (10YR4/1) silty clay loam, weak coarse subangular blocky structure, friable, common thick continuous black (10YR2/1) cutans along subvertical joint faces, occasionnal fine pebbles, noneffervescent, gradual boundary
239-345	C1	olive brown to light olive brown (2.5Y4/4-5/4) loam, massive, friable, noneffervescent, common coarse dark gray (2.5Y4/1)

		mottles, clear boundary
345-391	C2	dark grayish brown (2.5Y4/2) fine sandy loam, massive, friable, noneffervescent, common medium yellowish brown (10YR5/4) mottles, clear boundary
391-447	C3	dark grayish brown (2.5Y4/2) medium to coarse sand, single grain, loose, noneffervescent, abrupt boundary
447-base (660)	C4	stratified dark grayish brown (2.5Y4/2) loam, greenish gray (5G6/1) silt loam, and dark gray (10YR4/1) coarse sand and fine pebbles, noneffervescent, hole collapsed

90AB11

Location: site 90-109 SW1/4 SE1/4 sec.30 T71N R15W
Elevation: 847.7 ft
Landscape position: upper footslope descending to terrace
Slope:9-14%
Vegetation: pasture
Date described: 7/29/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-25	Ap	very dark grayish brown (10YR3/2) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots
25-53	AB	very dark grayish brown (10YR3/2) loam, moderate medium to fine angular blocky, friable, noneffervescent, clear boundary, common thin almost continuous very dark gray (10YR3/1) organs
53-104	Bw	very dark grayish brown (10YR3/2) heavy loam to clay loam, weak to moderate medium subangular blocky, friable, noneffervescent, clear boundary, few fine yellowish brown (10YR5/4) mottles
104-152	Bt1	dark brown to brown (10YR3/3-4/3) clay loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common fine iron and oxide accumulations, common thin discontinuous dark gray (10YR4/1) cutans
152-203	Bt2	dark yellowish brown to yellowish brown (10YR4/4-5/4) clay loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary, abundant fine yellowish brown

		(10YR5/6) mottles, iron and oxide accumulations as above, cutans as above, common medium to fine pebbles
203-234	BC	yellowish brown (10YR5/6) sandy clay loam, weak coarse subangular blocky, friable, noneffervescent, abrupt boundary, abundant thin discontinuous dark grayish brown (10YR4/2) cutans in root channels
		PRE-ILLINOIAN TILL
234-264	2C1 (MOU2)	brown to yellowish brown (10YR5/3-5/4) loam, massive, friable, weak to moderate effervescence, gradual boundary, common medium grayish brown (2.5Y5/2) mottles, common fine iron and oxide accumulations, occasional fine soft secondary carbonate accumulations, common pebbles
264-base (409)	2C2 (MRU)	dark grayish brown (2.5Y4/2) clay loam to loam , massive, friable, strong effervescence, abundant coarse dark gray (2.5Y4/0) and common medium brown (7.5YR4/4) mottles

90AB12

Location: site 90-109 SW1/4 SE1/4 sec.30 T71N R15W
Elevation: 844.8 ft
Landscape position: lower footslope descending to terrace
Slope: 5-9%
Date described: 7/29/86
Described by: E.A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-20	Ap	very dark grayish brown (10YR3/2) silt loam, cloddy, friable, noneffervescent, abrupt boundary
20-48	A	very dark grayish brown (10YR3/2) silt loam, moderate medium granular, friable, noneffervescent, gradual boundary, abundant roots
48-76	AE	very dark grayish brown (10YR3/2) clay loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, abundant thin discontinuous silans
76-122	Bt	very dark grayish brown to dark brown (10YR3/2-3/3) clay loam, moderate medium columnar, friable, noneffervescent, gradual boundary, common fine iron concretions, common thin almost continuous very dark grayish brown (10YR3/2) cutans
122-208	BC	brown (10YR4/3) heavy loam, weak coarse subangular blocky, friable, noneffervescent, gradual boundary, common medium yellowish brown (10YR5/6) mottles, abundant medium iron concretions, common fine oxides, few thin discontinuous very dark grayish brown (10YR3/2) cutans

208-252	CB1	brown (10YR4/3) silty clay loam, weak coarse subangular blocky structure, friable, noneffervescent, gradual boundary, common medium grayish brown (2.5Y5/2) mottles, iron and oxide accumulations as above
252-295	CB2	as above with yellowish brown mottles
295-328	C1	olive brown (2.5Y4/4) silt loam, massive, friable, noneffervescent, gradual boundary, common coarse yellowish brown and grayish brown (10YR5/6 and 2.5Y5/2) mottles, abundant fine iron and oxide accumulations
328-439	C2	dark grayish brown to olive brown (2.5Y4/2-4/4) stratified loam, silt loam, and fine sand, massive, friable, noneffervescent, abundant medium yellowish brown (10YR5/6) and few coarse light olive brown (2.5Y5/6) mottles
439-465	C3	oxidized medium to coarse sand, single grain, loose, noneffervescent, abrupt boundary
		PRE-ILLINOIAN TILL
465-485	2C1 (MOU)	olive brown (2.5Y4/4) pebbly loam, massive, firm, weak to moderate effervescence, common medium gray (2.5Y5/0) mottles, clear boundary
485-base (526)	2C2 (UU)	dark gray (2.5Y4/1) stratified loam diamicton, occasional fine sand laminae, massive, firm, strong effervescence,

90AB13

Location: site 90-109 SW1/4 SE1/4 sec.30 T71N R15W
Elevation: 851.3 ft
Landscape position: footslope
Slope: 5-9%
Vegetation: pasture
Date described: 7/29/86
Described by: E.A. Bettis III
Remarks: this area has an alluvial fan-like surface form but the deposits beneath the surface do not exibit alluvial fan characteristics

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-36	A	very dark grayish brown (10YR3/2) loam, moderate medium to fine granular, friable, noneffervescent, clear boundary, abundant roots
36-81	AE	very dark grayish brown (10YR3/2) heavy loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots, common thin discontinuous silans
81-137	Bt1	dark brown (10YR3/3) clay loam, moderate medium to coarse angular blocky, friable, noneffervescent, gradual boundary, common fine iron and manganese accumulations, common thin discontinuous very dark brown (10YR2/2) cutans
137-170	Bt2	brown (10YR4/3) clay loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, common medium dark gray (2.5Y4/0) mottles, iron and oxide accumulations as above, cutans as above

		PRE-ILLINOIAN TILL
170-310	2C1 (MOL)	yellowish brown (10YR5/4-5/6) loam, weak medium subangular blocky, firm, noneffervescent, clear boundary, abundant medium brown (7.5YR4/4) mottles, abundant medium iron concretions, common fine oxides
310-350	2C2 (MOU)	light olive brown (2.5Y5/4) loam with common pebbles, massive, firm, moderate to strong effervescence, abrupt boundary, abundant coarse grayish brown (2.5Y5/2) mottles, iron concretions and oxide accumulations as above
350-399	2C3 (OU)	yellowish brown (10YR5/4) medium sand, single grain, loose, strong effervescence, abrupt boundary
399-base (495)	2C4 (MOU)	dark grayish brown to olive brown (2.5Y4/2-4/4) loam with abundant pebbles, massive, firm, violent effervescence, common coarse light olive brown (2.5Y5/6) mottles, common fine iron concretions

90AB14

Location: site 90-109 SW1/4 SE1/4 sec.30 T71N R15W
Elevation: 847.2 ft
Landscape position: toeslope/alluvial fan
Slope: 5-9%
Vegetation: pasture
Date described: 7/30/86
Described by: E.A. Bettis III
Remarks: this area has an alluvial fan-like surface expression but the deposits beneath the surface do not exibit fan characteristics

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-13	A	very dark grayish brown (10YR3/2) silt loam, moderate medium to fine granular, friable, noneffervescent, clear boundary, abundant roots
13-28	E	very dark grayish brown to dark grayish brown (10YR3/2-4/2) silt loam, moderate medium to fine platy, friable, noneffervescent, commom roots, abundant thin discontinuous silt coatings
28-43	EB	very dark grayish brown (10YR3/2) silt loam, moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary, few roots, common thin discontinuous silt coatings
43-71	BE	very dark grayish brown (10YR3/2) silty clay loam, moderate medium angular blocky, friable, noneffervescent, clear boundary, few roots, silt coatings as above
71-135	Bt1	dark brown (10YR3/3) clay loam, strong coarse columnar, firm, noneffervescent, gradual boundary, common fine iron concretions, few fine oxides, common thin almost continuous very dark

		grayish brown (10YR3/2) cutans, occasional thin silt coatings over cutans in upper 15cm of horizon
135-180	Bt2	dark grayish brown (10YR4/2) clay loam, moderate coarse columnar, friable, noneffervescent, clear boundary, abundant fine iron and oxide accumulations, few thin discontinuous very dark grayish brown (10YR3/2) cutans
180-226	BC	brown (10YR4/3) silty clay loam, weak coarse columnar, friable, noneffervescent, clear boundary, common medium grayish brown (2.5Y5/2) mottles, iron and oxide accumulations as above
226-353	C1	dark yellowish brown (10YR4/4) heavy silt loam, massive, friable, noneffervescent, abrupt boundary, common coarse grayish brown (2.5Y5/2) mottles, iron and oxide accumulationa as above
353-483	C2	brown to grayish brown (10YR4/3-2.5Y5/2) stratified loam, silt loam, and medium sand, massive, slightly sticky plastic, noneffervescent, abrupt boundary, common coarse brown (7.5YR4/4) mottles in silt loam beds, few medium iron accumulations in medium sand beds
		PRE-ILLINOIAN TILL
483-526	2C1 (MOL)	light olive brown (2.5Y5/4) loam with common fine pebbles, massive, firm, noneffervescent, clear boundary, abundant medium to fine gray (2.5Y5/0) mottles
526-561	2C2 (MOU)	as above but with moderate effervescence
561-base (587)	2C3 (MRU)	dark olive gray (5Y3/2) loam with common fine pebbles, mas-

sive, firm, violent efferves-
cence, common ,medium to coarse
olive (5Y4/3) mottles

90AB15

Location: site 90-109 SW1/4 SE1/4 sec.30 T71N R15W
Elevation: 847.8 ft
Landscape position: floodplain near junction of streams
Slope: 0-5%
Vegetation: pasture
Date described: 7/30/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION CAMP CREEK MEMBER
0-58	+	dark grayish brown to brown (10YR4/2-4/3) stratified silt loam, massive breaking along bedding planes, friable, noneffervescent, abrupt boundary
		ROBERTS CREEK MEMBER
58-86	A1	black (10YR2/1) silt loam, weak medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, gradual boundary, common roots
86-112	A2	black to very dark gray (10YR2/1-3/1) silt loam with occasional fine pebbles, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few roots
112-147	A3	black to very dark gray (10YR2/1-3/1) loam, moderate medium columnar, friable, noneffervescent, clear boundary
147-182	Bt1	very dark gray to very dark grayish brown (10YR3/1-3/2) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, few fine reddish

		brown (5YR4/4) mottles, few thin discontinuous dark grayish brown (10YR4/2) cutans
182-206	Bt2	very dark grayish brown (10YR3/2) loam, moderate medium columnar, friable, noneffervescent, clear boundary, common medium yellowish brown (10YR5/6) mottles, common thin almost continuous grayish brown (10YR4/2) cutans
206-226	BC	grayish brown (10YR4/2) loam with common fine pebbles, weak coarse subangular blocky, friable, noneffervescent, abrupt boundary, common medium brown (7.5YR4/2 and5/4) mottles
		GUNDER MEMBER
226-279	2BC1b	brown (10YR4/3) silt loam, weak coarse subangular blocky, friable, noneffervescent, gradual boundary, abundant medium to coarse grayish brown (2.5Y5/2) and common medium yellowish brown (10YR5/6) mottles, common medium to fine iron accumulations, common thin discontinuous dark gray cutans
279-323	2BC2b	brown to dark yellowish brown (10YR4/3-4/4) silt loam, moderate medium columnar, friable, noneffervescent, gradual boundary, common medium to coarse grayish brown (2.5Y5/2) mottles, common medium yellowish brown (10YR5/6) mottles along root channels, abundant medium iron and oxide accumulations
323-361	2C1b	olive brown (2.5Y4/4) silt loam, massive, friable, noneffervescent, abrupt boundary, common coarse grayish brown (2.5Y5/2) mottles, abundant iron accumulation along root channels, common sand grains along root channels

361-389	2C2b	yellowish brown (10YR5/4) fine to medium loam, massive, friable, noneffervescent, abrupt boundary, abundant coarse yellowish red (5YR5/6) and common medium grayish brown (2.5Y5/2) mottles
389-422	2C3b	gray (7.5YR5/0) silt loam, massive, friable, noneffervescent, abrupt boundary, abundant coarse light olive brown (2.5Y5/4) and common medium yellowish red (5YR4/6) mottles
422-533	2C4b	brown (10YR5/3) medium to coarse loamy sand, single grain, loose, noneffervescent, abrupt boundary
533-560	2C5b	dark gray (10YR4/1) medium to coarse pebbly sand,single grain, loose, noneffervescent, abrupt boundary
560-base (577)	2C6b	dark gray (10YR4/1) coarse loamy sand and pebbles, single grain, loose, noneffervescent, hole collapsed

90AB16

Location: site 90-109 SW1/4 SE1/4 sec.30 T71N R15W
Elevation: 851.1 ft
Landscape position: toeslope descending to terrace
Slope: 5-9%
Vegetation: pasture
Date described: 7/30/86
Described by: E.A. Bettis III
Remarks: C-14 date 427cm--8680±140 B.P. (Beta-17319)

Depth (cm)	Soil Horizon (weathering zone)	Description
		DEFOREST FORMATION GUNDER MEMBER
0-226	modern solum	Aquoll developed in silty clay loam deposits, Bt horizon is very dark grayish brown to dark grayish brown (10YR3/2-4/2), noneffervescent, gradual boundary, 11cm of Camp Creek Member bury the surface soil
226-389	C1	brown (10YR4/3-5/3) silt loam, massive, friable, noneffervescent, abundant brown (7.5YR4/4) mottles, clear boundary
389-579	C2	stratified silt loam, and medium to coarse sand and gravel, occasional zones of organics, C-14 date on wood at 427cm--8680±140 B.P. (Beta-17319), abrupt boundary
		PRE-ILLINOIAN TILL
579-base (610)	2C (UU)	very dark gray (2.5Y3/1) loam diamicton, massive, firm, violent effervescence

04AB1

Location: SE1/4 SE1/4 sec.23 T70N R16W
Elevation: approximately 820 ft
Landscape position: loess-mantled terrace
Slope: 2-5%
Vegetation: alfalfa
Date described: 7/30/86
Described by: E.A. Bettis III
Remarks: laboratory data

Depth (cm)	Soil Horizon (weathering zone)	Description
		PEORIA LOESS
0-20	Ap	dark brown (10YR3/3) silt loam, cloddy, friable, noneffervescent, abrupt boundary, common roots
20-30	E1	brown (10YR5/3) silt loam, moderate fine platy, friable, noneffervescent, clear boundary, common fine iron concretions, common roots
30-53	E2	brown (10YR5/3) silt loam, moderate medium subangular blocky, friable, noneffervescent, abrupt boundary, few medium brown (7.5YR4/3) mottles, few roots
53-94	Bt1	dark brown (10YR3/3) silty clay, moderate coarse subangular blocky, firm, noneffervescent, gradual boundary, common fine yellowish brown (10YR5/4) mottles, few fine iron concretions, common medium oxides, common thin discontinuous very dark grayish brown (10YR3/2) cutans
94-152	Bt2	grayish brown to brown (10YR5/2-5/3) silty clay loam, moderate medium to fine angular blocky, firm, noneffervescent, abrupt boundary, abundant medium yellowish brown (10YR5/6)

		mottles, abundant medium iron and oxide concretions, common thin discontinuous dark brown (10YR3/3) cutans, common thin discontinuous silt coatings on peds
		FARMDALE SOIL DEVELOPED IN ROXANA-EQUIVALENT SILT
152-173	2ABb	dark grayish brown to brown (10YR4/2-4/3) silty clay loam, strong medium subangular blocky, firm, noneffervescent, clear boundary, abundant medium brown (7.5YR4/4) and common medium dark gray (10YR4/1) mottles, common thin discontinuous very dark grayish brown (10YR3/2) cutans
173-188	2Bwb	yellowish brown (10YR5/4) silt loam, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary, common medium brown (7.5YR4/4) mottles, common fine iron concretions, few fine oxides, common thin discontinuous silt coatings
		SANGAMON SOIL DEVELOPED IN ALLUVIUM
188-241	3BEtb	yellowish brown (10YR5/4) loam, strong coarse subangular blocky breaking to strong fine angular blocky, firm, noneffervescent, gradual boundary, common medium grayish brown (2.5Y5/2) mottles, common fine iron concretions, abundant thin discontinuous oxide patches, common thin almost continuous brown (10YR4/3) cutans, common thin discontinuous patches of silt coatings
241-317	3Btb	yellowish brown (10YR5/6) clay loam, very strong fine angular blocky, very firm, noneffervescent, gradual boundary, common coarse grayish brown (2.5Y5/2)

		mottles, abundant fine iron concretions, common medium oxides, abundant medium dark brown (10YR3/3) coatings on vertical ped faces, common thick continuous brown (7.5YR4/4) cutans
317-361	3BCb	yellowish brown (10YR5/6) loam, strong medium to fine angular blocky, firm, noneffervescent, clear boundary, common coarse grayish brown (2.5Y5/2) mottles, iron concretions and oxides as above, coatings on vertical ped faces as above
361-396	3C1b (MOL)	brown to strong brown (7.5YR5/4-5/6) loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, common medium grayish brown (2.5Y5/2) mottles, abundant fine iron concretions, few fine oxides
396-455	3C2b (MJOL)	strong brown (7.5YR5/6) loam with common fine pebbles, massive, firm, noneffervescent, few fine grayish brown (2.5Y5/2) mottles, occasional cutans along subvertical joints
455-546	3C3b (MOL)	yellowish brown (10YR5/4-5/6) stratified fine sandy loam and sandy loam, massive, friable, noneffervescent, abrupt boundary, few fine iron concretions, common fine oxides
546-574	3C4b (OL)	yellowish brown (10YR5/6) loamy sand, single grain, loose, noneffervescent, abrupt boundary
574-617	3C5b (OL)	yellowish brown and brownish yellow (10YR5/6 and 6/6) very finely bedded silt loam, massive, friable, noneffervescent, common fine oxides
617-706	3C6b	yellowish brown (10YR5/4) very

	(OL)	finely bedded silt loam, as above with few fine iron concretions and abundant fine oxides
706-719	3C7b (OL)	yellowish brown (10YR5/4) sandy loam grading to loam, massive, friable, noneffervescent, abrupt boundary, common fine iron concretions
719-739	3C8b (MOL)	dark yellowish brown (10YR4/4) clay loam, massive, firm, noneffervescent, abrupt boundary, abundant fine grayish brown (10YR5/2) mottles, iron concretions as above, few fine oxides
739-777	3C9b (OL)	yellowish brown (10YR5/6) sandy loam, massive, friable, noneffervescent, abrupt boundary, few finely disseminated organics
777-836	3C10b (MOL)	yellowish brown (10YR5/4-5/6) silt loam, massive, friable, noneffervescent, abrupt boundary, common medium light gray (10YR6/1) mottles, few fine oxides
836-base (970)	3C11b (MOL)	dark yellowish brown to yellowish brown (10YR4/4-5/4) very thinly bedded silt loam and silty clay, massive, firm, noneffervescent, few medium brown (7.5YR4/4) and gray (10YR5/1) mottles, abundant fine oxides

68LSC-2

Location: NW1/4 SE1/4 NE1/4 sec.28 T71N R16W
Elevation: approximately 835ft.
Landscape position: stream bank exposure along left (north) bank of Boyd Branch, floodplain
Slope: 2-5%
Vegetation: cultivated field
Date described: 4/29/86
Described by: E.A. Bettis III

Dark loamy, noncalcareous alluvium (Roberts Creek Member) with gray mottles and iron and manganese accumulations; unit is buried by .3m of lighter colored stratified noncalcareous alluvium (Camp Creek Member); at this locality the Roberts Creek Mbr. contains several superimposed AC soil profiles which may be middens. A small grit tempered chord roughened sherd was collected aproximately 2m below the land surface in one of these soils. A biface fragment was also collected in one of the soils approximately 3.2m below the land surface. The middens contain common charcoal and appear to be quite mixed. A radiocarbon sample (charcoal) was collected 2.7m below the land surface within a feature. The feature was about 2.5m long and consisted of a lenticular layer of iron cemented coarse sand filling a shallow basin shaped depression; radiocarbon date--2690$\pm$70 B.P. (Beta-16359).

90LSC-1 and 90LSC-1a

Location: site 90-90 SE1/4 SW1/4 NW1/4 sec.22 T71N R15W
Elevation: approximately 790ft.
Landscape position: floodplain along small tributary valley left (west) bank of creek
Slope: 2-5%
Vegetation: floodplain forest
Date described: 6/16/86
Described by: E.A. Bettis III

Stratified loamy and sandy alluvium (Camp Creek Mbr.) with an Entisol developed in its surface. Fill extends to below creek level (>3.0m) and truncates both Roberts Creek and Gunder Mbr. alluvium along this creek. Lower parts of the Camp Creek Mbr. contain organics and wood in this exposure. Two C-14 dates were obtained on organics collected 2.5m (90LSC-1a) and 3.0m (90LSC-1) below the land surface. Sample 90LSC-1 yielded a date of 360±60 B.P. (Beta-16754), while sample 90LSC-1a yielded a date of 210±60 B.P. (Beta-16753). This fill is angularly truncated by a younger Camp Creek Mbr. fill in several places along the stream.

04SC-A2

Location: center SW1/4 sec.3 T70N R16W
Elevation: approximately 780ft.
Landscape position: stream cut into low angle alluvial fan along right (south) bank of Soap Creek
Slope:2-5%
Vegetation: pasture
Date described: 7/31/86
Described by: E.A. Bettis III

This exposure is approximately 5.2m high and has no Camp Creek Mbr. deposits at its top. The exposure is in the distal part of an alluvial fan which is now completely surrounded by younger Holocene alluvium and consists of oxidized loamy and clay loam alluvium encompassing several fining upward sequences each with a paleosol developed in the upper part of the fining upward sequence (Corrington Mbr., DeForest Fm.). Three buried soils are exposed in this cut. The lowest two are Mollisols and contain Bw horizons. The uppermost buried soil is an Alfisol and is welded to the present surface soil which is a Mollisol (Typic Hapludoll). The lowest buried soil is at creek level and the fan deposits extend below creek level. C-14 date on charcoal contained within the second lowest buried soil (90cm above creek level), 4420±100 B.P. (Beta-17316). A flake was collected from the lowest buried soil in the exposure, and burned rocks were observed associated with the other buried soils in the exposure.

04SC-B

Location: SW1/4 NW1/4 SW1/4 sec.3 T70N R16W
Elevation: approximately 780ft.
Landscape position: terrace exposed in stream cut along left (north) bank of Soap Creek
Slope: 2-5%
Vegetation: pasture
Date described: 7/31/86
Described by: E.A. Bettis III

This exposure encompasses three separate alluvial fills exposed along a large bend in the creek. Going downstream the exposure includes: a dark loamy fill (Roberts Creek Mbr. of the DeForest Fm.), which truncates a oxidized loamy fill (Gunder Mbr.) with a Typic Hapludoll surface soil (this fill is probably equivalent to that exposed at 04SC-X and Y). The latter truncates and in part overlaps an older oxidized fill (Gunder Mbr.) which contains a prominent buried soil (Mollic Hapludalf). The surface soil developed into the downstream part of the exposure is an Alfisol whose Bt horizon is welded to the prominent buried soil. The alluvium above the buried soil and into which the surface soil is developed may be equivalent to the younger oxidized alluvium immeditally upstream. The lower oxidized alluvium into which the prominent buried soil is developed may laterally grade into the Corrington Mbr. (alluvial fans). The lower fill exibits moderate to strong soil structure throughout. All fills along this exposure are non-effervescent. Burned rocks were observed approximately 1.5m below the landsurface within the younger oxidized alluvium.

04SC-C

Location: SW1/4 NE1/4 SE1/4 sec.4 T70N R16W
Elevation: approximately 780ft.
Landscape position: terrace exposed along left (north) bank of Soap Creek
Slope: 2-5%
Vegetation: pasture
Date described: 7/31/86
Described by: E.A. Bettis III

Oxidized loamy alluvium (Gunder Mbr.) buried by 20cm of stratified loamy Camp Creek Mbr. A thick Mollic Hapludalf is developed into the upper part of the Gunder Mbr. at this locality. This fill appears to be equivalent to the older oxidized alluvium at 04SC-B, and is truncated by Roberts Creek Mbr. alluvium on the upstream end of the exposure. Charcoal was collected from a hearth located 1.25m below the landsurface within the Bt horizon of the soil developed into the Gunder Member. This charcoal yielded a C-14 date of 3320±60 B.P. (Beta-17317). Several burned rocks were also observed eroding out of this exposure at about the same level.

04SC-D

Location: SW1/4 NE1/4 SE1/4 sec.4 T70N R16W
Elevation: approximately 860ft.
Landscape position: large stream exposure in "upland" shoulder along right (south) bank of Soap Creek
Slope: 9-14%
Vegetation: pasture
Date described: 7/31/86
Described by: E.A. Bettis III

From creek level upward: 0-5.5m, UU massive clay loam diamicton with common sand diapiers; 5.5-9.1m, MRU loam diamicton grading laterally to stratified fine sand and UU loam diamicton, abrupt contact between this and the underlying unit; 9.1-15.2m, 7.5YR and 5YR coarse gravel grading upward to pebbles then sandy loam. A red Late Sangamon Soil is developed into the upper part of this unit. The geosol has abundant Mn accumulations in its Bt horizon. The sand and gravel is leached throughout. A thin discontinuous Peoria Loess cap is present across the top of the exposure. The top of this exposure is approximately 12m above "Late Sangamon" terraces along this section of Soap Creek (see description of 04AB-1 which was drilled on one of the loess-mantled "Late Sangamon" terraces).

04SC-X and 04SC-Y

Location: SE1/4 NW1/4 SW1/4 sec.3 T70N R16W
Elevation: approximately 780ft
Landscape position: bank exposure along right (south) bank of Soap Creek, terrace
Slope: 0-2%
Vegetation: pasture
Date described: 7/31/86
Described by: E.A. Bettis III

Both sections expose the Gunder Member of the DeForest Fm. The sections are adjacent along the same cut bank; SC-X is on the upstream end while SC-Y is located on the downstream end. At SC-X, from creek level up, the section is: 0-1.5m DeForest Fm. Gunder Mbr., 5YR iron cemented crossbedded coarse sand with occasional silt loam interbeds containing common organics. This interval appears to be a point bar sequence with the former channel located downstream along the exposure. C-14 date on organics within a silt loam interbed in the point bar 4.57m below land surface, 3530±70 B.P. (Beta-16751); 1.5-4.65m Gunder Mbr. The section fines upward above the point bar sequence to an oxidized, mottled loam and has a cumulic Haplaquoll developed in its upper part; 4.65-4.95m Camp Creek Mbr., stratified, oxidized, loamy alluvium, Ap horizon at surface.

At SC-Y the section from creek level upward is: 0-1.0m DeForest Fm. Gunder Mbr., stratified silt loam and loam alluvium, beds dip to the east into a channel deposit, alluvium is grayish brown and contains abundant to common mottles, noneffervescent. A C-14 date on organics contained within a silt loam bed, 3620±80 B.P. (Beta-16752); 1.0-4.75m, Gunder Mbr., loamy alluvium with a cumulic Haplaquoll developed in its upper part. The soil contains few thin discontinuous cutans in root channels, and gray and red mottles in the lower Bw horizon; 4.75-5.0M Camp Creek Mbr., very similar to that at SC-X. The Gunder Member at this locality angularly truncates Corrington Mbr. deposits located immediately downstream at 04SC-A2.

04SC-Z

Location: NE1/4 SW1/4 SE1/4 sec.3 T70N R16W
Elevation: approximately 800ft.
Landscape position: high level bench descending to Soap Creek, stream cut along right (south) bank of Soap Creek
Slope: 5-9%
Vegetation: alfalfa field
Date described: 7/31/86
Described by: E.A. Bettis III

Section from surfaces downward is: 0-2.13m, Peoria Loess with surface soil developed into it; 2.13-2.36m, Farmdale Soil developed in silty pedisediment; 2.36-6.32m, loamy alluvium with Late Sangamon Soil developed in upper part grading downward to coarse sand and gravel, abundant iron staining, noneffervescent, abrupt lower boundary; 6.32m-base of exposure (9.98m), JUU Pre-Illinoian till. Upper portion of the till is bedded and very deformed. This part of the till section contains abundant sand and gravel bodies, generally lenticular in shape and several meters across. The lower part of the exposed till is massive and contains abundant clasts of local Pennsylvanian rock. Lots of water is seeping out of the sand and gravel bodies in the till. Several springs and seeps are present in tributary valleys in this area, possibly associated with outcrops of this interval or till/rock contacts. Numerous fire-cracked rocks and a few chert flakes were observed eroding out of the EB horizon of the surface soil developed in Peoria Loess at the top of this cut

APPENDIX B

Descriptions of selected borings from SCS investigations. A complete set of descriptions from SCS investigations is available in Thompson's (1983a) notebook on file at the SCS office in Des Moines, Iowa.

F I E L D   N O T E S

DESCRIPTIONS OF BORINGS
SOAP CREEK WATERSHED STRUCTURE SITES

STRUCTURE SITE 4-95: Three terrace levels are present 6-8ft escarpments separate the terraces; the lowest terrace (T3) is the "flood plain." The upper terrace in the small valley extends out into the Soap Creek flood plain where it is buried by younger sediment (see slide of cut of terrace near junction with Soap Creek). The upper terrace (T1) is the most extensive in area and by volume. An alluvial fan (core 4-95-3) is present; it may be older than T1 (the latter appears to be inset into it). In other small valleys, alluvial fans clearly overlie T1, while large and low-angle fans are present in the Soap Creek valley at the mouths of the some of the smallest drainages (<100ac) along the norther sides of the valleys. [The cross section has been surveyed by J. Walker.] Peculiar bench-like remnants are present along the right side of the drainageway, as are truncated fans. The bench-like surfaces are higher than T1, but were not investigated. Pastured valley with some timber upstream. Good solid vehicle access. Area pastured (dam site) was probably cleared and broken with a walking plow and team. A 15 gully, with slumped sides, is present; fills are well drained. Little or no postsettlement alluvium is recognizable. NOTE: The Appanoose County Soil Survey distinguishes alluvial terraces and fans as SMUs. Dale Lockridge was the party leader; he's familiar with the terrace sequence and would be happy to spend a day or two in the field looking at the Holocene fills and talking about their correlation during the original county soil survey.

CORE/PROFILE: 4-95-1
STRUCTURE SITE:4-95 COUNTY: Appanoose
LOCATION: NE 1/4 Sec. 12, T70N, R16W
DRAINAGE AREA (ACRES):190 SLOPE: 0-3%
DATE DESCRIBED:4-15-85 DESCRIBED BY: Dean Thompson
NOTES: T2 terrace, right side of valley. 3in core; hole collapsed in sand; lower 6ft compressed and disturbed; H20 at 11ft.

UNIT	HORIZON	DEPTH (IN.)	DESCRIPTION
	A	0-12	very dark grayish brown to dark brown (10YR3/2-3) loam; moderate medium subangular blocky breaking to moderate medium granular; extremely friable; common fine roots; non-effervescent; gradual boundary
	B	12-28	color as above, sandy loam; strong medium subangular blocky; very friable; non-effervescent; clear boundary
	CB	28-33	very dark gray (10YR3/1) sandy loam; weak coarse subangular blocky; very friable; few large (.5in) angular gravels; noneffervescent; abrupt boundary
	C1	33-74	brown to yellowish brown (10YR4/3-6) sand and loamy sand; moderately stratified (+2in bands); loose; non-effervescent; abrupt boundary

UNIT	HORIZON	DEPTH (IN.)	DESCRIPTION
	C2	74-91	dark yellowish brown (10YR4/4-6) upward fining sands and gravels; stratified; loose, single grain; few fine C-14 flecks, <=2in common to abundant gravels; non-effervescent; abrupt boundary
	2C1	91-134	dark yellowish brown (10YR4/4) and gray (n5/) sandy loam; highly stratified; loose, single grain; few fine C-14 flecks at 114in; non-effervescent; clear boundary
	2C2	134-204	dark yellowish brown (10YR4/4) and darker upward fining sands and gravel; loose, single grain; occasional 2in gravels, very coarse gravel matrix in lower one-half; non-effervescent; abrupt boundary
PIT	3C1	204-324	very dark gray to black (10YR2-3/1) clay loam; massive; extremely firm; violent effervescence

CORE/PROFILE: 495-2
STRUCTURE SITE:4-95 COUNTY: Appanoose
LOCATION: see 495-1
DRAINAGE AREA (ACRES): see 495-1 SLOPE: 0-3%
DATE DESCRIBED:4-15-85 DESCRIBED BY: Dean Thompson
NOTES: T1 terrace, left side of valley opposite 4-95-1. 3in core to 9ft, then 2in core to rejection by large carbonate rock at 255in. Pastured.

UNIT	HORI-ZON	DEPTH (IN.)	DESCRIPTION
	A1	0-11	very dark gray (10YR3/1) loam; moderate medium granular; very friable; common fine roots; non-effervescent; diffuse boundary
	A2	11-15	very dark gray and dark gray (10YR3-4/1) loam; moderate to strong medium subangular blocky; very friable; few fine roots; gradual boundary
	AE	15-19	dark gray to dark brown (10YR4/1-3/3) loam; moderate fine to medium angular blocky; very friable; non-effervescent; clear boundary
	EA	19-25	dark brown (10YR3/3) loam; moderate medium angular blocky; friable; common thin brown (10YR4/3) coatings on peds; non-effervescent; clear boundary
	EA′	25-27	as above; abundant medium cutans as above; common very thin very pale brown (10YR8/3) grainy coats on peds; non-effervescent; gradual boundary
	B1t	27-36	brown to yellowish brown (10YR5/3-6) heavy loam; moderate coarse subangular blocky; firm; few thin dark yellowish brown (10YR4/4) cutans; non-effervescent; gradual boundary
	B2	36-47	dark grayish brown and dark yellowish brown (10YR4/2&4/4) loam; weak coarse subangular blocky; friable; non-effervescent; diffuse boundary
	C1	47-60	dark gray and dark yellowish brown (10YR4/1&4/6) sandy loam; common <=1in gravels; stratified; firm; non-effervescent; gradual boundary
	C2	60-103	brown to yellowish brown (10YR4/3&5/6) heavy loam; massive; firm; non-effervescent; abrupt boundary

	C3	103-116	yellowish brown (10YR5/6) loamy fine sand; weakly stratified; loose; non-effervescent; gradual boundary
	C4	116-137	yellowish brown (10YR5/4) silty clay loam; massive; common medium gray (10YR5/1) mottles; friable; non-effervescent; abrupt boundary
	C5	137-139	color as above, sand; non-stratified; loose, single grain; non-effervescent; abrupt boundary
	C6	139-149	color as above, fine sandy loam; massive; non-sticky, slightly plastic; few medium gray (10YR5/1) mottles; non-effervescent; clear boundary
	2C1	149-181	grayish brown to dark grayish brown (10YR5/2-4/2) silty clay loam; massive; non-sticky, plastic; few fine strong brown (7.5YR5/6) mottles; common very fine C-14 flecks; non-effervescent; abrupt boundary
	2C2	181-192	Dark gray (10YR4/1) fine sandy loam; massive; slightly sticky, non-plastic; few small gravels, abundant fine C-14 flecks; non-effervescent; abrupt boundary
	2C3	192-204	gray to dark gray (10YR5-4/1) loamy sand; massive; very slightly sticky, non-plastic; non-effervescent; abrupt boundary
	2C4	204-225	grayish brown to dark grayish brown (10YR5-4/2) fine to coarse sands and gravels; non-stratified; non-sticky, non-plastic; non-effervescent; abrupt boundary
	2C5	225-244	grayish brown and olive brown (2.5Y5/2&4/4) gravelly/sandy loam; slightly sticky, slightly plastic; non-effervescent; abrupt boundary
PIT	3C1	244-254	yellowish brown (10YR5/8) gravelly loam; loose, single grain; violent effervescence; abrupt boundary
	3C2	254-255	dark gray (N4/) gravelly loam; extremely firm; violent effervescence

CORE/PROFILE: 4-95-3
STRUCTURE SITE:4-95 COUNTY: Appanoose
LOCATION: see 4-95-1
DRAINAGE AREA (ACRES): see 4-95-1 SLOPE: 5-9%
DATE DESCRIBED:4/15/85 DESCRIBED BY: Dean Thompson
NOTES: Alluvial fan, center and upstream of medial fan. Surface is 10-15ft higher than T1 (4-95-2). 3in core to 10ft, then 2in; difficult drilling. Boring is "even" with the mouth of the sidevalley drainage. Fan materials are heavier textured than other fills. Contributory basin is less than 5 ac. Pastured. Possible archeological materials encountered 103-107in.

UNIT	HORIZON	DEPTH (IN.)	DESCRIPTION
	A1	0-4	very dark gray (10YR3/1) loam; moderate fine to medium granular; very friable; very few very fine roots; non-effervescent; gradual boundary

	A2	4-12	color and texture as above; moderate to strong fine subangular blocky; very friable; non-effervescent; gradual boundary
	AE	12-17	color as above, light clay loam; weak to moderate medium subangular blocky; friable; non-effervescent; clear boundary
	BEt	17-31	very dark grayish brown (10YR3/2) clay loam; moderate medium prismatic breaking to strong medium angular blocky; firm; few medium dark yellowish brown (10YR3/4) accumulations (silans?) on prismatic faces; moderate medium very dark gray (10YR3/1) cutans on ped faces; occasional very coarse sand grains on ped faces; non-effervescent; diffuse boundary
	Bt1	31-44	color and texture as above; moderate coarse prismatic breaking to moderate fine angular blocky; very firm; coatings as above; common very coarse sand grains on ped faces; non-effervescent; diffuse boundary
	Bt2	44-60	color and texture as above; weak to moderate coarse prismatic; extremely firm; few thin very dark gray (10YR3/1) cutans on ped faces; very coarse sand as above; non-effervescent; clear boundary
	CB	60-73	dark grayish brown to dark brown (10YR4/3-4/2) clay loam; massive; extremely firm; non-effervescent; diffuse boundary
	C1	73-103	yellowish brown to dark yellowish brown (10YR4/4-5/4) clay loam; massive; extremely firm; few pebbles and very coarse sands; non-effervescent; clear boundary
	C1′	103-117	as above; abundant very fine very dark gray and black (10YR3-2/1) oxides (?); abundant fine and medium C-14 flecks, common medium red (2.5YR4/8) patches of burned earth (zone is probably part of an archeological deposit, appears turbated and well mixed); non-effervescent; clear boundary
	C2	117-128	dark yellowish brown (10YR4/4) loam; massive; extremely firm; common medium dark gray (10YR4/1) mottles; non-effervescent; clear boundary
	C3	128-168	color as above, loam; massive; firm; few large dark gray (10YR4/1) mottles; non-effervescent; cler boundary
	C4	168-208	yellowish brown (10YR5/6) loam; massive; firm; few medium C-14 flecks; non-effervescent; clear boundary
	C5	208-241	gray and brown (10YR5/1-4) fine sandy loam; stratified (1-2in bands); loose; non-effervescent; abrupt boundary
	C6	241-255	yellowish brown (10YR5/4-6) very fine sands; loose and single grain; non-stratified; non-effervescent; abrupt boundary
	C7	256-264	color as above, loam; massive; very firm; slightly plastic, non-sticky; non-effervescent; abrupt boundary
P5/ PIT	C	264-290	gray (N4/) clay loam; massive; weakly stratified in lower part; extremely firm; violent effervescence; occasional pebbles of mixed lithology in lower part, few very fine sand lenses in lower part

LOGS OF CORES
SCS SOAP CREEK SURVEY
(September, 1983)

Following are selected logs of cores which were recovered during an SCS survey of flood plain damages in the Soap Creek drainage. The logs are included in the Appendices as background information on the variability of alluvial deposits.

All of the fills described in the logs are interpreted as Holocene deposits. All of the fills are non-calcareous. Cores were recovered with a 2in diameter soil sampling tube. Core/log numbers refer to SCS range surveys (see Fig. 5). (Selected cross-sections have been included to graphically portray the extent of recent flood plain modifications: sedimentation and scouring. Refer to Table 4).

CORE: S-A-9
Date: 9/13/83
Described by: Dean Thompson from 2in core
Boring on high alluvial terrace along the south side of Soap Creek valley: NE1/4, section 7, T70N, R13W

HOR-IZON	DEPTH (IN.)	DESCRIPTION
A-B	0-72	silty clay loam, alluvium, moderate soil development
C	72-84	fine sandy loam
2C	84-117	medium sands, upward fining

CORE: S-A-1
Date: 9/13/83
Described by: Dean Thompson from 2in core
Boring on low alluvial terrace along south side of Soap Creek

HOR-IZON	DEPTH (IN.)	DESCRIPTION
C1	0-2	fine sand, loose and single grain, abrupt boundary,
C2	2-14	loam, massive to weak blocky, abrupt boundary
2EAb	14-28	heavy silty clay loam, strong medium columnar, very firm, clear boundary
2Btb	28-69	as above, structure larger than tube, clear boundary
2BCb	69-80	MOL
2C	80-128	MOL

CORE: S-B-1
Date: 9/14/83
Described by: Dean Thompson from 2in core
Boring within meander of Soap Creek 1mi west of Floris: SW1/4 section 10, R13W, T70N

HOR-IZON	DEPTH (IN.)	DESCRIPTION

Ap	0-6	10YR4/2, loam, weak to medium fine platy, very friable, clear boundary
A1	6-9	as above, loam, weak coarse granular, friable, gradual boundary
A2	9-15	10YR5/3, loam, weak fine and medium subangular blocky, friable, gradual boundary
AB	15-27	as above, loam, weak coarse subangular blocky, friable, diffuse boundary, few fine 4/4 mottles
B	27-39	10YR5/3 with 4/2 coats on peds, light silty clay, moderate medium subangular blocky, firm, gradual boundary, mottles as above
Bt1	39-50	10YR3/2 and 4/1, clay loam, moderate medium to coarse subangular blocky, firm, clear boundary, common medium 4/6 mottles, very thin and discontinuous 3/2 clay skins on peds
C1	50-63	10YR5/8, silt loam, massive, non-sticky non-plastic, abrupt boundary, coarse medium 5/1 mottles
C2	80-144	10YR4/4, silt loam, massive, slightly sticky non-plastic, clear boundary, common to abundant fine 6/1 mottles (sand content and frequency of mottles increase with depth)
2C1	144-166	10YR5/8, medium sand, loose and single grain, abrupt boundary
2C2	166-172	10YR4/3, silty sand, massive, non-sticky non-plastic, abrupt boundary
2C3	172-176	10YR4/8 and 5YR4/8, very coarse sand, loose and single grain, abrupt boundary
2C4	176-183	10YR5/2, (saturated) medium sand, loose and single grain, abrupt boundary
2C5	183-186	7.5YR4/8, as above
2C6	186-189	As 2C7
2C7	189-190	10YR5/4, medium sand, loose and single grain, abrupt boundary
2C8	190-193	N/4 and lighter, very coarse and medium sand, loose and single grain

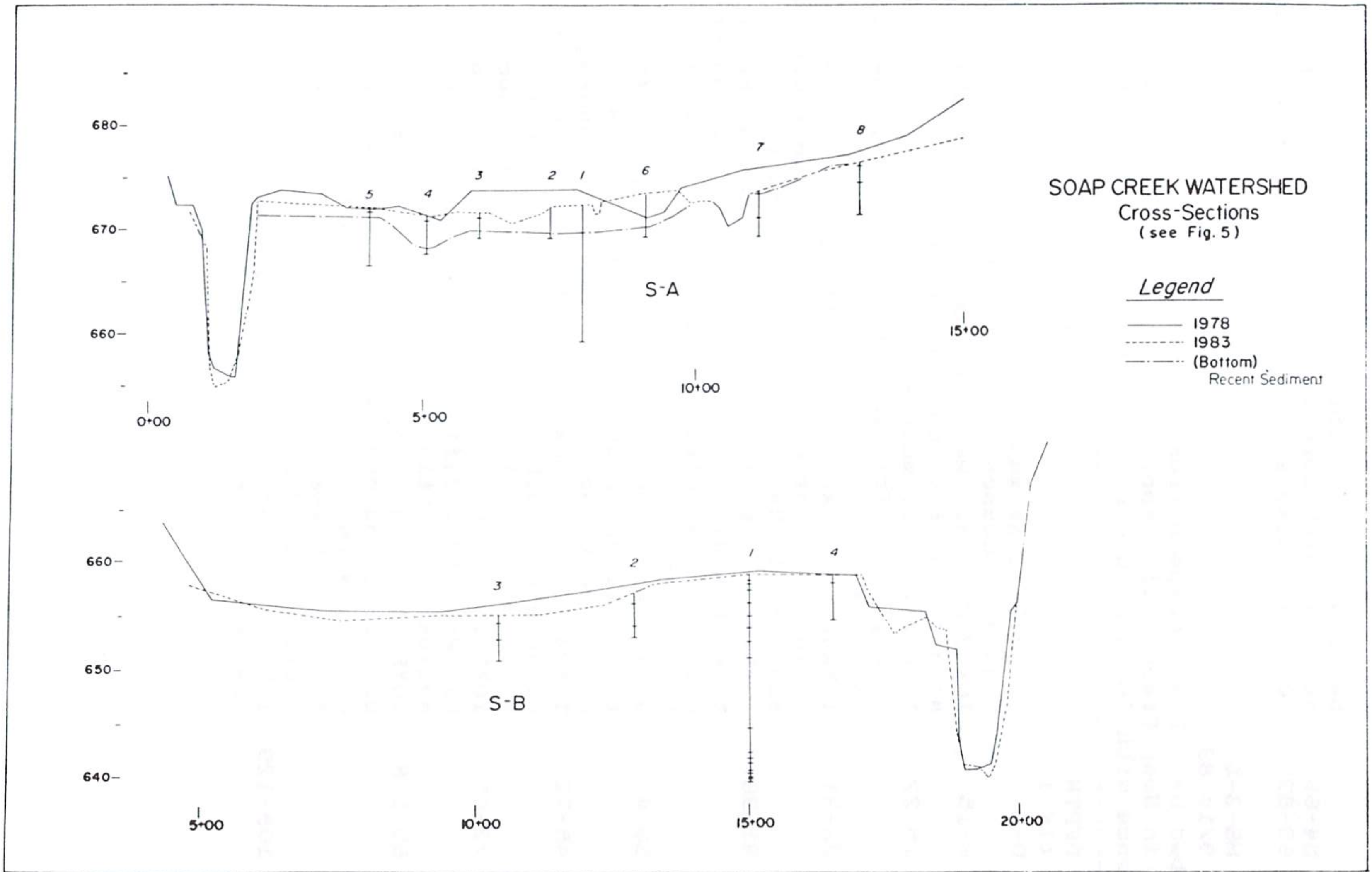
CORE: NS-1-5
Date: 9/19/83
Described by: Dean Thompson from 2in core
Boring along north side of Soap Creek: SE1/4, section 3, R16W, T70N

ZONE	DEPTH (IN.)	DESCRIPTION
OL	0-4	10YR4/3, loam very friable, abrupt boundary
OL	4-8	10YR3/2, weak fine platy breaking to weak medium granular, friable, clear boundary
OL	8-19	10YR3/3, loam, moderate fine to medium platy, friable, clear boundary
OL	19-29	10YR3/2, sandy loam, loose, abrupt boundary
OL	29-31	10YR4/3, medium sand, loose and single grain, abrupt boundary
MOL	31-54	10YR3/2, silt loam, stratified, non-sticky slightly plastic, abrupt boundary, parts on

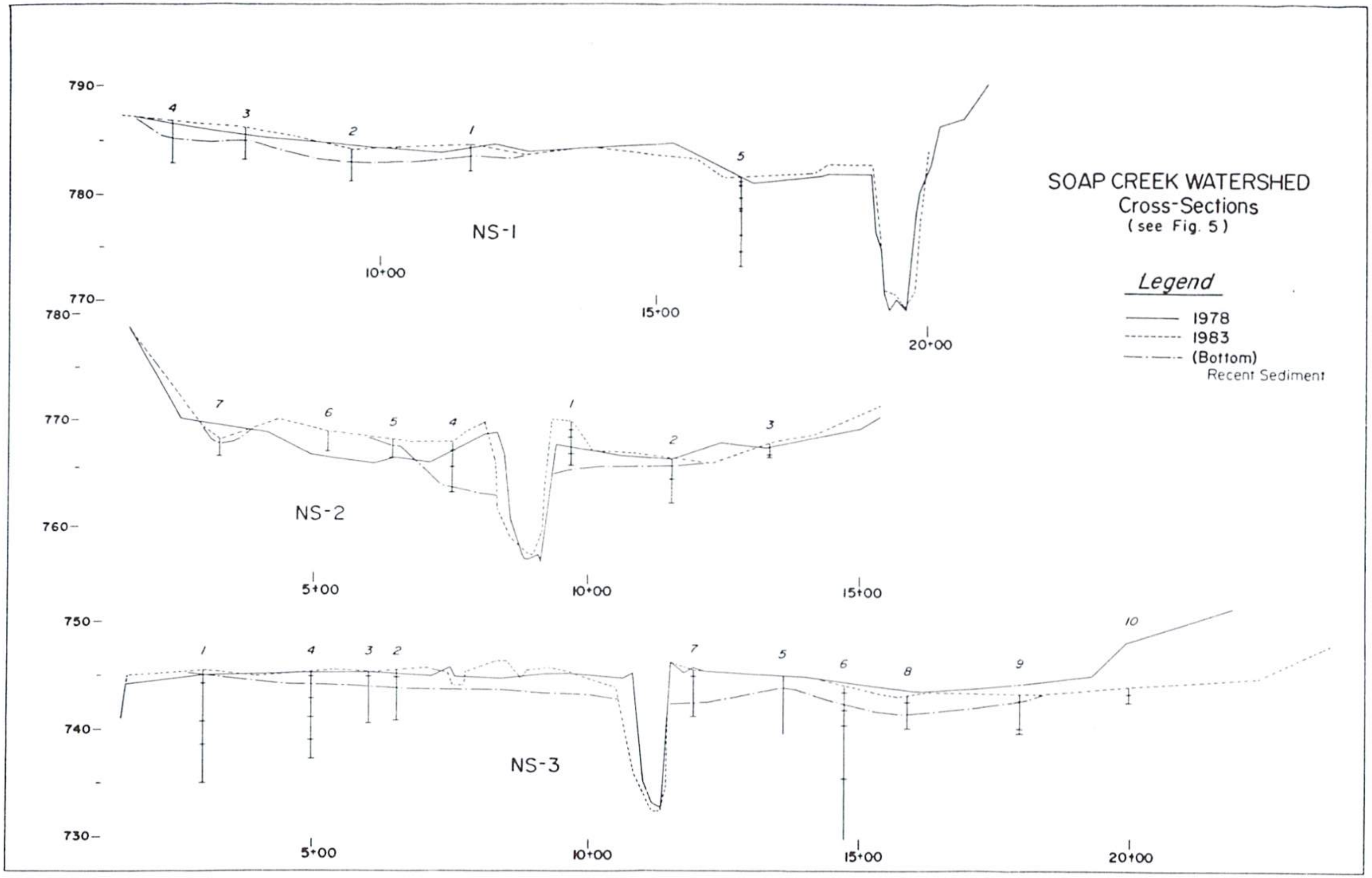
		bedding plants, 7.5YR4/4 accumulations on beds
OL	54-69	as above with more silt and decreased iron colors
OL	69-83	10YR4/4, loamy sand, slightly sticky non-plastic

CORE: NS-3-6
Date: 9/14/83
Described by: Dean Thompson from 2in core
Boring in Soap Creek valley approximately 1mi north from confluence with South Soap Creek: section 20, R15W, T70N

HOR-IZON	DEPTH (IN.)	DESCRIPTION
C	0-6	10YR3/3, loam massive, stratified, loose, abrupt boundary, common fine rootlets
Ap	6-15	10YR3/2, loam, weak medium blocky, friable, abrupt boundary, common fine rootlets
A1	15-22	10YR3/1, loam, moderate fine to medium subangular blocky, very friable, clear boundary, few fine rootlets
AB	22-31	10YR4/1 (4/2 kneaded), silty clay, moderate medium columnar breaking to moderate medium sub-angular blocky, firm, clear boundary
B	31-36	10YR4/1, clay, large faces (structure larger than tube) breaking to moderate medium subangular blocky, firm, clear boundary, many fine 4/6 mot-tles, thin 3/1 cutans
Bt2	36-45	as above, strong medium angular blocky (?), very firm, gradual boundary, few medium 4/3 mottles, medium continuous 3/1 cutans, +3.5 tons/sq. ft
BC	45-72	10YR4/1, clay loam, moderate medium and coarse subangular blocky, firm, diffuse boundary, few medium 3/3 mottles, very thin discontinuous cutans
CB	72-85	10YR4/1, clay loam, weak medium fine subangular blocky, firm, diffuse boundary, abundant fine to medium 4/3 mottles
C1	85-108	10YR5/1, light clay loam, massive firm, diffuse boundary, abundant medium 4/6 mottles, 2 tons/ sq. ft, Note: 1-2in "holes" (sub-vertical) in-filled with massive clay, very thick black slick-ensides around fill
C2	108-129	10YR4/6, light clay loam, massive, firm, abundant medium 5/1 mottles



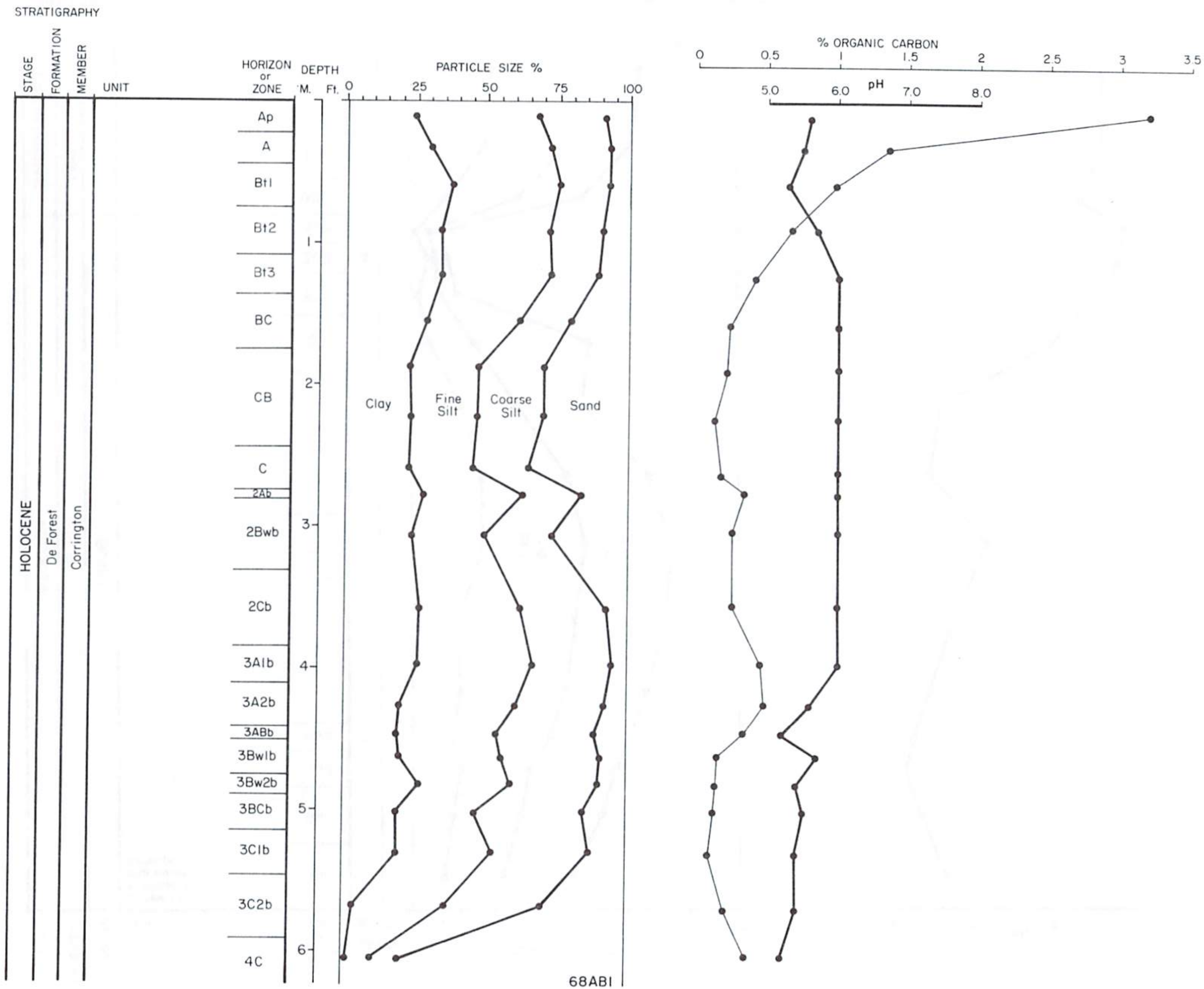
SCS surveyed profiles along S-A and S-B ranges, Soap Creek Watershed. See Figure 6 for location of the ranges.



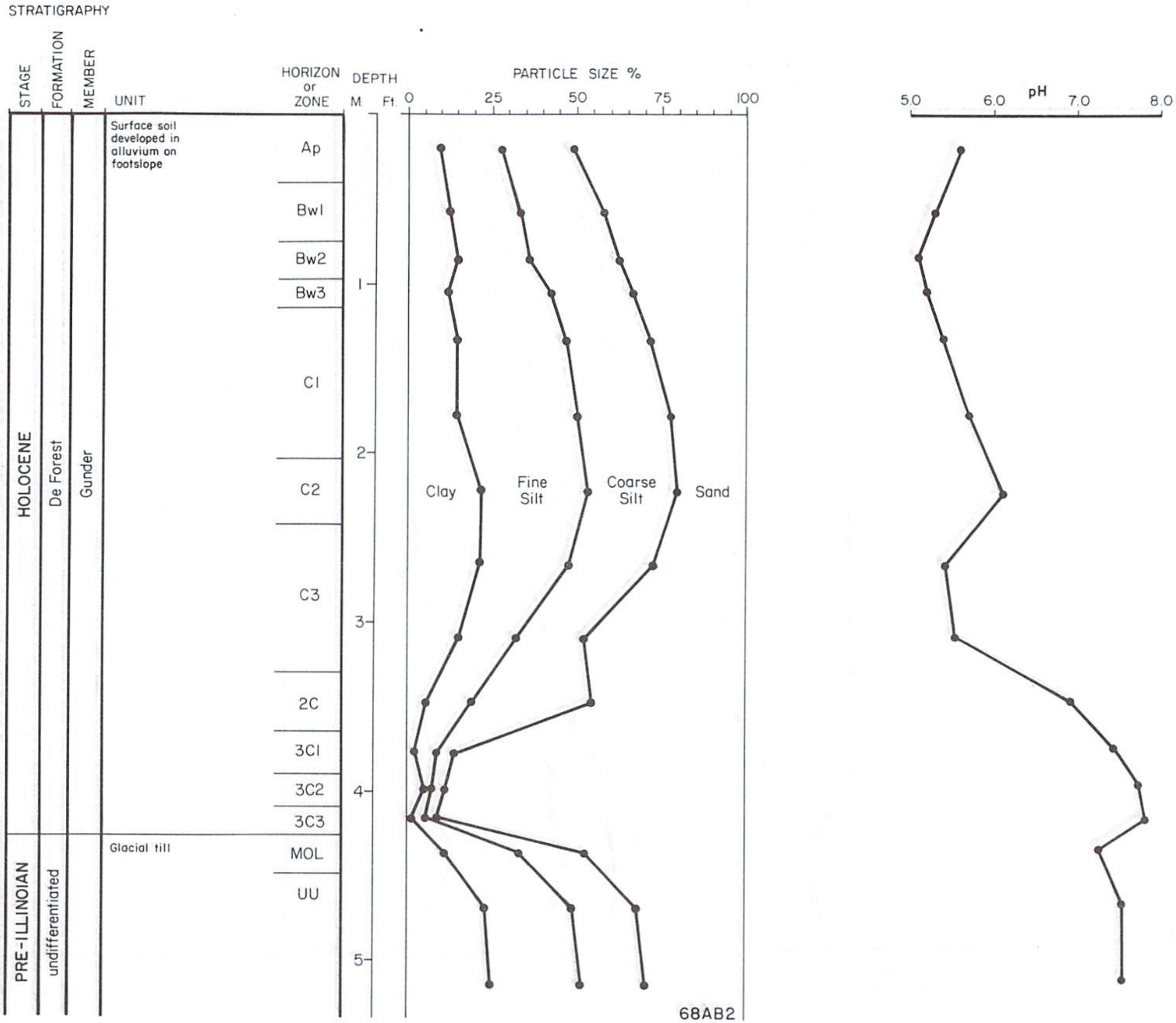
SCS surveyed profiles along NS-1 and NS-3 ranges, Soap Creek Watershed. See Figure 6 for location of the ranges.

APPENDIX C

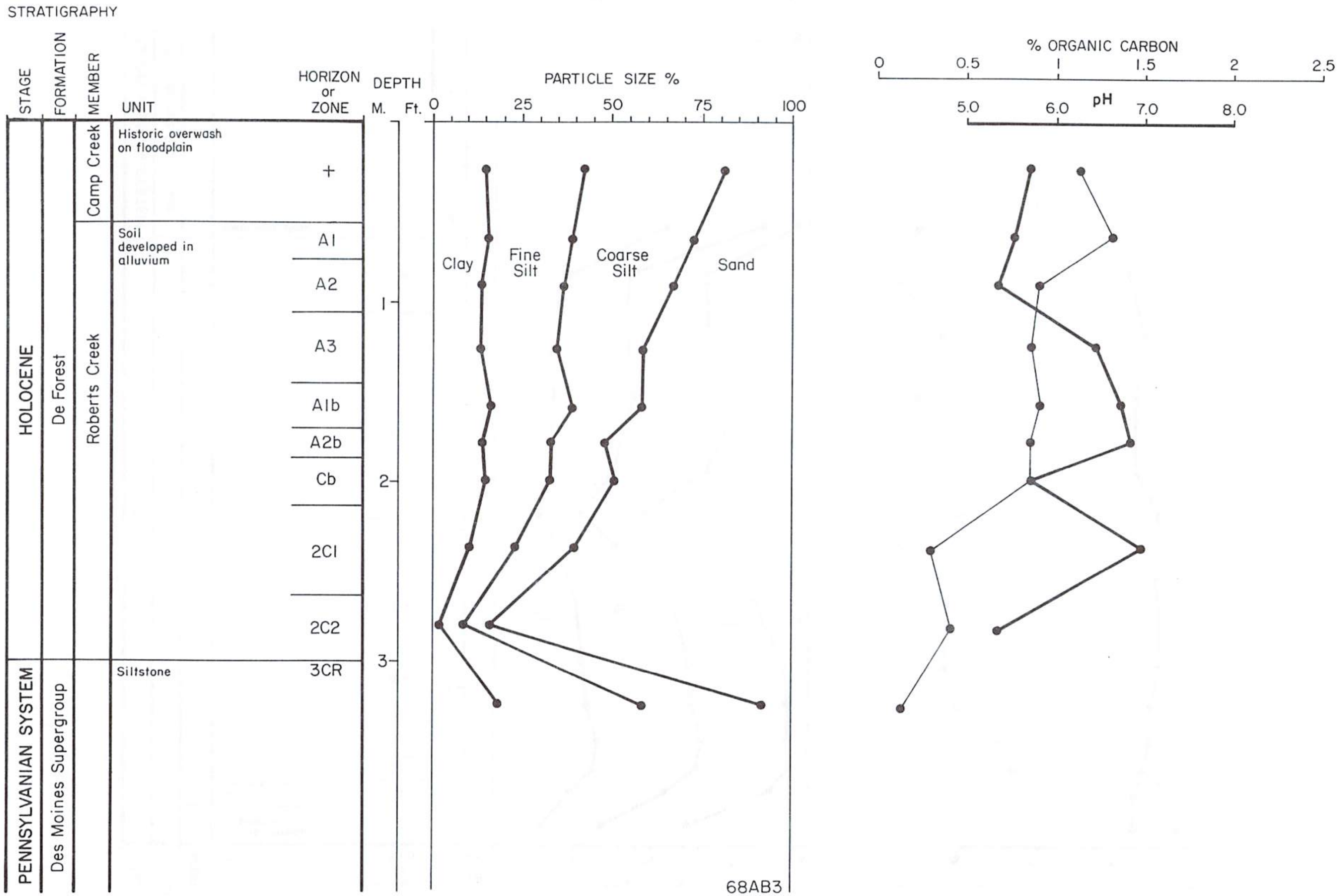
Profiles of laboratory data from selected GSB borings



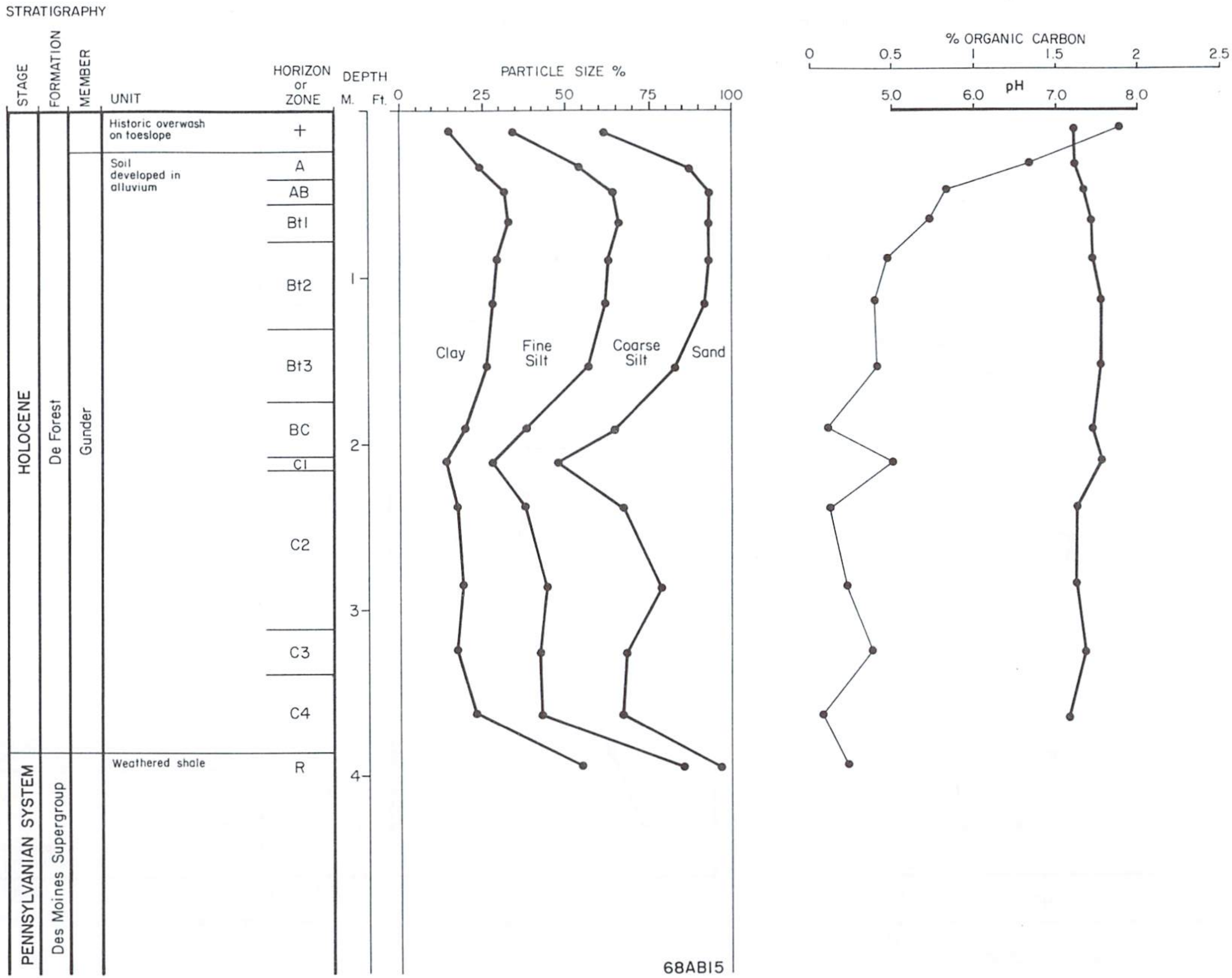
Laboratory data for core 68AB1, taken from the Corrington Member.



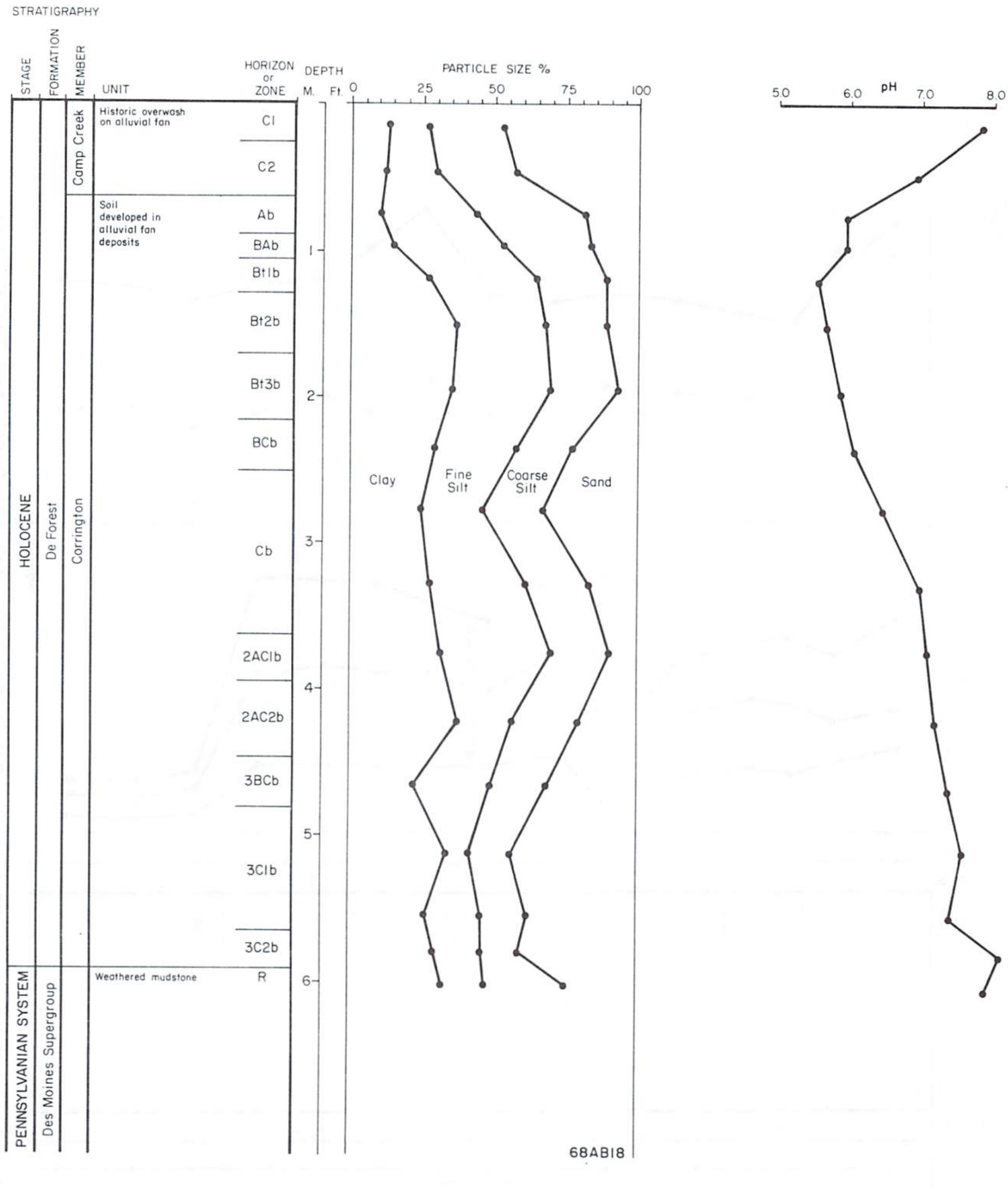
Laboratory data for core 68AB2, taken from the Gunder Member.



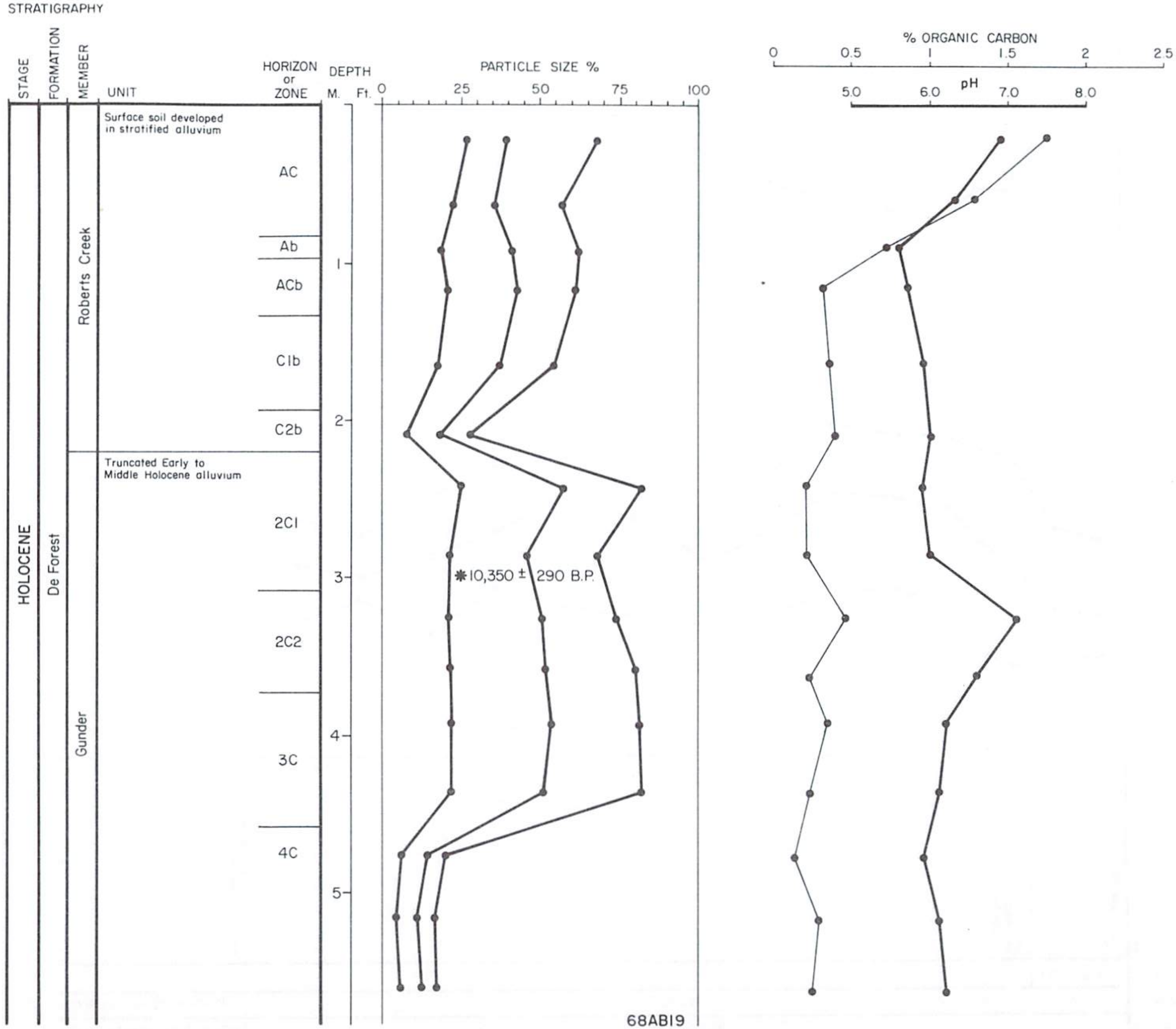
Laboratory data for core 68AB3, taken from the Camp Creek and Roberts Creek Members.



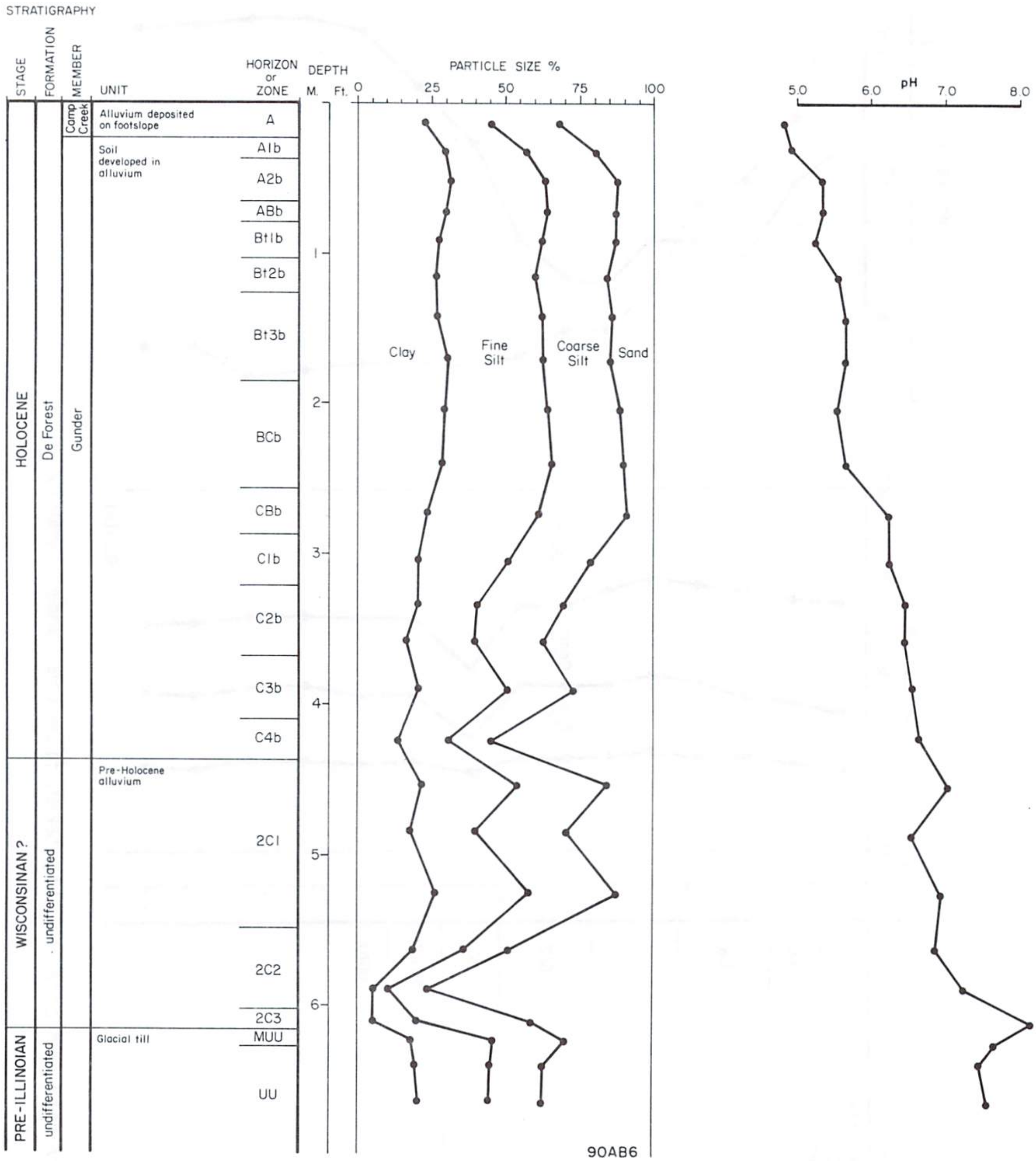
Laboratory data for core 68AB15, taken from the Gunder Member.



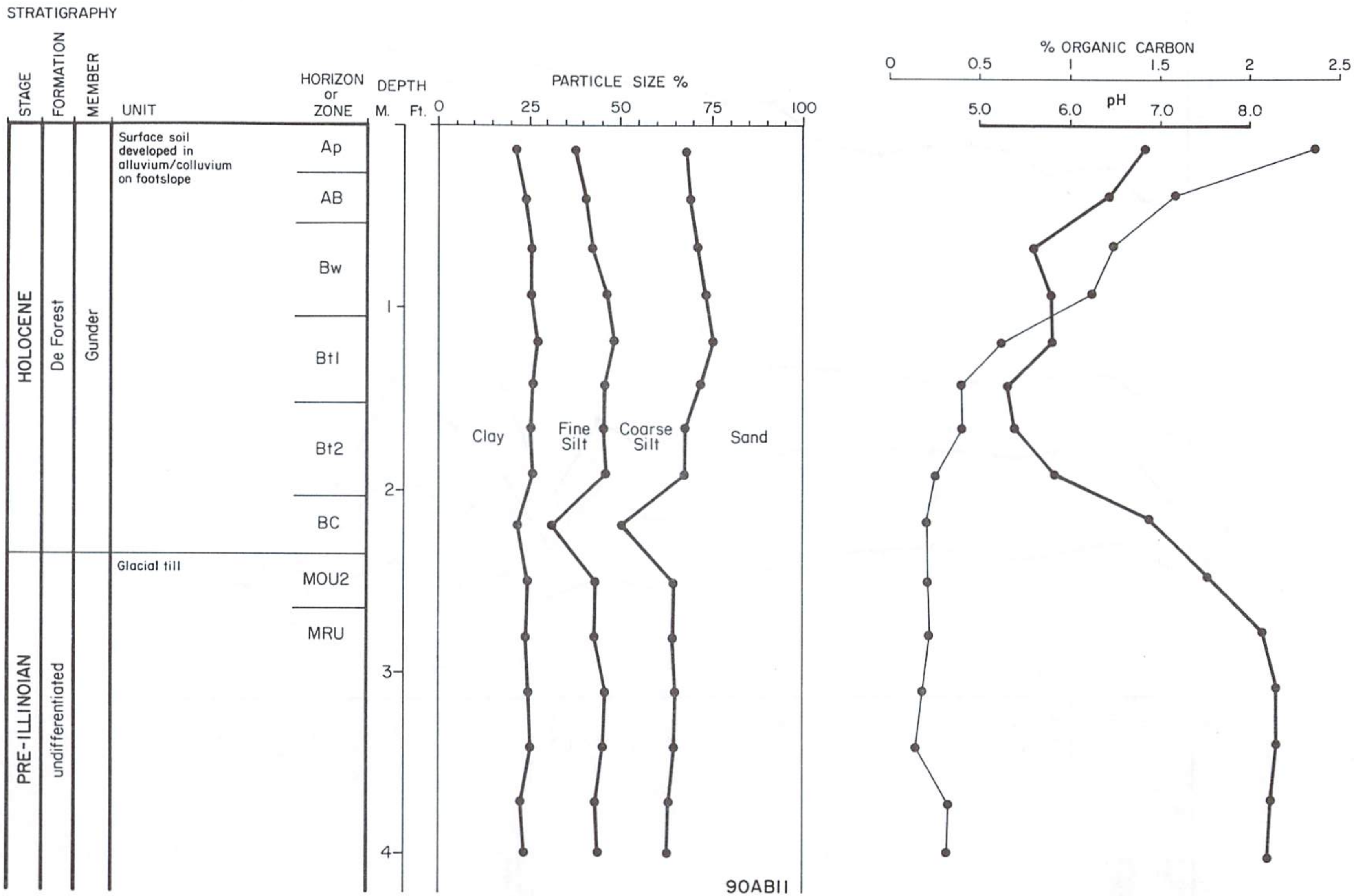
Laboratory data for core 68AB18, taken from the Camp Creek and Corrington Members.



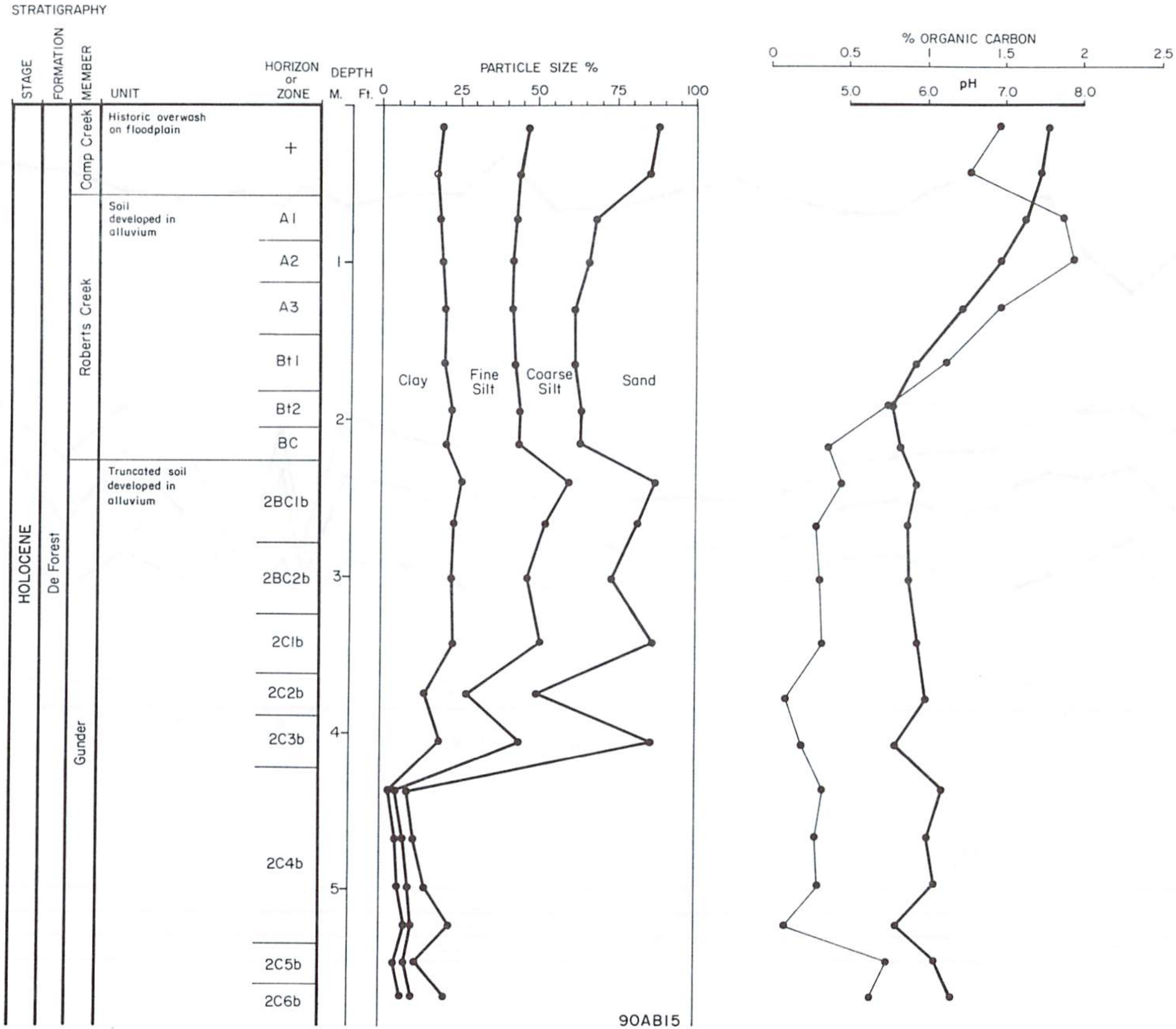
Laboratory data for core 68AB19, taken from the Roberts Creek and Gunder Member.



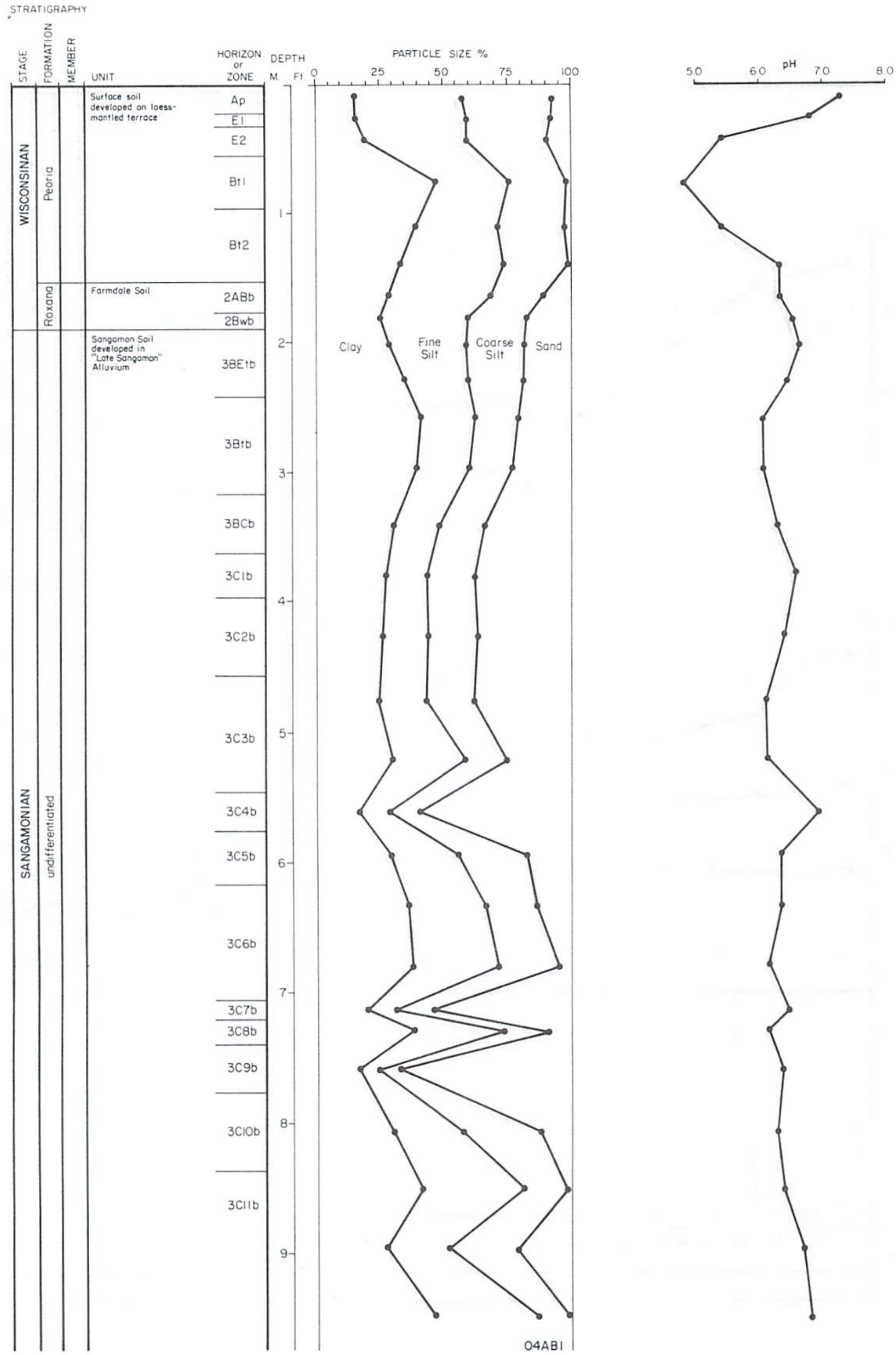
Laboratory data for core 90AB6, taken from the Gunder Member.



Laboratory data for core 90AB11, taken from the Gunder Member.



Laboratory data for core 90AB15, taken from the Camp Creek, Roberts Creek, and Gunder Members.



Laboratory data for core 04AB1, taken from loess-mantled "Late Sangamon" alluvium.