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LATE WISCONSINAN AND HOLOCENE LANDSCAPE EVOLUTION AND ALLUVIAL STRATIGRAPHY in the Saylorville Lake Area, Central Des Moines River Valley, Iowa

E. Arthur Bettis III
Research Geologist, Geological Studies

Bernard E. Hoyer
Associate State Geologist

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IOWA GEOLOGICAL SURVEY
Donald L. Koch, State Geologist and Director
123 N. Capitol Street
Iowa City, Iowa 52242

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LATE WISCONSINAN AND HOLOCENE LANDSCAPE EVOLUTION AND ALLUVIAL STRATIGRAPHY IN THE SAYLORVILLE LAKE AREA, CENTRAL DES MOINES RIVER VALLEY, IOWA

Prepared by

E. Arthur Bettis III
and
Bernard E. Hoyer
Principal Investigators

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Abstract

This is a report on the first detailed geomorphologic investigation of the Saylorville Lake area in the central Des Moines River Valley, Iowa. The purpose of this study is to identify, map, and date the landforms making up the valley landscape as well as the deposits below those landforms, in order to provide archaeologists and managers with a physical framework in which the cultural resources of the area can be evaluated.

Detailed stratigraphic studies were undertaken throughout the noninnundated portions of the Saylorville Lake area. Numerous radiocarbon and thermoluminescence dates were used to provide a chronologic framework for the alluvial stratigraphic units.

The highest and oldest fluvial deposits and alluvial landforms are late Wisconsinan-age benches and terraces. These developed as the late glacial Des Moines River downcut rapidly between 12,600 and 11,000 B.P. Five Holocene-age landform/sediment assemblages were identified and mapped throughout the area. These include: alluvial fans, colluvial slopes, the High Terrace (TH), the Intermediate Terrace (TI), and Low Terrace (TL). Alluvial fans, colluvial slopes and TH accumulated concurrently between about 10,500 and 4,000 years ago. TI accumulated between 4,000 and about 700 years ago, while TL accumulated after 700 years ago.

Limited investigations of the deposits preserved in tributary valleys suggest that the major period of tributary development was during the latest Wisconsinan and early through middle Holocene. Deposits preserved in the tributaries are time-equivalent to those in alluvial fans. Younger, late Holocene deposits are also present in the tributaries.

Maps of the landform/sediment assemblages were constructed in order to delineate the areas where deposits from the various culture periods could be preserved. Area and volume estimates of the landform/sediment assemblages provide the baseline information necessary to derive valid samples of the deposits for buried archaeological deposits. These maps and volume estimates also demonstrate that there are gaps in the remaining record. These need to be considered when reconstructing the culture history of the area.

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GLOSSARY

Alfisol - a soil order characterized by the lack of a mollic epipedon and a base status in some part of the B horizon lower than 50 but higher than 35 percent. Alfisols in central Iowa have developed under the primary influence of forest vegetation.

argillic horizon - a subsurface accumulation of clay. Silicate clay is transferred from overlying soil horizons to develop an argillic horizon. The Bt designation indicates an argillic horizon.

bench - an elevated, relatively level erosional feature or level in a valley.

calcareous - a substance that contains enough carbonate to react with dilute hydrocloric acid.

clast - an individual grain or fragment of a sediment or rock, produced by mechanical weathering of a larger rock mass.

cutan - a modification of the texture, structure, or fabric at natural surfaces in soil materials due to concentration of particular soil constituents or *in situ* modification of the plasma. In this report most cutans noted are probably clay coatings.

diamicton - as referred to in this report, poorly sorted, pebbly silt loam, clay loam, and loam.

englacial - contained, buried, or carried within the body of a glacier or ice sheet.

Entisol - an order of mineral soils whose distinguishing characteristic is the absence of a B horizon.

glacigenic - having an origin relating to the action of a glacier or ice sheet.

glaciofluvial - pertaining to the meltwater streams flowing from wasting glacial ice, especially to the deposit and landforms produced by such streams.

glaciolacustrine - pertaining to, derived from, or deposited in glacial lakes.

Holocene - an epoch of the Quaternary period, from the end of the Pleistocene, approximately 10,500 years ago to the present.

Inceptisol - an order of soils lacking a mollic epipedon and posessing a color or structural B horizon.

massive - possessing no prefferential planes of weakness or parting; lacking peds or stratification.

mollic epipedon - a thick, dark-colored A horizon meeting specific thickness and chemical criteria.

Mollisol - an order of soils posessing a mollic epipedon. Mollisols in Iowa have developed under the primary influence of prairie vegetation.

proglacial - immediately in front of or just beyond the outer limits of a glacier or ice sheet.

silan - a coating of silt grains on a ped surface or void wall.

slip-off slope - the long, low, relatively gentle slope on the inside of a stream meander, produced on the downstream face of the meander spur by the gradual outward migration of the meander as a whole.

terrace - an elevated, former floodplain level of a stream, this is a constructional landform.

Wisconsinan - pertaining to the last glacial stage of the Pleistocene, following the Sangamon Interglacial and preceeding the Holocene.

Introduction

Scientific archaeological investigations in the Saylorville Lake area began in the early 1960s (Benn, 1985a:14-29). Through the 1960s and 1970s the list of known archaeological sites in the project was greatly expanded. Most of these sites were located by pedestrian survey of cultivated fields and cleared areas. A few were found eroding from banks along the Des Moines River (DMR).

Beginning about 1974 site-specific geomorphic work was included in the assessment of a few sites in the project. Excavation of the Darr-es-Shalom site (13PK149), a deeply stratified Woodland and Late Archaic site, provided the first glimpse of the complexity of the Holocene alluvial stratigraphy facing archeologists working in the area (Timberlake, 1981). Following that excavation some attention was paid to the physical stratigraphy and landscape setting of sites tested in the area. Subsurface exploration of sites, intended to provide data on the soils and geomorphology, was included in the Stage 3 investigations conducted by Iowa State University archeologists (Osborn and Gradwohl, 1982). These geologic investigations were of limited utility because: 1) the soils and geomorphic data from the project were not used to seek out buried surfaces where cultural deposits might exist apart from those found on the surface; 2) cultural material was not adequately identified in stratigraphic context so that an analytical discussion of cultural sequences could not be developed from the site data; 3) in most cases the subsurface explorations did not extend deeper than 2 m and therefore much of the Holocene depositional sequence was not examined; and 4) geomorphic investigations were site-specific, little or no correlation of the sequences observed at the various sites was attempted and therefore the site/sediment associations observed could not be extrapolated to the reservoir area as a whole.

In 1981 a joint archaeological/geomorphical survey of the Downstream Corridor below Saylorville Dam was conducted to evaluate the stratigraphic context of the archaeological resource in that area (Benn and Bettis, 1981). That investigation resulted in the development of a landscape model delineating changes in the Des Moines Valley (DMV) landscape during the last 13,000 years. The model was employed to assess the stratigraphic potential for preservation of buried archaeological sites as well as to place known sites in their stratigraphic and chronologic context (Bettis and Benn, 1984).

As part of their relocation and testing of sites along the Saylorville Lake shoreline, Impact Services, Inc. produced a map of the major landforms and soil types of the area (Emerson, 1983: Fig. 3). The map was produced primarily from published soil survey reports, USGS 7.5 minute series topographic maps as well as 5 ft. contour interval maps of the reservoir area provided by the USACE. As noted by Emerson, the map information was "not intended as a substitute for the detailed studies of geomorphology and soils that are necessary to thoroughly define individual sites" (1983:8). They recognized three terrace levels above the floodplain level. (Our investigations reported herein indicate that all of the terrace levels recognized by Impact Services are late Wisconsinan in age.)

Followup studies by Impact Services provided more detailed information on several sites tested along the lake margins (Emerson, 1984). These investigations provided very detailed information on the soils and landforms present at individual sites but little or no stratigraphic work was done. As a result, the relationship between landforms observed in different portions of the lake could only be discussed in general terms. In addition, the potential for deeply buried sites and/or significant gaps in the depositional and archaeological records could not be addressed in other than very general terms.

The study reported herein is an extension of the landscape model of Bettis and Benn (1984), developed in the Downstream Corridor, to the entire Saylorville Lake project area. The model has also been expanded to include sidevalleys, alluvial fans, colluvial slopes, valley slopes, and uplands (see Appendix D). This volume in conjunction with the Overview of Cultural Resources and Management Plan for Saylorville Lake prepared by the Center for Archaeological Research, Southwest Missouri State University (Benn, 1985a and b) provides the stratigraphic and cultural framework necessary for sound management of cultural resources in the Saylorville Lake area. This geologic report also provides baseline information for evaluation and management of geological and biological resources in the project area.

Location

The Saylorville project includes lands owned by the U.S. Army Corps of Engineers (USACE) in and along Saylorville Lake, located 213.7 to 230.7 miles (341.9 - 369 km) above the confluence of the DMR with the Mississippi River, an additional 59 km (37 mi.) of flood control pool area north (upstream) of the lake (U.S.A.C.E., 1981:6), and the Downstream Corridor, located between Saylorville Dam and the 2nd Avenue Bridge in the City of Des Moines (U.S.A.C.E., 1970:7). The project extends from the City of Des Moines in Polk County, Iowa to the town of Fraser in northern Boone County (Fig. 1).

Saylorville Lake was created by impoundment of the central Des Moines River valley at mile 213.7, just upstream of the village of Saylorville in 1977. The central DMR, with a drainage area of 14,907 km^2 (5,823 $mi.^2$), flows roughly north-south down the axis of the Des Moines Lobe landform region of north-central Iowa (Prior, 1976; Plate 1). This landform region marks the extent of the last glaciation to affect Iowa about 14,000 to 12,000 years ago (Ruhe, 1969). The upland in this region is dominantly a low-relief till plain with extensive areas of ground moraine and a poorly-integrated drainage network. Until artificially drained in the late 19th and 20th centuries, closed depressions harboring extensive intermittent lakes and other wetlands were very abundant (State Highway Commission, 1916; Shimek, 1948; Conard, 1952; Clambey and Landers, 1976). Seven end moraines, marking former ice front positions, rise above the surrounding ground moraine (Fig. 2).

The DMV and its tributaries are cut into deposits of the late Wisconsinan-age Des Moines Lobe. The main valley and its tributaries are very steep walled. Except for major tributaries, the drainage network rarely extends farther than .5 km (5 mi.) away from the DMV. Numerous benches and terraces step down from the upland edge to the valley floor.

Within the project area the river occupies a gorge often cut through the sequence of Quaternary deposits into the underlying bedrock. Pennsylvanian-age shale, siltstone, sandstone, coal, and limestone of the Floris and lower portions of the Swede Hollow Formations (lower Desmoinesian Series, Cherokee Group) outcrop extensively along the lake shoreline and in the valley walls upstream of the lake (Lemish et al., 1981; Ravn et al., 1984). Coal and "fire clays" within the Pennsylvanian sequence were mined extensively during the mid to late 1800s and early 1900s (Beyer, 1895; Leonard, 1898; Schweider, 1983). Most of these mines were shallow drifts and shafts sunk into seams exposed along the valley wall. Extensive early 20th century coal mining was conducted

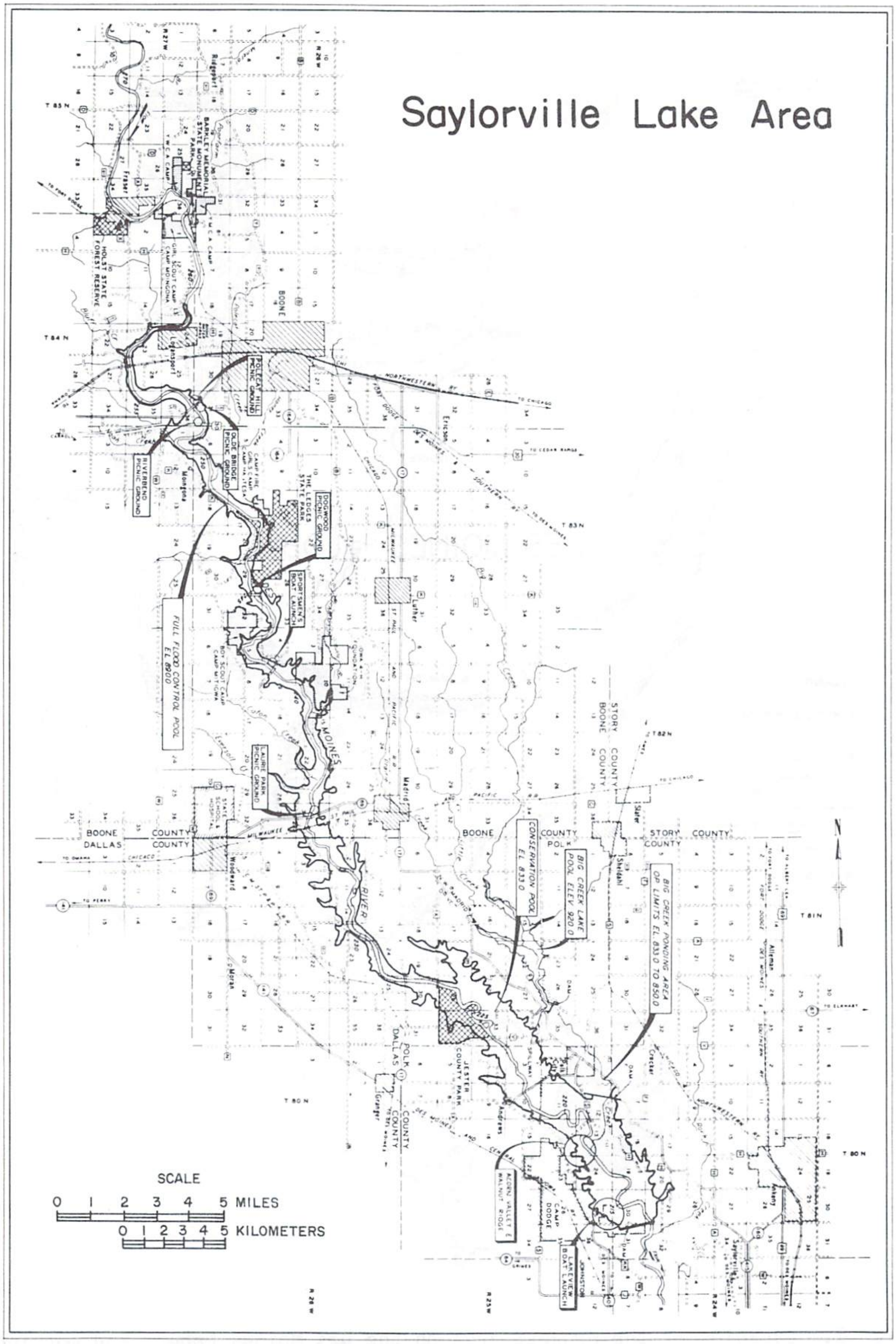


Figure 1. The Saylorville Lake Project area.

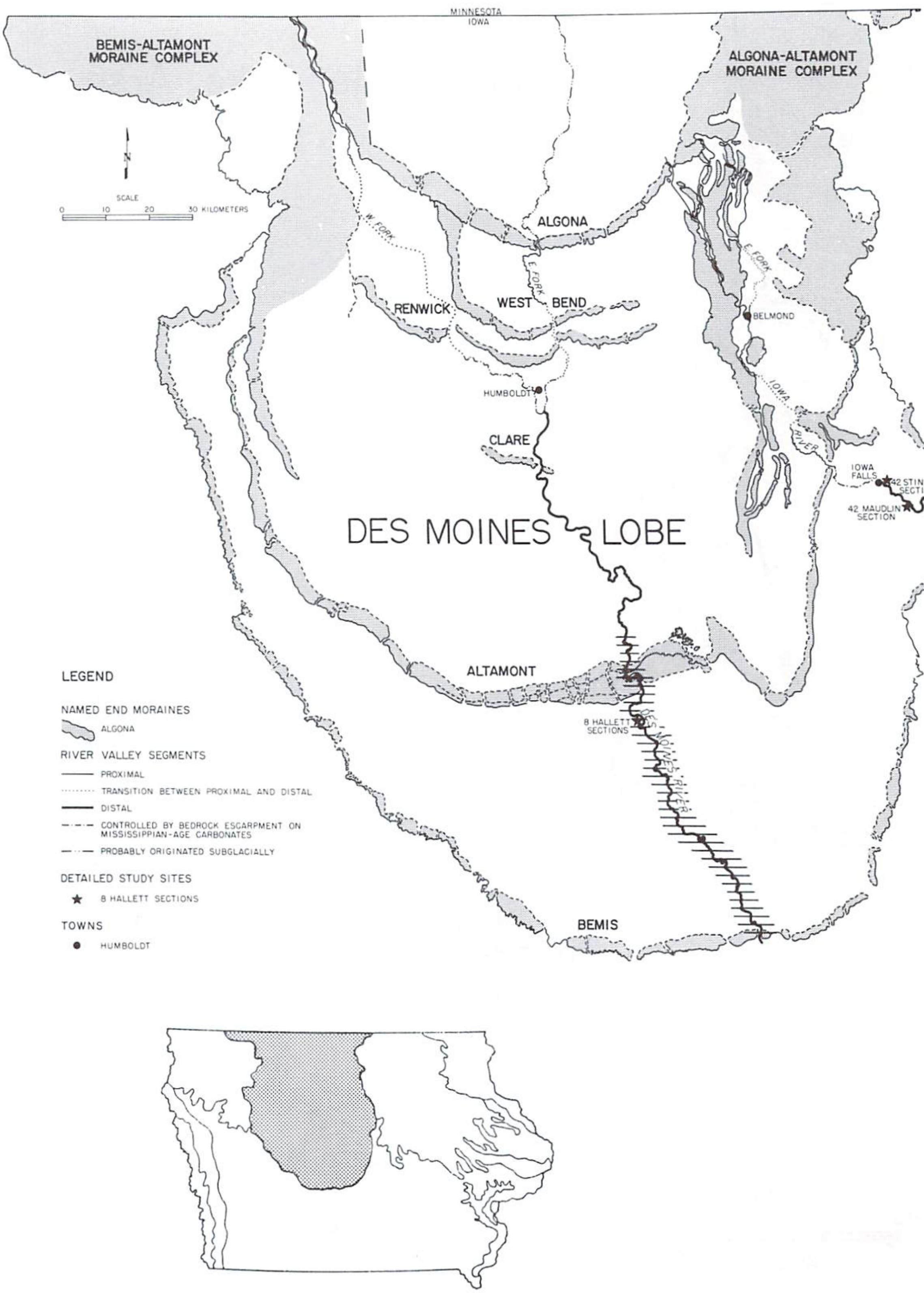


Figure 2. Location of the project area on the Des Moines Lobe. End moraines of the late Wisconsinan Des Moines Lobe are also shown. Study area is shown by the ruled pattern.

in the City of Des Moines, in the Madrid area (including High Bridge and Scandia), and between Boone and Fraser (including Moingona, Coal Valley, Centerville, and Logansport).

Climate

The present climate of north-central Iowa is a subhumid continental type. Winters are cold and summers are warm and humid. In Boone County the average winter temperature is 6° C (12° F) while the average daily winter minimum is 11° C (13° F) (Andrews and Dideriksen, 1981). The average summer temperature is 22° C (72° F) and the average daily summer maximum is 29° C (84° F). Temperatures of 38° C (100° F) in August are not uncommon. Total annual precipitation averages 85 cm (33.4 in.). Of this 61 cm (24 in.), or 73 percent, usually falls from April through September. In two years out of 10 the April through September rainfall is less than 51 cm (20 in.). Average seasonal snowfall is 81 cm (32 in.) and a heavy snowfall and/or blizzard is almost a yearly occurrence. The prevailing wind is from the northwest.

Original Historic Vegetation Patterns

Northcentral Iowa is located within the Prairie Peninsula (Wright, 1968). During the early to mid nineteenth century the Des Moines River valley harbored a forest community bisecting the extensive upland prairie. The first land survey (Secretary of the State of Iowa, 1847) described a mesic forest of cottonwood, maple, willow, elm, ash, sugar maple, hawthorn, and hickory on the floodplain area and around oxbow Lakes (see Benn, 1985a, Fig. 3). Terraces, sideslopes and tributary valleys hosted a forest dominated by oak, hickory, linden, ironwood, ash, chestnut, black walnut, hazletree, and sugarmaple. Some broad expanses of terraces, especially those in the wide valley segment below Mosquito Creek, were occupied by meadows and prairies, probably dominated by tall grass types.

Previous Investigations of the Quaternary Geology of the Central Des Moines Valley

The first published description of the geology of the central DMV is that by David Dale Owen (1852:123-125). The description, which appears in a report of a geological survey of Wisconsin, Iowa, Minnesota, and a portion of Nebraska territory, outlines some of the general features of the valley between the Raccoon River and Lizard Forks (now Lizard Creek). In addition, a map of the valley accompanied by a lithograph with geologic sections is included in the report.

Another early description of the area by Worthen (1858, vol. I, part I:172-173) was primarily concerned with description of the coal-bearing strata. In a two volume report on the Geology of Iowa published in 1870 Charles White wrote very insightful discussions of the deposits covering the state. He discussed the character of the "drift deposit" of northcentral Iowa and proposed the existence of two moraines marking former ice positions (White, 1870, vol. 1:98-99). The southernmost moraine he described is "Mineral Ridge" (the Altamont Moraine) in the vicinity of Boone. This is one of the earliest descriptions of moraines outside of a mountainous area. In addition to his discussions of the physiography and geology of the area White also described coal mines and clay pits along the DMV (ibid., vol. II:259, 261).

The glacial deposits through which the upper DMV flows were first mapped by Upham (1880) and Chamberlin (1883). At that time the outermost moraine was named Altamont Moraine because it was presumed to be contiguous with the ridge running through Altamont, South Dakota. Both Upham and Chamberlin recognized a second, inner moraine on the Des Moines Lobe. Chamberlin named this inner moraine the Gary Moraine, presuming that it was contiguous with the ridge running through the town of Gary, South Dakota. This was the terminology in use for Des Moines Lobe deposits when Iowa Geological Survey reports on the geology of Boone (Beyer, 1895), Polk (Bain, 1897), and Dallas (Leonard, 1898) Counties were published.

In his report on the Geology of Boone County Beyer noted a second drift sheet (till), buried beneath the Des Moines Lobe, which he correlated with the "Kansan Formation" (1895:203). Beyer also briefly described two terrace levels in the DMV "the most prominant and persistent appears about fifty feet above low water . . ." and "another terrace of less pronounced character . . . at an elevation of about 100 feet above the river" (ibid:182). Speculating on the age of the DMV Beyer noted several features pointing toward youthfulness of the system: 1) shortness and steepness of tributaries, 2) the lack of evidence for much lateral corrosion (a narrow valley) and, 3) stratigraphic evidence that the river is out of harmony with the topographic features of the older formations; i.e., the Des Moines is a superposed stream, younger than the glacial deposits it cuts through. He concluded that it "is highly improbable that any of the streams of the present drainage systems are coincident with those of pre-Pleistocene times" (ibid:202). Beyer also included a discussion of coal mines and clay pits along the valley. He noted that clay pits were common in the "Coal Measures" (Pennsylvanian) but that till and alluvium were also used as clay sources.

H.F. Bain, in his description and discussion of the geology of Polk County (1897), provides the first detailed analysis of some of the features and terraces of the central DMV. A large part of his discussion focuses on the valley south of Beaver Creek and north of the Raccoon River. After considering the topography, exposures, and limited subsurface information from well diggings and coal mines he concluded that a buried pre-glacial valley lay beneath Beaver Creek and between Capitol Hill and Four Mile Ridge in Des Moines. This buried valley, he concluded, was the pre-Wisconsinan DMV which joined with the modern DMV below the junction of the Raccoon River outside the Des Moines Lobe (1897:279-280). On the basis of topographic relationships and other evidence, such as that cited by Beyer (1895), Bain suggested that the valley above Beaver Creek was Wisconsinan in age. He felt that this upper part of the valley formed "all at once, not by simple and progressive headward erosion . . . It is hardly supposable that a river could by simple headward erosion cut back halfway across the state and yet not have time to invade the territory so near itself . . . The larger portion of the river course must then have been established with great rapidity, and was doubtless an immediate result of the ice melting." (Bain, 1897:283).

Bain also provided a good description of the Pleistocene deposits along the valley walls and in coal mines adjacent to the valley. He points out that, as proposed by McGee and Call (1882) the loess (windblown silt) present on the uplands outboard of the Des Moines Lobe passes beneath the Wisconsinan drift of the lobe (Bain, 1897:342). Bain also describes upland topography on the Des Moines Lobe in Polk County in some detail. Also provided in his report is a brief description of terraces in the DMV between High Bridge and Des Moines.

A.G. Leonard provided a brief description of a small section of the DMV in the Geology of Dallas County (1898). Based on the youthful appearance of the topography associated with them, he concluded that the Des Moines and Beaver Creek valleys were post-glacial in age (ibid:62).

By the turn of the century the regional geologic framework of the Pleistocene deposits into which the DMV is cut was agreed upon by most geologists working in the area. The terminus of the Wisconsinan-age Des Moines Lobe, then known as the Altamont Moraine, was placed at the City of Des Moines above the junction with the Raccoon River. Another more northern moraine, the Gary Moraine, was mapped in the vicinity of Boone in Boone County. An older drift sheet buried by the Des Moines Lobe was called the Kansan. It was agreed that the present DMV and its tributaries were cut into and therefore younger than the glacial deposits of the Des Moines Lobe. Most investigators felt that the DMV on the Des Moines Lobe was Wisconsinan in age, having formed during wastage of the last glacier to cover the area. A dissenting opinion was held by Frank Wilder who investigated the Geology of Webster County, north of Boone County. He felt that the DMV in Webster County was a pre-Wisconsinan valley which had been reexcavated during the Wisconsinan (Wilder, 1902:136-137). Bain realized that there was a discontinuity in valley size at Beaver Creek and proposed that the pre-Wisconsinan DMV trended northwesterly from that point. He had also recognized an abandoned channel between Capitol Hill and Four Mile Ridge in Des Moines. This he proposed, was an extension of the pre-Wisconsinan DMV which was also occupied during the close of the last glaciation. The DMV above Beaver Creek, Bain concluded, was Wisconsinan in age.

Up to this point in time little or no mention was made of the Holocene deposits in the DMV. Occasionally reference was made to terraces in the valley but they were those elevated five or more meters above the floodplain level, that are now known to be late Wisconsinan terraces and benches.

In the Annual Report of the Iowa Geological Survey for 1914 (vol. XXV) James Lees wrote a paper entitled "Physical Features and Geologic History of Des Moines Valley " (Lees, 1916:423-615). In that paper Lees argues for a pre-Wisconsinan age for the DMV above Beaver Creek. He cites Wilder's studies in Webster County in support of this hypothesis. Lees also thought that the cutting of benches into the Pennsylvanian rocks in the valley above Beaver Creek was "too great a task for the present stream to have accomplished . . ." (ibid.:513). He reasoned that benches cut into the "Coal Measures" must be pre-Wisconsinan in age and therefore the DMV was pre-Wisconsinan in age (ibid.:526). Siding with Wilder, he argued that the DMV above its junction with Beaver Creek was a reexcavated pre-Wisconsinan valley.

Lees provided the first detailed description of surfaces within the valley. Between Kalo in southern Webster County and Beaver Creek in Polk County he recognized three series of "benches" in the valley: 1) one ranging from 10 to 30 feet (3 to 9 m) above the river and forming the immediate boundary of the floodplain (this level is, in part, the High Terrace discussed later in this report), 2) another level ranging between 50 to 60 feet (15 to 18 m) above the river and, 3) an uppermost level ranging from 70 to 100 feet (21 to 30 m) above the bottomlands (ibid.:526). He recognized that the gravels on the upper levels were Wisconsinan in age and that the presence of several levels in the valley indicated that downcutting of the present valley had proceeded intermittently.

In 1922 Leverett extensively revised the nomenclature and mapping of moraine systems on the Des Moines Lobe (Leverett, 1922). He recognized that the outer margin of the Des Moines Lobe did not pass through Altamont, South Dakota as Upham and Chamberlin had suggested, but that it instead passed through Bemis, South Dakota (Kemmis et al., 1981:12). Consequently he proposed that the outermost moraine of the Des Moines Lobe be designated as the Bemis Moraine. In addition, Leverett recognized that the moraine north of the Des Moines Lobe terminus in the vicinity of Boone, Iowa (the Gary moraine of Beyer) was contiguous with the ridge passing through Altamont, South Dakota. He therefore suggested that the name Altamont be retained, but applied to the second moraine of the Des Moines Lobe instead of the outer ridge as proposed by Upham and Chamberlin. Leverett's designations are still in use today.

In a study of peat deposits on the Des Moines Lobe Smith (1924) mapped what he referred to as recessional moraines. He also recognized two additional moraines north of the "Gary" (Altamont) Moraine, the Humboldt and the Algona.

Ruhe (1952a) remapped the Des Moines Lobe, significantly changing the extent and location of all the moraine systems. Ruhe included extensive "minor moraine" areas (first identified by Gwynne, 1942) within the end moraines. Ruhe's map has been adopted in all subsequent publications showing the extent of moraines on the Des Moines Lobe. Ruhe also classified the Bemis Moraine as Cary in age while the younger inner moraine systems remained as Mankato in age as proposed by Leighton (1933) (Ruhe, 1952b). With the advent of radiocarbon dating in the 1950's an absolute chronology for Des Moines Lobe deposits was developed. Dates from the Des Moines Lobe were found to be older than those attributed to the classic Mankato areas and fit more into the time frame of Cary-age deposits (14,000 to 13,000 RCYBP). Consequently, deposits of the Des Moines Lobe in Iowa were reclassified as Cary (Ruhe and Scholtes, 1959).

During August of 1965 the VIIth congress of the International Association for Quaternary Research (INQUA) hosted a field trip to various localities in the Upper Mississippi Valley (Schultz and Smith, 1965). The trip passed through the DMV west of Boone and mention was made of three terrace levels, Cary and post glacial in age, present in the wide valley meander west of Boone (ibid.:119). In addition, the road cut for the then new U.S. 30 on the western valley wall was visited. The cut showed stratigraphy typical of upland positions in the southern portion of the Des Moines Lobe: 6.8 m (22 ft.) of Des Moines Lobe till burying 4.7 m (15.3 ft.) of loess overlying "Kansan" till.* Wood collected from within the loess was radiocarbon dated at 16,100 ±1000 B.P. (I-1270).

Patrick Walker studied the stratigraphy and soils of five bogs associated with the Bemis (Colo bog), Altamont (Jewell and McCulloch bogs), and Algona (Woden and Hebron bogs) moraines (Walker 1966). He correlated the fill sequences present in the bogs using radiocarbon dates and pollen profiles and related the fills to alternating episodes of landscape instability and stability in the surrounding basins. Pollen studies of some of Walker's cores were conducted by Grace Brush and the alternating episodes of landscape instability and stability were related to vegetation and climatic changes during the last 14,000 years (Walker and Brush, 1963; Walker, 1966; Brush, 1967). These bog studies have provided the framework for understanding postglacial landscape evolution on the Des Moines Lobe (Walker and Ruhe, 1968).

Kemmis et al. (1981) summarized previous investigations of the Des Moines Lobe in Iowa and presented a table of all radiocarbon dates from the area as of 1981. Their study and accompanying field guide focused on a portion of the eastern margin of the Des Moines Lobe. They also formalized a rock strati-

* The pre-Wisconsinan Quaternary stratigraphy of Iowa is being revised. Deposits formerly referred to as Kansan, Aftonian, and Nebraskan are now called Pre-Illinoian (Hallberg, 1980).

graphy of Des Moines Lobe deposits. The various drift deposits of the Des Moines Lobe are classified rock-stratigraphically as the Dows Formation (ibid.:41). The Dows Formation is subdivided into four members: 1) Alden Member - comprised dominantly of subglacially deposited basal till which is quite uniform texturally. 2) Morgan Member - supraglacially-deposited till-like sediments and associated meltwater deposits. This member is variable texturally and generally has a lower bulk-density than the Alden Member. Morgan Member sediments were deposited by melt-out on or near the glacier surface. 3) Lake Mills Member - glaciolacustrine sediments and, 4) Pilot Knob Member - upland sand and gravel deposits, dominantly ice-contact glaciofluvial deposits. A member encompassing sand and gravel deposits occurring as valley train was not named.

Presently the generalized stratigraphy of deposits through which the DMV cuts in Boone, Dallas, and Polk counties is well understood. Pennsylvanian rocks (dominantly shale, siltstone, limestone, sandstone, and thin coal seams) of the Cherokee Group (Swede Hollow and Floris Formations) are the oldest rocks exposed. A hiatus spanning approximately 280 million years separates the Pennsylvanian rocks from overlying Quaternary deposits. The oldest Quaternary deposits exposed in the area bury the Pennsylvanian rocks and consist of a complex of interbedded Pre-Illinoian tills and sand and gravels occasionally separated by paleosols. In Brushy Creek, a tributary to the DMR downstream of Ft. Dodge in Webster County, Pre-Illinoian age tills of both the Wolf Creek and older Alburnet Formations are present (Hallberg et al., 1980). These deposits are at least 500,000 years old (Hallberg, 1980; Hallberg and Boellstorff, 1978). Often a paleosol separates the Pre-Illinoian-age deposits from overlying Wisconsinan-age deposits. Paleosols in this stratigraphic position include the Yarmouth-Sangamon, Sangamon, and Late-Sangamon paleosols (Kemmis et al., 1981:80). The paleosols are developed in a variety of materials including till, alluvium or hillslope sediments (pedisediment). In some areas the pre-Wisconsinan paleosol was eroded off prior to deposition of the overlying Wisconsinan-age deposits. In Boone, Dallas, and Polk counties Wisconsinan-age loess buries the eroded and pedogenically-altered Pre-Illinoian deposits. In several exposures and core holes, an A-C soil profile is developed in the lower portion of the loess. This soil is informally referred to as the basal loess paleosol. In this part of the state this soil developed between about 21,000 and 22,000 years ago. Numerous radiocarbon dates form the area indicate that the loess began accumulating around 21,000 years ago and was buried by advancing ice of the Des Moines Lobe around 14,000 years ago (Ruhe, 1969). Des Moines Lobe ice reached its terminus about 14,000 years ago and began to waste soon thereafter. A single radiocarbon date from Dows Quarry located in the Altamont moraine suggests that ice was at that position about 13,500 years ago (Kemmis et al., 1981). Dates from outwash associated with the Algona moraine indicate that the ice had retreated to that position by about 12,600 years ago. By 11,000 years ago Des Moines Lobe ice had retreated from the area that is now Iowa (Wright et al., 1973:180-182).

Purpose of Investigations

As pointed out by Bettis and Thompson (1982:64), Bettis and Benn (1984:211), and Hoyer (1980:61-62) the existence of an archaeological record in an alluvial landscape is a dependent variable in the fluvial system. Sites will only be found where there are deposits old enough to contain them. A corollary is that where sufficiently thick deposits postdating an archaeological site are present, evidence of that site will not be found on the present surface. Mapping of terrace levels, combined with subsurface examination and radiocarbon dating of the deposits comprising terraces permits an accurate assessment of the geologic potential for the preservation of archaeological deposits within a valley. This, in turn, allows for more reasoned approaches to the interpretation and management of the archaeological resource and may point to some of the causes behind apparent patterning in the archaeological record (Thompson and Bettis, 1982:10-11).

Following this premise, the purpose of the present investigation was twofold: 1) to define the age and to map the extent of valley surfaces and landforms as well as to determine the age and sequence of the deposits underlying them, and 2) to use this information to construct a model of landscape evolution in the central DMV for the purpose of assessing the geological potential for preservation of various-age archaeological deposits within the valley deposits.

Methods

To accomplish the purpose outlined above several methods were used. The project area was divided into six reaches differing in valley width, materials making up the valley walls, and in the character and number of tributaries. USGS 7.5 minute topographic maps, USACE 5 foot interval contour maps, aerial photographs, and soil surveys were used to define the reaches. At least one intensive study area was chosen in each nonflooded reach where access was good and where a sequence of deposits typical for that reach was present.

Detailed subsurface investigations using 7.6 cm (3 in) diameter intact cores obtained with a Giddings hydraulic soil-coring machine were undertaken in each study area in order to determine the character, depth, and extent of deposits making up the various landforms present, and to establish the stratigraphic relationships between the landforms. Holes were also drilled outside the intensive study areas to help define terrace levels and landforms, and to place known archeological sites in their stratigraphic context. All holes were visually located on 1:6000 scale 1.5 m (5 ft.) contour interval topographic maps provided by the USACE. Backhoe trenches were dug in one intensive study area in order to examine stratigraphic relationships in detail. These trenches were also used in the archaeological investigation of the area. Detailed descriptions of all cores and selected natural and man-made exposures were made in the field using standard USDA procedures and terminology (Soil Survey Staff, 1951; 1975). These are presented in Appendix A. Moist colors were determined using Munsell color charts. Reaction was determined with 15% hydrochloric acid. Selected cores were sampled in the field for particle-size (grain-size) analysis and organic carbon content. Organic materials encountered in cores and exposures were collected for radiocarbon dating. Radiocarbon samples were submitted for analysis to Beta-Analytic Incorporated, Miami, Florida and the Illinois Geological Survey Radiocarbon Laboratory, Champaign, Illinois.

Holocene-age terrace levels and landforms were mapped on 1:6000 scale maps while higher late Wisconsinan-age terraces and benches were mapped on U.S.G.S. 7.5 minute (1:62,500 scale) topographic maps. Walking examinations were also made of several tributary valleys. These areas were generally covered with trees and brush and not accessable to the drill rig.

Particle-size analysis was performed at the Iowa Geological Survey using the pipette method as described by Walter et al. (1978). Size classes used were sand (200-50 μm), coarse silt (50-20 μm), fine silt (20-2 μm), and clay (<2 μm). Organic carbon analyses were performed on selected samples at the

Iowa State University Soil Survey Laboratory using the Walkley-Black Method.

Mineralogy of the clay fraction of selected samples was evaluated using the "semiquantitative" method of Glass as modified by Hallberg et al. (1978a). The analyses were performed on a Phillips APD 3500 Automated powder diffractometer.

Results

Bedrock

The uppermost bedrock beneath Quaternary deposits along the DMV in the Saylorville Lake area is Middle Pennsylvanian-age (Des Moinsean Series) rocks of the Floris and overlying Swede Hollow Formations of the Cherokee Group (Figure 3) (Ravn et al., 1984:24-40; Lemish et al., 1981). Regional dip of the Pennsylvanian rocks in Iowa is to the southwest into the Forest City Basin (Bunker, 1981). Because of this, progressively older portions of the sequence are exposed upstream along the DMV. In the extreme northern portion of the project area near the Boone/ Webster County line, the contact between the Floris and underlying Kalo Formation occurs along the walls of the DMV (Mary Howes, IGS personal communication).

Cherokee Group rocks are composed primarily of deltaic sediments deposited on a Mississippian-age erosion surface with considerable relief (Lemish et al., 1981:6). Encroachment of the Middle Pennsylvanian sea upon the subaerial Mississippian erosion surface resulted in the deposition of the predominately clastic, coal-bearing Desmoinsean Series in the Forest City Basin. Lemish et al. (1981) and Burggraf et al. (1981) proposed the existence of deltaic systems fringing the Basin during deposition of the Cherokee Group. These interpretations suggest that coals in the sequence originated as terrestrial peat developed on a deltaic platform. During eustatic rises in sea level these coal swamps were innundated and marine limestones and shales were deposited.

The Floris Formation includes Cherokee Group strata ranging from the base of the Laddsdale Member upward to the base of the Whitebreast Coal of the Swede Hollow Formation (Ravn et al., 1984:26). Lower portions of the Floris are characterized by the absence of widely traceable beds. Lithologies consist of unfossiliferous shale and sandstone including thick, sandy, channel-fill sequences. Examples of these channel-fill sequences are well exposed in Ledges State Park in Boone County. Occasional thin limestone beds and two widely tracable coals, the Laddsdale and Carruthers, are present in the Floris Formation. The middle and upper portions of the Floris consist of more widely traceable coals and associated strata.

Ravn et al., (1984:31-33) conclude that:

> ...the Floris represents a transition from sedimentation largely dominated by nonmarine fluvial and deltaic processes of the Kalo to sedimentation influenced more by lagoonal and marine processes. The closely related coals of the Laddsdale Member appear to represent a single major coal-forming event split by wedges of dominantly clastic sediment that periodically inundated the swamps in various areas. Localized marine deposition, perhaps occurring in interdistributary bays, is indicated by the impure, lenticular, fossiliferous limestones which are common in southeastern Wapello and northern Davis counties. Minor tectonic movements may also have contributed to the lateral irregular-

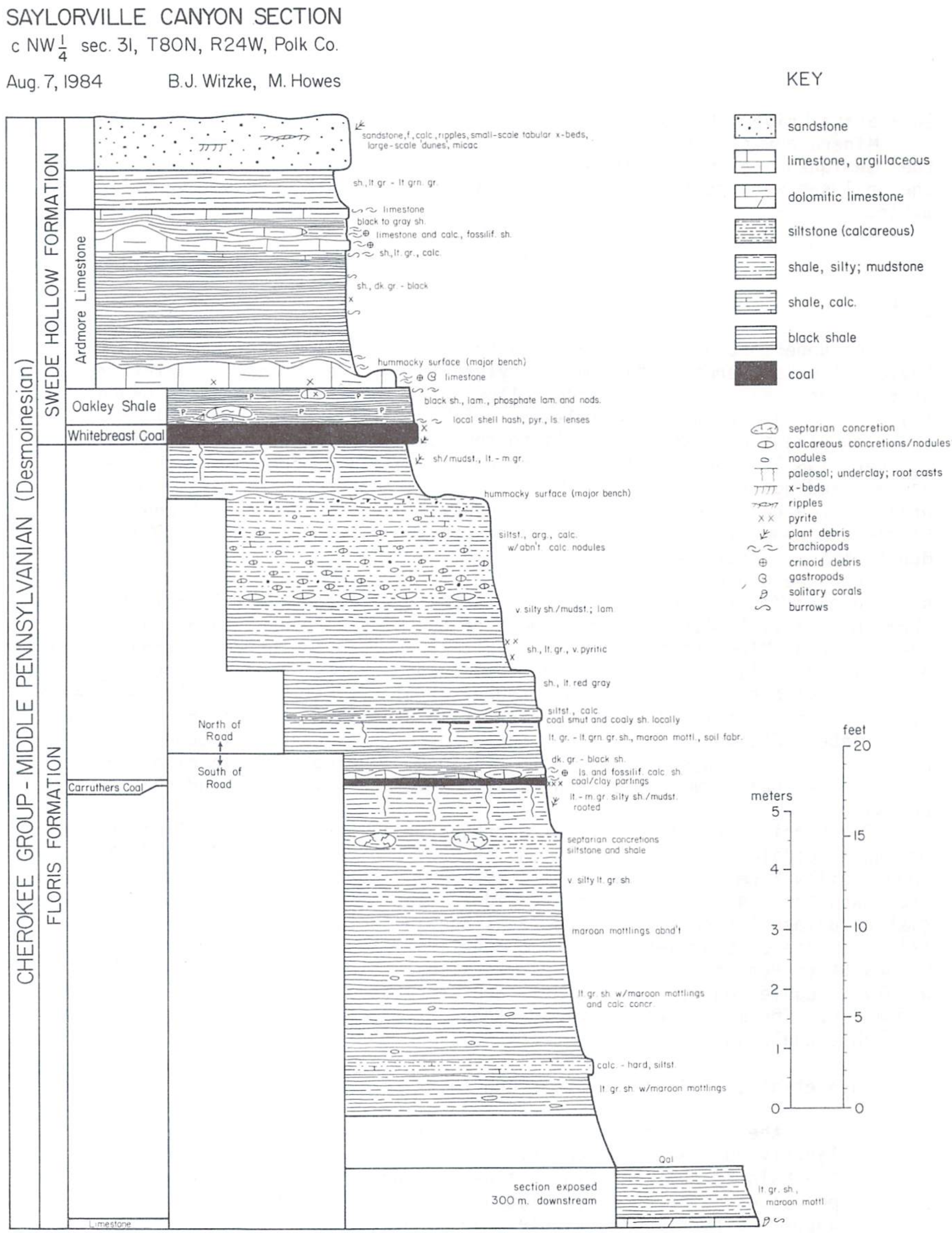


Figure 3. Pennsylvanian bedrock section exposed in the emergency spillway of Saylorville Dam. These rocks are exposed intermittently throughout the Saylorville Lake area.

ity of sedimentation. The coals in the upper portion of the Floris show a greater persistence than the Laddsdale coals. This increasing regularity of widespread coal beds, coupled with a greater proportion of associated marine sediments, appears to reflect the increasing marine influence upon sedimentation in the uppermost Cherokee Group. Major channelization, now represented by thick sandstones, probably occurred before the onset of deposition of the Carruthers Coal and associated strata.

The Swede Hollow Formation includes strata from the base of the Whitebreast coal to the base of the Excello Shale (Ravn et al., 1984:33). Individual beds in the Swede Hollow are significantly more laterally persistent than those in the underlying Floris Formation. In the Saylorville Lake area only the lower portions of the Swede Hollow Formation are preserved.

Regarding the depositional environment of the Swede Hollow Formation, Ravn et al. (1984:39-40) conclude:

> The Swede Hollow Formation contains sediments related to two different depositional regimes. The Whitebreast Coal, Oakley Shale, and Ardmore Limestone were deposited as a result of a major episode of eustatic marine transgression and regression. The remainder of the the formation consists of depositional cycles, probably related to deltaic progradation and abandonment.
>
> The thin lower portion of the Swede Hollow is in many ways comparable to the marine limestone-dominated portions of younger Marmaton Group and Missouri Supergroup depositional cycles. Heckel (1977, 1980) has developed a regional model for deposition of those younger Pennsylvanian cycles, which can be applied to the Swede Hollow Formation. The Whitebreast Coal was evidently deposited on a widespread surface of low relief that resulted from infilling of irregular early Floris topography by the upper portion of the Floris Formation. The initiation of eustatic marine transgression resulted in elevated local base levels and the widespread accumulation of peat. Clastic sediments in transport toward the basin center became stranded and were deposited in or adjacent to the channels of rivers flowing through the coal swamp. Although these deposits are time-transgressive, the degree of diachroneity may be slight. Peat probably accumulated in the eastern portion of the study area at the same time that the western portion of the area experienced oxygenated, shallow marine conditions and deposition of the thin gray, fossiliferous shale that underlies the black shale facies of the Oakley.
>
> The black, fissile, phosphatic, clay-shale facies of the Oakley is in all respects identical to those younger Pennsylvanian black shales discussed by Heckel (1977), and may be interpreted to have originated from the same processes. Water depths in the epeiric sea during the maximum phase of eustatic transgression became sufficiently great to permit formation of a thermocline. This restriction of vertical circulation resulted in the eventual depletion of oxygen in the near-bottom waters and in the creation of reducing conditions at or above the sediment-water interface. The relative abundance of phosphate

and other heavy elements in these black shales can be explained by the upwelling of cool, low-oxygen, nutrient-rich water from intermediate depths of the open ocean which, in conjunction with the thermocline, formed a circulatory trap for these materials. The great lateral extent of the Oakley Shale and its midcontinent correlatives suggest that this marine inundation may have been one of the most widespread of the Pennsylvanian transgressions.

The Ardmore Limestone Member represents the equivalent of the regressive (or upper) limestone discussed by Heckel (1977, 1980). The lower limestone bed evidently records the breakup of the thermocline and renewed vertical circulation during the initial stages of eustatic regression. The middle shale bed, with sparse fossils of low diversity, was evidently deposited rapidly, perhaps as distal prodeltaic influx was becoming widespread in water of intermediate depths (for an epeiric sea). The dark color of the shale may have resulted from the extremely high organic content (Hatch, personal communication) of the outflow of coal swamps to the north and east, rather than reestablishment of a thermocline. There is no suggestion of subaerial weathering at the top of the shale, and the green mottling noted earlier is most common where sediments between the Ardmore and the Wheeler Coal are thin, suggesting partial oxidation by meteoric waters during later stages of soil formation preceding deposition of the coal. Either the shifting of deltaic influx elsewhere or a minor transgression resulted in deposition of the upper Ardmore Limestone, which is commonly split by later prodeltaic pulses as regression continued or resumed. The great lateral persistence of the Wheeler Coal argues strongly for subaerial exposure of the entire study area during final regression of the Oakley-Ardmore eustatic cycle.

Age of the Des Moines Valley

Most of the historical discussions of the DMV on the Des Moines Lobe have centered around the age and origin of the valley. Many geologists felt that the short, steep tributaries characteristic of this valley pointed to youthfulness. Others thought that bedrock benches in the valley took a long time to develop and therefore a pre-Wisconsinan age was suggested. All investigators agreed that ice of the late Wisconsinan Des Moines Lobe had completely buried the landscape where the present valley is located. The age of the valley was not a central concern of this project but a few observations on the nature of the sub-Des Moines Lobe surface and deposits exposed along the valley are presented here.

The valley in the Beaver Creek area in Polk County is different than that portion of the valley above Beaver Creek. This was recognized by Bain (1897) and expanded on by Lees (1916). Size (valley width) is the most obvious difference--the valley above Beaver Creek averages 1-2 km in width while in the Beaver Creek area the valley averages about 5 km in width. Borings for wells in Johnston and near Woodward located in Beaver Creek Valley typically show 3 to 5 m of sand and gravel overlying approximately 6 m of glacial till buring a thick (15-20 m) sequence of sand and gravel (Carol Thompson, personal communication). The lower sand and gravel unit is underlain by Pennsylvanian-age bedrock (shale). The upper sand and gravel unit is variable and in some areas in Beaver Creek Valley glacial till is at the surface. Mineralogically the glacigenic deposits (tills) filling Beaver Creek valley contain relatively high amounts of illite, suggesting a Des Moines Lobe origin (Table 1; Kemmis et al. 1981:table 14). Since the Beaver Creek bedrock valley is filled with Des Moines Lobe glacigenic deposits it must be pre-Des Moines Lobe in age.

Beaver Creek valley ends abruptly at the Altamont Moraine in Greene County. It appears that Beaver Creek was acting as an outwash channel when Des Moines Lobe ice stood at this position. The interbedded nature of sand, gravel, and diamicton (till) in the lower part of Beaver Creek valley and the fact that it is all Des Moines Lobe in origin suggests that the valley may have been active subglacially when Des Moines Lobe ice was at the Bemis Moraine front. Further suggesting a subglacial origin is the fact that the valley walls step down gradually to the floor of Beaver Creek. Other valleys on the Des Mones Lobe typically are deeply incised and the drop from the uplands is abrupt. The Skunk River valley, also suspected of having a subglacial origin has valley wall morphology very similar to that of Beaver Creek valley (George Hallberg, personal communication). After ice retreated north of the Altamont Moraine Beaver Creek no longer carried outwash and the active stream became confined to a narrow meanderbelt within the broad Beaver Creek valley.

In the DMV, exposures along the eastern shoreline of Saylorville Lake just north of the Visitor Center and in the emergency spillway of Saylorville Dam along the western valley wall reveal a series of loamy pre-Wisconsinan-age alluvial fills cut into Pre-Illinoian-age Wolf Creek Formation till or Pennsylvanian-age bedrock and buried by Wisconsinan-age loess and Des Moines Lobe till (Bettis et al., 1985). This pre-Wisconsinan alluvium is filling a buried valley, possibly a tributary of the pre-Des Moines Lobe Beaver Creek valley. The pre-Wisconsinan alluvium thins rapidly to the north and is not present at the Lake View boat ramp on the west side of the DMV. The northern valley wall of the pre-Wisconsinan valley is exposed just north of the Visitor Center on the eastern side of the modern DMV. Here the Late-Sangamon Paleosol decends down the paleo valley slope and diverges into several paleosols developed into the pre-Wisconsinan alluvial sequence.

North (upstream) of Beaver Creek and the dam area no pre-Wisconsinan valley deposits have been observed. In a few areas, such as the eastern valley wall between old and new U.S. 30, sand and gravel is encountered beneath Des Moines Lobe deposits or between Pre-Illinoian-age tills. This alluvium is interpreted as glacigenic, not deposited in a valley during an interglacial period. Elsewhere glacigenic deposits and bedrock lie beneath Wisconsinan-age deposits exposed along the DMV.

Two exposures, Boone Waterworks and Acorn Valley, typify the sequence of Quaternary deposits exposed along the valley. The Boone Waterworks section (8-L-2) is a borrow pit and road cut made in 1980 along county road E26 just north of the Boone Waterworks along the eastern wall of the DMV (SW 1/4 SW 1/4 sec. 18 T84N R26W). Pre-Illinoian-age glacial till is exposed at the base of the section (Figure 4; see description in Appendix A). The till is overlain by fine-textured (swale-fill?) sediments into which a gleyed (poorly-drained) Yarmouth-Sangamon Paleosol is developed. This soil was developing during the latter portion of Pre-Illinoian time, during the Illinoian glaciation (which didn't directly affect northcentral Iowa) and during the Sangamon Interglacial. The paleosol is overlain by 4.9 meters (16 ft.) of Wisconsinan-age loess which is buried by 16.7 meters (55 ft) of Des Moines Lobe diamicton (Dows Formation, Alden Member) which is the surficial deposit. The modern surface soil is developed into the upper 1.5 m (5 ft) of the Des Moines Lobe deposits.

Table 1. Clay mineralogy data for selected till samples in the Saylorville project. Summary data for the Dows Formation is from Kemmis et al., 1981 and that for eastern Iowa Pre-Illinoian tills is from Hallberg, 1980.

Clay Mineralogy %		
Expandables	Illite	Kaolinite + Chlorite
Dows Formation (Des Moines Lobe)		
69	19	12
Eastern Iowa Wolf Creek Formation (Pre-Illinoian)		
59	18	23
Eastern Iowa Alburnett Formation (Pre-Illinoian)		
44	24	32
Central Des Moines Valley Samples		
Beaver Creek tills (10 Samples) (Des Moines Lobe)		
70	19	11
08BC1 (Des Moines Lobe)		
63	27	11
Acorn Valley (Pre-Illinoian, Wolf Creek Fm.)		
74	12	14
Polk City High Bridge upper till (Pre-Illinoian, Wolf Creek Fm.)		
74	17	9
Polk City High Bridge lower till (Pre-Illinoian, Wolf Creek Fm.)		
69	16	15
8 Luther West (Pre-Illinoian, Alburnett Fm.)		
47	20	23
44	17	39
08AB20 Boone Bottoms (Pre-Illinoian, Wolf Creek Fm.)		
64	16	20

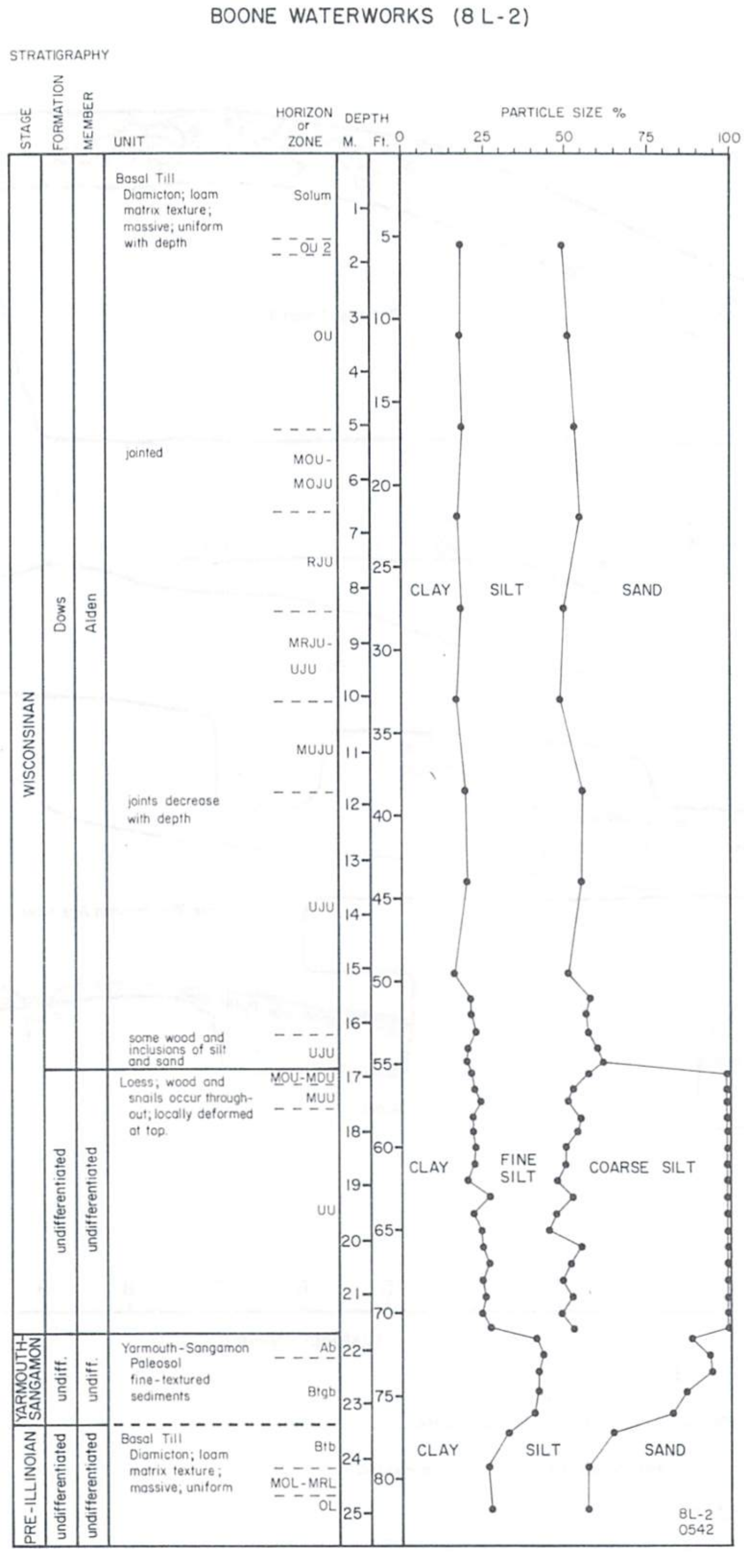


Figure 4. Particle-size plot and stratigraphy of the Boone Waterworks section (8-L-2). The stratigraphy exposed here is typical for upland sites in the southcentral portion of the Des Moines Lobe.

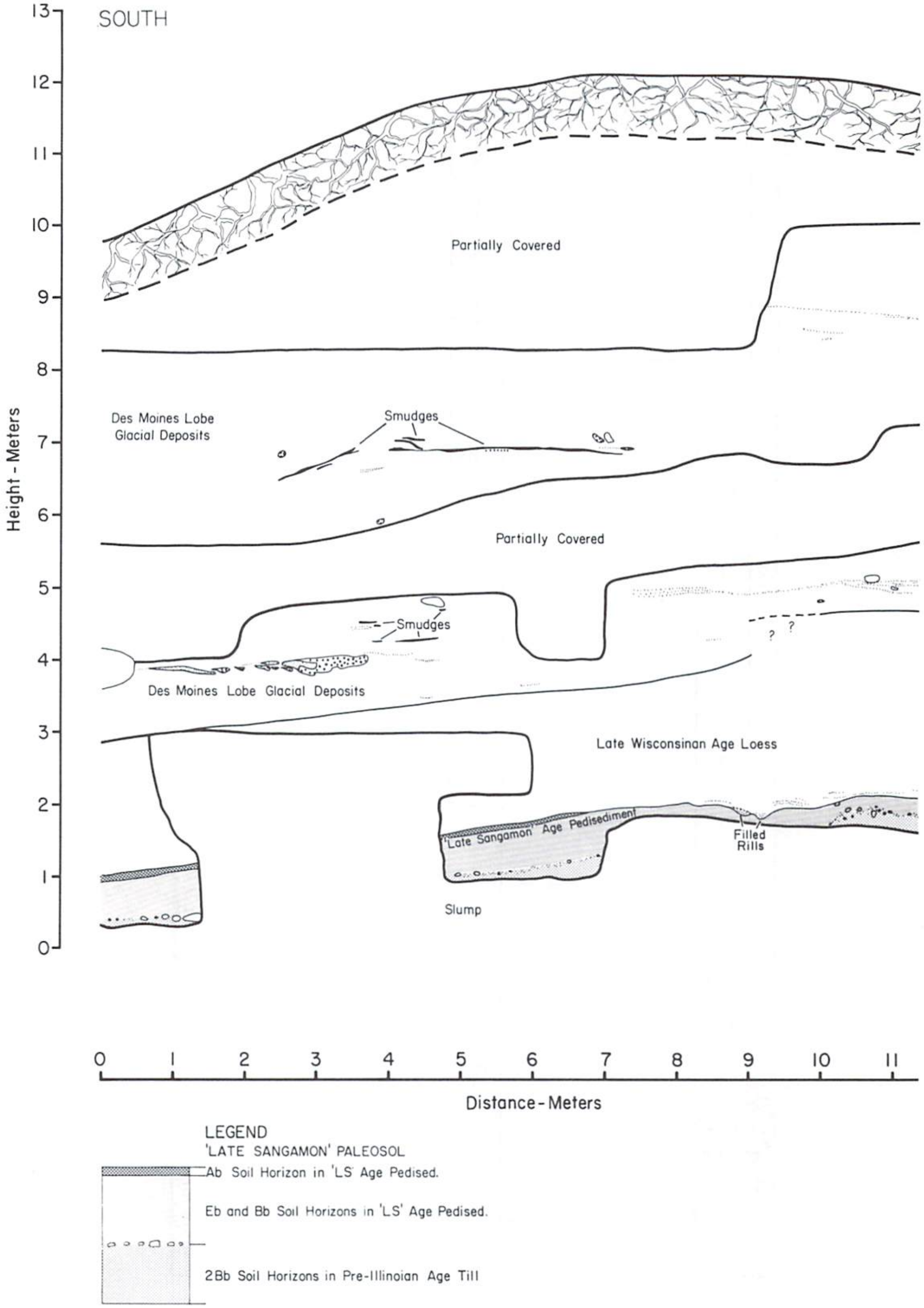
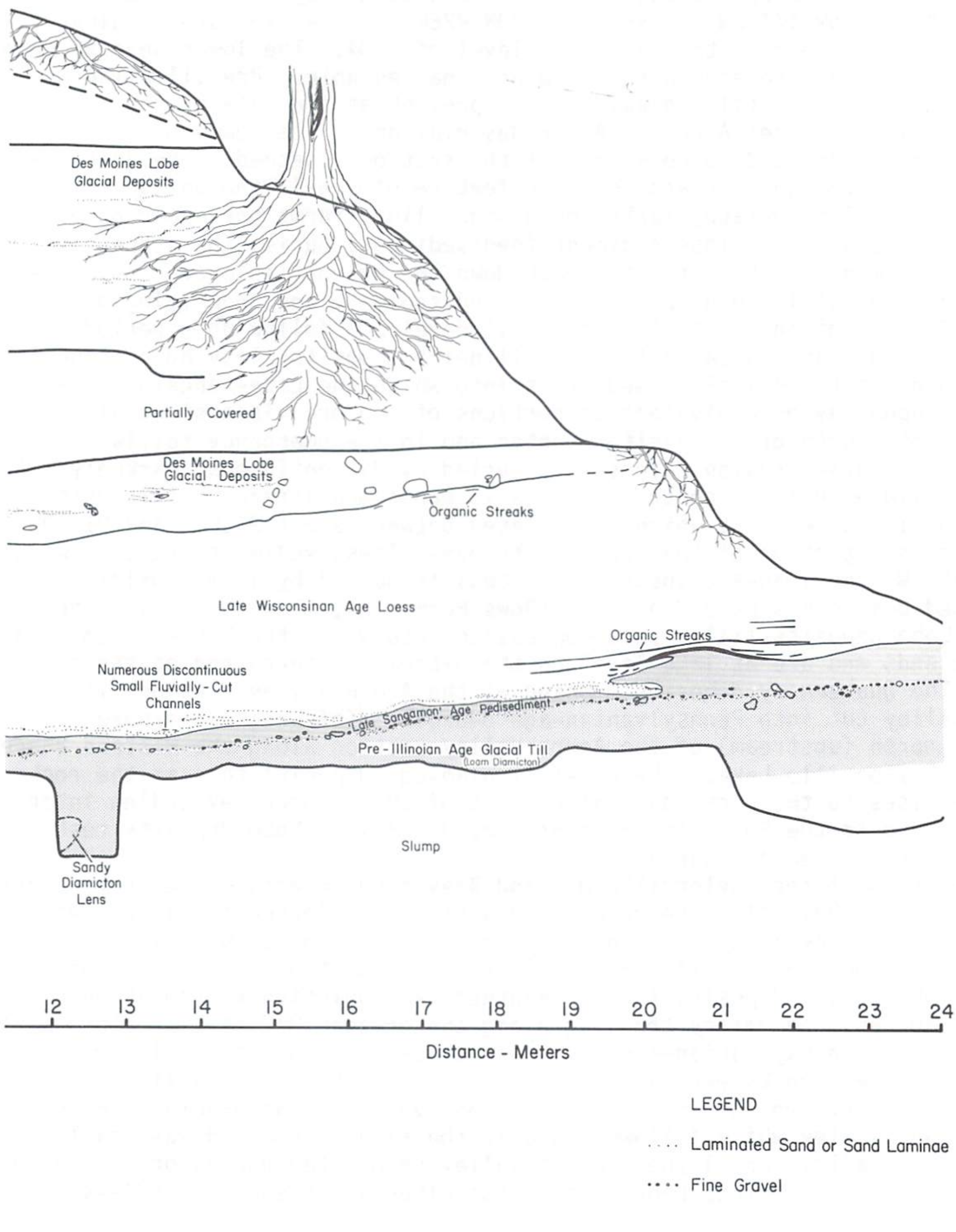


Figure 5. Quaternary deposits exposed at the Acorn Valley section. The stratigraphy at this site is typical for upland sites in the southern portion of the Des Moines Lobe.

NORTH



Des Moines Lobe
Glacial Deposits
Partially Covered
Des Moines Lobe
Glacial Deposits
Organic Streaks
Late Wisconsinan Age Loess
Organic Streaks
Numerous Discontinuous
Small Fluvially-Cut
Channels
Late Sangamon Age Pedisediment
Pre-Illinoian Age Glacial Till
(Loam Diamicton)
Slump
Sandy
Diamicton
Lens
12
13
14
15
16
17
18
19
20
21
22
23
24
Distance - Meters
LEGEND
Laminated Sand or Sand Laminae
Fine Gravel

The Acorn Valley section (77AV-1) is located along the western shoreline of Saylorville Lake approximately 3 km northwest of Saylorville Dam in Polk County (NE 1/4 SW 1/4 SW 1/4 sec. 13 T80N R25W). This exposure originated as a wave cut scarp during the high lake level of 1984. The lower several meters of the section are covered with slump and unaccessable. Pre-Illinoian-age Wolf Creek Formation till (diamicton) is present at the base of the exposed section (Figure 5; see Appendix A for description). The loamy diamicton is jointed, oxidized, and, across most of the section, leached. The joints are heavily iron stained, a characteristic feature of Pre-Illinoian-age tills in Iowa. An erosion surface, marked by a stone line, forms the upper boundary of this unit. Loamy hillslope sediment (pedisediment) buries the stone line. The pedisediment thickens to the south down the paleohillslope. The Late-Sangamon Paleosol is developed into the pedisediment and underlying portions of the Pre-Illinioan-age till. This soil developed following a period of slope erosion that truncated the Pre-Illinoian deposits, leaving a stone line as a lag deposit. Hillslope sediments into which the Late-Sangamon Paleosol has developed may be equivalent to portions of the pre-Wisconsinan alluvium exposed both north of the Visitor Center and in the emergency spillway sections. The Late-Sangamon Paleosol is buried by discontinuous, markedly siltier hillslope sediment containing organic bands and streaks. This unit is the basal loess sediment which accumulated between about 25,000 and 21,000 RCYBP in this portion of the state. The basal loess sediment grades upward into late Wisconsinan-age loess. The loess is buried by loamy, oxidized, and unleached Des Moines Lobe diamicton (Dows Formation, Alden Member). The Des Moines Lobe deposits fill a paleodepression into which the Late-Sangamon Paleosol decends and are at lake level on the extreme southern end of the exposure. The Quaternary deposits exposed at the Acorn Valley section fill a small valley cut into Pennsylvanian-age bedrock. This rock is exposed immediately north (upstream) of the Acorn Valley section along the western shoreline of Saylorville Lake. The Pre-Illinoian-age deposits thin as the rock surface rises to the north and, along most of the exposure extending intermittently up to the Polk City High Bridge, Des Moines Lobe deposits rest directly on the bedrock surface.

Upstream of the Saylorville Dam and Beaver Creek area Quaternary deposits exposed in the DMV walls are upland deposits. No evidence for a pre-Des Moines Lobe valley is present in the depositional record. Only in the vicinity of the junction with Beaver Creek north to the dam area are pre-Des Moines Lobe valley deposits found. Another fact pointing to the absence of a pre-Des Moines Lobe valley trending along the present DMV is that along most of the valley Pennsylvanian-age rocks are exposed along both valley walls. In many cases these rocks extend far up the sides of the valley walls. This indicates one of two things: 1) the present valley is an exhumed pre-Des Moines Lobe valley which followed exactly the same course and was smaller than the present valley, or 2) the present valley originated during or following wastage of the Des Moines Lobe. The first alternative seems much less likely than the latter.

A few areas along the present DMV do show evidence of now buried Pre-Illinoian-age drainage systems. In these areas one or both valley walls are composed of Pre-Illinoian-age diamicton buried by Wisconsinan-age deposits. The texture and clay mineralogy of these Pre-Illinoian deposits (Table 1) suggests correlation with the Wolf Creek and Alburnett Formations of east-central Iowa. These deposits appear to be filling small bedrock valleys trending northwest to southeast. The DMV has cut across these valleys and they are now exposed in the modern valley walls. Examples of this situation are present just west of Boone in the large valley meander referred to as the "Boone Bottoms" or "Coal Valley" and in the Hubby Bridge area, southwest of Luther in southern Boone County (SE 1/4 sec. 5 T82N R26W).

Well logs on file at the Iowa Geological Survey show no indication of a buried bedrock valley in the vicinity of the DMV. These records do indicate the presence of the buried Beaver Creek valley. The surface of the Pennsylvanian rocks beneath the Quaternary deposits does not decrease in elevation as the DMV is approached. These lines of evidence also suggest that no major pre-Des Moines Lobe valley paralleling the trend of the present DMV existed.

In summary, the available geomorphic and stratigraphic evidence does not support the conclusions of Lees (1916) and Wilder (1902) that the present DMV on the Des Moines Lobe is occupying an exhumed pre-Wisconsinan valley. All evidence points to the fact that the valley is Des Moines Lobe and post-Des Moines Lobe in origin. Beaver Creek valley, on the other hand was in existence prior to advance of the Des Moines Lobe. Pre-Wisconsinan alluvial deposits associated with the buried Beaver Creek bedrock valley and its tributaries are present from just north of Saylorville Dam southward to the junction of the present Des Moines and Beaver Creek valleys. We agree with Bain (1897) that the bedrock valley beneath Beaver Creek is the northern segment of the pre-Wisconsinan DMV. This buried valley trends northwest to southeast and joins with the exposed pre-Wisconsinan DMV in the City of Des Moines below the junction of the modern Des Moines and Raccoon Rivers.

Late Wisconsinan Valley History

The late Wisconsinan history of the DMV is relatively short but complex. The valley pattern and location as well as many of its striking landscape features, such as the deep entrenchment and high outwash terraces and benches originated during wastage of the Des Moines Lobe glacier between about 14,000 and 11,000 RCYBP.

Exactly how the DMV came into existence is poorly understood. In the previous section we concluded that prior to the advance of the Des Moines Lobe into Iowa, a valley did not exist in the location of the present DMV. As Des Moines Lobe ice moved southward around 14,000 years ago it overran a coniferous forest growing on the loess-mantled landscape of central Iowa (Ruhe, 1969:41-42). Evidence of this forest was uncovered in the borrow area for Saylorville Dam just south of the Cherry Glen recreation area (NW 1/4 sec. 29 T80N R24W). During borrowing activity in 1976 numerous coniferous logs rooted in the top of the loess buried beneath Des Moines Lobe till were uncovered.

Exposures along the emergency spillway for Saylorville Dam also reveal a coniferous forest plowed down by advancing Des Moines Lobe ice (Bettis et al., 1985). A pine log (probably jackpine, _Pinus banksiana_ - Frances King - personal communication) collected from the base of the Des Moines Lobe till (Dows Formation, Alden Member) in a roadcut near the Visitor Center along highway 405 just east of Rock Creek (NW 1/4 SW 1/4 NE 1/4 sec. 32 T80N R24W) was radiocarbon dated at 13,560 ±90 B.P. (Beta-2749). This date agrees well with numerous radiocarbon dates from the base of the Des Moines Lobe near its terminus (see Kemmis et al., 1981, Table 1). By 14,000 B.P. Des Moines Lobe ice had reached its terminus along the northern valley wall of the Raccoon River valley in what is now the City of Des Moines. Wastage of the ice sheet began soon thereafter. By about 13,500 B.P. the ice stood at the position of the Altamont Moraine running through northern Boone County in the northernmost portions of the study area. At that time Beaver Creek and the Skunk River, both originally subglacial streams when the ice was at the Bemis terminus, may have been acting as subareal meltwater channels in front of the Altamont terminus.

The DMV cuts through the Altamont Moraine and does not change in width, depth, or valley pattern in the vicinity of the moraine. No upland outwash deposits are associated with the DMV in the vicinity of the Altamont Moraine. These lines of evidence suggest that when ice was at the position of the Altamont Moraine, the DMV was not in existence as a major drainage line.

Exposures in several tributaries of the DMV in Boone County shed some light on the origin of the DMV on the southern portion of the Des Moines Lobe. These exposures are all located .4 km or less (linear distance) from the main valley. The sequence of deposits found in these exposures from the base up is: Pre-Illinoian-age or Pennsylvanian-age deposits overlain by Wisconsinan loess buried, and in some cases, angularly truncated by calcareous medium to coarse sand which occasionally contains fine gravel. The sands are overlain by calcareous Des Moines Lobe glacial till. Sedimentary structures within the sands such as trough crossbeds indicate that they are fluvial deposits. The contact between the sands and Des Moines Lobe glacial till is abrupt but conformable and the sands do not appear to be deformed. The sands appear to thicken toward the DMV. In most exposures thickness of the sands ranges from 2-4 m. We interpret these sands as subglacial or englacial Des Moines Lobe deposits. Originally these deposits may have occurred as a large lenticular body in a subglacial or englacial channel at the base of or within the Des Moines Lobe ice. Between about 13,500 and 12,600 B.P. Des Moines Lobe ice stagnated and a sag developed along what was to become the course of the DMV. Water from the melting ice and precipitation events was channeled toward the sag and the valley began to develop. As time passed the channel began to cut down through debris-covered ice and eventually into the sand and gravel fill of the englacial or subglacial channel. As the valley deepened and widened during the period of time when the ice front was at the Algona Moraine (Fig. 2) most of the original sand body of the former glacial channel was eroded away. Today only marginal portions of the former channel are preserved. Exposures of the sands beneath Des Moines Lobe glacial till can be seen: 1) in a small SE-NW trending tributary at the eastern entrance to Ledges State Park (SE 1/4 SE 1/4 sec. 16 T83N R26W); 2) in the upper portions of small N-S trending gullies draining to a right bank DMV tributary in NW 1/4 SE 1/4 SE 1/4 sec. 32 T83N R26W; 3) in a large cut bank along the left bank of a left bank DMV tributary at Sportsman's Access (SW 1/4 NW 1/4 SW 1/4 sec. 28 T83N R26W); 4) in a cutbank along the left bank of the Des Moines River valley north of old U.S. Highway 30 (S 1/2 SE 1/4 SW 1/4 sec. 25 T84N R27W) and; 5) in a small W-E flowing tributary of the DMV in Holst State Forest across the river from Fraser in northern Boone County (SE 1/4 NW 1/4 SW 1/4 sec. 34 T85N R27W).

After the ice had retreated from the position of the Altamont Moraine and shortly before or early during its stand at the Algona Moraine, the proto Des Moines River advanced northward through a narrow interfluve west of Capitol Hill in Des Moines and entrenched through that portion of Beaver Creek Channel east of Highland Park and Capitol Hill (Fig. 6). The portion of Beaver Creek channel east of Highland Park and Capitol Hill was stranded and the combined proto Des Moines and Beaver Creek flowed through a narrow gorge (the present course of the DMV) and into the Raccoon River. The abandoned Beaver Creek valley segment to the east is now evident as a broad sag between Fourmile Ridge and Capitol Hill in the City of Des Moines.

By the time the ice front had retreated and readvanced to the position of the Algona Moraine around 12,300 RCYBP the DMV was acting as a meltwater

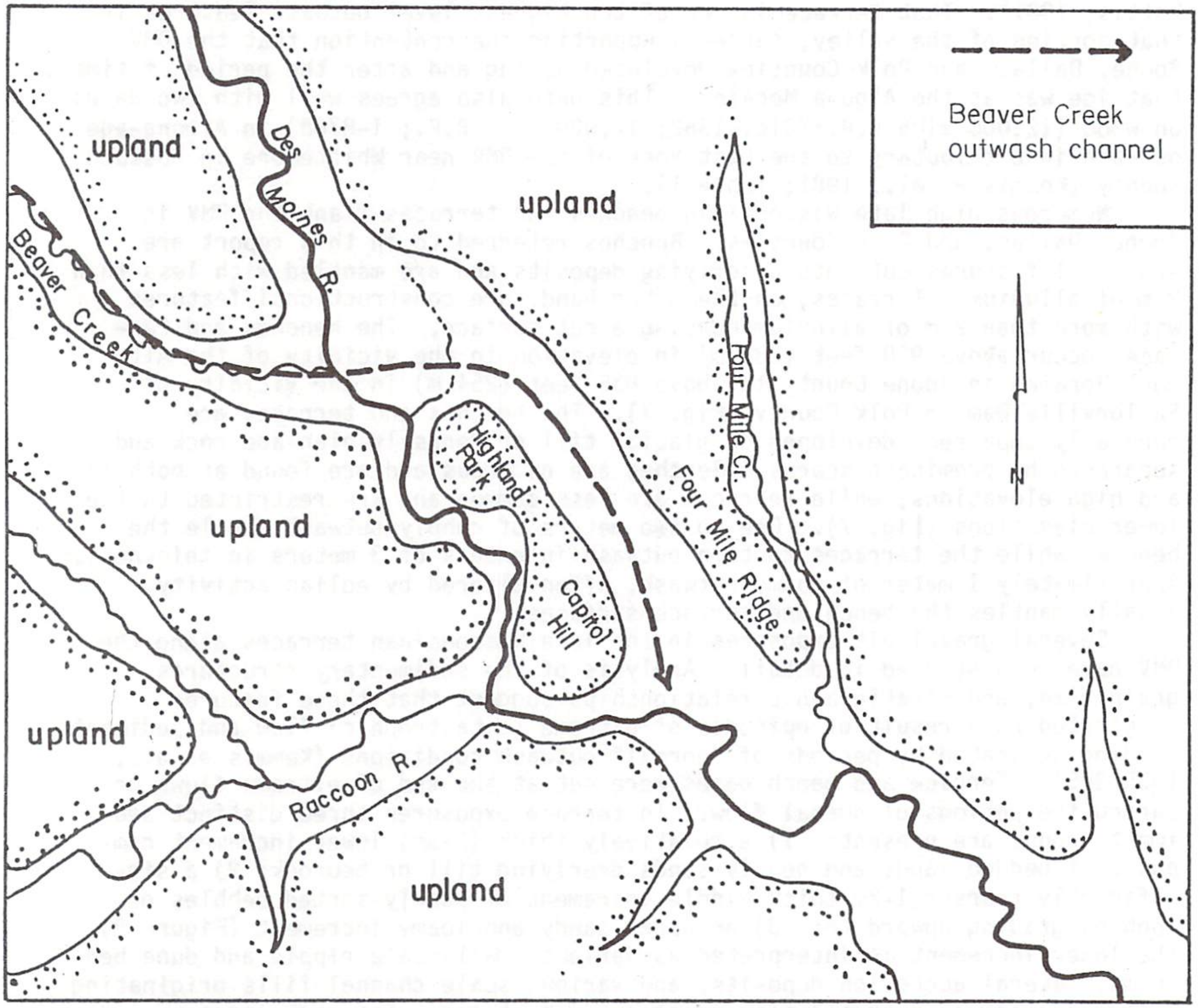


Figure 6. Schematic of physiographic features and late Wisconsinan drainage in the vicinity of Des Moines, Iowa (after Lees, 1916).

channel. Extensive outwash aprons, abandoned outwash channels, and pitted outwash terraces of the DMV are associated with the Algona Moraine. A date on coniferous wood buried at the base of an outwash terrace along the right bank of the Des Moines River south of Saylorville Dam (SE 1/4 NE 1/4 NE 1/4 sec. 6 T79N R24W) indicates the overlying outwash was deposited when Des Moines Lobe ice was standing at the Algona Moraine (12,160 ±80 B.P., Beta-2632; Benn and Bettis, 1981). That terrace is one of the highest level outwash features in that portion of the valley, further supporting the contention that the DMV in Boone, Dallas, and Polk Counties developed during and after the period of time that ice was at the Algona Moraine. This date also agrees well with two dates on wood (12,000 ±105 B.P.; Dic.-1362; 12,020 ±170 B.P.; I-8768) in Algona-age outwash in a tributary to the East Fork of the DMR near Whittemore in Kossuth County (Kemmis et al., 1981; Table 1).

Numerous high late Wisconsinan benches and terraces flank the DMV in Boone, Dallas, and Polk Counties. Benches referred to in this report are erosional features cut into underlying deposits and are mantled with less than 2 m of alluvium. Terraces, on the other hand, are constructional features with more than 2 m of alluvium burying a cut surface. The benches and terraces occur above 930 feet (283 m) in elevation in the vicinity of the Altamont Moraine in Boone County to above 835 feet (254 m) in the vicinity of Saylorville Dam in Polk County (Fig. 7). The benches and terraces are generally unpaired, developed on glacial till or Pennsylvanian-age rock and separated by prominent scarps. Benches are numerous and are found at both low and high elevations, while terraces are less common and are restricted to the lower elevations (Fig. 7). One to two meters of cobbly outwash mantle the benches while the terraces contain outwash in excess of 3 meters in thickness. Approximately 1 meter of loamy outwash, often altered by eolian activity, usually mantles the bench and terrace surfaces.

Several gravel pit exposures in the late Wisconsinan terraces along the DMV have been studied in detail. Analysis of the sedimentary structures, grain size, and stratigraphic relationships suggest that these features originated as a result of episodes of extreme (catastrophic) flow and sediment loading separated by periods of "normal" outwash conditions (Kemmis et al., 1985:295). Terrace and bench bases were cut at the end of extreme flows or during the periods of normal flow. In terrace exposures three distinct sediment groups are present: 1) a relatively thick (2-5m) lower increment composed of bedded sands and pebbly sands overlying till or bedrock; 2) a significantly coarser 1-2m thick middle increment of poorly-sorted pebbles or cobbles grading upward to: 3) an upper sandy and loamy increment (Figure 8). The lower increment is interpreted as various small-scale ripple and dune bedforms, lateral accretion deposits, and various scale channel fills originating during periods of "normal" flow in an outwash stream. The much coarser middle increment consists of sheet-like cobbles and pebbles with occasional bar and channel-fill structures deposited during periods of greatly increased flow and sediment supply. The uppermost, fining-upward increment preserves no observable sedimentary structures and was deposited during waning flow and/or overbank periods following deposition of the middle increment. This unit may have been further modified by Holocene eolian, blow sand activity. Only the middle and upper increments are preserved on benches. The periods of increased flow and sediment supply during which the middle increment was deposited resulted from low frequency, high magnitude meltwater discharge events such as subglacial bursts, supraglacial or proglacial lake bursts, extreme rainfall or ice-melt events, or other catastrophic releases of water and sediment.

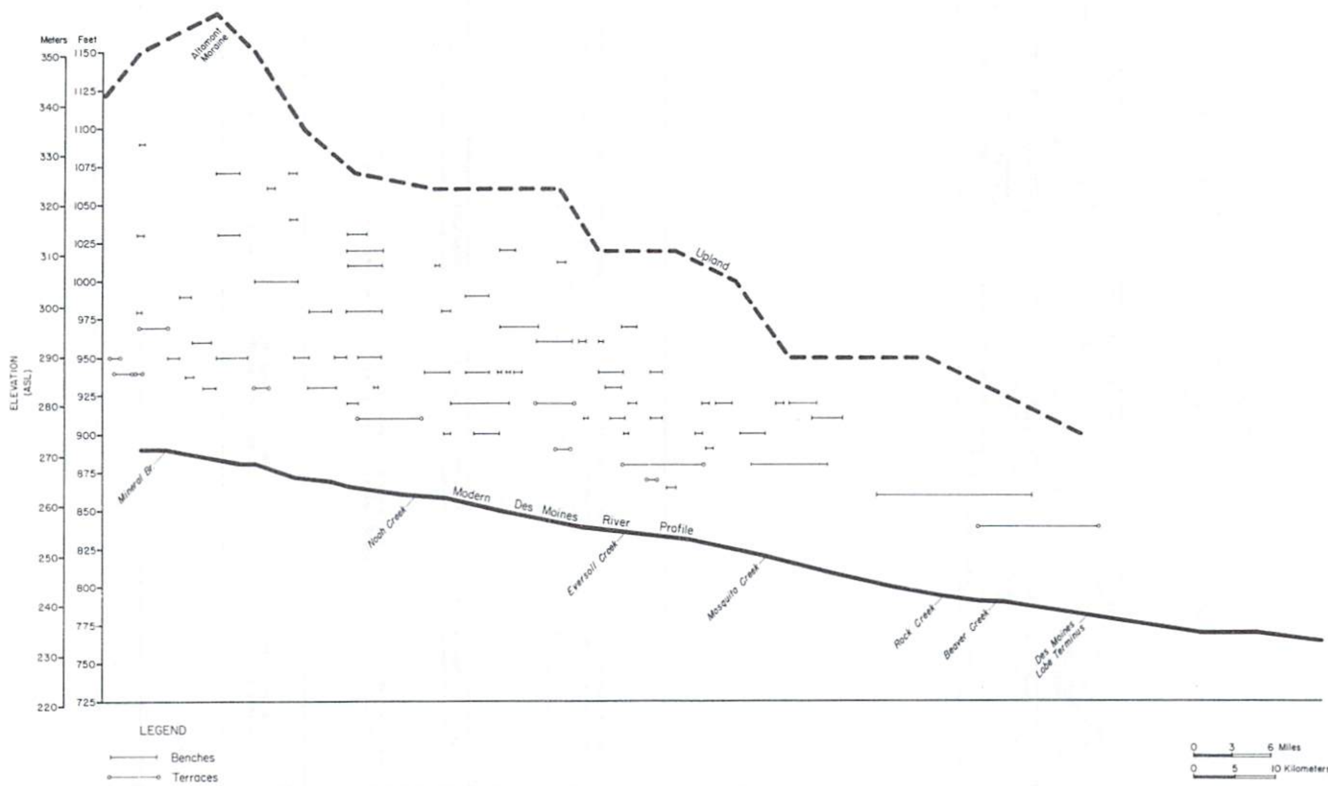


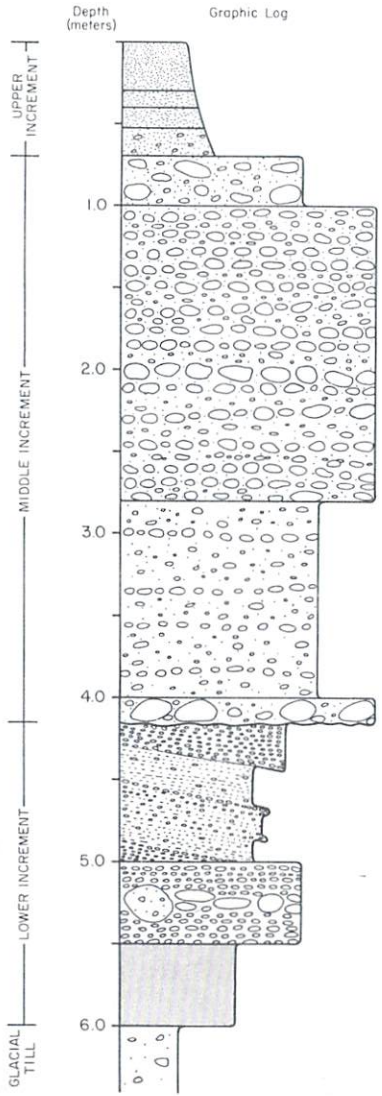
Figure 7. Late Wisconsinan bench and terrace levels along the Central Des Moines River valley.

DES MOINES RIVER VALLEY

8 HALLETT-1 COMPOSITE SECTION

Location: NW 1/4, NW 1/4, Sec. 36, T.84N., R.27W., Boone Co., Iowa

Point Type Terrace



Lithofacies	Description	Notes	
F(m)	Massive loam; very dark grayish brown (10YR3/2); weak medium to fine subangular blocky soil structure; very friable; clear smooth lower boundary.	Ap horizon of modern soil profile; abundant roots; leached.	SECTION 1
	Massive loam; very dark grayish brown (10YR3/2); moderate medium subangular blocky soil structure; friable; gradual smooth lower boundary.	A1 horizon of modern soil profile; common roots; leached.	
	Massive loam; dark brown (10YR3/3); moderate medium subangular blocky soil structure; friable; gradual smooth lower boundary.	AB horizon of modern soil profile; common roots; leached.	
F(m)	Massive pebbly loam; dark brown (10YR3/3-4/3); moderate medium to coarse subangular blocky soil structure; friable; common pebbles up to 3cm in diameter; clear smooth lower boundary.	2Bt1 horizon of modern soil profile; common roots; leached.	
CGms(m)	Massive matrix-supported cobbles; dark brown (7.5YR4/3); cobbles are well-rounded, mixed lithologies, and range up to 20cm in diameter; many of the granitic cobbles are decomposed; the matrix consists of pebbly loam; secondary clay coatings on some clasts; clear smooth lower boundary.	3Bt2 horizon of modern soil profile; common roots; leached.	
CGmc(pl)	Crudely planar-bedded, sub-rounded, matrix-supported to clast-supported cobbles; cobbles are sub-rounded, mixed lithologies, typically range from 7-20cm in a-axis length, and are crudely imbricated, dipping upvalley to the NW; the matrix consists of poorly-sorted sub-rounded pebbly sands; the crudely planar beds are slightly undulatory with amplitudes of 10 to 15cm and wavelengths of 900 to 1500cm.	4C horizon of modern soil profile; oxidized, calcareous; some secondary carbonate coatings and partial secondary carbonate cementing.	SECTION 2
PGmc(pl), CGmc(pl)	Crudely planar-bedded, sub-rounded, matrix-supported to clast-supported pebbles and cobbles; cobbles are sub-rounded, mixed litholgies, up to 10cm in a-axis length, and crudely imbricated upvalley to the NW; the cobbles often occur as one clast thick lags; the matrix consists of pebbly sands; the crudely planar beds are slightly undulatory with amplitudes of 10 to 15cm and wavelengths generally of 400 to 600cm; the cobble lags, bedded every 20 to 35cm in depth, particularly help to define this bedding.	Oxidized, calcareous; some secondary iron-oxide mottling.	
CGcs(lag)	Discontinuous one-clast thick cobble lag; cobbles are sub-rounded, mixed lithologies.	Oxidized, calcareous.	
PGcs(la), PGms(la)	Lateral accretion sets of matrix-supported and clast-supported pebbles; set thicknesses range from 15 to 30cm and sets dip 10° to 20° to the east-southeast; occasional pebble lags at base of sets; pebbles are sub-rounded, mixed lithologies.	Oxidized, calcareous; one lateral accretion bed had a measured strike of 31°-211° and a dip to the SE at 18°; the base of individual lateral accretion sets are long, measuring over 4m.	
PGcs(pl), CGcs(lag)	Crudely planar-bedded clast-supported fine pebbles with lags of clast-supported cobbles; clasts are sub-rounded, mixed lithologies; the cobble lags are 1 to 2 clasts thick and contain diamicton balls up to 40cm in diameter.	This unit appears to be the lowest terrace deposit and to be related to incision into the underlying diamicton.	
	Covered.	Underlying diamicton has undulatory upper surface. This is the maximum depth to the underlying diamicton surface.	
Dmm	Massive, matrix-dominated diamicton; silt loam matrix texture; mottled reduced and unoxidized; calcareous.	Glacial till; mottled reduced and unleached; calcareous; Pre-Illinoian in age.	

Figure 8. Vertical profile of a late Wisconsinan terrace at the 8-Hallett-1 section.

Good exposures of the deposits making up late Wisconsinan terraces can be seen at the Hallet gravel pits north of U.S. 30, west of Boone (sec. 36 T84N R27W) and at two smaller gravel pits west of Luther in Boone County (NW 1/4 NW 1/4 SW 1/4 sec. 4 and SE 1/4 NE 1/4 SE 1/4 sec. 5 T83N R26W). Figure 9 is a sketch of the northern wall of the Hallet gravel pit south of U.S. 30 (NW 1/4 NE 1/4 SE 1/4 Sec. 36, T84N R26W, showing the deposits making up the late Wisconsinan terrace there).

Between about 12,600 and 11,000 years B.P., during Des Moines Lobe deglaciation in Iowa, the DMV acted as an active outwash channel. Occasionally extreme discharge events shot down the valley, deposited coarse alluvium, abandoned that floodplain level and incised deeper into till or bedrock. In this 1,600 year period the DMR downcut approximately 68 meters (157 ft.) in northern Boone County and 48 meters (223 ft.) in the vicinity of Saylorville Dam.

Late Wisconsinan benches and terraces occur in two settings along the present valley. In large valley meanders the benches and terraces occur as a series of steps along the inside bend of the valley meander (Fig. 10). These are referred to as slip-off slopes in the geomorphology literature (Thornbury, 1969:111). The other common setting for Wisconsinan benches and terraces in the DMV is as a series of stair-like steps along the valley wall in staight reaches of the valley.

Most of the larger DMV tributary valleys developed along subglacial or supraglacial drainage lines between about 13,500 and 11,000 years ago. Ice stagnation features are associated with the high benches along Big Creek in the southern portion of the reservoir area and blowsand is very abundant on the uplands southeast of Big Creek. Mosquito Creek, a large left bank tributary near the Polk/Boone county border, occupies a high, abandoned outwash channel of the DMV. Other large tributaries, such as Bear Creek near Madrid (right bank), Peese Creek in Ledges State Park (left bank), and Bluff Creek north of Boone (right bank), are probably supraglacial in origin, following drainage lines originally developed on stagnated Des Moines Lobe ice. Other tributary valleys originated as the DMR downcut rapidly between about 12,600 and 11,000 RCYBP.

Valley Reaches

The DMV in the project area is made up of several valley segments, or reaches, which exibit distinct variations in geomorphic features and/or degree of innundation by Saylorville Lake. These reaches were used to separate the project area into study areas.

Reach 1 extends from the terminus of the Des Moines Lobe in the City of Des Moines to the junction of Saylor Creek (left bank) with the DMR (NE 1/4 SE 1/4 NE 1/4 sec. 21 T79N R24W). This reach is relatively short (approximtely 7 river miles) and has a river gradient of approximately .19 m/km (1.0 ft/mi). Along this reach the valley is narrow. Benches are common along both valley walls. Pennsylvanian rocks (dominantly shale) outcrop extensively. This reach is extensively disturbed by urban development. No study areas were located in this area.

Reach 2 is located from the junction of the DMR with Saylor Creek north to Saylorville Dam. This reach encompasses approximately 6 river miles and has a river gradient of approximately .19 m/km (1.0 ft/mi). This is the portion of the DMV which runs tranversely across the former Beaver Creek valley. The DMV is very wide (up to 4.5 km; 2.8 mi) and is bordered by high outwash terraces associated with Beaver Creek valley in this area. The valley narrows to approximately 1.6 km (1.0 mi) in the northern 2.4 km (1.5 mi) of the reach

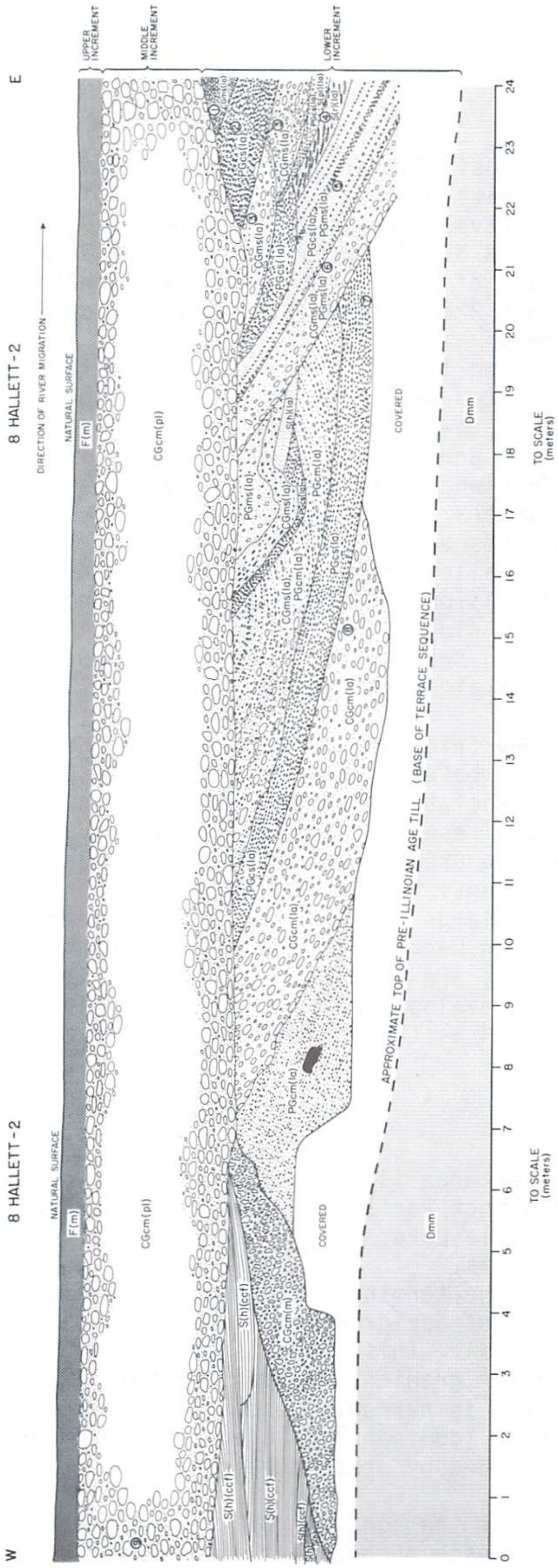


Figure 9. Sketch of the 8-Hallett-2 section showing the stratigraphy discussed in the text. The descriptive lithofacies code used is outlined on the next page.

DESCRIPTIVE LITHOFACIES CODE FOR FLUVIAL DEPOSITS (PROVISIONAL)[1]

Gross Particle Size - first symbols			
BG[2]	boulder gravel	cs[5]	clast-supported
CG[2]	cobble gravel	ms[5]	matrix-supported
PG[2]	pebble gravel	cm[5]	clast-to matrix-supported
S[3]	sand		
F[4]	fines		

Bedding Structures[6] - second symbols, in parentheses	
(m)	massive.
(pl)[7]	plain-bedded; crudely horizontal; may be slightly undulatory.
(h)[7]	horizontal laminated; may be slightly undulatory.
(r)	ripple-drift cross-laminated (various types).
(t)	trough cross-bedded; size (scale) and single or multiple sets noted on log.
(w)[8]	wedge cross-bedded; size (scale) and single or multiple sets noted on log.
(p)[8]	planar cross-bedded; size (scale) and single or multiple sets noted on log.
(la)[9]	lateral accretion deposits.
(ccf)[10]	channel cut-and-fill; massive or simple structures mimmicking the scoured channel cross-section.
(ccfc)	channel-cut-and-fill structure with complex facies changes within the fill (see Ramos and Sopeña, 1983).
(ccft)	channel cut-and fill structure with transverse fill (see Ramos and Sopeña, 1983).
(ccfms)	channel cut-and-fill structure with multi-storey fill.
(lag)	lag at base of channel or crossbed set.
(g)	normally graded.
(ig)	inversely graded.
(n-i)	normal to inversely graded.
(i-n)	inverse to normally graded.
(l)	low angle (<10°) crossbeds.
(e)	erosional scours with intraclasts.
(s)	broad shallow scours.
(sc)	laminated to massive fines.

1 This is a descriptive code, interpretations not made here. Modified to greater or lesser extents from Miall (1977), Eyles et al. (1983), McCabe et al., (1984), Ramos and Sopeña (1983), and the authors' own work. Further additions probable. Lithofacies for diamictons are given in Eyles et al. (1983); not listed here. Deformation structures are described separately in detail.

2 Mnemonic; first letter denotes largest particle size present: boulder, cobble, or pebble.

3 Upper particle-size limit is 2 mm; as used here "sand" is material which has <30% silt and clay matrix.

4 This category includes a variety of sand-silt-clay mixtures; we further break down this category with U.S.D.A. textural classifications (Soil Survey Staff, 1975) in the descriptions; e.g., loam, silt loam, silty clay loam, etc.

5 In gravelly deposits particle-size grading becomes apparent and has hydrodynamic significance; hence, subdivision as cs, ms, or cm.

6 Certain structures, such as ripple-drift cross-lamination, are generally restricted to only certain particle sizes.

7 The distinction between plain-bedded and horizontally laminated is made on the bases of bed thickness and differences in the particle sizes involved.

8 Differentiation as wedge or planar sets appears to be based on scale: planar sets have greater width to height ratios. Planar sets are also referred to by some authors as tabular crossbeds.

9 In some instances, various lithofacies may occur as sets in this geometry. In that case, this designation becomes a third symbol; e.g. S(r)(la).

10 Occurs on a larger scale than trough cross-bedding.

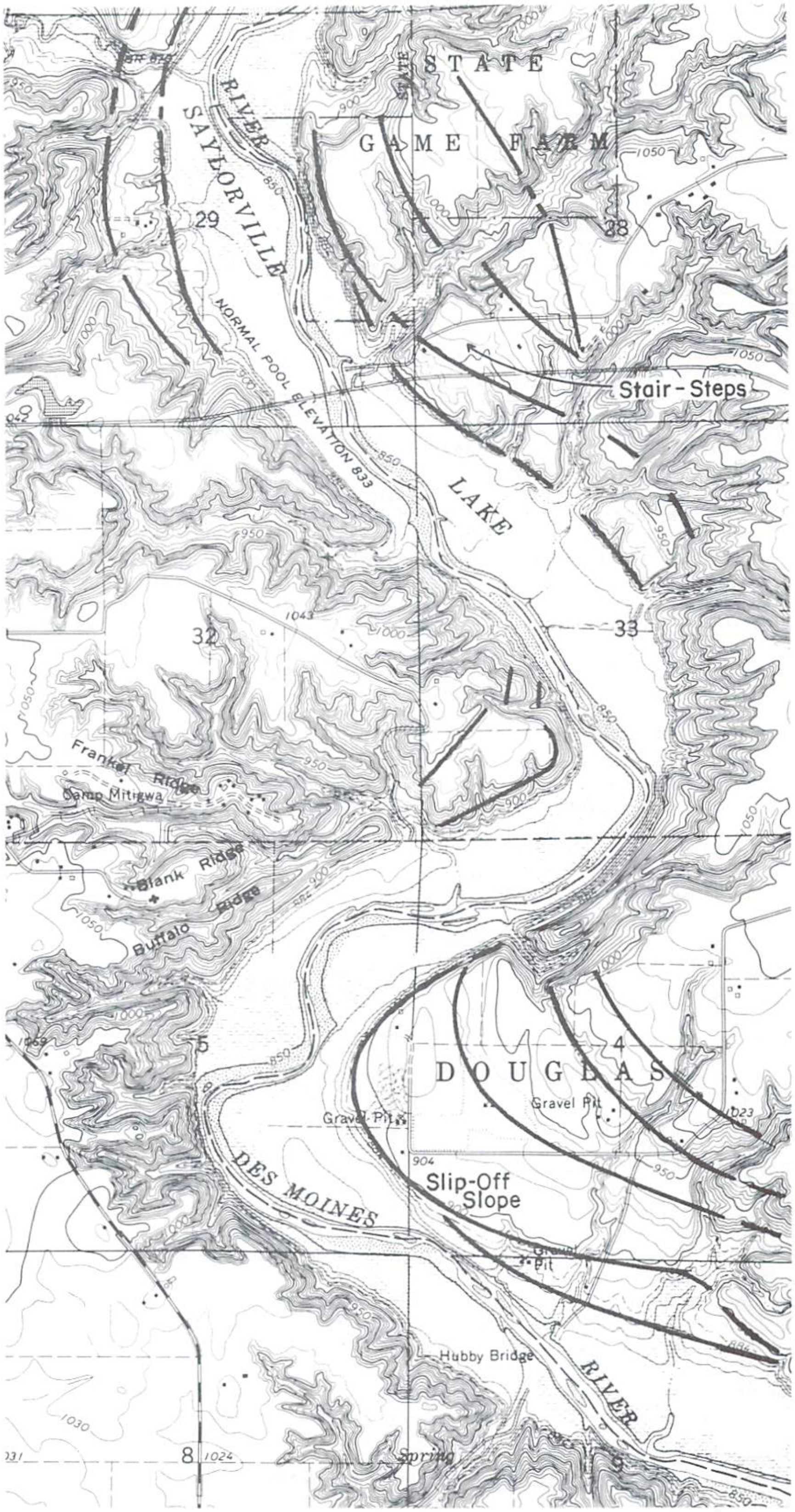


Figure 10. Portion of U.S.G.S. 7.5 minute Madrid NW quadrangle showing late Wisconsinan terraces and benches occurring on a slip-off slope on the inside of a large valley meander, and as a series of stair-like steps along a straight valley segment.

where it leaves the former Beaver Creek valley. Numerous abandoned Holocene-age DMR meanders are present within reach 2. Two major tributaries, Beaver Creek (right bank) and Rock Creek (left bank) enter in this reach. Pennsylvanian rocks outcrop along the valley walls only in the northern portion of this reach. Interstate 80 crosses the DMV along the southern end of reach 2. The west side of the valley is extensively disturbed by gravel pits just north of I-80. No investigations were carried out in this reach during the present project. This reach was investigated in 1980 by Benn and Bettis (Benn and Bettis, 1981; Bettis and Benn, 1984).

Reach 3 extends upvalley from Saylorville Dam to the junction of the DMR with Mosquito Creek (left bank NE 1/4 sec. 29 T81N R25W). Two major left bank tributaries, Mosquito Creek and Big Creek are present along this reach. Tributaries draining the western valley wall are shorter and steeper than those draining the opposite valley wall. The valley averages slightly over 2 km (1.25 mi.) in width in this area. River gradient is .36 m/km (1.92 ft/mi.), the steepest in the project area. Pennsylvanian rocks outcrop extensively along the western (right) valley wall but are only exposed along the extreme southern portion of the eastern valley wall. The western valley wall is much steeper than the eastern wall. Benches are present along both sides of the valley but are much more extensive along the eastern valley wall. Blow sand is common on the eastern uplands south and east of Big Creek. Saylorville Lake innundates all Holocene valley surfaces in this reach. Prior to innundation numerous abandoned DMR meanders were present in reach 3. Wave erosion has severely impacted both valley walls along the entire reach. No subsurface investigations were conducted in this reach because of innundation by Saylorville Lake.

Reach 4 encompasses the valley from Mosquito Creek to State Highway 210 west of Madrid in southern Boone County. This reach is approximately 10 river miles in length. The valley is narrow in this area ranging in width from 1.2 to 4 km (.75 to .25 mi.). River gradient averages .28 m/km (1.45 ft/mi.) along this reach. One major left bank tributary, Murphy Branch enters in this valley segment. Tributaries entering from the west are much more abundant than those entering from the east. Benches are present along both valley walls and a high abandoned valley segment is present on the "upland" below the junction of Murphy Branch and the DMR. Mosquito Creek occupies the downvalley portion of this abandoned valley segment. Pennsylvanian rocks outcrop extensively along both valley walls. Lower portions of the Holocene valley floor are innundated by Saylorville Lake in this area. The Holocene valley floor is completely innundated when Saylorville Lake is at maximum flood pool level. The Xenia study area is located in reach 4.

Reach 5 extends from State Highway 210 upvalley to the junction of Turkey Creek (right bank) with the DMR (NW 1/4 NE 1/4 SW 1/4 sec. 17 T83N R26W). This reach covers 11 river miles. The valley is very narrow in this reach, averaging about .53 km (.33 mi.). Along this reach the valley pattern consists of low amplitude meanders. River gradient is .73 m/km (1.5 ft/mi.). Late Wisconsinan benches and terraces are most abundant on the inside of the valley meanders where they occupy slip-off slopes. Tributaries are abundant along this reach including six large ones; Preston Creek (right bank), Caton Branch (right bank), Eversoll Creek (right bank), Richardson Branch (left bank), Bear Creek (right bank), and Peese Creek (left bank). Pennsylvanian bedrock outcrops intermittently along the valley walls in this area. Extensive outcrops of Cherokee Group sandstone occur in the northern portion of reach 5 in and around Ledges State Park. This reach is not innundated at normal conservation pool lake levels (836 ft). The Hubby Bridge study area is located in this reach.

The northernmost reach in the project area extends from the junction of Turkey Creek with the DMR to just above Frazer in northern Boone County. This reach is about 19 river miles in length. The valley in this reach is relatively narrow (.4-.96 km; .25 -.6 miles) and consists of broad, sweeping valley meanders. Late Wisconsinan benches and terraces are very abundant in this reach and occur both along the inside bend of valley meanders and in stair step fashion along straight valley segments of the reach. River gradient is .61 m/km (1.25 ft/mi.) along this valley segment. Pennsylvanian rocks (dominantly siltstone and shale) outcrop intermittently throughout the reach. Five large tributaries; Honey Creek (left bank), Noah Creek (right bank), Bluff Creek (right bank), Bass Point Creek (left bank), and Elkhorn Creek (left bank) join the main valley in this area. Smaller tributaries entering from both sides of the valley are abundant. The Altamont Moraine is present on the upland in the extreme northern portion of reach 6. The Honey Creek and Boone Bottoms study areas are located in this reach.

Overview of the Holocene History of the DMV

By 11,000 years B.P. the Des Moines Lobe had retreated from the Des Moines River Basin and a fundamental change in river sedimentation took place. Holocene deposits in the valley occur as horizontal sequences (Bettis and Thompson, 1982:70) composed of fine-grained loamy alluvium, with subordinate amounts of sandy loam and silt loam alluvium, deposited by a meandering stream. The Holocene alluvium occurs as three terrace complexes: the High (TH), Intermediate (TI), and Low (TL) Holocene terraces. These terrace complexes are separated by prominent 1-3 m scarps. Individual terrace complexes may contain a number of low-relief terraces occurring at about the same level.

The Holocene terrace complexes show consistent age relationships along the valley. The High Terrace (TH) was deposited episodically by flood events between 11,000 and 4,000 years B.P., and contains various paleosols (buried soils) within the alluvial sequence, indicating local periods of landscape stability on the DMR floodplain during this time interval. TI deposits accumulated between 4,000 and 750 years B.P. The alluvial sequences comprising this terrace complex often contain weakly-developed buried soils. The TL terrace complex dates from 750 years B.P. to the present. No buried soils are associated with this level.

The High Terrace occurs as a relatively featureless level above the present level of flooding (excluding the effect of Saylorville Lake). Deposits making up this level are generally oxidized and loam to silt loam texture. Stratification is usually evident only in the lower portions of TH deposits. Relatively thick, dark colored surface soils (Mollisols), often with argillic horizons (zone of secondary clay accumulation), are developed on this level.

TI usually exhibits undulations across its surface. These undulations reflect scarps separating individual terraces within the TI complex as well as partially masked natural levees, chutes, and abandoned channels. This level occupies higher portions of the modern floodplain. TI deposits are usually darker colored than TH deposits. Stratification is more pronounced in TI deposits than it is in TH deposits. Dark colored surface soils are developed on TI. These are morphologically less well expressed than are those on TH.

TL occupies the lowest portions of the modern floodplain. It is marked by ridge-and-swale topography and has much more surface relief than TI. Alluvial landforms on TL are less masked by overbank deposits than are those on TI. Surface soils on TL are Entisols (A-C profiles).

Alluvial fan deposition occurs where tributaries join the main DMV. The main period of alluvial fan deposition was from 11,000 to 4,000 years B.P., contemporaneous with deposition of the High Terrace. Paleosols within the fan sequence represent periods of stability following episodic deposition across the fan surface.

The following section details the evidence for this Holocene history. Intensive study areas, distributed from the Downstream Corridor to the Boone/Webster County line provide the stratigraphic foundation on which this history rests. These areas will be discussed from north (upstream) to south.

Intensive Study Areas

Sweet Jane Fan

The Sweet Jan Fan (13BN279) is located along the western valley wall (right bank) of the DMV approximately 1.5 km south of the Boone/Webster County line (NE 1/4 SW 1/4 and NW 1/4 SE 1/4 SW 1/4, sec. 3, T85N R27W). This locality includes small remnants of two steep, coalescing alluvial fans emerging from two small southwest to northeast-trending drainages (total drainage area <49 ha; <20 ac). The DMR is meandering into the fans and the present river bank exposes a transverse section through the apex or upper mid fan. When the fans were developing the DMR was on the opposite side of the valley. Only the downstream side of the northernmost fan was studied in detail because of time limitations. This portion of the exposure includes those portions of 13BN279 investigated by Benn (1985b).

Several buried paleosols are exposed (Figure 11). Soils were numbered, from top to bottom, I (the modern surface soil) through VII. Soil VII is developed in silty alluvium which grades downward into stratified silt loam, sand, and sand and gravel. The well-sorted nature of this lowermost deposit coupled with its distinct planar bedding suggest that this is probably pre-fan alluvium deposited by the DMR. Deposits burying soil VII are variable across the exposure. Those to the north (upriver) are coarse, poorly-sorted cobbly alluvium, sand, and loam grading upward into a loamy sediment (Figure 11). To the south these deposits grade into planar-bedded silt loam, fine to medium sand, and loam. Several thin, unnumbered A-C soil profiles are developed in these deposits. Deposits below soil VI represent fan and fan-floodplain transition deposits. Hoyer (1980) described a similar sequence in the lower portion of the Corrington Fan at the Cherokee Sewer Site (13CK405) in the Little Sioux River valley of western Iowa.

Soil VI is variable in morphology across the exposure primarily because of differences in the texture and drainage of the materials it is developed in. Soil VI is buried by silty and loamy deposits into which soil V is developed. Buried soils III and IV are morphologically the most well expressed. Across the exposure these soils intermittently exibit an argillic horizon and moderate structural development. Most of the buried soils at Sweet Jane are also evident as bulges in the organic carbon profile of the fan (Appendix B, B-30). These bulges result from additions of carbon to the fan surface by vegetation and other biota when the paleosols were the surface soil. The modern surface soil is the thickest and morphologically most well expressed in the exposure. This soil is not directly comparable to the buried soils however, since many soil properties (such as organic matter content) change after burial (Yaalon, 1971; Gardiner and Walsh, 1966). Nevertheless, several radiocarbon dates from within the fan deposits indicate that the present surface soil has been at the land surface much longer than any of the buried soils were.

A detailed description of the fan deposits and buried paleosols near the central portion of the fan apex is provided in Appendix A. The buried paleosols tend to be morphologically best expressed at a distance from the fan

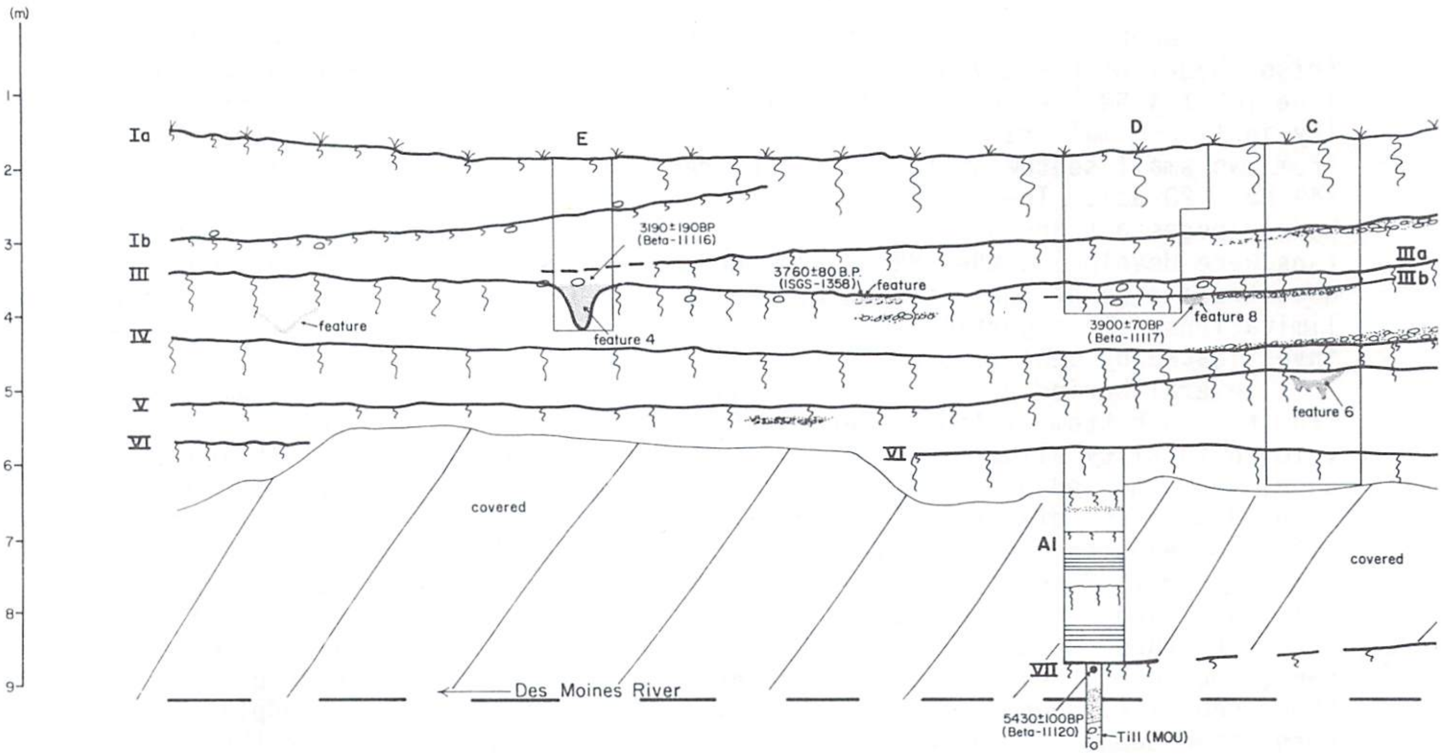
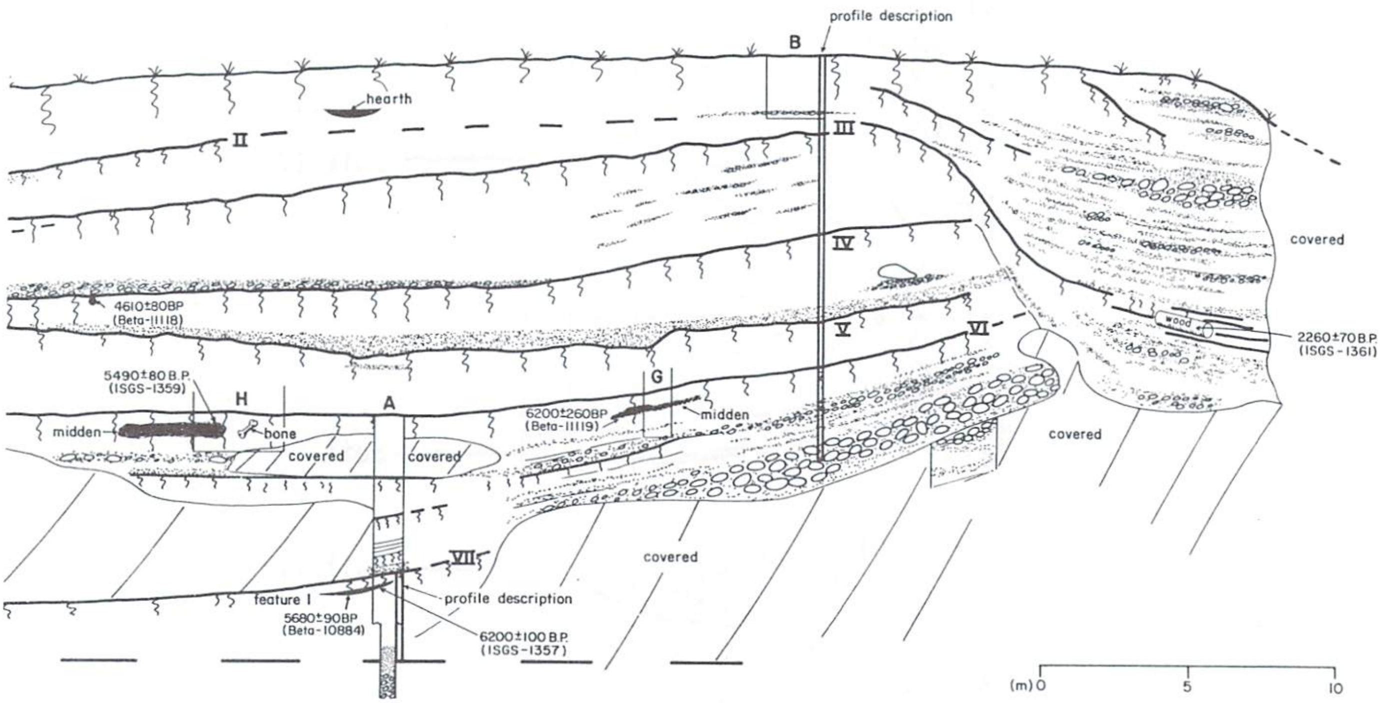


Figure 11. Sketch of the vertical section exposed at the Sweet Jane Fan near the Boone/Webster County line in the northern portion of reach 6. North is to the right side of the figure.



profile description
B
hearth
II
III
IV
V
VI
VII
covered
4610±80BP
(Beta-11118)
2260±70B.P.
(ISGS-1361)
wood
5490±80B.P.
(ISGS-1359)
H
A
G
6200±260BP
(Beta-11119)
midden
bone
feature I
5680±90BP
(Beta-10884)
profile description
6200±100B.P.
(ISGS-1357)
(m) 0
5
10

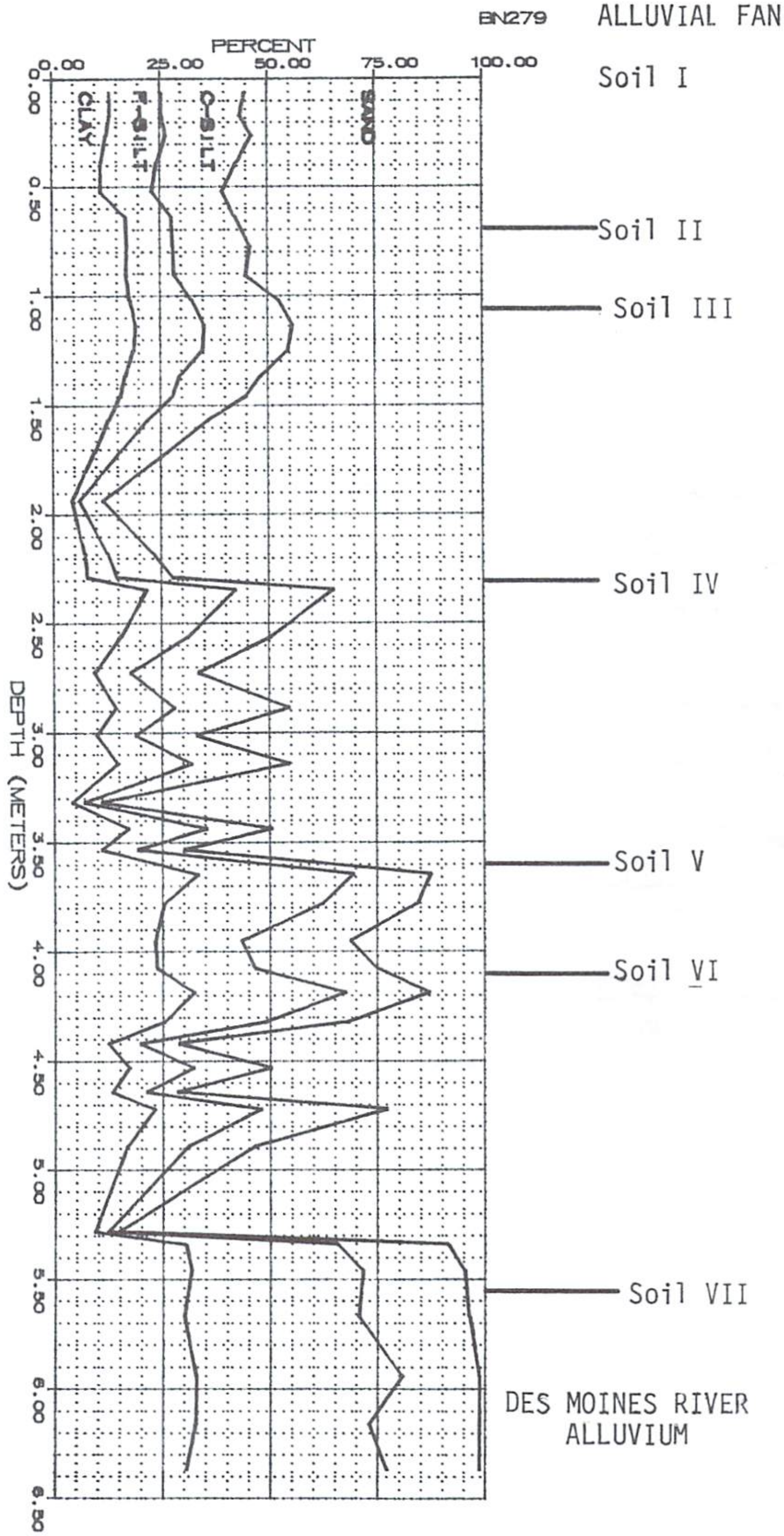


Figure 12. Particle-size profile at the Sweet Jane Fan (see Fig. 11 for location of the profile). Note the several fining-upward sediment packages with soils developed in the upper portion of the packages.

axis. This is probably due to more rapid and greater overall sedimentation along the fan axis where the feeder stream occurs. In addition, the fan deposits fine in texture away from the axis. All other factors being equal, soil structure tends to be more well expressed in finer-textured materials within the loamy textural range (Riecken and Poetsch, 1960; Harradine and Jenny, 1958). Also paleosols are morphologically more well expressed on the portion of the fan north of the fan axis. This may be related to less rapid sedimentation on the upvalley portion of the fan and the fact that deposits in this portion of the fan are finer texturally than those downstream.

A repetive sequence of deposits occurs within the fan. The deposits generally fine upward from the upper surface of one paleosol to the top of the overlying paleosol (Figure 12). This sedimentation pattern was also observed by Hoyer (1980) in the Corrington Fan. Deposition on alluvial fans occurs episodically (Schumm, 1977; Johnson & Rahn, 1970; Hoyer, 1980). These episodes of deposition result from episodic periods of runoff and erosion in the tributary basin above the fan. In the Sweet Jane Fan we can see that there were at least six significant periods of instability in the tributary basin. Unstable periods, marked by deposition of fan sediments, were followed by periods of stability and soil formation.

Sedimentation on the fan surface occurred by slopewash, overbank deposition, and debris flow. The package of deposits from the top of one paleosol to the next probably accumulated quite rapidly (a few years to a few decades) then was pedogenically modified during a subsequent relatively long (a few hundred to a thousand years) stable period. Sedimentation and erosion were not uniform across the fan surface. This is indicated by the fact that paleosols merge and/or diverge and that some of the buried soils are differentially truncated across the exposure (Figure 11).

Close examination of the top of the buried paleosols at the Sweet Jane Fan suggests that these soils were partially truncated. Many of the paleosol epipedons have clay coatings and blocky structure which suggests that they were in the lower portion of an A horizon or in an AB transition horizon. The presence of relatively coarse overlying deposits, a few filling rills cut into the underlying surface, are also consistent with an interpretation of erosion of the paleosol surfaces. The distribution of cultural material in the blocks excavated during the testing also suggest somewhat "deflated" soil surfaces (Benn and Bettis, 1985:52).

The right hand side of Figure 11 shows alluvium filling a former fan head trench that extends down the fan axis. This paleo-trench is analagous to the modern fan head trench that cuts into the right (upstream) side of the profiled section. The paleo-trench truncates deposits into which paleosols VI through II are developed. Development of this fan head trench occurred during the early part of the late Holocene (around 3000-2500 B.P.). A cedar log buried within the alluvium filling the fan head trench was dated at 2260 ±70 B.P. (ISGS-1361). Sedimentation on the fan proper decreased dramatically following incision of the fan head trench.

Nine radiocarbon dates are available from the fan deposits at 13BN279. Charcoal from feature 4, associated with soil III, dated 3190 ±190 B.P. (Beta-11116). Charcoal from a nearby feature on the surface of soil IIIa yielded a date of 3760 ±80 B.P. (ISGS-1358) while feature 8, associated with soil IIIb, yielded a date of 3900 ±20 B.P. (Beta-11117) on charcoal. Soil III, then, developed between about 3900 and 3000 B.P. A date of 4610 ±80 B.P. (Beta-11118) was obtained on charcoal found in the upper portion of soil IV. Two dates 5490 ±80 (ISGS-1359) and 6200 ±260 B.P. (Beta-11119) are associated with middens within soil VI. Two other very similar dates, 5680 ±90 B.P. (Beta-

10884) and 6200 ±100 B.P. (ISGS-1357) were obtained from charcoal associated with a noncultural tree burn in soil VII. The inversion of some dates in the lower fan sediments is problematic.

Dates from the fan indicate that it accumulated during the middle to early-late Holocene. These dates, when compared to others from throughout the upper Midwest, indicate that alluvial fan formation was primarily a phenomenon occurring from the early Holocene through the early part of the late Holocene (Bettis et al., 1984:13).

Fan sedimentation was terminated around 3000 B.P. when the stream feeding the fan incised and a fan head trench developed. Paleosols and deposits in the upstream portion of the Sweet Jan Fan (not profiled or examined in detail) grade into DMR deposits making up the Holocene High Terrace (TH) to the north.

South (downstream) of the Sweet Jane Fan the DMR exposes portions of another small alluvial fan. The downstream portion of that fan is angularly truncated by stratified, dark-colored loamy DMR alluvium. Charcoal collected from the river alluvium immediately overlying the truncated fan surface was radiocarbon dated at 1490 ±80 B.P. (Beta-11167). That alluvium is part of a larger sediment package making up the Holocene Intermediate Terrace (TI) level. The High and Intermediate terrace levels will be discussed in detail in the following sections.

Boone Bottoms

Stratigraphic relationships of the major late Wisconsinan and Holocene alluvial and colluvial depositional units present in the Saylorville Lake area are well expressed within the wide valley meander southwest of Boone (Boone Bottoms) (Figure 13). In this area the valley is successively incised into late Wisconsinan-age Des Moines Lobe till, Pre-Illinoian-age till, interbedded sand and gravel, and Pennsylvanian-age (lower Desmoinesian Series, Cherokee Group) siltstone, shale, coal, limestone, and sandstone of the Floris Formation. The river level is approximately 72m (265 ft) below the adjacent upland. This study area is separated into three localities for ease of discussion. These include: 1) the 13BN27 area located on the eastern side of the valley north of old U.S. Highway 30 (E 1/2 NE 14 sec. 36, T84N R26W); 2) the 13BN40 and 13BN106 area located on the same side of the valley, but south of old U.S. 30 (SW 1/4 NW 1/4 and NE 1/4 SW 1/4 sec. 31, T84N R26W); and 3) the west side of the valley.

Several late Wisconsinan benches are present between 29 and 27.4 m (950 and 900 ft.) in elevation along the eastern valley wall of the Boone Bottoms (Figure 13). These are age-equivalent to the extensive suite of benches and terraces occupying the slip-off slope on the inside bend of the valley meander on the other side of the river. The sequence of deposits making up the benches and terraces has been described on pages 24-27 of this report. In this area a late Wisconsinan terrace below that exposed in the Hallett-2 pit is composed of loamy sand alluvium. A section of this latest Wisconsinan alluvium is exposed along the eastern wall of the Hallett-3 pit.

Two relatively steep alluvial fans are partially buried by and interfinger with DMR alluvium making up the High Terrace (TH) at 13BN27. The fans emerge from two very steep, small (approximately 2.5 ha; 5 ac) drainage basins. Toward the river a short, steep (approx. 2.5-3 m; 8-10 ft) scarp separates the western edge of TH from the lower lying Intermediate Terrace (TI) to the west. Low Terrace (TL) deposits are present west of the tree line that parallels the river.

A transect was drilled from the northern fan across TH and onto TI (Fig.

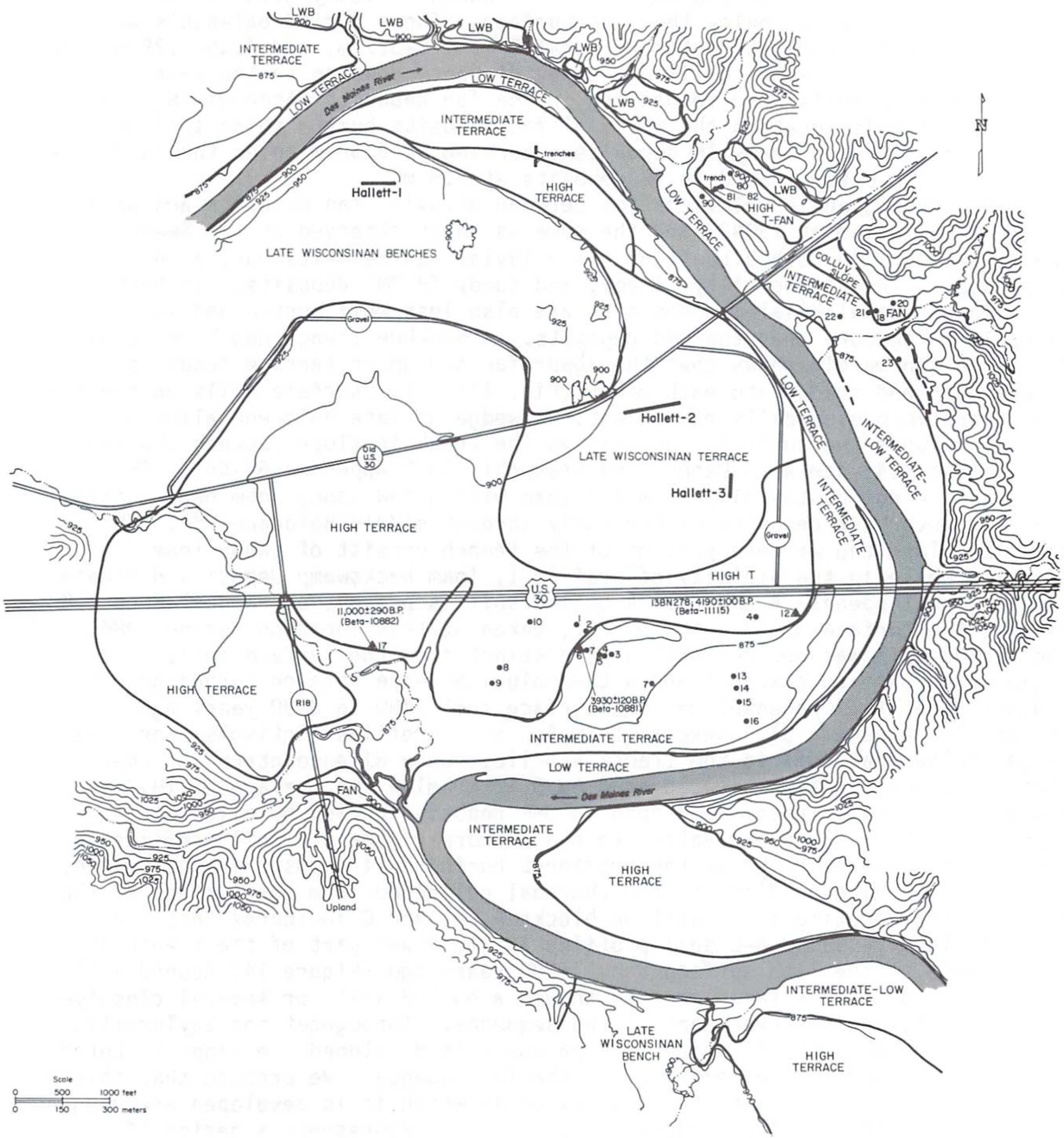


Figure 13. Map of the Boone Bottoms study area showing location of drill holes, radiocarbon dates, and distribution of landform/sediment assemblages.

13). Hole 80, drilled on the upper midfan, ended in loamy alluvial fan deposits 8.6 m (28.2 ft) below the land surface. Three buried paleosols were recognized in the core at depths of 1.2-1.9 m, 1.9-3.7 m, and 4.55-5.28 m (see Appendix A). At hole 82, drilled a short distance downfan to the west (Fig. 13), two buried soils were recognized in the fan deposits (Appendix B, profile 08AB82). At this location the alluvial fan deposits bury a third soil developed in silty and loamy TH deposits occurring at 3.32 m below the land surface. This hole terminated in TH deposits at 6.6 m.

The stratigraphic relationships between alluvial fan deposits and underlying DMR alluvium at 13BN27 are the same as those observed at the Sweet Jane Fan (13BN279). In both situations the alluvial fan deposits bury a soil developed in underlying silty, loamy, and sandy TH DMR deposits. In both situations, the alluvial fan deposits are also less well sorted and more variable in texture than the DMR deposits. A backhoe trench dug back across TH to the fan margin shows that the lower fan and upper terrace deposits interfinger and grade into each other (Fig. 14). The surface soils on the fan and TH are morphologically equivalent. A wedge of late Holocene alluvium/colluvium forms the surficial deposit at the break in slope between the fan and TH (Fig. 14; see also Osborn and Gradwohl, 1982 Appendix:62-66). TH deposits are dominantly silt loam and loam with a few sandy loam beds. All these are overbank deposits of the early through middle Holocene DMR. TH deposits along the western portion of the trench consist of sandy-loam deposits while in the vicinity of profile 1, loam backswamp deposits dominate the section (Appendix A and B). A buried soil is present at about 1.6 to 1.8 m below the surface of TH. In core 81, taken at this location during 1984, the buried soil was not recognized as distinct from the surface soil. A radiocarbon date on charcoal and a thermoluminescence date on burned granite indicate that this paleosol was the surface soil 3400 to 3900 years ago (Figure 14; Appendix C). Several thin A-C soil profiles (Entisols) were recorded below that soil in the trench profile. Core 81 encountered another buried A-C soil profile between 4.74 to 5.12 m below the surface of TH. It appears that the paleosol developed in DMR deposits buried by alluvial fan deposits at hole 82 is equivalent to one or more of the A-C soil profiles in the trench and core 81 below the prominent buried soil exposed in the trench. A radiocarbon date on disseminated charcoal collected from the surface of the same A-C soil profile in excavation blocks A, B, and C indicates that the several closely-spaced A-C soil profiles in the lower part of the trench at 13BN27 were at the land surface about 6200 years ago (Figure 14; Appendix C).

Almost all cores taken from TH showed a buried soil, or several closely-spaced soils, in the lower part of the sequence. Throughout the Saylorville Lake area the deposits in which this paleosol is developed are finer textured than those making up the remainder of the TH sequence. We propose that this buried soil and the fine-textured alluvium in which it is developed are roughly time equivalent in the project area. The soil represents a period of relative stability on the valley floor around 6,000 B.P. The several closely-spaced, deeply buried A-C soil profiles at 13BN27 are equivalent in time to soil VII at the Sweet Jane Fan. Above this paleosol TH deposits are less than 6,000 years old (also see Bettis and Benn, 1984:217).

The Intermediate Terrace (TI) was drilled west of the scarp separating TH and TI (Figure 13). Hole 90 revealed a typical late TI sequence consisting of stratified sandy and loamy alluvium with an Entisol (A-C profile) developed at the top of the sequence. No buried soils were recognized in the TI deposits. The TI deposits were buried by 10 cm of loamy alluvium, showing no pedogenic alteration. This alluvium was probably deposited following the closing of Saylorville Dam in 1976.

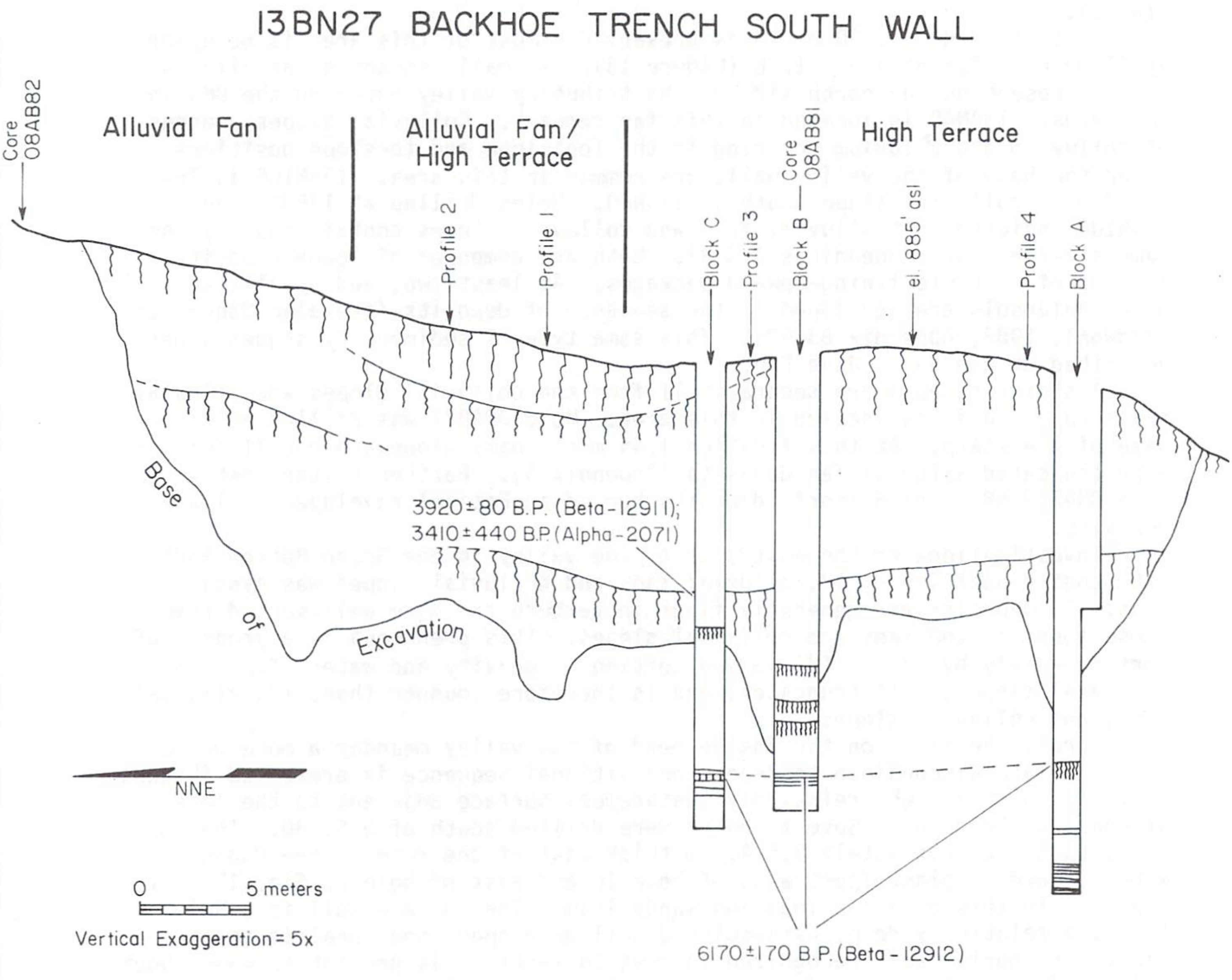


Figure 14. Profile of south wall of backhoe trench at 13BN27. Trench cuts through an alluvial fan and across TH. See Appendices A and B for description of cores and profiles and for laboratory data.

The floodplain surface west of the treeline paralleling the river is TL. This area is morphologically distinct from TI. It has well expressed ridge-and-swale topography and has virtually no pedogenic alteration near the land surface. Deposits in this area are less than approximately 750 years old (ibid.).

South of old U.S. 30 no TH is preserved. Most of this area is occupied by TI or undifferentiated TI/TL (Figure 13). A small remnant of an alluvial fan is present on the north side of the tributary valley entering the DMV in this area. 13BN40 is located in this fan remnant. Colluvial slopes, aprons of colluvium and alluvium occuring in the footslope and toeslope positions along the base of the valley wall, are common in this area. 13BN106 is located on a colluvial slope south of 13BN40. Holes drilled at 13BN40 and 13BN106 indicate that alluvial fans and colluvial slopes contain roughly the same stratigraphy (Appendices A & B). Both are composed of loamy deposits made up of multiple fining-upward packages. At least two, and usually several more, paleosols are developed in the sequence of deposits (see also Osborn and Gradwohl, 1982; Appendix 83-92). This same type of sedimentary sequence was described at the Sweet Jane Fan.

A short, steep scarp separates TI from the colluvial slopes and alluvial fan into which it is incised in this area. Hole 08AB21 was drilled at the base of the scarp. At this location 1.44 m of loamy slopewash and TI deposits bury truncated alluvial fan deposits (Appendix A). Farther to the west at hole 08AB22 56 cm of Historic deposits buried an Entisol developed in loamy TI deposits.

Investigations on the east side of the valley in the Boone Bottom indicate that deposition of TH, alluvial fans and colluvial slopes was synchronous. TH deposits are generally finer in texture and more well-sorted than those found in the fans and colluvial slopes. This phenomena is a product of sorting solely by water (TH) versus sorting by gravity and water (fans and colluvial slopes). TI truncates, and is therefore younger than, TH, alluvial fans, and colluvial slopes.

Across the river on the inside bend of the valley meander a more or less complete late Wisconsinan to Recent depositional sequence is preserved (Figure 13). TH forms a high, relatively featureless surface adjacent to the late Wisconsinan terraces. Several holes were drilled south of U.S. 30. The TH deposits are approximately 3.5-4.5 m thick east of the road to the Ogden water treatment plant (just west of hole 10 and east of hole 8, Fig. 13). TH deposits in this area are loam and sandy loam. The surface soil is a Mollisol, a relatively deep, dark-colored soil developed under prairie vegetation. The buried soil recognized in most TH sections is present between about 1.7 and 2.5 m below the modern surface. To the west TH deposits thicken (8.8 m at holes 8 and 9, 6 m at hole 17). The elevation of the TH surface also rises in this direction. These changes probably result from sediment deposition by two tributaries entering the DMV, Noah and Coal Creeks. TH deposits are finer textured in this part of the terrace, usually silt loam or silty clay loam. Two superimposed buried soils are present in the western portion of this TH at approximately 3.0 and 4.8 m depths. These soils usually have an argillic (Bt) horizon and are comparable in degree of development to the modern surface soil (Appendices A and B). Organics collected below the lowest paleosol at a depth of 5.52 to 5.8 m in hole 17 (Fig. 13) yielded a radiocarbon date of 11,000 ±290 B.P. (Beta-10882, Appendix C). This is the oldest date obtained from TH deposits in the Saylorville Project.

An archaeological site, 13BN278 was discovered at hole 12 on the eastern edge of this TH in natural levee deposits 1.78 m below the present land surface. Since approximately the upper 2m of the TH here were used for borrow during construction of the new U.S. 30, 13BN278 was originally buried approximately 3.8 m below the TH surface. Charcoal from the site was radiocarbon dated at 4190 ±100 B.P. (Beta-11115). This site was located 50 cm above the persistent buried soil developed in the finer-textured lower part of the TH sequence.

On this side of the valley a prominent scarp and abandoned channel again mark the TH-TI boundary. The TI surfaces average about 2 meters lower in elevation than TH. Several abandoned channels are evident on the TI surface. Holes 3 through 7 and 13 through 16 were drilled on the TI. These showed 3 to 5 m of stratified loamy alluvium with Entisols (A-C profiles) or Inceptisols (A-Bw-C profiles) developed as the surface soils. Buried soils were recognized only in holes 3 through 7 in proximity to the abandoned channel marking the western boundary of TI (Fig. 13). Wood collected between 4.1 and 4.27 m in hole 6 was radiocarbon dated at 3930 ±120 B.P. (Beta-10881).

Two short backhoe trenches were dug on and at the base of the TH scarp at 13BN114, located north of old U.S. 30 on the west side of the valley (Figure 13). The southernmost trench on TH showed stratigraphy very similar to that exposed in the trench at 13BN27. Charcoal collected 30 cm below the surface of TH in a hand-dug excavation along the TH scarp at 13BN114 yielded a radiocarbon date of 2080 ±60 B.P. (Beta-12910).

The northernmost trench at 13BN114 was dug into TI at the base of the scarp ascending to TH. At this location TI deposits were composed of weakly stratified loam and silt loam with occasional, discontinuous thin stringers of sand. An A-C soil profile was observed approximately 80 cm below the land surface within the TI deposits. Charcoal collected 1 m below the land surface near the base of the paleosol was radiocarbon dated at 1670 ±175 B.P. (Beta-12909).

Dates obtained from carbon enclosed in TI deposits in the Boone Bottom agree well with other TI dates in the Saylorville Lake and Downstream Corridor areas (Bettis and Benn, 1984). These dates indicate that TI sedimentation began around 4,000 B.P. and continued into the late Holocene.

A prominent scarp and abandoned channel separate TI and TL here. TL is covered with floodplain forest and exibits pronounced ridge-and-swale topography. Abandoned channels associated with TI are angularly truncated by TL channels. Only a narrow belt of TL is present in this section of the valley, indicating that the channel position has been relatively stable for the last several centuries.

Honey Creek Area

The Honey Creek study area is located southeast of the town of Moingona at and around the junction of Honey Creek (left bank) with the DMR. This area is in the extreme southern portion of the northern reach (reach 6, Figure 15). Honey Creek is a relatively large tributary (drainage area approximately 12.8 km^2; 5 mi^2) for this part of the valley. In this area the DMR is cut approximately 67 m (220 ft.) below the upland surface. Numerous abandoned clay pits are developed into Pennsylvanian rocks south of Moingona on the west side of the valley and in the lower reaches of Honey Creek on the east side of the DMV. Several levels of late Wisconsinan benches step down the western valley wall from about 30.5 m (1000 ft.) to approximately 27.1 m (890 ft.) ASL. (Figure 16). Gravel pits are developed in some of these levels. On the opposite side of the valley a sloping and eroded late Wisconsinan bench is present between about 28.3 m (930 ft.) and 24.4 m (800 ft.) in elevation. Cobbles are abundant on the cultivated surfaces of the bench. This bench is cut to the east of and isolates a small, steep, pyramid-shaped hill composed of till which rises to an elevation of about 29.6 m (970 ft.) (Figure 16). Headward erosion of small tributaries on the north and south sides of this outlier have helped to further isolate it from the valley wall. An apron of coalescing alluvial fans grading into TH toward the river is present adjacent to the late Wisconsinan bench on the east side of the valley (Figure 16). Two small intermittent drainages cross this level and descend to TI. A short, steep scarp separates TH from TI. In this area TI is marked by two well-expressed linear natural levees roughly paralleling the present course of the DMR. Low Terrace (TL) is present in a narrow band along the present river. This level is separated from TI by a short scarp and an abandoned channel in the southern portion of the area. TL is marked by ridge-and-swale topography and has more surface relief than TI. All Holocene valley surfaces in this area, except TL, are cultivated. A sparse floodplain forest dominated by cottonwood and willow occupies TL.

Eight holes (08AB43-50) were drilled on the fan/TH surface (Figure 16). Holes 44 and 48 penetrated the TH deposits. In this area TH consists of loamy alluvium becoming stratified at depth. No buried soils were recognized in the cores, but both showed thick surface soils with argillic (Bt) horizons (Appendix A). Both cores terminated in calcareous, medium to coarse sand, channel deposits of the early to middle Holocene DMR. Hole 50 was drilled on the backside of TH where it overlaps the eroded late Wisconsinan bench. At that location a buried soil with an argillic (Bt) horizon was encountered at a depth of 2.67 m (see Appendix A). This hole extended to 4.04 m where it terminated in coarse gravel, probably late Wisconsinan alluvium. Hole 49 was drilled farther to the east on the footslope of the late Wisconsinan bench which decends to TH. No buried soils were found here. The surface soil is very thick (2.3 m) and has an argillic (Bt) horizon.

Holes 43, 46, and 47 were drilled on alluvial fans (Figure 16, Appendix A). There are two types of alluvial fans in this area; small, relatively steep-angle fans, much like those at 13BN27 and the Sweet Jane Fan; and large low-angle fans with a surface expression very similar to TH. The small fans emerge from short, steep tributary valleys while the larger, low-angle fans are associated with larger tributaries such as Honey Creek. The large fans are best preserved on the downvalley side of the tributary junction. Hole 43 was drilled on a small, steep fan while holes 46 and 47 were drilled on a large low-angle fan associated with Honey Creek (Figure 16). The sedimentary sequence in both types of fans is similar. It consists of several fining-upward packages of loamy sediments, typically with a paleosol developed in the upper part of each package (see Appendix A, Appendix B--profile 08AB46). This is the same sedimentary sequence observed in other alluvial fans in the Saylorville Project and elsewhere (Hoyer, 1980; Wiant et al., 1983).

The large alluvial fan in the Honey Creek area fines in texture to the south, down the DMV. At hole 46 the texture of the fan deposits varies from loam to silty clay loam. The gravels at the base of the cores drilled into the fan may be basal alluvial fan deposits or late Wisconsinan DMR alluvium.

Hole 45 was drilled in a TH-alluvial fan transition. Deposits in that location have properties intermediate between the fans and TH.

The remainder of the holes in this area were drilled on TI and one (08AB22) on TL (Figure 16). Numbers 52, 54, 71, and 73 were drilled on natural levees while 51, 69, 71, and 74 were drilled in intervening swales or chutes. Deposits on the levees are coarser textured (loam or sandy loam) than those in the chutes or swales (dominated by silt loam) (Appendix A). A buried soil was encountered in some of the TI cores. These soils have A-C or A-Bw-C

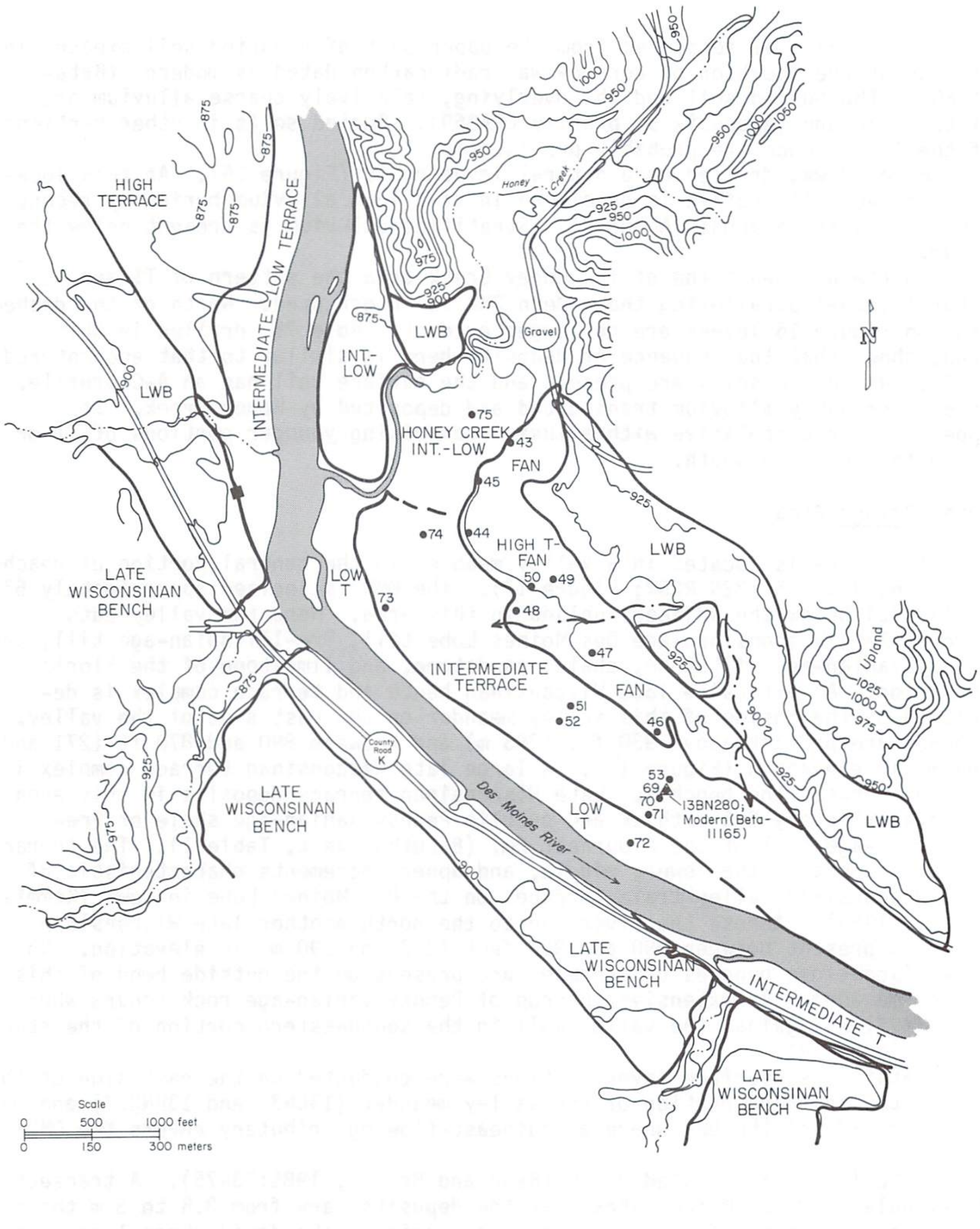


Figure 16. Map of the Honey Creek study area showing location of drill holes, radiocarbon date, and distribution of landform/sediment assemblages.

profiles. Charcoal recovered from the upper part of a buried soil exposed in a pit dug at the location of core 69 was radiocarbon dated as modern (Beta-11165). The buried soil and the overlying, relatively coarse alluvium are Historic in age (Appendix B, profile 08AB69). Buried soils in other portions of the TI sequence are probably prehistoric.

Hole 72 was drilled on a natural levee on TL (Figure 16). At this location an A-C soil profile is developed in silt loam alluvium buried by recent flood deposits (Appendix A and B). Stratified alluvium is present below the solum.

On the northeast end of the Honey Creek area the pattern of TI and TL natural levees paralleling the modern DMR is interrupted. North of the dashed line on Figure 16 levees are no longer evident. Hole 75, drilled in this area, shows that the sequence of deposits here is similar to that encountered in TI. No buried soils are present and the surface soil has an A-C profile. This is probably alluvium transported and deposited by Honey Creek. It appears to be correlative with alluvium comprising younger portions of TI or TL to the west and south.

Hubby Bridge Area

This area is located in a valley meander in the central portion of reach 5 (sections 4 and 5 T82N R26W; Figure 17). The DMR is incised approximately 57 m (190 ft) below the adjacent upland in this area. Here the valley cuts through late Wisconsinan-age Des Moines Lobe till, Pre-Illinoian-age till, and Pennsylvanian-age siltstone, shale, sandstone, and limestone of the Floris Formation. An extensive late Wisconsinan bench and terrace complex is developed on the inside of this valley meander on the east side of the valley. Benches are present above 930 ft. (283 m) and between 890 and 870 ft (271 and 265 m) in elevation (Figure 18). A large late Wisconsinan terrace complex is present between the benches. Late Wisconsinan terrace deposits in this area are approximately 8.5 m thick and overlie Pennsylvanian-age shale or Pre-Illinoian-age till of the Alburnett Fm. (8-Luther West, Table 1). The terrace sequence contains the lower, middle, and upper increments characteristic of late Wisconsinan valley train terraces on the Des Moines Lobe in Iowa (Kemmis et al., 1985). Across the river and to the north another late Wisconsinan bench is present between 990 and 950 feet (302 and 290 m) in elevation. No late Wisconsinan benches or terraces are present on the outside bend of this valley meander. An extensive outcrop of Pennsylvanian-age rock occurs where the DMR flows against the valley wall in the southwestern portion of the study area (Figure 18).

Detailed subsurface investigations were conducted on the east side of the DMR in the southern portion of the valley meander (13BN38 and 13BN277) and on the west side of the DMR where a southeast-flowing tributary enters the DMV (13BN203).

Site 13BN38 is located on TH (Benn and Bettis, 1985:73-75). A transect of drill holes across TH indicates that the deposits vary from 3.5 to 5 m thick in this area. Because of the presence of a prominent abandoned channel and associated levee the TH surface in this area exhibits more relief than is typical. Nevertheless the sedimentary sequence of this TH remnant (Appendix B, profile 08AB29) is very similar to other TH remnants in the project area. Surface soils on this TH remnant are generally not as well expressed morphologically as those on other TH remnants in the project area. In addition, the total thickness of TH here is less than in most other areas. It is possible that this TH remnant is, in part, younger than most others in the Saylorville Lake area.

The presence of a Middle Woodland component dating from ca 2050-1550 B.P. (ibid.:26) on the surface of TH at 13BN38 indicates that TH sedimentation had ended at this locality by about the same time it had elsewhere in the project area. A poorly-drained, seepy area is present on the east edge of TH. Seeps are emerging from the Pennsylvanian sequence making up the steep slope forming the eastern boundary of TH. Core 30 showed 3.5 m of dominantly fine-textured very poorly-drained to reduced alluvium overlying Pennsylvanian shale in this area. These deposits are equivalent to TH deposits.

North of the TH remnant a prominent bench stands approximately 1.5 m above the TH surface. Hole 24 (Figure 18) was drilled on this bench. This hole encountered a thick Mollisol with an argillic (Bt) horizon developed in silty and loamy alluvium/colluvium burying Pennsylvanian siltstone at a depth of 2.55 m (Appendix A). This bench and the deposits on it may be early Holocene in age and time equivalent to earlier portions of TH (finer textured portion below the paleosol) in other parts of the valley. If this is true, it is probable that the other TH remnant to the south at 13BN38 was deposited during the late to middle portion of TH accumulation elsewhere in the valley.

A prominent scarp descends from the bench and TH to TI. At hole 25 (Figure 18) two buried soils were encountered at 2.04 and 3.54 m below the land surface developed in loamy TI deposits (Appendix B, profile 08AB25). The TI is well exposed along the river northwest of hole 25. 13BN277 is located in TI deposits along this exposure (ibid.:75-78). The TI exposure reveals several fining-upward sequences, grading from sandy loam to loam. This sedimentary sequence is also evident in the particle-size and organic carbon plots of hole 08AB25 (Appendix B). Buried Entisols (A-C soil profiles) and Inceptisols (A-Bw-C) are developed in the upper part of several of these fining-upward sequences. The buried soil surfaces within TI are not level. As one would expect, relief on the paleosurfaces is similar to, but does not mimic, that on the present uncultivated TI surface. At least one buried point bar and upper portions of an associated abandoned channel are also evident along this exposure.

Burned rock collected from a clam midden resting on a rock strath at the extreme northern end of the TI exposure was thermoluminescence dated at 4200 - 1300 B.P. (Alpha-2072; Fig. 18). Since no plateau was present in the glow curve this date is a maximum age (Murray Tamers, Alpha-Analytic, Inc., personal communication). At this location 13BN277 is buried within slopewash from the early Holocene bench immediately to the east. The slopewash interfingered with DMR alluvium making up TI. Pottery collected downstream in upper portions of the TI exposure indicates a Woodland occupation. Woodland occupation of the central DMV spans the period from about 1550 to 850 B.P (ibid.:31-32). These upper and lower limiting ages indicate that TI in this study area accumulated during the same interval of time as elswhere in the project area.

Deposits making up the Low Terrace are present along the extreme inside bend of the river meander in the BN277-38 area (Figure 18). TL deposits are distinct from TI deposits in that they are much more stratified, contain abundant logs and organics and contain no buried soils. In addition, the surface soil on TL is much thinner than that on TI. A prominent scarp and associated abandoned channel separate TL and TI here. TL exibits pronounced and ridge-and-swale topography typical of this level elsewhere in the project area.

Across the river and north of the 13BN38 and 13BN105 area is a large, low-angle alluvial fan on which 13BN203 is located (Figure 18). Holes drilled on this fan encountered several buried soils in over 6 m of fan deposits (Appendix A, holes 08AB33-35; Appendix B, profile 08AB33). Organics collected 6.2-6.4 m below the fan surface yielded a radiocarbon date of 13,980 ±170 B.P. (Beta-

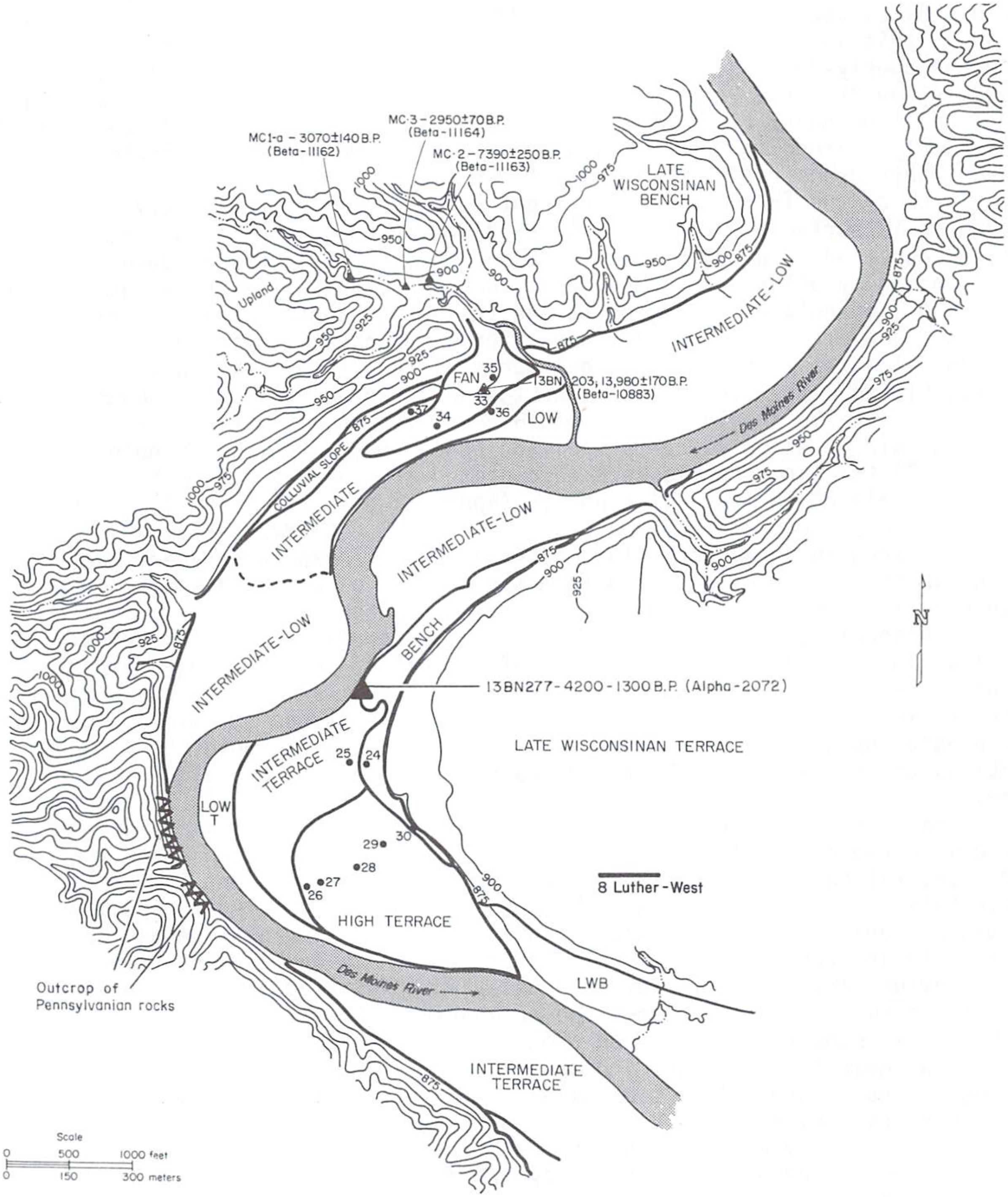


Figure 18. Map of Hubby Bridge study area showing location of drill holes, radiometric dates, and distribution of landform/sediment assemblages.

10883). This date is too old since Des Moines Lobe ice was covering this area at that time. Possibly the organics were contaminated with small fragments of Pennsylvanian coal or Cretaceous lignite eroded from rocks or till along the valley wall or in the tributary valley feeding the fan.

A steep scarp separates the alluvial fan on which BN203 is located from TI to the east. Core 08AB36 was taken from TI. It revealed five AC soil profiles developed into the sediments making up TI. TI is also exposed in a cut bank downstream from the BN203 fan (Figure 18). The deposits exposed here are very similar to those described at 13BN277 across the river. TI merges gradually with TL on the downstream end of the cut bank. At this location there is no sharp break between youngest TI deposits and TL deposits. East of hole 36 where TL cuts out older TI deposits the two levels are separated by a short, steep scarp.

A brief reconnaissance up the tributary above the 13BN203 fan resulted in the discovery of datable material in the tributary alluvium. A high, 4-5 m thick terrace dominates the tributary valley. The modern stream is incised approximately 4 m below the surface of this terrace. Deposits making up the terrace consist of oxidized silt loam and loam. One buried Mollisol and several buried Entisols were observed in various exposures in the terrace. Radiocarbon dates on charcoal collected from within the terrace deposits (2070 ±140 B.P. -Beta-11162; 2950 ±70 B.P. -Beta-11164; 7390 ±250 B.P. -Beta -11163) indicate that the tributary terrace deposit accumulated comtemporaneously with the alluvial fan at the tributary mouth. Inset into the high tributary terrace deposit is darker colored, stratified loamy alluvium which is probably late Holocene in age and correlative with TI and TL in the main valley.

Xenia Area

The Xenia study area is located in approximately the center of reach 4 southwest of Madrid in northeastern Dallas County (Figure 17). In this area the DMR is incised approximately 53 m (175 ft.) below the uplands into Des Moines Lobe till, Wisconsinan-age loess, Pre-Illinoian-age till, and Pennsylvanian-age bedrock (dominantly shale in this area).

A high meltwater channel of the DMR occupies the eastern part of this area (Figure 17). This meltwater channel is present between 24.8 and 25.6 m (815 and 840 ft.) in elevation and is the highest and oldest DMV remnant in the southern part of the project area. Today Mosquito Creek occupies the broad sag marking the former valley course. Several late Wisconsinan benches are cut below the highest level. Prominent groups of benches are evident at about 28 m (920 ft.), 27.4 m (900 ft.), 27.1 m (890 ft.), and and approximately 26.7 m (875 ft.) (Figures 17 and 19). Sands and gravels mantling the cut surface of the benches rest on a variety of materials. The large bench in the southern portion of the Xenia area is cut into shale and siltstone of the Floris Fm. while the bench at roughly the same elevation on the northern end of this area is cut into Wisconsinan loess and Pre-Illinoian till (X on Figure 19).

Both of the broad lower benches in the Xenia area are in part mantled with Holocene alluvium from intermittent streams, alluvial fans, and colluvial slopes. Hole 68 was drilled on the northern bench west of the gravel road (Figure 19; Appendix A). At this location 1.13 m of dark-colored late Holocene alluvium overlies stratified silty and loamy early to mid Holocene alluvium. Colors of the deposits as well as the presence of moisture-tolerant vegetation here and there across this bench indicate that the water table is high in this area. One hundred fourty centimeters of loamy and sandy Holocene alluvium/colluvial deposits bury the cut surface of the bench in the southern portion of

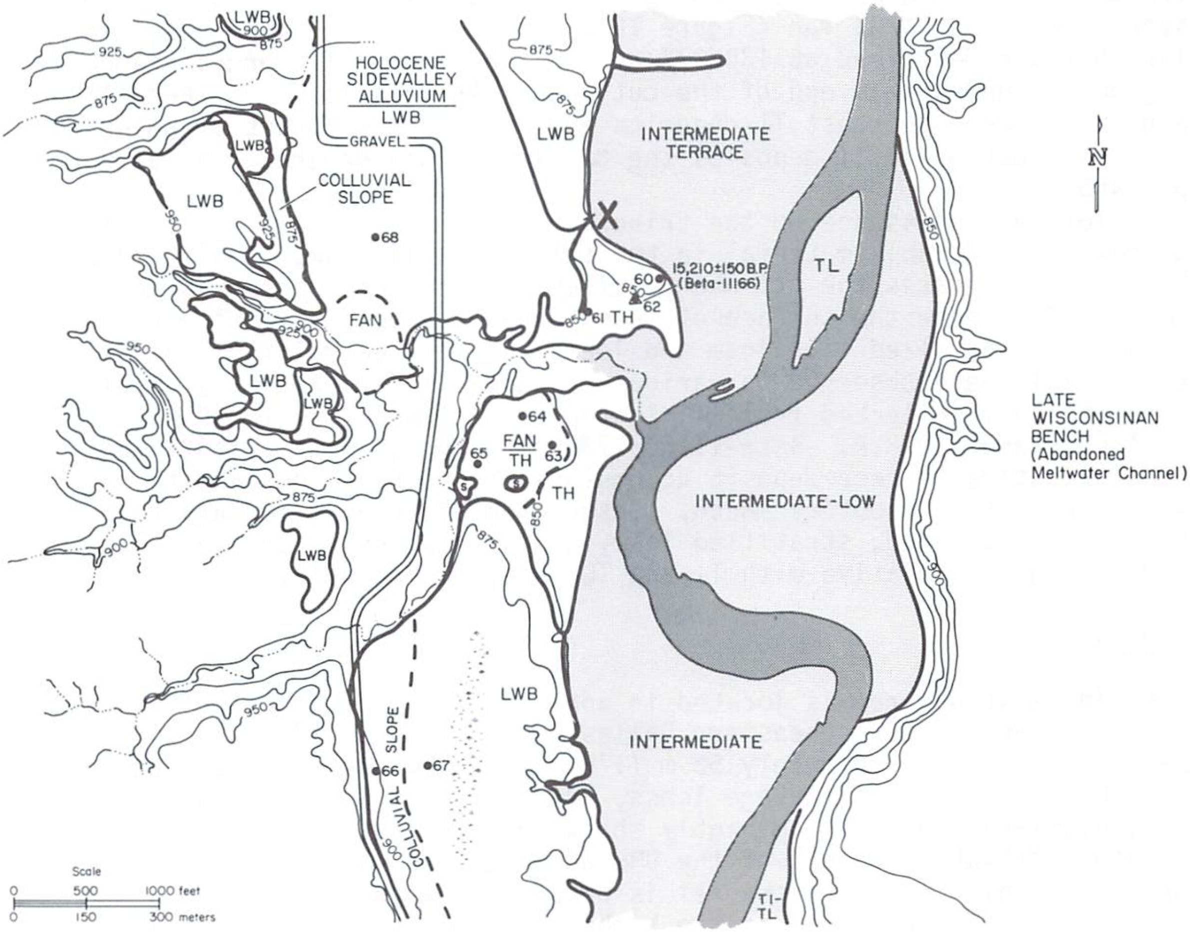


Figure 19. Map of Xenia study area showing location of drill holes, radiocarbon date, and the distribution of landform/sediment assemblages. The shaded area is innundated by Saylorville Lake.

the Xenia area. Hole 67 encountered late Wisconsinan sand and gravel beneath the Holocene deposits (Figure 19; Appendix A). East of hole 67 a large seepy area is present on this bench. Water was standing on the surface at the time of our investigations in this area. Hole 66 was drilled farther to the west on a small, steep alluvial fan making up part of a larger colluvial slope along the western valley wall (Figure 19). At that location 1.52 m of loamy alluvial fan deposits mantle sandy and gravelly late Wisconsinan alluvium (Appendix A).

A High Terrace remnant is present in the central portion of this study area (Figure 19). TH is bisected by a west-flowing tributary. A transect of three holes (60-62) was drilled across the northern TH remnant (Appendix A). Three buried soils were recorded within the silty alluvium making up TH at hole 60 along the eastern terrace margin (Appendix B, profile 08AB60). The lower two buried soils were Inceptisols (A-Bw-C) while the uppermost was an Alfisol (A-BE-Bt-C). To the west at holes 61 and 62 only two buried soils were evident (Appendix A). In both cases the uppermost was the most well expressed and had an argillic (Bt) horizon while the lower was an A-C or A-Bw-C profile.

At 6.3 m below the land surface in hole 62 and 5-6 m below the surface in hole 61 the deposits became firm and were reduced. Organics collected 7-7.4 m below the surface in hole 62 yielded a radiocarbon date of 15,210 ±150 B.P. (Beta-11166). The sample contained abundant spruce needles and macrofossils of aquatic plants. We interpret this as pre-Des Moines Lobe late Wisconsinan alluvium which probably accumulated in an upland depression or small drainageway. Advancing Des Moines Lobe ice buried this locality about 14,000 years ago. The firmness of the upper part of the late Wisconsinan alluvium was probably produced by glacial loading.

The presence of several buried soils at hole 60 along the eastern TH margin coupled with the fact that TH deposits fine toward the center of this TH remnant (Appendix B, compare profiles 08AB60 and 08AB62) suggest that we have a natural levee-backswamp transition preserved in this area. Hole 60 and the eastern TH margin are in the levee area while hole 62 is in the backswamp. Moving to the west from hole 62, deposits coarsen again toward the former scarp against the late Wisconsinan bench (Appendix A, compare profiles 62 and 61). A Middle Archaic through Woodland archaeological site, 13DA162, is eroding out of TH along the natural levee area.

Three holes were also drilled on the southern TH remnant in the Xenia area (Fig. 19). A low-angle alluvial fan mantles the surface of TH in this area. All holes drilled in this area revealed a buried soil developed in TH deposits beneath coarser fan deposits. The fan deposit was quite thin (1-2 m) and had a surface soil with A-Bw-C profile sequence developed into it. No soils were found buried within the TH sequence in this area.

The southern TH remnant suffered extensive disturbance during the early 20th century by coal mining activity. The southern portion of this area was the site of the coal mining town of Scandia (Hastie, 1938; Benn, 1985a:79). At the time of our field investigations and when Saylorville Lake is at flood pool level Holocene surfaces below TH are innundated in the Xenia area (Fig. 19).

<u>Stratigraphy, sedimentology and distribution of landform/sediment assemblages within the reaches.</u>

The foregoing discussions have outlined, in general terms, the nature of the valley landscape in each of the six reaches and, in more specific terms, the stratigraphy and chronology of portions of the landscape within three of the reaches (6, 5, and 4). Bettis and Benn's (1984; Benn and Bettis, 1981) investigation of the Downstream Corridor provides the detailed stratigraphic and chronologic information for reaches 1 and 2. Most of the Holocene terrace levels in reach 3 are flooded by Saylorville Lake. Limited subsurface investigations were carried out in this area by Iowa State University archaeologists prior to the closing of Saylorville Dam (Osborn and Gradwohl, 1981; 1982, Gradwohl, 1975). This information, in conjunction with the more detailed studies up and downstream, permit assessment of the Holocene deposits now covered or destroyed by Saylorville Lake. This section will discuss the stratigraphy and distribution of the various landform/sediment assemblages within the six reaches in the project area. This provides the background information for assessing the influence of DMV fluvial history on the preservation and visibility of the archaeological record.

Reach six is the northern-most within the project area (Fig. 15). Here the river flows along numerous sweeping valley meanders and is deeply entrenched in a narrow, canyon-like valley. Late Wisconsinan benches and terraces are very abundant, especially on the inside bend of the large valley meanders where they occupy slip-off slopes. Alluvial fans are very abundant within this reach (Table 2). These occur where tributary valleys enter the main valley in three settings. The first is on late Wisconsinan benches and terraces at a distance from the present river. In this situation the fans mantle underlying late Wisconsinan sand and gravel. These fans are steep and relatively small when the tributary valley is cut into till and/or bedrock. When the tributary cuts through sand and gravel on higher benches or terraces the fan is low angle and generally larger, probably due to the lower angle of repose of the coarser materials and repeated shifting of the feeder stream across the fan (Harvey et al., 1985). Small fans also occur as part of larger colluvial slopes. These are generally small steep fans found along steep valley walls.

Investigations at the Corrington alluvial fan in the Little Sioux Valley of western Iowa (Hoyer, 1980) and at the Koster and Napolean Hollow fans in the Lower Illinois River valley (Hajic, 1981a; Wiant et al., 1983) indicate that sedimentation and erosion was not uniform across exposed fan surfaces. Sedimentation rates were greater in proximity to the feeder stream, whose location usually shifted through time (White, 1982:19-29; Schumm, 1977:252-255). Erosion of the fan surface would be concentrated in the feeder stream's channel and where rills developed along oversteepened portions of the fan surface. The most significant type of alluviual fan erosion, in regard to the archaeological record, has been that caused by migration of the DMR and downcutting of fan head trenches after the bulk of the fan had accumulated.

Reach 6 contains about half of the area occupied by alluvial fans and 23 percent of the area occupied by colluvial slopes in the area above Saylorville Dam (Table 2). Overall, though, the area occupied by these landform/sediment assemblages is small compared to that occupied by other landform/sediment assemblages.

The High Terrace (TH) landform/sediment assemblage is the highest and oldest of the DMV Holocene terrace sequences. This occurs as a relatively level, featureless surface elevated three to five meters above the DMR floodplain. TH remnants are most common on the inside bend of the large valley meanders within this reach (Fig. 15). Immediately downstream of large tributaries, TH and low-angle alluvial fans grade into each other. On Table 2 these areas are recorded as Fan/TH.

Deposits making up TH consist of oxidized silty and loamy alluvium deposited by the DMR. These deposits are usually calcareous at depth and were probably all calcareous when deposited. Nearly all cores extracted from TH

TABLE 2

Central Des Moines River Valley -- Saylorville Lake Area; area occupied by landform/terrace levels (hectares)

Reach	FAN/LWB	Fan/Colluvial Slope	Fan	Fan/TH	TH	TI	TI/TL	TL
Fraser → Turkey Creek								
Total area	6.3	4.9	51.9	48.6	383.8	336.7	135.2	117.1
% of reach	1	.4	5	4	35	31	12	11
% of reservoir	.1	.1	1	1	10	9	3	3
% of level in reservoir	*	23	48	45	39	22	21	29
Turkey Creek → Hwy. 210								
Total area	18.4	9.8	32.6	11.1	54.7	354.4	124.5	11.2
% of reach	3	2	5	2	9	57	20	2
% of reservoir	.5	.2	1	.3	1	9	3	0.3
% of level in reservoir	*	46	30	10	6	23	19	3
Hwy. 210 → Mosquito Ck.								
Total area	*	*	*	23	67.9	224.6	147.5	34.7
% of reach				5	14	45	30	7
% of reservoir				1	2	6	4	1
% of level in reservoir				22	7	14	23	8
Mosquito Ck. → Dam								
Total area	*	6.8	24.7	25.4	474.2	649.0	241.6	247.7
% of reach		.4	1	2	28	39	14	15
% of reservoir		.2	1	1	12	17	6	6
% of level in reservoir		31	22	23	48	41	37	60
TOTAL AREA		21.5	109.2	108.1	980.6	1564.7	641.8	410.7

* individual occurrences of these levels are very small and difficult to map at this scale.

revealed at least one buried soil. A buried soil developed in the finest-textured portion of TH was consistently recognized throughout the reach. This same soil was also recognized in DMR deposits buried beneath alluvial fan deposits in several areas. In some cases, such as 13BN27 and downstream of large tributary valleys, TH and alluvial fan deposits interfinger. Stratigraphic relationships as well as radiocarbon dates demonstrate that TH and alluvial fans accumulated during the same interval of time from the early Holocene to the early late Holocene.

The bulk of the TH deposits examined in cores and trenches are overbank deposits which accumulated during flood events on the DMR. Portions of TH which remained near the channel for extended periods are composed of loamy natural levee deposits. Those portions of TH on the valley wall side of the levee are finer textured and are referred to as backswamp areas. TH channel deposits are at or slightly below the present river level. Technical difficulties associated with drilling and extracting saturated sand and gravel prevented examination of Holocene channel deposits of the DMV. Bridge borings and seismic profiles across the valley at the junction of Mineral Branch Creek in northern Boone County and along old U.S. 30 west of Boone indicate that sands and gravel, some of which may be Holocene channel deposits, are generally less than 15 m thick (Thompson, 1984:19-20).

The presence of buried soils within the TH sequence indicates that TH sedimentation was not continuous. Periods of aggradation were punctuated by periods of little or no sedimentation and soil formation. The consistent buried soil developed in the fine-textured part of TH marks a period of valley stability which affected the entire study area. Surface soils developed on TH are Mollisols and in a few areas, Alfisols. These soils are usually thick, exibit textural B horizons and contain greater than 1.8 percent organic carbon in the surface horizon (Appendix B).

The largest accessible area of TH in the project above Saylorville Dam is within reach 6 (Table 2). As previously mentioned, however, TH is not uniformly distributed throughout the reach. A few large TH remnants located on the inside bend of large valley meanders account for the bulk of this landform/sediment assemblage in reach 6 (Fig. 15).

TI is separated from TH by a steep scarp and is 3 to 5 meters lower in elevation than TH within this reach. TI occupies the highest portions of the modern DMR floodplain. Surface relief is greater on TI than on TH. Numerous alluvial landforms, such as natural levees, point bars, chutes, and abandoned channels are evident on TI. These features are often subdued because of masking by variable amounts of later overbank deposits. Several subtle terrace levels are often observable in the area encompassed by TI. These descend in elevation toward the present DMR channel. In many areas lower lying TI deposits are buried by TL deposits.

TI deposits consist of dark-colored loamy and silty overbank alluvium of the DMR. Deposits are calcareous at depth and most of the TI deposit was probably calcareous when deposited. Stratification is much more evident in TI than in TH. TI is composed of several superimposed fining-upward sequences. Entisols are often developed in the upper part of the fining-upward sequences. These soils may represent episodes of localized floodplain stability produced by migration of the channel away from an area or conversely, they may represent valley-wide periods of infrequent flooding and minimal overbank deposition. Surface soils on TI are Entisols (A-C profiles) or minimally developed Mollisols (A-Bw-C profiles). These soils have less than 1.5 percent organic carbon in their surface horizon (Appendix B). TI deposits occur throughout reach 6 and are most extensive on the inside bend of large valley meanders.

TL occurs between the DMR and TI throughout much of reach 6 (Fig. 15).

This is the lowest portion of the modern floodplain. In reach 6 a prominent scarp usually separates TL from TI. In addition, TL truncates TI natural levees and abandoned channels. TL is marked by numerous natural levees, chutes, point bars, and abandoned channels. These alluvial landforms are not as masked with overbank deposits as they are on TI. As a result, surface relief on TL is greater than on TI.

TL deposits tend to be slightly coarser and much more stratified than TI deposits. Beds of organic materials and logs are common in TL deposits. Some TL deposits are calcareous while others are not. No buried soils were observed in TL. Surface soils on TL are Entisols.

In some areas no scarp is evident separating TI and TL. Deposits in those areas usually have properties intermediate between those of TI and TL. These are designated TI-TL on Table 2 and the figures.

Reach 5 differs from reach 6 primarily in the fact that Pennsylvanian rocks outcrop much more extensively in reach 5. Thick Pennsylvanian-age sandstone channel fills are restricted to the northern portion of reach 5, and are especially abundant in and around Ledges State Park. Along Peese Creek, a major tributary flowing through Ledges State Park, vertical cliffs, palisades and rock overhangs of the sandstone are abundanat.

Late Wisconsinan benches and terraces are abundant in reach 5. These occur on the inside bend of valley meanders, just as in reach 6, and also along straight valley reaches as several levels stepping down toward the valley floor. The distribution of alluvial fans and colluvial slopes is similar to the situation in reach 6. About three times as large an area of fans mantling benches and twice as large an area of colluvial slopes are present in reach 5 (Table 2). Several large, low-angle alluvial fans are present in this reach. TH remnants are not abundant in reach 5. Those that are present are most common on the inside bend of valley meanders such as that at the Hubby Bridge study area (Fig. 18). TH decreases in elevation relative to TI and TL in this reach and is usually elevated 2-3 m above TI. The character and distribution of TI and TI-TL in reach 5 are very similar to their distribution in reach 6 (Fig. 17; Table 2). Very little TL is present in this reach. This suggests that the channel location has not changed much during the last several centuries.

Reach 4 extends southward from State Highway 210 to the junction of Mosquito Creek and the DMR. Late Wisconsinan benches are common in this area and are dominated by stair-step-like flights ascending to the upland. A very high abandoned DMR meltwater channel is present south of the City of Madrid and north of the present DMV (Fig. 17). Mosquito Creek occupies the downstream portion of this abandoned channel. The DMV is deeply incised into a narrow gorge south of the abandoned channel. Late Wisconsinan benches are also present along this younger gorge (Fig. 17). The southern valley wall of the DMV in this area is composed of Pennsylvanian rocks containing abundant thin limestone beds.

Alluvial fans and colluvial slopes are very rare in reach 4 (Table 2). Two large TH remnants (at the Xenia area and where State Highway 17 crosses the DMR) make up the bulk of TH in reach 4 (Fig. 17). Meandering and migration of the DMR during the time TI and TL were accumulating voided (eroded away) many older valley deposits (TH, alluvial fans, colluvial slopes). TH continues to decrease in elevation relative to TI and TL; in this area TH is 2-3 m higher in elevation than TI.

The distribution of TI and TI-TL is similar to that in reaches to the north (Fig. 17; Table 2). A large, low-angle alluvial fan partially buries and merges with TI just downstream of State Highway 17 on the south side of the valley (Fig. 17). This fan is late Holocene in age and apparently developed after the DMR migrated into the valley wall during the early part of TI accumulation. Many of the lower TI levels and all TI-TL areas are innundated by Saylorville Lake at flood pool level. TL occupies a greater proportion of reach 4 than of reach 5 (Table 2). This indicates that the channel position has changed more in this reach during the last several centuries than it has in reach 5.

Reach 3 extends from Mosquito Creek to Saylorville Dam (Fig. 20). This area is occupied by Saylorville Lake at normal conservation pool level. Pennsylvanian rocks (dominantly shales) outcrop along nearly the entire western valley wall in this reach. These rocks outcrop along the eastern valley wall only at and directly north of Saylorville Dam. The valley is not as deeply incised into the upland and is much wider in this reach than it is to the north. Late Wisconsinan benches occur intermittently along the western valley wall and are more or less continuous along the eastern valley wall. These benches occur in stair-step fashion, ascending to the upland. Since the Holocene valley floor in this reach is innundated it could not be mapped in the field. Information from above and below this area combined with data from archaeological investigations in reach 3 prior to the closing of Saylorville Dam allow us to map the terrace levels now beneath Saylorville Lake with certainty.

The DMR meanders more within this reach than in those to the north. This is to be expected since the river gradient in this reach is the steepest in the project area. The DMR within the project area plots in the upper part of the meandering stream area on Lane's (1957) diagram of channel slope versus mean annual discharge. The DMR compensated for increased gradient in reach 3 by an increase in sinuosity, effectively lengthening the river in this area. Alluvial fans and colluvial slopes are abundant in this reach (Table 2). Both large, low-angle and smaller, steep fans are common. Numerous steep, small fans were present along the valley wall prior to the closing of the Saylorville Dam. Large low-angle fans and most of the colluvial slopes were present along the eastern valley wall (Fig. 20). Archaeological investigations at 13PK175, located on and in a large, low-angle alluvial fan just south of the Polk City High Bridge, and at 13PK251 west, located in the Acorn Valley recreation area (Benn, 1985b), indicate that the stratigraphy of fans in this area is similar to that elsewhere in the reservoir (unpublished maps on file at Iowa State University Archaeology Laboratory).

South of Big Creek valley the eastern valley wall has a gentler slope than it does to the north. Several sandy late Wisconsinan benches are present in this area. Upper portions of the outwash on these benches have been reworked by wind during the Holocene. In addition, sandy slopewash has accumulated to depths of 2-4 meters along the base of the valley slope in this area. Site 13PK165, the Saylorvillage Site was located within the upper part of one of these sandy colluvial slopes just north of Saylorville Dam (Osborn et al., 1978).

Reach 3 contains 48 percent of the TH area in the project north of Saylorville Dam (Table 2). Several large TH remnants are present in reach 3 (Fig. 16). All except one are located on the east side of the valley. This indicates that the DMR has been migrating westward across the valley floor during the late Holocene. TH is elevated 2-3 m above TI in this area.

Reach 3 contains more TI, TI-TL, and TL acreage than any other reach north of the dam. These areas are marked by abandoned channels, chutes, and natural levees. Several intermittent oxbow lakes were present in these areas before closing of the dam. The extensive post-TH area in this reach indicates that the channel has moved back and forth across the valley floor quite a bit during the last 4,000 years. Excavations at 13PK149 and 13PK183, both located on and in TI show that the nature of these deposits in reach 3 is very similar to TI deposits farther up the valley (Osborn and Gradwohl, 1981:112-118, 291; Timberlake, 1981; unpublished maps and descriptions on file at Iowa State University Archaeological Laboratory).

Reach 2 is located south of Saylorville Dam to the junction of Saylor Creek (Fig. 20). The DMV cuts across the abandoned Beaver Creek outwash channel in this area. Small late Wisconsinan benches are present along both valley walls at and below 26.2 m (860 ft.) in elevation. The abandoned Beaver Creek channel, at 26.2 - 25.6 m (860 - 840 ft.) in elevation forms both "valley walls" from about 3 km south of the dam to the southern border of this reach.

Alluvial fans are common in this area and are restricted to the eastern valley wall (Table 2; Fig. 20). Many of these interfinger with TH (Bettis and Benn, 1984). An extensive TH remnant is present below Rock Creek on the eastern side of the valley. Another TH remnant on the west side of the valley just north of I-80 is currently being destroyed by gravel pit operations. Investigations by Benn and Bettis (1981) indicate that the properties of TH in reach 2 are similar to those in reaches 6 through 4.

A unique aspect of reach 2 is the extensive backswamp development on the valley wall side of the TH remnant east of the river. Small streams draining the eastern upland join Saylor Creek along the base of the valley wall and flow southward. Some of this area has been artificially drained. Most of the TH in reach 2 is outside the limits of Corps ownership.

The largest tracts of TI, TI-TL, and TL in the central DMV are present in reach 2 (Table 2; Fig. 20). These areas are present within large abandoned meander loops (Benn and Bettis, 1981). Investigations by Benn and Bettis (ibid) show that the properties of the valley deposits in reach 2 are very similar to those elsewhere in the project area.

Reach 1 extends from Saylor Creek to the terminus of the Des Moines Lobe in the City of Des Moines (Fig. 20). The valley along this reach is very narrow. Pennnsyvlanian bedrock outcrops extensively along both valley walls. No subsurface investigations have been conducted in this area. No alluvial fans, colluvial slopes or TH remnants are present in this reach due to later migration of the DMR across the entire valley floor. TL is very extensive in this reach indicating very active river migration during the last few centuries. Urban development has extensively disturbed the valley surfaces in reach 1.

Tributary Valleys

Tributary valleys began developing as the DMR downcut rapidly during the late Wisconsinan. As discussed previously, some of the larger tributaries probably formed along former subglacial and/or supraglacial drainage lines. Several tributary valleys were walked and deposits within them were examined in bank exposures and with hand probes. These valleys have steep gradients and are floored on glacial till, loess, or Pennsylvanian bedrock in their upper and middle reaches. Both large and moderate-sized tributary valleys appear to have similar morphology and stratigraphy. At least one and usually several prominent terrace remnants are elevated several meters above the present stream level. Deposits in these terraces consist of oxidized loamy alluvium, usually with a lag of gravel or pebbly loam at their base. The terrace bases are usually exposed in the upper reaches where the modern stream cuts into underlying pre-Holocene deposits. In middle reaches the base of the terraces is usually at or near the present stream level. The terrace bases are below modern stream level in the lower reaches of the tributaries. The presence of several terrace levels in the upper reaches indicates that downcutting was episodic during early development of the tributary valleys. This is also the pattern observed in late Wisconsinan terraces and benches in the DMV. Most likely the tributary valley downcutting was in response to downcutting in the main valley. Often several terrace levels in the upper reaches will gradually merge to form one level in the middle and lower reaches. These high tributary terraces appear to grade to alluvial fans at the junction of the tributaries with the DMV. Often colluvial slopes and small alluvial fans merge with the valley wall side of these terraces. The surface soils on these upper level terraces are usually Alfisols (Appendix A, 13BN271).

Very limited dating of tributary valley alluvium was undertaken during this project. Dates from the valley above the alluvial fan on which 13BN203 is located indicate that the extensive high tributary terrace in this valley accumulated during development of the alluvial fan at the tributary's mouth. At 13BN271, located in the tributary valley above Sportsmans Access (Benn, 1985b), Woodland artifacts were found in upper parts of a terrace remnant elevated above the modern floodplain. A similar pattern of Woodland site distribution has been documented on alluvial fans and TH in the DMV (ibid.; Bettis and Benn, 1984). Just as in the main valley, maximum downcutting in lower portions of the tributaries had occurred by around 11,000 to 10,000 B.P. Following that, the tributaries alluviated in conjunction with the fans at their mouth.

A lower terrace or floodplain level is inset below the upper level tributary terraces. Deposits making up this lowest level are usually darker colored than those comprising the upper level. The lower level usually occupies the greatest area in the tributary valleys. Deposits making up the lower level are probably late Holocene and Historic in age. These deposits are probably equivalent to those filling the fan head trench at 13BN279 and to those making up TI and TL in the DMV. Soils developed on the lower level in the tributary valleys are Inceptisols (A-Bw-C profiles) and Entisols (A-C profiles).

Small tributaries (those less than about .5 km in length) are very steep and have V-shaped valleys with little or no floodplain area. Only small patches of pre-late Holocene alluvium are preserved in these valleys. Most of their valley floor is late Holocene and Historic in age. Often, trenched, steep-angled fans are found where these tributaries join larger tributaries or the DMV.

Some tributaries have witnessed extensive reworking of their Holocene alluvium during the Historic period. An example of this situation is present in Stringer Creek which forms the northwestern border of the 13BN27 area near Boone. Older terrace levels are very infrequent and are perched high above the present floodplain. Several terrace levels are present below these patchy high levels. The lower levels are loamy and sandy and contain Historic artifacts. This valley was the site of an Historic kiln and intensive coal mining activity (Gradwohl and Osborn, 1976). These activities in conjunction with forest clearing greatly increased slope erosion and runoff which caused Stringer Creek to downcut and meander across its entire valley floor during the last 100 years.

Chronology of Landscape Evolution in the DMV

Radiocarbon dates, in conjunction with age estimates based on archaeological remains enclosed within the landform/sediment assemblages, allow us to outline the chronology of the Holocene evolution of the DMV. The dates on which this chronology is based are presented in Appendix C. Benn (1985a) provides a detailed discussion of the archaeological data.

By about 11,000 B.P. the DMR had downcut to a level slightly deeper than that at which the present river flows. By that time the Des Moines Lobe glacier had retreated out of the DMR basin and the Holocene river regime was being established. Tributary valleys were actively downcutting and lengthening, supplying large volumes of loamy sediment to the river. From about 11,000 to 7,000 or 6,000 B.P. the river meandered across the valley floor and deposited silty and fine-loamy overbank deposits. Alluvial fans began to accumulate where tributary valleys joined the main valley. It seems likely that the large volumes of sediment being brought to the main valley by the tributary streams may have acted to deflect the main channel away from the tributary junctions, allowing the fans to prograde into the main valley. Between about 6,500 and 6,000 B.P. sedimentation in the main valley slowed appreciably and soils began to develop on the early middle Holocene floodplain.

Shortly after 6,000 B.P. sedimentation rates increased and loamy alluvium began to bury the soils developed during the early middle Holocene. From this time until about 4,000 to 3,500 B.P. rapid alluviation of the DMV continued. Alluvial fans accumulated concurrently and, in many areas interfingered with the floodplain deposits.

Around 4,000 B.P. the DMR began a short downcutting episode. This left the former floodplain level as a terrace now referred to as TH. Soils began developing on the TH surface at that time. Fans continued to accumulate where tributary valleys joined the main valley. From 4,000 B.P. until the present the DMV continued to meander across its valley floor. This area is marked by the occurrance of TI and TL today. During large floods portions of TH received small amounts of sediments. These areas were restricted to portions of TH close the DMR channel, especially in portions of the valley below Boone where TH is not elevated as far above TI as it is to the north. TH also continued to receive sediment along the base of the valley wall and where tributaries crossed it.

Sometime around 3,000 to 3,500 B.P. fan head trenches developed and sedimentation on alluvial fan surfaces virtually ceased. Central portions of the fans were truncated by their feeder streams and the modern surface soils began to develop across the fan surfaces.

Between 4,000 B.P. and today, the DMR downcut slightly (2-3 m) as it migrated laterally across the valley floor. As a result, TI consists of several individual terrace levels separated by short scarps. These individual levels can not be traced a great distance up or down the valley with any certainty. As the channel migrated away from an area, the area became less and less susceptible to rapid sedimentation and soils began to develop in the surface. This phenomena has produced soil development sequences across adjacent TI levels of differing age (Bettis and Benn, 1984:220). Sometime around 750 B.P., the DMR downcut slightly again and abandoned a series of large valley meanders between its junction with Mosquito Creek and Saylor Creek. The area across which the DMR has migrated and meandered since that time is TL. Sedimentation has continued on most TI levels, although it has been of much greater magnitude on the lower levels. In contrast to the period from 10,500 to 4,000 B.P., sediment delivery to the main valley during the last 4000 years has been minimal. During this period the DMV has been primarily reworking deposits delivered to the valley prior to 4,000 B.P.

Hillslopes

The entire landscape can be subdivided into various hillslope elements. For the purpose of this discussion we will restrict our discussion of hillslopes to those elements making up the upland and valley walls in the Saylorville Lake area. Several models of hillslope development have been formulated. The model outlined by Ruhe and Walker (1968) is applicable to both the upland and valley wall elements of the Des Moines Valley landscape.

In their model Ruhe and Walker divide a hillslope into profile elements and geomorphic components where the itensity of erosion vs deposition varies in a systematic fashion. The profile of a hillslope descending from the level upland to the base of the slope successively crosses: summit, shoulder, backslope, footslope, and toeslope. These hillslope elements are outlined diagramatically in Figure 21. The summit is the most stable area, the shoulder and backslope are zones of net erosion, while the footslope and toeslope are depositional areas. Slopes are not two dimensional, but instead occupy three dimensions. Hillslope profiles are parts of larger geomorphic components which comprise the landscape. These geomorphic components are: interfluve-- upland areas located between hillslopes; headslope-- the head of a tributary valley where slope lengths converge; sideslope-- forms the sides of the valley, slope lengths are generally parallel in these areas and; noseslope-- located at the valleyward end of the interfluve where slope lengths diverge downward.

In general, noseslopes are areas of net erosion while headslopes are areas of net slope deposition. Obviously the lower portions of both areas (footslope, toeslope) are depositional areas while headward erosion of a tributary can cause erosion in a headslope. Another important aspect of hillslopes, and the landscapes that they are portions of, is that they evolve through time. An area that 10,000 years ago was a footslope may be in a toeslope position today, or an area that was a summit may now be a shoulderslope, and so on.

In the simplest of situations the hillslope is developed into a single, relatively uniform parent material. As an example applicable to the Saylorville Lake area, let's assume that the hypothetical hillslope is developed in Des Moines Lobe glacial till. The till is older than the earliest documented occurrence of man in the Midwest and therefore evidence of human occupation will not be buried within the till. Since its deposition about 14,000 years ago the till has been subjected to a host of pedogenic and geomorphic processes which have altered it in various ways. On the summit various amounts of windborn aerosols (dust) and blow sand, in conjunction with bioturbation, littering, freeze-thaw, and shrink-swell phenomena may have acted to bury prehistoric cultural material (Johnson and Hansen, 1974; Johnson et al., 1977; Baxter and Hole, 1967; Hole, 1981). Data presented in Stanley and Benn (1985) suggest that in the Saylorville Lake area most of the cultural material buried in summit positions will be found at or above the interface between the A (or E) and B soil horizons (Appendix A, profile 13PK299).

On the shoulder and backslope prehistoric cultural materials will be at or near the land surface, provided the parent material of the slope is older than 12,000 years. These are areas of net erosion and therefore deep burial is precluded. Often these hillslope positions exibit a weakly expressed stone line, an erosional lag. The stone line may be buried by a thin layer of slope sediment (pedisediment) derived from erosion upslope. Cultural materials may be buried in the pedisediment.

The most likely locations for the burial of prehistoric cultural materials along a slope profile are in the footslope and toeslope positions. Sites such as 13PK165 were buried in this position (Osborn et al., 1978). Large footslope and toeslope positions have been referred to as colluvial slopes in this report.

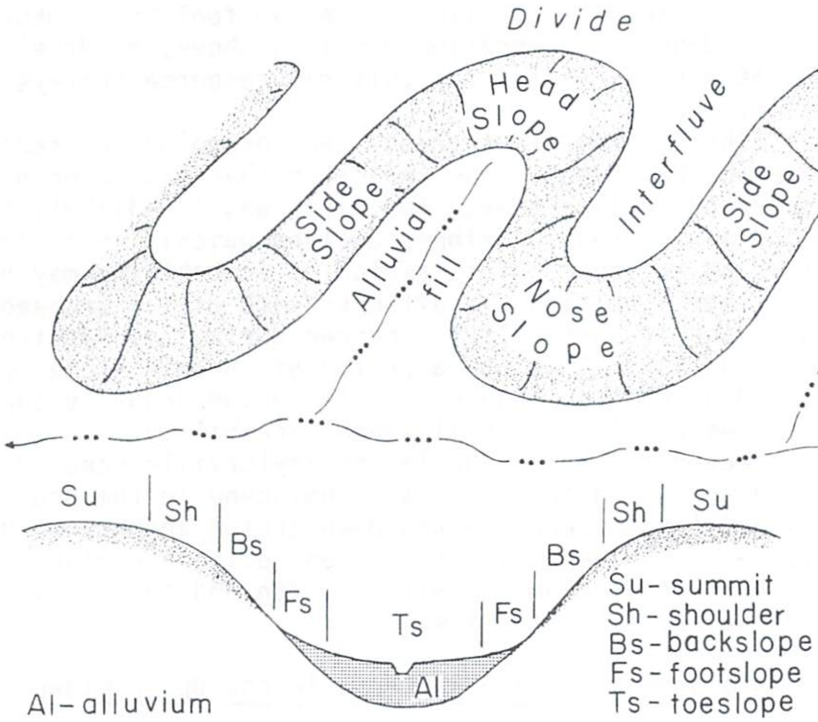


Figure 21. Geomorphic components of a hillslope. See text for explanation. Taken from Ruhe (1969).

Very little of the modern landscape is made up of the simple slopes discussed above. Instead most slopes consist of a complex array of summit - shoulder - backslope - footslope - shoulder - backslope - footslope - toeslope sequences (Hallberg et al., 1978b:2-18; Canfield et al., 1984:Fig. 1). Also, very few areas of uniform parent material are present on the Des Moines Lobe landscape. Holocene blowsand, alluvium, and slope deposits mantle, while other pre-Holocene materials outcrop along slopes. These differing materials may dramatically affect slope development (Canfield et al., 1984).

The major problem with developing maps and/or detailed models of the hillslope elements in the project area is the small scale of most individual elements and the variation of erosion and deposition processes across them. Phenomena such as tree fall, rilling, and slumping may impact relatively small areas at a given time, but can have a severe impact on the integrity of an archaeological site. Because of these limitations we feel that, other than the general erosion and deposition senarios outlined above, no detailed model of slope development at a scale useful for cultural resource surveys can be presented at this time.

Work by Walker (1966) on the stratigraphy and chronology of sediments in closed depressions on the Des Moines Lobe indicates that two major periods of slope instability occurred in this area. The first was immediately following deglaciation as buried ice melted and slopes evolved quickly in response to slumping, debris flow and collapse. This period of instability may have occurred too early to have significantly affected much of the archaeological record. The second period of instability occurred during the Hypsithermal from about 8,000 to 3,000 B.P. This was a period of intense slope erosion related to climatic and vegetation changes. This period probably consists of several distinct episodes of slope stability and instability.

Both episodes affected the landscape in the Saylorville Lake area. The first episode may have continued into the early Holocene in the project area because of slope instability fostered by the downcutting and headward migration of tributary valleys. Evidence for the second episode during the middle Holocene is found in the large volume of alluvial fan and colluvial slope deposits found on the valley floor margins.

Holocene Climate and Vegetation Patterns in the Upper Midwest

Reconstructions of Holocene climates in the midcontinent are almost entirely based on fossil pollen data. Pollen data preserved in water-lain sediments provide the relatively long, continuous, datable records necessary to evaluate temporal changes in vegetation patterns at specific sites. Geographic networks of pollen diagrams have permitted mapping of the changing vegetation and associated climatic patterns of the late glacial and Holocene (Bernabo and Webb, 1977; Bartlein et al., 1984; Webb et al., 1983).

Pollen studies have been conducted by Brush (1967) on cores from several upland fens on the Des Moines Lobe, by Durkee (1971) on a core from Woden Bog, also on the Des Moines Lobe, and by Van Zant (1979) on a core from Lake West Okoboji on the northwestern edge of the Des Moines Lobe in Iowa. Van Zant's was the most detailed study and also included a study of plant macrofossils associated with the fossil pollen. As part of the present investigation, the fossil pollen of a core collected from a small upland depression east of the DMV just in front of the Altamont Moraine in the northern portion of reach 6 was studied by Dr. R. G. Baker of the University of Iowa Geology Department. His report and pollen diagram is included at the end of this discussion.

By 12,500 B.P. the Des Moines Lobe glacier had retreated from the project area and was standing at the position of the Algona Moraine in northcentral Iowa. At that time a spruce-larch forest inhabited the area south of the glacier's margin, including the project area. This forest extended from north-central Nebraska to Ohio, and from Minnesota to Kansas.

Fir trees were a minor constituent of this forest but in sharp contrast to the modern boreal forest, pine was not present in any abundance. As the climate warmed toward the end of the late glacial, birch and alder increased in abundance while spruce declined (Van Zant, 1979:377). As birch and alder declined, black ash (*Fraxinus nigra*) increased in abundance. Black spruce may have survived in protected areas, such as valleys and around upland depressions, until around 11,000 B.P. or slightly later. In addition, some hardwood species (such as oak) were lesser components of this late glacial spruce forest (Baker et al., 1980). The lack of modern analogues makes it difficult to make paleoclimatic interpretations for the late glacial from the fossil pollen spectra. Bartlein et al. (1984:322) suggest that thermal contrast along the edge of the retreating Laurentide ice sheet may have been sufficient to lock in and stregthen the belt of westerlies there and, as the ice retreated northward, the axis of strongest westerlies accompanied it. As the climate shifted rapidly from boreal to more temperate, conditions for the regeneration of spruce trees became increasingly less favorable. Trees that replaced spruce were those that were already at hand or were good colonizers on space vacated by spruce (Webb et al., 1983:160).

By about 11,000 to 10,000 B.P. the late glacial boreal forest had given way to a deciduous forest dominated by oak and elm. This forest was closed at the beginning of this period, but as the climate became warmer and drier, herbs became more abundant as meadows opened in the forest (Van Zant, 1979:377). The early Holocene forest contained much more elm and other mesic deciduous trees than occur in deciduous forests in the region today. Webb et al. (1983:161-162) interpret this as indicating that the early Holocene (10,000 -8,000 B.P.) was more moist and had slightly cooler summers than are characteristic of the area today.

Between about 9,000 and 7,000 B.P. the Prairie Peninsula spread eastward rapidly (Wright, 1968). Fire may have aided the displacement of the hardwood forest and savanna and the spread of prairie (Van Zant, 1979:377). Pollen-derived estimates of climatic change show that from 9,000 to 6,000 B.P. annual precipitation decreased by as much as 20 percent across northcentral Iowa while the July mean temperature increased slightly (Bartlein et al., 1984:368); Webb, 1985:178). Maximum dryness in northcentral Iowa was attained between about 7,000 and 6,000 B.P. (Van Zant, 1979:377; Bartlein et al., 1984:371).

Little is known about vegetation patterns in valleys such as the DMV during the early and middle Holocene. It seems likely that these areas provided more protected, moist environs than the upland till plain of the Des Moines Lobe. As the climate dried from 9,000 to 6,000 B.P., the closed deciduous forest in the valley may have become restricted to north and east-facing slopes, while parkland and prairie occupied broad late Wisconsinan terraces, west and south-facing slopes, and the upland till plain. The floodplain area may have supported a mesic forest of maple, elm, hackberry, etc., interrupted by meadows. Dense stands of willows and other pioneer plants probably grew on bars in the channel and around the channel margins. During the dry maxima from 7,000 to about 6,000 B.P., prairie may have been common in the valley, especially where the valley was broad, such as in the large valley meanders, and the valley between Mosquito and Saylor Creeks (reaches 3 and 2).

Replacement of the retreating Arctic air masses by warmer and drier

Pacific air masses from 9,000 to 6,000 B.P. may have been the cause behind the general warming and precipitation decrease from the early through middle Holocene (Bartlein et al., 1984:372). After 6,000 B.P. the Pacific air masses were replaced by the even warmer, but more moist, Atlantic air masses. This arose as a semi-permanent ridge in the westerlies developed over the western part of the continent in conjunction with the development of a trough in the eastern part. That lead to a greater meridional (north-south) exchange of air masses over the midwest in contrast to the more zonal (west to east) circulation characteristic of the early to middle Holocene.

By 5,000 B.P. oak pollen began to increase across the area, signalling an increase in precipitation resulting from increased frequency of moist Atlantic (maritime tropical) air masses over the area (Webb, 1985:179). After 3,000 B.P. climatic and vegetation conditions very similar to early Historic patterns became established. During the late Holocene (after 4,000 B.P.) vegetation patterns in the DMV probably were much like those described by the first land survey (Secretary of the State of Iowa, 1847). These were previously described in the section on original Historic vegetation patterns (page 5).

Pilot Mound Pollen Core

R. G. Baker
Geology Department
University of Iowa

The pollen diagram from the Charles Eastland farm east of Pilot Mound, Boone County, Iowa (Fig. 22) shows changes in vegetation typical of small wetland depressions on the Des Moines Lobe (see description Appendix A, profile 08AB19). Zone 1 at the base is strongly dominated by spruce (*Picea*) pollen, along with peaks in larch (*Larix*) and total tree pollen (AP). The thin zone immediately above (zone 2) also has high spruce percentages, but ash (*Fraxinus*) values rise to a prominent peak, and other deciduous elements like alder (*Alnus*), elm (*Ulmus*), and hornbeam/hop-hornbeam (*Ostrya/Carpinus*) reach small peaks as well. The total tree pollen (AP) percentages are very high throughout these two zones. A radiocarbon date of 9300 ±100 RCYBP (Beta-12343) at the boundary between these two zones is out of sequence with a date higher in the core, and is considered to be too young, possibly because of contamination.

In the succeeding transition zone (zone 3), spruce pollen drops off to negligible percentages, larch disappears, and prairie forbs (especially chenopods/amaranths) and grass gradually rise. The radiocarbon date on this boundary is 9730 ±130 RCYBP (Beta-12591). During the time sediment in zone 4 was being deposited, tree pollen reached a minimum and a large peak of chenopods/ amaranths occurred. Percentages of other prairie forbs were also high. A date in the middle of this zone is 4960 ±90 RCYBP (Beta-12590), while the upper zone boundary dates at 3250 ±60 RCYBP (Beta-12342).

Zone 5 records the rise of oak (*Quercus*) pollen percentages to their peak on the diagram. Chenopod/amaranth pollen percentages decrease, and grass and sedge pollen rise to high values. The top of this zone is dated at 2500 ±70 RCYBP (Beta-12589). The uppermost zone seems to occur in disturbed sediments that probably represent the plowed zone. Its pollen was analyzed to check this hypothesis, and the pollen content does seem rather homogeneous, lacking the characteristic ragweed zone at the top that represents the introduction of European agriculture in North America.

The interpretation of zone 1 is that a spruce-larch forest was present at the site. When zone 2 sediment was deposited, spruce, and larch declined as

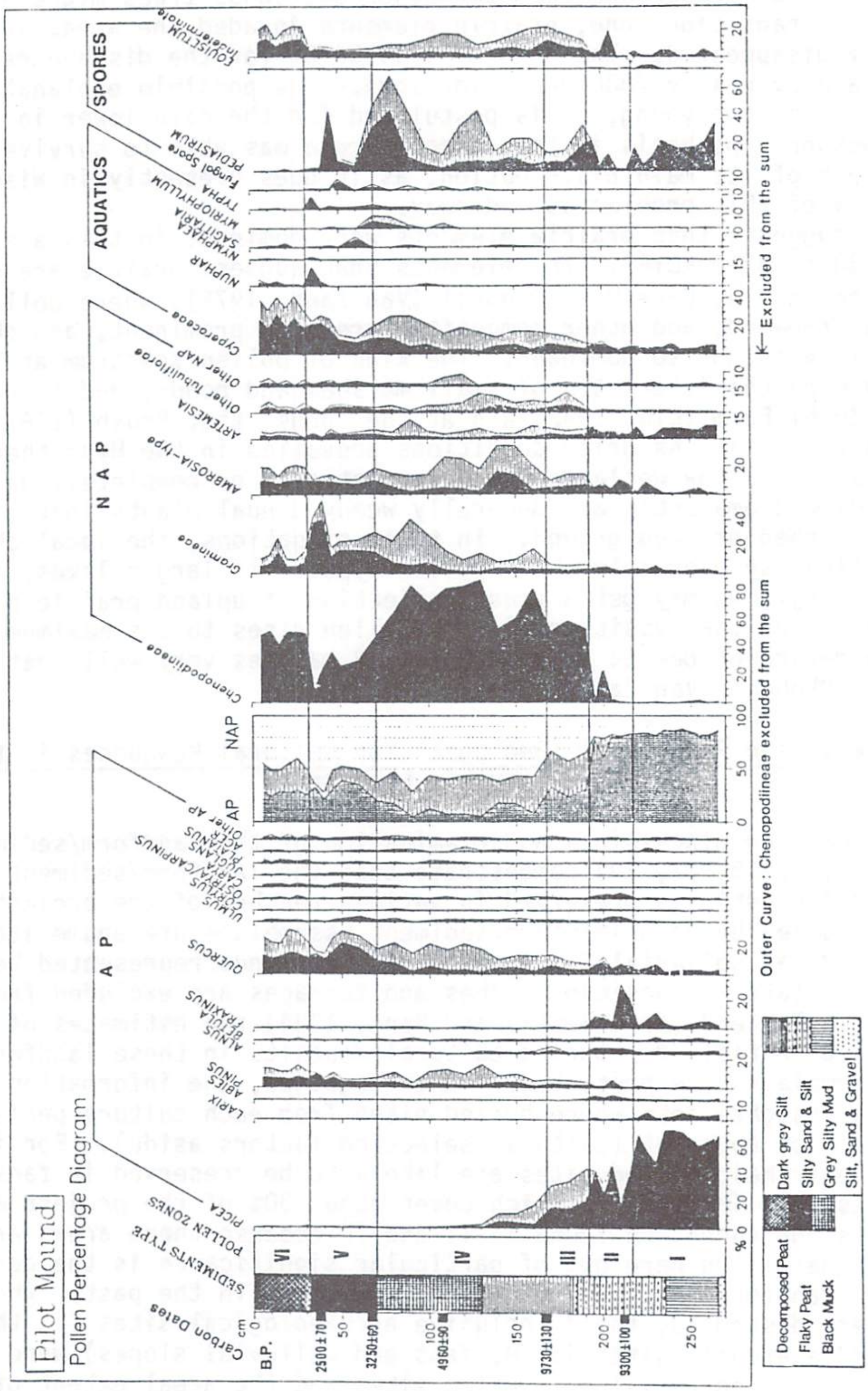


Figure 22. Pollen percentage diagram for core 08AB19, taken from the Pilot Mound wetland located just in front of the Altamont Moraine east of the Des Moines Valley.

ash, elm, hornbeam or hop-hornbeam and other deciduous trees migrated into the area. In the transition zone, prairie elements invaded the area, and deciduous trees nearly disappeared. The date of 9730 RCYBP for the disappearance of spruce is late by nearly 2000 years for Iowa. One possible explanation is that this date is also too young, as is postulated for the date lower in the sequence. Another hypothesis is that black spruce was able to survive in Iowa wetlands south of its main distribution, as it does presently in Wisconsin. Further study of this problem is underway.

Zone 4 suggests that prairie elements were dominant in this area from possibly 9730 to 3250 RCYBP. The elements that suggest prairie are different here than they are at Lake West Okoboji (Van Zant, 1979), where pollen of wormwood, grass, ragweed, and other composites are more prominent, and chenopod/amaranth pollen is not so dominant. The kind of pollen spectrum at Pilot Mound seems to be more characteristic of small marshes and ponds, and it resembles spectra at Zuehl Farm (Kim, 1982) and at the "bogs" that Brush (1967) worked on in northcentral Iowa. As drier conditions prevailed in the Hypsithermal, many of these small, shallow wetlands may have partially or completely dried up. The chenopods and amaranths are generally weedy annual plants that often colonize disturbed or open ground. In these situations, the local chenopod/-amaranth pollen may overwhelm other pollen types. In larger lakes, such as Lake West Okoboji, we may get a truer reflection of upland prairie pollen rain.

At the end of the Hypsithermal, oak pollen rises to its maximum. The date of the return of oak at about 3200 RCYBP matches very well that horizon at Lake West Okoboji (Van Zant, 1979).

Preservation Potentials (Geologic) for Cultural Resources in the Saylorville Lake Area

The preceeding discussions and examination of the landform/sediment assemblage maps (Figs. 15, 17, 20) demonstrate that the landform/sediment assemblages are differentially preserved in various reaches of the project area. The areas occupied by each landform/sediment assemblage are enumerated in Table 2 (LWB/Fan and Fan/Colluvial Slope categories are underrepresented because of the map scale; late Wisconsinan benches and terraces are excluded from the analysis). In Table 3 (from Bettis and Benn, 1984) the estimates of site preservation potentials for buried cultural deposits in these landform/sediment assemblages are presented. Taken together, the information in these tables gives insights into where buried sites from each culture period are likely to be most abundant (cultural selection factors aside). For instance, buried Middle Archaic period sites are likely to be preserved in fans, colluvial slopes, and TH deposits which cover about 30% of the project area. Sites of this age cannot be found in TI and TL because these areas are too young. Not quantified here but of particular significance is the certainty that younger landforms replaced older ones sometime in the past. When older landforms were destroyed, their inclusive archaeological sites (in the above example, Middle Archaic sites in TH, fans and colluvial slopes) were also destroyed. When the potential for buried sites and the areal extent of landform/sediment assemblages are known, the information necessary for predicting site densities and for explaining apparent gaps in the archaeological record is available. These are the intial steps in generating a reliable sampling strategy for archaeological sites in alluvial contexts.

The next step in deriving buried site potentials and sampling strategies is the consideration of each landform/sediment assemblage as a three-dimensional space. Table 4 presents calculated volumes for the landform/ sediment

TABLE 3

Preservation potentials for buried cultural deposits in the Saylorville Lake area (assuming all surfaces cultivated)

Culture Period	Alluvial Fans	High Terrace	Inter-mediate Terraces	Low Terrace
Paleo-Indian	++	+(late)	-	-
Early and Middle Archaic	++	++	-	-
Late Archaic	++	+	++	-
Woodland	+-	-	++	-
Oneota and Great Oasis	+-	-	++	+-
Historic	-	-	+-	++

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

assemblages in the Saylorville Lake area. These are conservative calculations! Basal sands and gravels were excluded from depth measurements used to calculate volumes. The calculations involved derivation of an average thickness of the depositional units based on outcrop and drill hole information, then calculating the volume by multiplying the depth figure by the area figure in Table 2. In Table 4 the scaling of the sampling problem for identifying buried sites is quite apparent.

It should be obvious that failure to consider the differential preservation of deposits potentially containing archaeological sites during the initial phases of survey in alluvial contexts can lead to erroneous conclusions about site distributions (and therefore about prehistoric culture). Returning to the Middle Archaic example, the paucity of reported sites in Saylorville Lake (Benn, 1985a:37) may be a result of deep burial and limited exposure rather than a general lack of occupation during that culture period. Results of the SMSU excavations seem to confirm this hypothesis (Benn and Bettis, 1985; Benn, 1985b). Thus, an additional benefit of three-dimensional landscape analysis is that it allows one to concentrate survey and testing efforts in the potentially most productive places. A search for Paleo-Indian and Early Archaic sites would not need to include TI and TL and upper portions of TH since these deposits are too young to contain these sites. Likewise, surficial survey of TL and portions of TI mantled with recent overbank deposits would not yield prehistoric sites for the same reason. Methods other than surface survey and/or

TABLE 4

Central Des Moines River Valley -- Saylorville Lake Area. Volume of landform/sediment assemblage with potential for containing buried prehistoric cultural material (cubic meters).

Landform/sediment assemblage	Fan/Colluvial Slope	Fan	Fan/High T	High T	Intermediate T	Intermediate/Low	Low T*
average thickness (m) (excluding basal sand and gravel)	3.67	5.26	5.0	4.65	2.96	2.8	2.73
area in project (hectares)	21.5	109.2	108.1	980.6	1564.7	648.8	410.7
volume (m^3)	789,050	5,743,920	5,405,000	45,597,900	46,315,120	18,166,400	11,212,110

*portions of TL may be too young to contain prehistoric cultural remains shallow shovel testing are necessary to adequately evaluate the archaeological potential of TI, TH, and Fans. On the other hand, late Wisconsinan terraces and benches can be effectively evaluated using surficial techniques because there are only shallow deposits dating to the period of human presence in the New World in these areas.

The DMV contains a complex but orderly array of landforms and deposits. These can be arranged in a chronology, and their potentials for containing archaeological sites of various culture periods can be quantitatively assessed. This then allows for a reasoned approach to evaluating the existing record of prehistoric cultural remains and provides sound information relating to the search for missing parts of the archaeological record. The stratigraphic approach to archaeological methologies has also been employed with success in western Iowa (Bettis and Thompson, 1982) and in the lower Illinois River valley (Hajic, 1981b; Hajic and Styles, 1982). The landscape approach has the potential to standardize goals of archaeological surveys in diverse landform/sediment assemblages under common principals of late Wisconsinan and Holocene landscape evolution and thus allow for comparison of archaeological contexts and preservation potentials of the archaeological record in different areas.

Relations To Other Midwestern Alluvial Sequences

Episodes of Holocene fluvial activity in the DMV can be related to those identified in other river systems in the Upper Midwest. Recent investigations in the Pomme de Terre River valley in southcentral Missouri (Brackenridge, 1981), the Lower Illinois River valley (Hajic and Styles, 1982; Wiant et al., 1983), the Driftless Area of southwestern Wisconsin (Knox et al., 1981), and western Iowa (Bettis and Thompson, 1982) have shown that the valley landscape is composed of several distinct landform/sediment assemblages which accumulated episodically during the Holocene.

Each of these areas has unique aspects which cause the exact timing and/or nature of discontinuities to vary from one area to the next, but several region-wide patterns are evident. All areas experienced a major change in sedimentary activity between about 11,000 and 10,000 B.P., coincident with wastage of late Wisconsinan glaciers in the Upper Midwest. As discussed previously, wastage and retreat of the Laurentide ice sheet prompted dramatic and rapid changes in the upper atmospheric circulation. Major changes in fluvial activity during this interval can be related to the direct impact of glacial meltwater and/or the termination of loess deposition in all but the Pomme de Terre Valley. The shift in the Pomme de Terre may be related to a change from zonal to meridonal circulation producing increased incidence of large floods (Brackenridge, 1981:75). This change in upper-air circulation also affected the other areas, but whether it overrode the effects of meltwater, the end of loess deposition, and downcutting in the Missouri and Mississippi valleys (the base level for the Upper Midwest) is debatable.

Valleys throughout the Upper Midwest downcut during the early Holocene. Following this entrenchment alluviation resumed throughout the region. Usually several episodes of downcutting and alluviation, producing a complex array of valley surfaces, took place from about 9,000 to 6,000 B.P. Episodes of downcutting and alluviation were not always synchronous from one area to the next or within different parts of the same drainage network. One early and middle Holocene phenomena which does appear to be synchronous across the Upper Midwest is the accumulation of alluvial fans (Hoyer, 1980; Wiant et al., 1983; Bettis et al., 1984). This was a period of time characterized by an increase in the strength of the mean westerly circulation (Borchert, 1950:38). During this interval of increasing dryness and warmth, vegetative cover and type would have decreased in response to the long-term change in climate. The combined effects of climate and vegetation change fostered a reduction in mean annual runoff and significant increases in hillslope erosion (Knox et al., 1981:Table 1). This scenario is ideal for the construction of large alluvial fans and colluvial slopes. An additional factor important in the development of fans and colluvial slopes during this period is the great local relief present at the onset of the period due to the early Holocene entrenchment. This relief, coupled with extension and entrenchment of small tributaries, would greatly enhance fan and colluvial slope development.

Large valleys in the Upper Midwest continued the pattern of aggradation characteristic of the middle Holocene until around 4,000 to 3,000 B.P. Small valleys in the Driftless Area of Wisconsin shifted to a pattern around 6,000 B.P. which continued through the late Holocene (Knox et al., 1981:121) while western Iowa small valleys began late Holocene alluviation around 2,000 B.P. In all these areas late Holocene alluvium contains more organic matter than does alluvium which accumulated during the early and middle Holocene. This is probably a result of oxidation of the organic material in the alluvium during the warm, dry middle Holocene (Knox et al., 1981:121; Bettis, 1983). The late Holocene witnessed an increase in annual precipitation and slight cooling. These conditions promoted increased flood magnitudes and an increase in floodplain activity. All valleys in the region were characterized by several episodes of slight downcutting, lateral channel migration, and alluviation during the late Holocene.

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APPENDIX A

Detailed Descriptions

Boone Waterworks Section (8-L-2)

Location: SW 1/4, SW 1/4, Sec. 18, T84N, R26W
Landscape position: east bluff of Des Moines Valley, south side of County Road E-26.
Elevation: approximately 1020 ft.
Date Described: 7/17/80
Described by: G.R. Hallberg, T. J. Kemmis, A.J. Luteneggar

Depth (m)	Weatering Zone (Soil Horizon)	Description
		Des Moines Lobe Till (Dows Fm. Alden Mbr.)
0 - 1.5	OL	Modern solum; thin pedisediment on oxidized and leached Des Moines Lobe till.
1.5 - 1.8	OU2	oxidized unleached Des Moines Lobe till with secondary carbonate accumulations.
1.8 - 5.3	OU	oxidized and unleached Des Moines Lobe till with weakly expressed subvertical joints.
5.3 - 6.6	MOU-MOJU	mottled oxidized and unleached Des Moines Lobe till with subvertical joints.
6.6 - 8.4	RJU	reduced unleached and jointed Des Moines Lobe till.
8.4 - 10.0	MUJU-RJU	mottled unoxidized to reduced, jointed, unleached Des Moines Lobe till.
10.0 - 11.7	MUJU	mottled unoxidized, jointed, unleached Des Moines Lobe till.
11.7 - 16.8	UJU	unoxidized, jointed, unleached Des Moines Lobe till, joints increase in intensity and prominence with depth, till very uniform, abundant wood and sand lenses in lower 15 to 60 cm.
		Wisconsinan Loess
16.8 - 17.0	MOU, MDU	silt loam loess, common wood and very disturbed Ab soil horizon at top, oxidized and mottled grading to deoxidized, unleached.
17.0 - 17.5	MUU	mottled unoxidized unleached loess, common wood and mollusc shells.
17.5 - 21.6	UU	unoxidized and unleached loess, common wood and mollusc shells.

Boone Waterworks Section (8-L-2)
Page -2-

Depth (m)	Weatering Zone (Soil Horizon)	Description
		Yarmouth Sangamon Paleosol developed in pedisediment and Pre-Illinoian till
21.6 - 22.1	(Ab)	Ab horizon of Yarmouth Sangamon Paleosol.
22.1 - 23.3	(Btgb)	gleyed argillic horizon of Yarmouth Sangamon Paleosol.
		Pre-Illinoian Till (Wolf Creek Fm. Hickory Hills Till Mbr.)
23.3 - 24.1	(Btb)	argillic horizon of Yarmouth Sangamon Paleosol developed in Pre-Illinoian till.
24.1 - 24.6	MOL-MRL	mottled and oxidized to mottled and reduced leached Pre-Illinoian till.
24.6 - base of exposure (25.0)	OL	oxidized and leached Pre-Illinoian till.

77AV1
Profile 1 22.1 m
Top of stone line is datum

Depth (cm)	Soil Horizon (weathering zone)	Description
		Basal Loess Sediment
+50-+34	3C (MOU)	dark grayish brown, brown and pale brown (10YR 4/2, 5/3 and 6/3) stratified silt loam, massive, friable, weak to strong effervescence, abrupt wavy boundary, abundant fine yellowish brown (10YR 5/8) mottles, abundant fine pipestems, occasional soft medium to fine carbonate concretions, occasional charcoal flecks.
		"Late Sangamon" Pedisediment
+34-+12	4EB16	strong brown (7.5YR 4/6) loam, moderate medium breaking to weak fine subangular blocky, friable, noneffervescent, clear smooth boundary, abundant fine strong brown (7.5YR 5/6) mottles.
+12-0	4EB2b	strong brown (7.5YR 4/6) loam, moderate medium platy breaking to moderate fine subangular blocky, friable, noneffervescent, abrupt irregular boundary, few discontinuous brown (10YR 5/3) silans, abundant fine strong brown (7.5YR 5/8) mottles.
		Stone Line
0-19	5Btb	dark yellowish brown (10YR 4/6) loam matrix supported cobbles and pebbles, moderate medium angular blocky (matrix), friable, noneffervescent, abrupt irregular boundary, iron staining on pebbles and cobbles, few thin discontinuous brown (7.5YR 4/4) cutans, abundant medium and fine yellowish red (5YR 4/6) mottles.
		Pre-Illinoian till (Wolf Creek Fm, Hickory Hills Mbr.)
19-31	6Bt1b	dark yellowish brown (10YR 4/6) clay loam, with common pebbles, moderate to strong fine angular blocky, friable, noneffervescent, gradual smooth boundary, thin almost continuous brown (7.5YR 4/4) cutans, few fine oxides.

77AV1 - Profile 1
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
31-45	6Bt2b	strong brown (7.5YR 4/6) clay loam with pebbles as above, strong fine angular blocky, friable, noneffervescent, clear smooth boundary, thick continuous brown (7.5YR 4/4) cutans, oxides as above, common medium grayish brown (10YR 5/2) mottles.
45-64	6Bt3b	strong brown (7.5YR 4/6-5/6) clay loam to loam, strong fine angular blocky, friable, non-effervescent, clear smooth boundary, thick continuous brown (7.5YR 4/4) cutans, oxides and mottles as above, occasional slickensides, faint joints with iron staining along them evident, occasional fine pebbles.
64-81	6Bt4b	strong brown (7.5YR 4/6) loam, strong medium to fine angular blocky, friable, noneffervescent, clear smooth boundary, thick continuous brown (7.5YR 4/4) cutans, common thin discontinuous oxides on cutans, iron stained joints, common and prominent, occasional fine pebbles.
81-99	6BCb	light brownish gray to light yellowish brown (10YR 6/2-6/4) loam, moderate coarse angular blocky, friable, noneffervescent, abrupt smooth boundary, joints as above, occasional patches of brown (7.5RY 4/4) thin cutans in joints, abundant fine oxides, occasional meidum to fine pebbles.
99-109	6CBb	as above except abundant oxides or peds.
19-179	6C1b (MJOL)	brown to grayish brown (10YR 5/3-5/2) loam, massive but breaks into coarse angular blocks, friable, noneffervescent, strong brown (7.5YR 5/6-4/6) accumulations on faces of coarse blocks, prominent joints with 3-5 cm thick strong brown (7.5YR/4/6-5/6) oxidation rinds, occasional fine pebbles.
179-base (209)	6C2 (MJOL2)	brown to grayish brown (10YR 5/3-5/2) loam, massive but breaks to coarse angular blocks, friable, staining along joints as above, moderate to strong effervescence, common medium hard secondary, carbonate accumulations, common medium to fine strong brown (7.5RY 5/6) mottles, common pebbles and occasional cobbles granitics are soft.

Location: 13PK299; test pit 1; SE 1/4 SW 1/4 NW 1/4 NE 1/4 sec. 18 T80N R24W
Landscape position: backslope of large dune
Elevation: approximately 953 ft.
Parent material: blowsand
Slope: 5-9%
Vegetation: grass on former cultivated field (original: forest)
Date described: 8/13/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
		Blow Sand
0-26	Ap	very dark grayish brown (10YR 3/2) fine sandy loam, weak medium subangular blocky breaking to weak medium granular, friable, noneffervescent, abrupt smooth boundary, abundant roots.
26-34	E	dark grayish brown to brown (10YR 4/2-4/3) fine sandy loam, moderate medium subangular blocky, friable, noneffervescent, clear irregular boundary; common fine oxides, common roots, common grayish brown (10YR 5/2) medium to coarse krotovina
34-52	Bt1	brown to dark yellowish brown (10YR 4/3-4/4) sandy loam, moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, common roots, occasional discontinuous grayish brown (10YR 5/2) silans, common thin discontinuous dark brown (10YR 3/3) cutans which occur as diffuse 7-10 cm thick lamallae within the horizon
52-75	Bt2	brown to dark yellowish brown (10YR 4/3-4/4) loamy sand (more clay than above), moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, common roots, cutans occurring in diffuse lamallae as above but common to abundant.
75-84	BC1	dark yellowish brown (10YR 4/4) loamy sand, weak medium subangular blocky, friable, noneffervescent, clear smooth boundary, occasional thin (2-3 cm) brown (10YR 5/3) zones, few roots.

Location: 13PK299; test pit 1
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
84-105	Bt3	dark yellowish brown (10YR 4/4) loamy sand, moderate medium subangular blocky, friable, nonefferescent, clear smooth boundary, few grayish brown (2.5Y 5/2) mottles with brown (7.5YR 4/4) halos, common thin discontinuous dark grayish brown to dark brown (10YR 4/2-3/3) cutans.
105-125	BC2	dark yellowish brown (10YR 4/4) sandy loam, weak to moderate medium subangular blocky, friable, noneffervescent, abrupt smooth boundary, mottles as above, very few thin discontinuous yellowish brown (10YR 5/4) coatings on sand grains
		Pedisediment
125-140	2Bt	dark yellowish brown to yellowish brown (10YR 4/4-5/4), sandy loam, moderate medium angular blocky, friable, noneffervescent, common fine iron accumulations, common medium oxides, common thin dicontinuous dark yellowish brown (10YR 4/4) cutans, stone line composed of fine to medium well rounded pebbles at base of horizon
140-185	3C (MOL)	brown to yellowish brown (10YR 5/3-5/4) stratified medium to coarse sand and loamy sand, massive, friable, noneffervescent, common to abundant medium brown (7.5YR 4/4) mottles, abrupt smooth boundary, stone line at base of horizon
		Des Moines Lobe till
185-base (200)	4C (MOU)	yellowish brown (10YR 5/4) silt loam diamicton, massive, friable, strong effervescence, common medium grayish brown (2.5Y 5/2)

Location: 13PK111, 9-10E 9-10N; NW 1/4 SE 1/4 NW 1/4 SW 1/4 sec. 18 T80N R24W
Landscape position: Wisconsinan bench
Elevation: approximately 840 ft.
Parent material: blow sand over outwash
Vegetation: bare, former cultivated field (original: mixed trees and prairie)
Slope: 0-2%
Date described: 9/14/84
Described by: E. A. Bettis III

Depth (cm)	Soil Horizon (weathering zone)	Description
		BlowSand
0-13	Ap	very dark gray to dark gray (10YR 3/1-4/1) loam, very weak medium subangular blocky, friable, noneffervescent, abrupt smooth boundary, occasional dark grayish brown (10YR 4/2) insect burrows
13-21	AB	very dark grayish brown and dark grayish brown (10YR 3/2-4/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, abundant insect burrows filled with contrasting color, occasional well rounded fine pebbles.
21-30	Bw1	dark grayish brown (10YR 4/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual smooth boundary, common brown (10YR 4/3) insect burrows.
30-45	Bw2	dark grayish brown to brown (10YR 4/2-4/3) sandy loam, weak medium subangular blocky, friable, noneffervescent, gradual smooth boundary, occasional burrows as above.
45-63	BC	brown (10YR 4/3) sandy loam, very weak medium subangular blocky, friable, noneffervescent, gradual smooth boundary, very few burrows as above, occasional subrounded fine pebbles.
		Outwash
63-84	2CB	brown (7.5YR 5/4) loamy sand, very weak medium subangular blocky to single grain, very friable to loose, noneffervescent, gradual smooth boundary, few discontinuous pebble bands composed of fine subrounded pebbles.
84-178	2C1 (OL)	brown (7.5YR 4/6) medium to coarse sand, single grain, loose, noneffervescent, clear, smooth boundary, common pebble bands composed of medium subrounded pebbles -- 1 pebble thick

Location: 13PK111; 9-10E 9-10N
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
178-218	2C2 (OL)	subrounded matrix supported medium pebbles to cobbles, mixed lithology, single grain, loose, matrix is coarse sand, noneffervescent, abrupt irregular boundary.
		Pre-Illinoian till
218-base (250)	3C (MOL)	yellowish brown (10YR 5/4) loam diamicton, massive, friable, common pebbles and cobbles, common coarse grayish brown (2.5Y 5/2) mottles, noneffervescent.

Location: 13BN271; SE 1/4 SE 1/4 NE 1/4 SE 1/4 sec. 29 T83N R26W
Landscape position: footslope of colluvial slope decending to sidevalley terrace
Elevation: approximately 885 ft.
Parent material: alluvium/colluvium
Slope: 5-9%
Vegetation: deciduous trees
Date described: 10/8/84
Described by: E. A. Bettis III
Remarks: profile described is in the approximate center of the trench, west wall

Depth (cm)	Soil Horizon (weathering zone)	Description
0-8	A1	black (10YR 2/1) sandy loam, moderate medium to fine granular, friable, noneffervescent, clear smooth boundary, abundant roots.
8-30	A2	black (10YR 2/1) loam, moderate medium granular, friable, noneffervescent, gradual smooth boundary, common to abundant roots.
30-44	A3	very dark gray to very dark grayish brown (10YR 3/1-3/1) loam, moderate medium subangular blocky, friable, gradual wavy boundary, common roots, common brown (10YR 4/3) filled insect burrows.
44-53	AE	very dark yellowish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, few roots, common thin discontinuous light gray (10YR 7/2) silans.
53-66	E1	dark brown (10YR 3/3) loam, moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, very few roots, silans as above, common very dark grayish brown (10YR 3/2) filled insect burrows.
66-76	E2	dark grayish brown (10YR 4/2) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear wavy boundary, abundant thin discontinuous light gray (10YR 7/2) silans.

Location: 13BN271
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
76-102	Bt1	very dark grayish brown to dark brown (10YR 3/2-3/3) sandy loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual smooth boundary, common coarse grayish brown (2.5YR 5/2) mottles with dark yellowish brown (10YR 4/6) halos, silans as above, few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
102-122	Bt2	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate coarse subangular blocky, friable, noneffervescent, gradual smooth boundary, silans as above, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
122-141	Bt3	very dark grayish brown (10YR 3/2) clay loam, moderate coarse subangular blocky, friable, noneffervescent, gradual smooth boundary, common thin discontinuous light gray (10YR 7/2) silans, abundant thin almost continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.
141-base (170)	Bt4	very dark grayish brown (10YR 3/2) clay loam, moderate coarse subangular blocky, friable, noneffervescent, silans as above, common thin discontinuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.

Location: 13PK251W, SE 1/4, NE 1/4 SW 1/4 SW 1/4 sec. 13 T80N R25W
Landscape position: alluvial fan
Elevation: Approximately 885 ft.
Parent material: alluvium/colluvium
Slope: 5-9%
Vegetation: trees
Date described: 9/26/84
Described by: E. A. Bettis III
Remarks: this profile is outside the midden areas

Depth (cm)	Soil Horizon (weathering zone)	Description
0-6	+	very dark gray to dark gray (10YR 3/1-4/1) loam, massive, friable, noneffervescent, abrupt wavy boundary, abundant organics, wave reworked zone.
6-23	E	dark grayish brown to brown (10YR 4/2-4/3) loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, abundant roots, common fine grayish brown (2.5Y 5/2) mottles, few fine oxides.
23-34	BE1	dark grayish brown to grayish brown (10YR 4/2-5/2) loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, abundant roots, abundant fine to medium grayish brown (2.5Y 5/2) mottles, common fine oxides, few thin discontinuous light gray (10YR7/2) silans.
34-46	BE2	dark grayish brown to brown (10YR 4/2-4/3) loam, moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, common roots, abundant medium grayish brown (2.5Y 5/2) mottles, common fine oxides, few fine iron concretions, common thin discontinuous silans, occasional well rounded fine pebbles.
46-67	BE3	brown (10YR 4/3) loam, moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, common roots, mottles, oxides and iron concretions as above, abundant thin discontinuous silans, pebbles as above.

Location: 13PK251W
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
67-77	Bt1	dark brown to brown (10YR 3/3-4/3) heavy loam, moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, few roots, common coarse grayish brown (2.5Y 5/2) mottles, abundant fine oxides, common fine iron concretions, few thin discontinuous very dark grayish brown (10YR 3/2) cutans, occasional well rounded medium to fine pebbles.
77-base (120)	Bt2	brown to dark yellowish brown (10YR 4/3-4/4) clay loam, moderate to strong medium angular blocky, friable to firm, noneffervescent, common coarse dark gray (10YR 4/1) mottles, abundant fine oxides, common fine iron concretions, common thin almost continuous very dark grayish brown (10YR 3/2) cutans, pebbles as above.

Location: 13PK251W 13-14E 7-8N; SE 1/4 NE 1/4 SW 1/4 SW 1/4 sec. 13 T80N R25W
Landscape position: midfan of small alluvial fan burying depression
Elevation: Approximately 885 ft.
Parent material: alluvium/colluvium
Slope: 9-12%
Vegetation: trees
Date described: 6/26/84
Described by: E. A. Bettis III
Remarks: This pit is immediately N of the midden area, a shallow (today) surface depression forms the northern site boundary, this pit is in a fan burying this depression; the base of the small fan deposits is at the 2-3 material contact; hand probed below floor of pit and encountered another Ab horizon at 40 cm.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-7	+	very dark gray to dark gray (10YR 3/1-4/1) loam, massive, friable, abrupt irregular boundary, organics at base, wave reworked zone.
7-9	A1	black to very dark gray (10YR 2/1-3/1) loam, weak fine granular, friable, noneffervescent, clear smooth boundary, abundant roots.
9-15	AE	dark gray (10YR 4/1) loam, moderate fine granular, friable, noneffervescent, clear smooth boundary, abundant roots.
15-23	Bw	dark gray (10YR 4/1) loam, moderate fine subangular blocky, friable, noneffervescent, abrupt smooth boundary, commn roots, common well rounded fine to medium pebbles.
23-40	2Ab	very dark grayish brown (10YR 3/2) loam, weak to moderate fine subangular blocky, friable, noneffervescent, gradual smooth boundary, common roots.
40-68	2Bwb	dark brown to dark grayish brown (10YR 3/3-4/2) loam, weak medium subangular blocky, friable, noneffervescent, abrupt smooth boundary, common pebble bands becoming increasingly coarser with depth, lag of medium to coarse well rounded pebbles at base, occasional charcoal flecks.
68-79	3Ab	very dark grayish brown to dark gray (10YR 3/2-41) loam, weak to moderate medium to fine subangular blocky, friable, noneffervescent, gradual smooth boundary, occasional well rounded medium pebbles.

Location: 13PK251W 13-14E 7-8N
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
79-96	3ABb	dark brown (10YR 3/3) heavy loam, moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, common fine oxides and iron concretions, common fine well rounded pebbles.
96-110	4Ab	very dark grayish brown (10YR 3/2) heavy loam, weak to moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, oxides and iron concretions as above, pebbles as above.
110-base (180)	4Bwb	dark brown to brown (10YR 3/3-4/3) loam, moderate medium subangular blocky, friable, weak to strong effervescence, oxides, iron concretions and pebbles as above.

Location: 13BN277 Area A, test unit 1, NW 1/4 NW 1/4 NE 1/4 SE 1/4 sec. 5
T82N R26W
Landscape position: Intermediate Terrace; footslope of bench
Elevation: approximately 868 ft.
Parent material: alluvium
Slope: 5-9%
Vegetation: weeds and trees
Date described: 11/8/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-7	+	black to very dark gray (10YR 2/1-3/1) silty clay loam, massive dries to moderate fine angular blocky, friable, noneffervescent, abrupt smooth boundary, abundant roots.
7-33	Ap	very dark grayish brown (10YR 3/2) fine sandy loam, massive, friable, noneffervescent, abrupt wavy boundary, abundant roots.
33-85	C1	very dark brown to very dark grayish brown (10YR 2/2-3/2) loam, massive, friable, noneffervescent, gradual smooth boundary, common roots.
85-120	C2	dark brown (10YR 3/3) loam, massive, friable noneffervescent, clear smooth boundary, common roots.
120-134	AC1b	very dark grayish brown (10YR 3/2) fine sandy loam, moderate fine subangular blocky, friable, noneffervescent, gradual smooth boundary, common roots.
134-149	C1	dark brown (10YR 23/3) fine sandy loam, massive, friable, noneffervescent, clear smooth boundary, few roots.
149-194	AC2b	very dark grayish brown to dark brown (10YR 3/2-3/3) fine sandy loam, weak medium to fine subangular blocky, friable, noneffervescent, clear smooth boundary.
194-214	AC3b	dark brown (10YR 3/3) loam, weak medium to fine subangular blocky, friable, weak effervescence, abrupt smooth boundary, common charcoal flecks at top of horizon.
214-225	C2	brown (10YR 5/3) fine to medium sand, single grain, loose, noneffervescent, clear smooth boundary.

Location: 13BN277 Area A, test unit 1.
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
225-246	2A1b	very dark grayish brown (10YR 3/2) silt loam, weak to moderate medium to fine subangular blocky, friable, noneffervescent, gradual smooth boundary.
246-274	2A2b	very dark grayish brown (10YR 3/2) loam, weak to moderate medium to fine subangular blocky, friable, moderate effervescence, clear smooth boundary.
274-297	2C1	dark brown (10YR 3/3) sandy loam, massive, friable, weak effervescence, gradual smooth boundary.
297-330	2C2	brown(10YR 4/3) loamy sand, massive to single grain, friable, weak to moderate efferve-scence, abrupt irregular boundary, common medium dark yellowish brown (10YR 4/4) mottles, shell midden at base of horizon.
330-base (335)	R	Pennsylvanian sandstone.

Location: 13BN279 Block B surface through soil VI, Trench A Soil VII-base; NW 1/4 NW 1/4 SE 1/4 SW 1/4 Sec. 3 T85N R27W
Landscape position: lower apex of alluvial fan, downstream side
Elevation: approximately 917 ft.
Parent material: alluvium/colluvium
Slope: 5-9%
Vegetation: deciduous trees
Date described: 10/10 and 11/7 '84
Described by: E. A. Bettis III
Remarks: described from exposure; the 6C2b through 6C6b horizons fine to the south (down valley) and are discontinuous in that direction; several AC soil profiles downvalley grade into these horizons

Depth (cm)	Soil Horizon (weathering zone)	Description
		Soil I
0-12	A1	black (10YR 2/1) sandy loam, moderate medium to fine granular, friable, noneffervescent, gradual smooth boundary, abundant roots.
12-22	A2	black (10YR 2/1) sandy loam with common fine pebbles, moderate medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, gradual smooth boundary, abundant roots.
22-30	A3	very dark brown to very dark grayish brown (10YR 2/2-3/2) sandy loam, moderate fine subangular blocky, friable, noneffervescent, clear smooth boundary, abundant roots, common black and dark brown (10YR 2/1-3/3) filled insect burrows.
30-47	E	dark grayish brown (10YR 4/2) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual wavy boundary, common roots, common thin discontinuous light gray (10YR 7/2) silans, common fine very dark grayish brown (10YR 3/2) filled insect burrows.
47-57	EB	dark grayish brown to brown (10YR 4/2-5/3) sandy loam, moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, common roots, silans as above.
57-70	Bt	brown (10YR 4/3) sandy loam, moderate medium subangular blocky, friable, noneffervescent, abrupt smooth boundary common roots, few thin discontinuous very dark grayish brown (10YR 3/2) cutans, pebble line at bottom of horizon.

Location: 13BN279
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
		Soil II
70-85	2Atb (Bt2)	dark brown (10YR 3/3) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual smooth boundary, common roots, cutans as above, occasional charcoal flecks.
85-96	2Bb (Bt3)	brown (10YR 4/3) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear smooth boundary, few roots, very few thin discontinuous very dark grayish brown (10YR 3/2) cutans, (C-14 sample 3190 ±190 B.P. - Beta-11116).
96-107	2BCb	yellowish brown (10YR 5/4) loam, weak medium subangular blocky, friable, noneffervescent, abrupt irregular boundary, very few roots, pebble line at base of horizon grades to medium to coarse sand to the south (downvalley).
		Soil III
107-120	3Atb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, very few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
120-130	3ABtb	dark grayish brown (10YR 4/2) loam with common fine pebbles, moderate medium to fine columnar, friable, noneffervescent, clear smooth boundary, few fine iron concretions, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
130-143	3Bt1b	dark brown (10YR 3/3) loam to sandy loam with common fine to medium pebbles, moderate medium to fine columnar, friable, noneffervescent, clear smooth boundary, few fine iron concretions, common thin discontinuous very dark grayish brown (10YR 3/2) cutans (C-14 sample 3900 ±70 B.P. - Beta 11117).

Location: 13BN279
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
143-149	3Bt2b	as above but pebbles are abundant.
149-164	3Bt3b	dark brown (10YR 3/3) sandy loam with occasional thin discontinuous pebble bands, moderate coarse breaking to fine columnar, friable, noneffervescent, clear smooth boundary, abundant medium iron concretions, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
164-178	3BCb	dark brown to brown (10YR 3/3-4/3) sandy loam with occasional thin discontinuous pebble bands, moderate coarse subangular blocky, friable, noneffervescent, abrupt wavy boundary, few fine iron concretions.
178-209	3C1b	brown to very pale brown (10YR 4/3-7/3) pebbly medium to coarse sand with common 1-.5 m wide troughs of matrix supported well rounded medium to fine pebbles, single grain, loose, very weak effervescence, abrupt irregular boundary, this horizon consists of several superimposed channel fills.
209-226	3C2b	brown (10YR 4/3-5/3) sandy loam with few medium to fine pebbles, massive, friable, weak effervescence, clear smooth boundary, grades to a medium to coarse sandy channel fill to the south (downvalley), top of this horizon is truncated by overlying channels.
226-231	3C3b	dark brown (10YR 3/3) pebbly sandy loam massive, friable, weak effervescence, abrupt smooth boundary, common medium iron concretions.
		Soil IV
231-238	4A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak coarse columnar breaking to moderate medium to fine subangular blocky, friable, weak to moderate effervescence, clear smooth boundary, common fine soft carbonate concretions (C-14 sample 4610 ±80 B.P. - Beta-11118).

Location: 13BN279
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
238-247	4A2b	dark grayish brown (10YR 4/3) loam with common fine pebbles, moderate medium subangular blocky, friable, weak to moderate effervescence, gradual smooth boundary, carbonate concretions as above.
247-265	4Bwb	brown (10YR 4/3) loam with common fine pebbles, moderate medium subangular blocky, friable, weak to moderate effervescence, gradual smooth boundary, common medium to fine soft carbonate concretions, very few fine iron concretions, common charcoal flecks.
265-280	4C1b	brown to yellowish brown (10YR 4/3-5/4) weakly stratified loam and sandy loam, weak medium subangular blocky to massive, friable, weak effervescence, abrupt wavy boundary, few fine carbonate concretions, very few fine iron concretions, fine pebbles at base of horizon.
280-297	4C2b (ACb?)	brown (10YR 4/3) loam with few fine pebbles, weak medium subangular blocky, friable, moderate to strong effervescence, clear smooth boundary, common medium to fine soft carbonate concretions in and around root channels, very few fine oxides, occasional charcoal flecks, occasional gastropod shells.
297-305	4C3b	brown (10YR 4/3) pebbly sandy loam, massive, friable, strong effervescence, abrupt smooth boundary, very few medium soft carbonate concretions.
305-323	4C4b (ACb)	dark brown to brown (10YR 3/3-4/3) loam, weak medium to fine subangular blocky, friable, strong effervescence, abrupt smooth boundary, common medium soft carbonate concretions, few medium iron concretions, few fine oxides.
323-340	4C5b	brown to very pale brown (10YR 5/3-7/3) stratified sandy loam, medium to coarse pebbles and medium to coarse sand, massive and single grain, friable and loose, weak effervescence, abrupt irregular boundary.

Location: 13BN279
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
340-347	4ACb	dark grayish brown (10YR 4/2) loam, weak medium subangular blocky to massive, friable, moderate effervescence, clear smooth boundary, very few fine soft carbonate concretions, occasional gastropods shells.
347-359	4Cb	brown (10YR 5/3) sandy loam with occasional fine pebbles, massive, friable, moderate effervescence, abrupt smooth boundary, common medium soft carbonate concretions
		Soil V
359-370	5Ab	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) silty clay loam, strong medium to fine columnar breaking to strong fine angular blocky, friable, weak to moderate effervescence, gradual smooth boundary, common fine to medium brown (10YR 4/3) krotovina.
370-386	5Bt1b	brown (10YR 4/3) silt loam, moderate medium columnar breaking to moderate medium to fine subangular blocky, friable, weak effervescence, gradual smooth boundary, few medium soft carbonate concretions, common thin discontinuous very dark grayish brown (10YR 3/2-4/2) cutans, abundant very dark grayish brown to dark grayish brown (10YR 3/2-4/2) krotovina.
386-404	5Bt2b	brown (10YR 5/3) loam, moderate medium columnar, friable, weak effervescence, gradual smooth boundary, few medium soft carbonate concretions, few thin discontinuous very dark grayish brown and dark grayish brown (10YR 3/2-4/2) cutans, occasional charcoal flecks, occasional gastropods shells.
404-411	5BCb	grayish brown to brown (10YR 5/2-5/3) silt loam, weak medium subangular blocky, friable, moderate to strong effervescence, abrupt smooth boundary, abundant medium soft carbonate concretions, abundant charcoal flecks, common gastropod shells.

Location: 13BN279
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
		Soil VI
411-426	6Ab	dark brown (10YR 3/3) silty clay loam, moderate medium to fine columnar, friable, moderate effervescence, gradual smooth boundary, few fine soft carbonate concretions, abundant charcoal flecks (C-14 sample 6200 ±250 B.P. - Beta-11119; 5490 ±80 B.P. ISGS-1359).
426-438	6Btb	dark grayish brown to brown (10YR 4/2-5/3) loam, moderate medium subangular blocky, friable, moderate to weak effervescence, clear smooth boundary, common thin discontinuous dark brown (10YR 3/3) cutans.
438-446	6C1b	brown (10YR 4/3-5/3) stratified pebbly sandy loam, massive, friable, weak effervescence, abrupt smooth boundary.
446-460	6C2b	brown (10YR 4/3-5/3) stratified fine to medium sand and loam, massive, friable, moderate effervescence, abrupt smooth boundary, common fine soft carbonate concretions, few fine iron concretions, occasional gastropod shells.
460-468	6C3b	brown (10YR 4/3) pebbly sandy loam, massive, friable, weak effervescence, abrupt smooth boundary, occasional gastropod shells.
468-476	6C4b	dark grayish brown (10YR 4/2) silt loam, massive, friable, moderate to strong effervescence, abrupt irregular boundary, common fine soft carbonate concretions, abundant charcoal flecks, occasional gastropod shells.
476-502	6C5b	brown to dark grayish bown (10YR 4/3-4/2) stratified loam and sandy loam filling voids between cobbles ranging up to 20 cm in diameter, massive, friable, moderate to strong effervescence, abrupt irregular boundary, few fine iron concretions, occasional gastropod shells.
502-554	6C6b	crudely bedded clast supported cobbles up to 30 cm in diameter, medium to coarse pebbles and sand, single grain, loose, moderate effervescence, abrupt smooth boundary .

Location: 13BN279
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
		Des Moines River Alluvium
		Soil VII
554-566	7A1b	dark gray to dark grayish brown (10YR 4/1-4/2) silty clay loam, weak to moderate fine subangular blocky, friable, noneffervescent, gradual smooth boundary, occasional very dark gray (10YR 3/2) smears, occasional gastropod shells in upper 3 cm.
566-577	7A2b	dark grayish brown to brown (10YR 4/2-4/3) silty clay loam, moderate fine subangular blocky, friable, noneffervescent, gradual smooth boundary, abundant charcoal (C-14 samples 5430 ±100 B.P. - Beta 11120; 5680 ±90 B.P. - Beta 10884; 6200 ±100 B.P. - ISGS-1357).
577-604	7Btb	dark grayish brown to brown (10YR 4/2-4/3) silty clay loam, moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, common medium grayish brown and dark yellowish brown (10YR 5/2 and 4/4) mottles, common fine iron concretions, common thin discontinuous very dark grayish brown (10YR 3/2) cutans, occasional gastropod shells.
604-653	7C1b	dark grayish brown (10YR 4/2 and 2.5Y 4/2) stratified silty clay loam, massive, friable, weak to moderate effervescence, abrupt smooth boundary, mottles as above, abundant medium to fine iron concretions, beds are planar and 2-3 cm thick.
653-base (673)	7C2b	light brownish gray and dark grayish brown (2.5Y 6/2 and 4/2) stratified silty clay loam, massive, friable, moderate effervescence, common coarse grayish brown (2.5Y 5/2) mottles, abundant medium to fine iron concretions, bedding as in overlying horizon.

Location: 08AB1 Coal Valley; NE 1/4 NW 1/4 SW 1/4 NE 1/4 Sec. 1 T83N R27W
Landscape position: High Terrace
Elevation: approximately 883 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: oats
Date described: 9/18/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-20	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
20-35	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, weak medium subangular blocky, breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common roots.
35-60	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, few roots, common very dark grayish brown to dark brown (10YR 3/2-3/3) filled insect burrows.
60-70	Bw1	dark brown (10YR 3/3) loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary, very few roots, insect burrows as above.
70-104	Bw2	dark brown to brown (10YR 3/3-4/3) sandy loam, weak medium to coarse subangular blocky, very friable, noneffervescent, clear boundary.
104-168	Bw3	brown (10YR 4/3) sandy loam, weak medium to coarse subangular blocky, very friable, noneffervescent, abrupt boundary.
168-179	2Ab	brown (10YR 4/3) sandy loam, weak medium columnar, friable, noneffervescent, clear boundary, common thin discontinuous light brownish gray (10YR 6/2) silans.
179-190	2Bt1b	brown (10YR 4/3) loam, moderate medium columnar, friable, noneffervescent, clear boundary, common thin continuous dark brown (10YR 3/3) cutans and clay bridges.

Location: 08AB1 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
190-225	2Bt2b	dark brown to brown (10YR 3/3-4/3) loam with common coarse sand grains, moderate medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary, few thin discontinuous dark brown (10YR 3/3) cutans.
225-253	2BCb	dark brown (7.5YR 3/2) sandy loam with occasional well rounded fine pebbles, weak medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary.
253-base (380)	3C	brown (10YR 4/3-5/3) pebbly loamy sand, single grain, loose, strong to violent effervescence, auger rejected.

Location: 08AB2 Coal Valley; NE 1/4 NW 1/4 SW 1/4 NE 1/4 Sec. 1 T83N R27W
Landscape position: High Terrace, natural levee
Elevation: approximately 883 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: oats
Date described: 9/18/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-23	Ap	black to very dark gray (10YR 2/1-3/1) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
23-38	A1	black to very dark gray (10YR 2/1-3/1) loam, weak medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common roots.
38-66	A2	very dark gray (10YR 3/1) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
66-93	BA	very dark gray to dark gray (10YR 3/1-4/1) loam, weak coarse columnar breaking to moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, very few roots.
93-117	Bw1	dark grayish brown (10YR 4/2) sandy loam, weak medium subangular blocky, friable, noneffervescent, clear boundary.
117-155	Bw2	dark grayish brown to brown (10YR 4/2-4/3) loamy sandy, very weak medium subangular blocky, very friable, noneffervescent, gradual boundary.
155-223	BC	brown (10YR 4/3) loamy sand, very weak medium subangular blocky to massive, very friable, noneffervescent, clear boundary.
223-284	2Btb	dark grayish brown (10YR 4/2) loam, moderate coarse columnar breaking to moderate medium to coarse subangular blocky, friable, non-effervescent, gradual boundary, common thin continuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB2 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
284-316	2BC1b	brown (10YR 4/3) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary.
316-356	2BC2b	dark brown (7.5YR 4/4) loam with occasional well rounded fine pebbles, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary.
356-base (410)	3C	brown (7.5YR 4/4) pebbly coarse sand, single grain, loose, noneffervescent, common to abundant strong brown (7.5YR 5/6) stains on and around pebbles.

Location: 08AB3 Coal Valley; SW 1/4 NE 1/4 SW 1/4 NE 1/4 Sec. 1 T83N R27W
Landscape position: Intermediate Terrace, point bar.
Elevation: approximately 876 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 9/18/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-3	+	dark gray (10YR 4/1) clay loam, massive, firm, moderate effervescence, abrupt boundary.
3-22	Ap	very dark gray (10YR 3/1) silt loam, cloddy, friable, noneffervescent, clear boundary, abundant roots.
22-43	A1	very dark gray (10YR 3/1) loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common roots.
43-72	A2	dark grayish brown (10YR 4/2) loam, weak medium to coarse subangular blocky, friable, noneffervescent, clear boundary, few roots, occasional thin discontinuous black (10YR 2/1) organs.
72-98	C1	dark grayish brown (10YR 4/2) sandy loam, massive, friable, weak to moderate effervescence, gradual boundary.
98-135	C2	very dark grayish brown (10YR 3/2) silt loam, massive, friable, moderate to strong effervescence, abrupt boundary, common very dark gray (10YR 3/1) filled insect burrows.
135-146	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, moderate medium subangular blocky breaking to moderate medium granular, friable, weak to moderate effervescence, clear boundary.
146-161	2A2b	dark brown (10YR 3/3) silt loam, weak to moderate medium to fine subangular blocky, friable, noneffervescent (matrix) with moderate effervescence in pores where few thin discontinuous carbonate accumulations occur, gradual boundary, common very dark gray (10YR 3/1) filled insect burrows.

Location: 08AB3 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
161-198	2Bwb	dark grayish brown (10YR 1/2) loam, weak medium to fine subangular blocky, friable, noneffervescent, clear boundary, very few fine very dark gray (10YR 3/1) mottles.
198-272	C1	dark grayish brown (10YR 1/2) silt loam, very weak fine subangular blocky to massive, friable, weak to moderate effervescence, clear boundary, common fine dark brown (7.5YR 3/2) mottles.
272-308	C2	dark grayish brown (10YR 4/2) silty clay loam, very weak fine subangular blocky to massive, friable, noneffervescent, abrupt boundary, common medium brown (7.5YR 4/4) mottles, occasional gastropod shells, 3 cm thick black (10YR 2/1) clay loam bed at base with mud cracks.
308-340	C3	dark grayish brown (2.5YR 4/2) loam, massive, slightly sticky nonplastic, moderate to strong effervescence, abrupt boundary, abundant medium brown (7.5YR 4/4) mottles.
340-base (400)	2C	dark grayish brown (2.5YR 4/2) sandy loam, single grain, loose, strong effervescence, mottles as above.

Location: 08AB4 Coal Valley; SW 1/4 NE 1/4 SW 1/4 NE 1/4 Sec. 1 T83N R27W
Landscape position: Intermediate Terrace
Elevation: approximately 875 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 9/18/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-3	+	dark gray (10YR 4/1) clay loam, massive, firm, moderate effervescence, abrupt boundary.
3-30	Ap	very dark gray (10YR 3/1) loam, cloddy, friable, noneffervescent, clear boundary, common roots.
30-43	A	very dark gray to dark gray (10YR 3/1-4/1) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common roots.
43-78	Bw1	dark gray to dark grayish brown (10YR 4/1) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots, very few thin discontinuous very dark gray (10YR 3/1) organs.
78-96	Bw2	dark grayish brown (10YR 4/2) sandy loam, weak medium to fine subangular blocky, very friable, noneffervescent, clear boundary, occasional very dark gray (10YR 3/1) filled insect burrows.
96-115	Bw3	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, moderate effervescence, abrupt boundary, burrows as above.
115-129	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate medium subangular blocky breaking to moderate medium granular, friable, moderate effervescence, clear boundary.
129-135	2A2b	very dark grayish brown (10YR 3/2) loam. moderate medium to fine subangular blocky, friable, weak effervescence, clear boundary.

Location: 08AB4 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
135-150	2Bw1b	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common very dark gray to very dark grayish brown (10YR 3/1-3/2) filled insect burrows.
150-192	2Bw2b	dark brown (10YR 3/3) loam, weak medium subangular blocky, friable, moderate effervescence, gradual boundary.
192-286	2C	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam grading to silt loam, very weak medium subangular blocky grading to massive, friable, moderate effervescence, abrupt boundary, few fine iron concretions, common gastropod shells.
286-410	3C1	brown (10YR 5/3) fine to medium sand, single grain, loose, moderate to strong effervescence, clear boundary, common broken gastropod shells.
410-base (440)	3C2	grayish brown (2.5YR 5/2) fine to medium sand, single grain, loose, moderate to strong effervescence, clear boundary, common medium olive brown (2.5 Y 4/4) mottles, common broken gastropod shells.

Location: 08AB5 Coal Valley; SE 1/4 NW 1/4 SW 1/4 NE 1/4 Sec. 1 T83N R27W
Landscape position: Intermediate Terrace, center of abandoned channel
Elevation: approximately 871 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: bare
Date described: 9/18/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-5	+	black (10YR 2/1) loam, massive, firm, noneffervescent, abrupt boundary.
5-25	Ap	black (10YR 2/1) silty clay loam, cloddy, friable, noneffervescent, abrupt boundary, few roots.
25-36	A1	black (10YR 2/1) heavy loam, weak to moderate medium granular, friable, noneffervescent, gradual boundary, few roots, occasional hackberry seeds.
36-57	A2	black (10YR 2/1) loam, moderate medium, subangular blocky, friable, noneffervescent, gradual boundary, very few roots, occasional pressure faces along vertical ped faces.
57-78	A3	black (10YR 2/1) heavy loam, moderate medium angular blocky, friable, noneffervescent, gradual boundary, common pressure faces along vertical ped faces.
78-112	A4	very dark grayish brown (10YR 3/2) loam, weak medium to coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary.
112-140	AC	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) sandy loam, weak medium to coarse subangular blocky, very friable, noneffervescent, gradual boundary.
140-187	C1	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) loam, massive, friable, noneffervescent, clear boundary, few fine iron concretions, common thin discontinuous very dark gray (10YR 3/1) coatings in insect burrows and root channels.

Location: 08AB5 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
187-216	C2	very dark gray (10YR 3/1) silt loam, massive, friable, noneffervescent, gradual boundary, few fine oxides.
216-340	C3	dark grayish brown (2.5Y 4/1) heavy loam, massive, friable, noneffervescent, gradual boundary, common fine light olive brown (2.5Y 5/6) mottles, occasional black (2.5Y 2/1) organic streaks.
340-384	C4	very dark grayish brown to dark grayish brown (2.5Y 3/2-4/2) heavy loam, massive, friable, noneffervescent, abrupt boundary, abundant medium light olive brown (2.5Y 5/6) mottles, common fine iron concretions.
384-442	C5	grayish brown and light brownish gray (2.5Y 5/2 and 6/2) stratified silt loam and fine sand, massive, friable, noneffervescent, abrupt boundary.
442-base (450)	2C	light olive brown (2.5Y 5/4) medium to coarse sand, single grain, loose, moderate to strong effervescence, hole collapsed.

Location: 08AB6 Coal Valley; SE 1/4 NW 1/4 SW 1/4 NE 1/4 Sec. 1 T83N R27W
Landscape position: Intermediate Terrace, western edge of abandoned channel
Elevation: approximately 871 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: bare
Date described: 9/18/84
Described by: E. A. Bettis III
Remarks: approximately 10m west of #5; C-14 sample 410-427 cm, 3930± 120 B.P. (Beta-10881)

Depth (cm)	Soil Horizon (weathering zone)	Description
0-46	+	dark grayish brown to brown (10YR 4/2-4/3) sandy loam, massive, very friable, noneffervescent, abrupt boundary, 1984 flood deposits.
46-160		very dark grayish brown (10YR 3/2) loam, Entisol with Ap horizon in upper 20 cm, friable, noneffervescent, clear boundary, Historic deposits.
160-200		black to very dark gray (10YR 2/1 3/2) loam, Entisol with Ap horizon in upper 20 cm, friable, noneffervescent, clear boundary, boundary.
200-300	2C1	dark grayish brown (10YR 4/2) stratified loam, and silt loam, massive, friable, noneffervescent, gradual boundary.
300-398	2C2	dark grayish brown (2.5Y 4/2) silt loam, massive, friable, noneffervescent, clear boundary.
398-427	2C3	dark gray (2.5YN 4/) loam, massive, friable, noneffervescent, abrupt boundary, occasional pelecypod shells, abundant organics, C-14 horizon 410-427 cm 3930± 120 B.P. (Beta-10881).
427-base (450)	3C	light olive brown (2.5Y 5/4) medium to coarse sand, single grain, loose, strong effervescence.

Location: 08AB7 Coal Valley; NE 1/4 SE 1/4 SW 1/4 NE 1/4 Sec. 1 T83N R27W
Landscape position: Intermediate Terrace
Elevation: approximately 877 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 9/18/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-27	Ap	very dark grayish brown (10YR 3/2) sandy loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
27-61	BA1	very dark grayish brown to dark gray (10YR 3/2-4/1) sandy loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few roots.
61-84	BA2	very dark grayish brown to dark gray (10YR 3/2-4/1) sandy loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary, few roots.
84-122	BE	dark brown (10YR 3/3) sandy loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, very few roots.
122-150	Bt	dark brown (10YR 3/3) sandy loam, moderate medium columnar breaking to moderate medium subangular blocky, friable, weak effervescence, clear boundary, very few thin discontinuous dark grayish brown (10YR 4/2) cutans.
150-199	BC	brown (10YR 4/3) sandy loam, weak coarse subangular blocky, friable, weak effervescence, clear boundary.
199-289	C1	brown to light brownish gray (10YR 5/3-6/2) fine to medium sand, single grain, loose, weak effervescence, abrupt boundary.
289-base (580)	C2	stratified brown to light brownish gray (10YR 5/3-6/2) medium to coarse sand and brown (10YR 4/3) loamy sand, single grain, loose, weak to strong effervescence.

Location: 08AB8 Coal Valley; SE 1/4 NE 1/4 SE 1/4 NW 1/4 Sec. 1 T83N R27W; 13BN162
Landscape position: High Terrace
Elevation: approximately 880 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 9/19/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-19	Ap	black to very dark gray (10YR 2/1-3/1) silt loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
19-42	A1	very dark gray (10YR 3/1) silt loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
42-58	A2	very dark gray (10YR 3/1) silt loam, moderate coarse subangular blocky, friable, noneffervescent, clear boundary, common roots.
58-71	AB	very dark grayish brown (10YR 3/2) silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, common roots.
71-103	BE1	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, weak medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, few roots.
103-140	Bt1	brown (10YR 4/3) loam, moderate medium columnar, breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, very few roots, few thin discontinuous very dark grayish brown (10YR 3/2) cutans on vertical faces of columns.
140-191	Bt2	dark brown to brown (10YR 3/3-4/3) loam, weak coarse columnar breaking to weak medium subangular blocky, friable, noneffervescent, clear boundary, very few fine iron concretions, occasional thin cutans on columns as above.

Location: 08AB8 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
191-217	C1	dark grayish brown to brown (10YR 4/2-4/3) loam, very weak medium subangular blocky to massive, friable, noneffervescent, clear boundary, iron concretions as above.
217-280	C2	dark grayish brown (10YR 4/2) silt loam, massive, friable, moderate effervescence, gradual boundary, few fine iron concretions, very few fine soft carbonate accumulations in pores.
280-314	C3	dark grayish brown (10YR 4/2) silt loam, massive, friable, moderate to strong effervescence, clear boundary, few fine dark brown (7.5YR 3/4) mottles, common fine soft carbonate concretions.
314-332	2A1b	dark grayish brown (10YR 4/2) silt loam, very weak fine subangular blocky, friable, moderate effervescence, clear boundary, very few fine oxides.
332-365	2A2b	dark grayish brown (10YR 4/2) silty clay loam, very weak fine subangular blocky, friable, weak effervescence, gradual boundary, oxides as above.
365-445	2BEb	brown (10YR 5/3) silty clay loam, weak to moderate fine angular blocky, friable, moderate to strong effervescence, clear boundary, few fine soft carbonate concretions.
445-487	2Btb	brown (10YR 4/3-5/3) silt loam, moderate medium to coarse subangular blocky, friable, strong effervescence, abrupt boundary, common medium iron concretions, carbonate concretions as above, very few thin discontinuous dark grayish brown (10YR 4/2) cutans.
487-494	3A1b	dark gray to dark grayish brown (10YR 4/1-4/2) silty clay loam, moderate medium to fine subangular blocky breaking to moderate fine granular, friable, weak effervescence, clear boundary, common fine oxides, few broken gastropod shells, very few charcoal fleaks, horizon has a mottled appearance (midden?)

Location: 08AB8 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
494-505	3A2b	grayish brown to brown (10YR 5/2-5/3) silty clay loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, very few fine iron concretions, common fine oxides.
505-525	3Bt1b	dark grayish brown (10YR 4/2) silty clay loam, moderate to strong coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few fine oxides, common thin discontinuous very dark grayish brown (10YR 3/2) cutans on columns.
525-559	3Bt2b	dark grayish brown (10YR 4/2) silty clay loam, strong medium columnar breaking to moderate medium angular blocky, friable, noneffervescent, clear boundary, common thick continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.
559-576	3Bt3b	dark grayish brown to grayish brown (10YR 4/2-5/2) silty clay, strong medium to fine angular blocky, firm, noneffervescent, clear boundary, common thin almost continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.
576-592	3Bt4b	brown (10YR 5/3) silty clay, strong fine angular blocky, firm, noneffervescent, clear boundary, common fine iron concretions, few thin discontinuous dark grayish brown (10YR 4/2) cutans.
592-613	3BC1b	brown to yellowish brown (10YR 5/3-5/4) silty clay loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few medium grayish brown (2.5Y 5/2) mottles, common fine iron concretions, occasional pressure faces.
613-633	3BC2b	brown (10YR 5/32) silty clay loam, moderate medium angular blocky, friable, non-effervescent, clear boundary, common coarse grayish brown (2.5Y 5/2) and abundant fine dark yellowish brown (10YR 4/6) mottles, common fine iron concretions, few fine oxides, occasional pressure faces.

Location: 08AB8 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
633-691	3C1	brown to yellowish brown (10YR 5/3-5/4) silty clay loam, massive, friable, noneffervescent, abrupt boundary, abundant fine grayish brown (2.5Y 5/2) and dark yellowish brown (10YR 5/6) mottles, few fine iron concretions.
691-719	3C2	grayish brown (2.5Y 5/2) silty clay loam, massive, friable, noneffervescent, clear boundary, common fine iron concretions, common fine oxides.
719-735	3C3 (ACb?)	grayish brown (2.5Y 5/2) silty clay loam, moderate fine angular blocky, friable, noneffervescent, clear boundary, common fine iron concretions, abundant fine oxides.
735-775	3C4	olive brown to light olive brown (2.5Y 4/4-5/4) silty clay loam, massive, friable, noneffervescent, abrupt boundary, abundant medium grayish brown (2.5Y 5/2) mottles, common fine oxides.
775-base (846)	4C	olive brown (2.5Y 4/4) sandy loam, coarsening with depth, single grain, loose, non-effervescent, common medium grayish brown (2.5Y 5/2) mottles.

Location: 08AB9 Coal Valley; SW 1/4 NE 1/4 SE 1/4 NW 1/4 Sec. 1 T83N R27W; 13BN162
Landscape position: High Terrace
Elevation: approximately 881 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 9/19/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-30	Ap	black (10YR 2/1) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
30-44	A1	very dark gray (10YR 3/1) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common roots.
44-68	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots, common thin discontinuous black (10YR 2/1) organs.
68-92	AB	very dark grayish brown (10YR 3/2) loam, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few roots, organs as above, few thin discontinuous grayish brown (10YR 5/2) silans.
92-118	Bt1	dark brown (10YR 3/3) loam, moderate coarse subangular blocky, friable, noneffervescent, gradual boundary, few roots, few thin discontinuous black (10YR 2/1) organs, common thin discontinuous grayish brown (10YR 5/2) silans, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
118-147	Bt2	dark brown (10YR 3/3) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few fine iron concretions, common fine oxides, few thin discontinuous grayish brown (10YR 5/2) silans on columns, common thin almost continuous very dark grayish brown (10YR 3/2) cutans on columns.

Location: 08AB9 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
147-187	Bt3	dark brown (10YR 3/3) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, iron concretions and oxides, as above, common thin discontinuous very dark grayish brown (10YR 3/2) cutans on columns.
187-194	BC	dark brown (10YR 3/3) sandy loam, very weak medium subangular blocky, friable, noneffervescent, abrupt boundary, few fine iron concretions, common fine oxides.
194-316	C1	dark grayish brown to brown (10YR 4/2-4/3) silt loam, massive, friable, noneffervescent, clear boundary, common fine dark gray (10YR 4/1) mottles, few fine iron concretions, common fine oxides.
316-455	C2	dark grayish brown to brown (10YR 4/2-5/3) silt loam, massive, friable, moderate to strong effervescence, abrupt boundary, abundant fine dark gray (10YR 4/1) mottles, few fine iron concretions, few fine oxides, charcoal at top of horizon.
455-459	2A1b	very dark gray (10YR 3/1) silt loam, massive, friable, noneffervescent, clear boundary, occasional brown (10YR 5/3) blotches, occasional charcoal flecks.
459-507	2A2b	dark gray to dark grayish brown (10YR 4/1-4/2) silt loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, very few fine grayish brown (10YR 5/2) mottles, few fine iron concretions, few fine oxides.
507-547	2ABb	dark grayish brown (10YR 4/2) heavy silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, iron concretions and oxides as above.
547-571	2Bt1b	dark grayish brown to brown (10YR 4/2-4/3) silty clay loam, strong fine angular blocky, firm, noneffervescent, gradual boundary, few fine iron concretions, common fine oxides, common thin discontinuous dark gray (10YR 4/1) cutans, occasional pressure faces.

Location: 08AB9 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
571-594	2Bt2b	brown (10YR 5/3) silty clay loam, moderate to strong fine angular blocky, firm, noneffervescent, clear boundary, abundant fine iron concretions, common fine oxides, few thin discontinuous dark grayish brown (10YR 4/2) cutans, occasional pressure faces.
594-630	2BCb	brown to yellowish brown (10YR 5/3-5/4) silty clay loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, abundant fine to medium iron concretions, abundant fine oxides.
630-720	2C1	yellowish brown (10YR 5/4) silt loam, massive, friable, noneffervescent, clear boundary, common medium dark yellowish brown (10YR 4/6) and grayish brown (2.5Y 5/2) mottles, abundant fine to medium iron concretions, common fine oxides.
720-800	2C2	light olive brown (2.5Y 5/4) silt loam, massive, friable, moderate to strong effervescence, gradual boundary, abundant medium to coarse grayish brown (2.5Y 5/2) mottles, common medium iron concretions, common medium oxides, common medium soft carbonate concretions occuring in 3 cm wide bands.
800-840	2C3	grayish brown (2.5Y 5/2) silt loam, massive, slightly sticky nonplastic, violent effervescence, abrupt boundary, abundant coarse light olive brown (2.5y 5/4) mottles, few fine soft carbonate concretions, occasional thin fine sand lenses.
840-base (880)	3C	dark greenish gray (5GY 4/1) fine to medium sand, single grain, loose, violent effervescence.

Location: 08AB10 Coal Valley; SW 1/4 SW 1/4 NW 1/4 NE 1/4 Sec. 1 T83N R27W; 13BN162
Landscape position: High Terrace
Elevation: approximately 881 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 9/19/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-20	Ap	black to very dark gray (10YR 2/1-3/1) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
20-35	A1	black to very dark gray (10YR 2/1-3/1) loam, weak medium subangular blocky breaking to moderte medium granular, friable, noneffervescent, gradual boundary, abundant roots.
35-50	A2	very dark grayish brown (10YR 3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common roots.
50-70	A3	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, few roots, common very dark gray (10YR 3/1) filled insect burrows.
70-87	Bw1	very dark grayish brown to dark brown (10YR 3/2-3/3) sandy loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, few roots, insect burrows as above.
87-125	Bw2	dark brown (10YR 3/3) sandy loam, moderate medium to coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
125-165	Bw3	dark brown to brown (10YR 3/3-4/3) sandy loam, weak coarse subangular blocky, very friable, noneffervescent, clear boundary, common thin discontinuous very dark grayish brown (10YR 3/2) coatings in root channels.

Location: 08AB10 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
165-192	C	brown (10YR 4/3) sandy loam, massive, friable, noneffervescent, abrupt boundary.
192-211	2A1b	dark gray to dark grayish brown (10YR 4/1-4/2) loam, weak medium columnar breaking to weak fine subangular blocky, friable, noneffervescent, gradual boundary, common fine brown (10YR 4/3) mottles.
211-239	2A2b	very dark gray to dark grayish brown (10YR 4/1-4/1) clay loam, moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary, very few fine iron concretions.
239-274	2Bt1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, moderate coarse subangular blocky breaking to moderate fine angular blocky, friable, noneffervescent, gradual boundary, common thin discontinuous black (10YR 2/1) cutans.
274-305	2Bt2b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, strong medium columnar breaking to strong fine angular blocky, firm, noneffervescent, clear boundary, common thin continuous black (10YR 2/1) cutans, common coarse sand grains at base.
305-330	2BCb	dark grayish brown to brown (10YR 4/2-4/3) loam, weak coarse subangular blocky, friable, noneffervescent, clear boundary, common medium dark yellowish brown (10YR 4/6) and few medium grayish brown (12.5Y 5/2) mottles, few fine iron concretions.
330-385	2C1	brown (10YR 4/3) loam, massive, friable, noneffervescent, abrupt boundary, mottles as above, common fine iron concretions and oxides.
385-404	2C2	dark grayish brown (10YR 4/2) silt loam, massive, friable, noneffervescent, abrupt boundary, mottles as above, iron concretions as above.

Location: 08AB10 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
404-423	3A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam with common very coarse sand grains, weak medium subangular blocky, friable, noneffervescent, gradual boundary.
423-450	3A2b	very dark grayish brown (10YR 3/2) clay loam with common coarse sand grains, weak fine subangular blocky, friable, noneffervescent, clear boudary.
450-473	3Bwb	dark grayish brown (10YR 4/2) loam, weak fine angular blocky, friable, noneffervescent, gradual boundary, common fine dark yellowish brown (10YR 4/6) mottles, common fine oxides.
473-base (520)	4C	brown (10YR 4/3) grading to strong brown (7.5YR 4/6) pebbly loamy sand, single grain, loose, noneffervescent.

Location: 08AB11 Coal Valley; NE 1/4 NE 1/4 SE 1/4 NE 1/4 Sec. 1 T83N R27W; 13BN162
Landscape position: High Terrace
Elevation: approximately 881 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 9/20/84
Described by: E. A. Bettis III
Remarks: top of section has been borrowed for fill for U.S. 30

Depth (cm)	Soil Horizon (weathering zone)	Description
0-23	Ap	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
23-62	Bw	dark grayish brown (10YR 4/2) loam, strong medium angular blocky (compacted), very firm, noneffervescent, clear boundary, few roots.
62-97	BC	brown (10YR 4/3-5/3) sandy loam, moderate medium angular blocky (compacted) firm, noneffervescent, gradual boundary, very few roots.
97-143	CB	brown (10YR 4/3) sandy loam, very weak medium subangular blocky, friable, noneffervescent, gradual boundary.
143-245	C1	dark grayish brown to brown (10YR 4/2-4/3) sandy loam, massive, friable, noneffervescent, gradual boundary, few fine oxides.
245-302	C2	brown (10YR 4/3-5/3) loam, massive, friable, noneffervescent, abrupt boundary, common fine grayish brown (2.5Y 5/2) mottles, very few fine iron concretions, oxides as above.
302-316	2A1b	dark grayish brown to brown (10YR 4/2-4/3) loam, very weak medium to fine subangular blocky, friable, noneffervescent, gradual boundary, very few fine oxides.
316-330	2A2b	dark brown (10YR 3/3) silt loam, weak medium subangular blocky, friable, noneffervescent, clear boundary, oxides as above.
330-350	2Bw1b	brown to dark yellowish brown (10YR 4/3-4/4) silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, very few fine dark yellowish brown (10YR 4/6) mottles, few fine iron concretions, few fine oxides.

Location: 08AB11 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
350-389	2Bw2b	dark yellowish brown to yellowish brown (10YR 4/4-5/4) silty clay loam, moderate fine angular blocky, friable, noneffervescent, gradual boundary, mottles, iron concretions, and oxides as above.
389-398	2Bw3b	dark yellowish brown (10YR 4/4) silt loam, weak medium subangular blocky, friable, noneffervescent, common fine grayish brown (2.5Y 5/2) mottles, abundant fine iron concretions, common fine oxides.
398-420	3C1	dark yellowish brown (10YR 3/3) loamy sand, massive, friable, noneffervescent, occasional organics.
420-base (450)	3C2	yellowish brown (10YR 5/4) medium to coarse sand and fine pebbles, single grain, loose, noneffervescent, auger rejected.

Location: 08AB12 13BN278; NE 1/4 NW 1/4 SW 1/4 NW 1/4 sec. 6 T83N R26W
Landscape position: High Terrace; levee
Elevation: approximately 879 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 9/20 and 10/31 '84
Described by: E. A. Bettis III
Remarks: upper approximately 2m of section has been stripped off for U.S. Hwy. 30 described from core and backhoe trench

Depth (cm)	Soil Horizon (weathering zone)	Description
0-60	AB	dark brown (10YR 3/3) sandy loam, weak medium angular blocky (compacted), friable to firm, noneffervescent, gradual irregular boundary.
60-143	C1	brown (10YR 4/3) sandy loam, massive, friable, noneffervescent, clear smooth boundary.
143-178	C2	brown (10YR 4/3) sandy loam, massive, friable, moderate to strong effervescence, abrupt smooth boundary, lower 10cm of horizon contains discontinuous thin lenses of light gray (10YR 7/2) fine sand separated by thin silty sand lenses.
178-187	Ce	dark grayish brown to brown (10YR 4/2-4/3) loam, massive, friable, moderate to strong effervescence, abrupt smooth boundary, abundant charcoal and burned earth common shell and rocks, midden C-14 sample 4190 ±100 B.P. (Beta-1115).
187-223	C3	brown (10YR 4/3) sandy loam, massive, friable, moderate to strong effervescence, clear wavy boundary.
223-233	C4	pale brown (10YR 6/3) sandy loam, single, grain, loose, moderate effervescence, abrupt smooth boundary.
233-265	2ACb	dark grayish brown (10YR 4/2) loam, very weak fine subangular blocky, friable, violent effervescence, common medium to coarse grayish brown (2-5Y 5/2) and common medium dark brown (10YR 3/3) mottles.

Location: 08AB13 Coal Valley; SW 1/4 NE 1/4 SE 1/4 NE 1/4 Sec. 1 T83N R27W; 13BN124
Landscape position: Intermediate Terrace
Elevation: approximately 876 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 9/24/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits, 15 x 20 cm polygonal dessication cracks on surface.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-4	+	very dark gray (10YR 3/1) silt loam, massive, friable, strong effervescence, abrupt boundary.
4-27	Ap	very dark grayish brown (10YR 3/2) loam, cloddy, friable, noneffervescent, clear boundary, abundant roots.
27-32	A1	very dark grayish brown (10YR 3/2) loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
32-52	A2	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) weak to moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary, common roots.
52-90	A3	dark grayish brown (10YR 4/2) sandy loam, weak medium columnar breaking to weak medium subangular blocky, friable, noneffervescent, clear boundary, few roots.
90-115	AC	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) sandy loam, very weak coarse subangular blocky, friable, weak effervescence, gradual boundary, very few roots.
115-163	C1	brown (10YR 5/3) medium to fine loamy sand, single grain, loose, moderate effervescence, abrupt boundary.
163-243	C2	dark grayish brown and brown (10YR 4/2 - 5/3) stratified loamy sand and medium to fine sand, massive to single grain, very friable to loose, violent to moderate effervescence, abrupt boundary.

Location: 08AB13
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
243-base (310)	C3	pale brown (10YR 6/3) medium sand grading to coarse sand, single grain, loose, moderate to weak effervescence.

Location: 08AB14 Coal Valley; SW 1/4 NE 1/4 SE 1/4 NE 1/4 Sec. 1 T83N R27W; 13BN124
Landscape position: Intermediate Terrace, abandoned channel
Elevation: approximately 869 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: fallow field
Date described: 9/24/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-18	+	black to very dark gray (10YR 2/1-3/1) clay loam, massive, firm, moderate to strong effervescence, abrupt boundary.
18-28	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, massive, friable, very weak effervescence, abrupt boundary, few roots.
28-48	A1	very dark grayish brown (10YR 3/2) loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, few roots.
48-67	A2	very dark grayish brown (10YR 3/2) heavy loam, moderate fine subangular blocky, friable, noneffervescent, clear boundary, very few roots.
67-96	A3	very dark grayish brown (10YR 3/2) loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary.
96-133	Bw1	very dark grayish brown to dark brown (10YR 3/2-3/3) sandy loam, moderate coarse subangular blocky, friable, noneffervescent, gradual boundary, very few thin discontinuous very dark grayish brown (10YR 3/2) coatings in root channels.
133-154	Bw2	dark brown (10YR 3/3) sandy loam weak coarse subangular blocky, friable, noneffervescent, clear boundary.
154-170	C1	brown (10YR 4/3) loamy sand, single grain, loose, noneffervescent, abrupt boundary.

Location: 08AB14
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
170-226	C2	dark grayish brown (10YR 4/2) silt loam, weak fine subangular blocky, friable, moderate to strong effervescence, abrupt boundary.
226-314	C3	dark grayish brown (10YR 4/2) stratified silt loam and medium sand, massive and single grain, friable, and loose, strong and weak effervescence, abrupt boundary, silt loam beds are about 8 cm thick while medium sand beds are about 15 cm thick.
314-333	C4	black (10YR 2/1) clay loam, massive, firm, strong effervescence, abrupt boundary.
333-base (501)	C5	brown (10YR 4/3) medium to fine sand grading to grayish brown (2.5 Y 5/2) medium sand, single grain, loose, moderate grading to strong effervescence.

Location: 08AB15 Coal Valley; NW 1/4 SE 1/4 SE 1/4 NE 1/4 Sec. 1 T83N R27W; 13BN124
Landscape position: Intermediate Terrace
Elevation: approximately 862 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: fallow field
Date described: 9/24/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-16	+	black (10YR 2/1) clay loam, massive, firm, violent effervescence, abrupt boundary, common plant fragments, organic mat at base.
16-48	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
48-70	A1	very dark grayish brown to very dark gray (10YR 3/2-3/1) loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary, few roots.
70-91	A2	very dark grayish brown (10YR 3/2) loam, moderate fine subangular blocky, friable, noneffervescent, clear boundary, few roots.
91-120	Bw	very dark grayish brown to dark brown (10YR 3/2-3/3) sandy loam, weak medium subangular blocky, very friable, weak to moderate effervescence, gradual boundary, very few roots.
120-140	BC	brown (10YR 5/3) fine sand, single grain, loose, weak effervescence, abrupt boundary.
140-147	C1	brown (10YR 5/3) fine sand, single grain, loose, weak effervescence, abrupt boundary.
147-164	C2	dark brown (10YR 3/3) sandy loam, massive, friable, moderate to strong effervescence, abrupt boundary.
164-210	C3	pale brown (10YR 6/3) fine to medium sand, single grain, loose, weak effervescence, abrupt boundary.
210-260	C4	dark brown (10YR 3/3) loamy sand, massive, very friable, moderate effervescence, abrupt boundary.

Location: 08AB15
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
260-284	C5	dark brown to dark grayish brown (10YR 3/3-4/2) fine to medium sand, single grain, loose, moderate effervescence, abrupt boundary.
284-base (290)	2C	oxidized coarse sand and fine subrounded pebbles of mixed lithology, single grain, loose, strong effervescence.

Location: 08AB16 Coal Valley; SW 1/4 SE 1/4 SE 1/4 NE 1/4 Sec. 1 T83N R27W ; 13BN124
Landscape position: Intermediate Terrace, abandoned channel
Elevation: approximately 868 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: fallow field
Date described: 9/24/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-10	+	very dark gray (10YR 3/1) clay loam, massive, firm, moderate effervescence, abrupt boundary.
10-35	Ap	very dark gray (10YR 3/1) silty clay loam, cloddy, friable, noneffervescent, abrupt boundary.
35-47	A1	very dark gray (10YR 3/1) silty clay loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
47-60	A2	very dark gray (10YR 3/1) clay loam, moderate medium angular blocky, friable, non-effervescent, clear boundary.
60-92	AB	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary.
92-120	Bw	dark brown (10YR 3/3) sandy loam, very weak medium subangular blocky, friable, noneffervescent, clear boundary.
120-133	C1	dark brown (10YR 3/3) sandy loam, massive , friable, weak effervescence, gradual boundary.
133-211	C2	brown (10YR 4/3) sandy loam, massive, friable, weak to moderate effervescence, abrupt boundary, few fine light olive brown (2.5Y 5/4) mottles.
211-base (310)	C3	brown to pale brown (10YR 5/3-6/3) medium sand grading to coarse pebbly sand, single grain, loose, moderate effervescence, occasional broken gastropod shells.

Location: 08AB17 Coal Valley; SE 1/4 NE 1/4 SW 1/4 NW 1/4 Sec. 1 T83N R27W
Landscape position: High Terrace, on edge of low scarp decending to Noah Creek
Elevation: approximately 883 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: wheat
Date described: 9/26/84
Described by: E. A. Bettis III
Remarks: C-14 date on organics 552-570 cm. 11,000 ±290 B.P. (Beta-10882); the 4A1 appears to be a separate soil superimposed on the underlying soil.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-30	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
30-55	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
55-69	A2	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, few roots.
69-88	A3	very dark grayish brown (10YR 3/2) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, abrupt boundary, few roots.
88-107	2Bt1 (Ab?)	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam with common coarse sand grains, moderate medium to fine columnar, friable, noneffervescent, clear boundary, very few roots, very few thin discontinuous very dark gray (10YR 3/1) cutans.
107-131	2Bt2	dark grayish brown (10YR 4/2) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common medium to fine light olive brown (2.5Y 5/4) mottles, common medium iron concretions, common medium iron concretions very dark grayish brown (10YR 3/2) cutans, occasional charcoal flecks.

Location: 08AB17 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
131-164	2Bt3	dark gray (10YR 4/1) silty clay loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common fine oxides, few fine iron concretions, common thick continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.
164-200	2BC	dark grayish brown (10YR 4/2) loam with common coarse sand grains and fine pebbles, weak coarse subangular blocky, very friable, moderate effervescence, abrupt boundary, common medium grayish brown and light olive brown (2.5Y 5/2 and 5/4) mottles, oxides, and iron concretions as above, occasional gastropod shells.
200-224	3Ab	dark gray (10YR 4/1) loam with common coarse sand grains, very weak medium to fine subangular blocky, friable, moderate effervescence, clear boundary, oxides and iron concretions as above.
224-243	3C1	dark grayish brown (10YR 4/2) sandy loam, massive friable, moderate effervescence, abrupt boundary, common medium olive brown (2.5Y 4/4) mottles, occasional gastropod shells.
243-257	3C2	dark grayish brown (10YR 4/2) sandy loam, single grain, loose, moderate effervescence, abrupt boundary, mottles and gastropod shells as above.
257-288	3C3	dark grayish brown (10YR 4/2) silt loam, massive friable, moderate effervescence, abrupt boundary, mottles and gastropod shells as above.
288-318	4A1b	dark gray to dark grayish brown (10YR 4/1-4/2) silt loam, very weak medium subangular blocky to massive, friable, moderate to violent effervescence, clear boundary, common dark gray (10YR 3/1) coatings in pores.
318-340	4A2b	very dark gray to dark gray (10YR 3/1-4/1) silt loam, weak medium to fine subangular blocky, friable, weak effervescence, clear boundary.

Location: 08AB17 Coal Valley
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
340-364	4Bg1b	olive gray (5Y 1/2) silt loam, weak medium to fine subangular blocky, friable, weak effervesence, gradual boundary, abundant medium olive (5Y 4/6) mottles, very few fine soft carbonate concretions.
364-381	4Bg2b	dark greenish gray to greenish gray (5GY 4/1-5/1) silty clay loam, moderate fine angular blocky, friable, weak effervescence, gradual boundary, abundant medium to coarse olive (5Y 4/6) mottles, carbonate concretions as above.
381-415	4Bg3b	dark greenish gray to greenish gray (5GY 4/1-5/1) silt loam, weak medium to fine subangular blocky, friable, very weak effervescence, gradual boundary, mottles and carbonate concretions as above.
415-427	4C1	greenish gray (5GY 5/1) silt loam, massive, friable, very weak effervescence, clear boundary, mottles and carbonate concretions as above.
427-510	4C2	greenish gray (5GY 5/1) silt loam,massive, slightly sticky nonplastic, noneffervescent, gradual boundary, common medium olive (5Y 4/4) mottles.
510-base (600)	4C3	greenish gray to gray (5GY 5/1- 5Y 5/1) stratified silt loam and fine to medium sand, massive, nonsticky nonplastic, noneffervescent, common organics 552-570 cm, C-14 date on organics 11,000 ±290 B.P. (Beta-10882).

Location: 08AB18; SE 1/4 SE 1/4 SW 1/4 NW 1/4 Sec. 31 T84N R26W; 13BN40
Landscape position: alluvial fan, midfan position
Elevation: approximately 885 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 9/25/84
Described by: E. A. Bettis III
Remarks: the upper part of the soil originally developed in the 2 material was eroded off prior to deposition of the overlying material.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-26	Ap	black to very dark gray (10YR 2/1-3/1) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
26-38	A1	black to very dark gray (10YR 2/1-5/1) loam, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common roots.
38-54	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam with occasional coarse sand grains, moderate coarse subangular blocky breaking to moderate medium granular, friable, noneffervescent, clear boundary, common roots.
54-64	EB	very dark grayish brown (10YR 3/2) loam with common stratified subrounded fine pebbles, moderate medium subangular blocky breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, few roots, common thin discontinuous grayish brown (10YR 5/2) silans, flake at base of horizon.
64-83	Bt1	brown (10YR 4/3) loam, strong medium subangular blocky, firm, noneffervescent, clear boundary, common fine oxides, few fine iron concretions, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
83-94	Bt2	dark brown to brown (10YR 3/3-4/3) sandy loam, moderate medium subangular blocky, friable, noneffervescent, abrupt boundary, oxides and iron concretions as above, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB18
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
94-127	BC	brown (10YR 4/3) stratified loam and medium to coarse sand, weak to moderate medium columnar, friable, noneffervescent, abrupt boundary, abundant fine oxides, few fine iron concretions.
127-160	2Btb	very dark grayish brown (10YUR 3/2) silt loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common fine oxides, common thin almost continuous very dark grayish brown (10YR 3/2) cutans, occasional charcoal flecks.
160-182	2BCb	dark yellowish brown (10YR 4/4) silt loam, weak medium to fine subangular blocky, friable, noneffervescent, clear boundary, very few fine oxides and iron concretions.
182-195	2CBb	dark yellowish brown (10YR 4/4) silt loam, very weak medium to fine subangular blocky, friable, weak to moderate effervescence, abrupt boundary, oxides and iron concretions as above.
195-212	3Ab	dark brown (10YR 3/3) silt loam, weak to moderte medium subangular blocky, friable, moderate effervescence, gradual boundary, common fine oxides, occasional charcoal flecks.
212-237	3EBb	dark brown (10YR 3/3) silt loam, moderate coarse subangular blocky, friable, moderate to strong effervescence, gradual boundary, common fine oxides, common fine to medium soft carbonate concretions, common charcoal flecks, occasional krotovina.
237-264	3Bt1b	dark brown to brown (10YR 3/3-4/3) silty clay loam, moderate medium to fine subangular blocky, friable, strong effervescence, gradual boundary, oxides and carbonate concretions as above, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB18
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
264-282	3Bt2b	dark brown to brown (10YR 3/3-4/3) silt loam grading to loam, moderate medium to fine subangular blocky, friable, weak effervescence, abrupt boundary, oxides and carbonate concretions as above, few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
282-296	4C1	pale brown (10YR 6/3) loamy sand, massive, friable, weak effervescence, clear boundary, common medium oxides.
296-450	4C2	dark grayish brown to grayish brown (10YR 4/2 -2.5Y 5/2) stratified loamy sand and medium to coarse pebbly sand, single grain, loose, strong effervescence, clear boundary.
450-576	4C3	light brownish gray (2.5Y 6/2) fine to medium sand, single grain, loose, violent effervescence, clear boundary, common coarse olive brown (2.5Y 4/4) mottles, abundant soft diffuse carbonate accumulations.
576-590	4C4	light brownish gray (2.5Y 56/2) fine sand, massive, nonsticky nonplastic, violent effervescence, abrupt boundary, carbonate accumulations as above decreasing in abundance to few at base.
590-base (750)	5C	oxidized subrounded medium to coarse gravel with coarse sand filling voids between the clasts, single grain, loose, strong effervescence, abundant brown (7.5YR 4/4) iron stains on clasts.

Location: 08AB19 Pilot Mound Pollen Core; NW 1/4 NW 1/4 NE 1/4 SE 1/4 sec. 20 T85N, R26W
Landscape position: closed depression, approximate center
Elevation: approximately 1145 ft.
Parent material: peat and local alluvium
Slope: 0-2%
Vegetation: grass and sedges
Date described: 9/25/84
Described by: E. A. Bettis III
Remarks: Depression is owned by Charles Eastland who lives across the road to the east.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-33	Oep	black to very dark brown (10YR 2/1-2/2) hemic peat, soft, noneffervescent, abrupt boundary, abundant roots.
33-41	Oi1	very dark brown (10YR 2/2) fibric peat, abundant dark yellowish brown (10YR 4/4-4/6) plant fibers and macrofossils, soft, noneffervescent, clear boundary, common roots.
41-70	Oi2	black (10YR 2/1) fibric peat, common to abundant dark brown (10YR 3/3) plant fibers and macrofossils, firm, noneffervescent, clear boundary, few roots, 2500 ±70 B.P. 35-40 cm Beta-12589); 3250 ±60 RCYBP 65-70 cm (Beta-12342).
70-87	Oa	black (10YR 2/1) muck, massive, friable, noneffervescent, abrupt boundary, few roots.
87-92	2C	brown (10YR 4/3) silt loam, massive, friable, noneffervescent, abrupt boundary, very few fine brown (7.5YR 4/4) mottles, very few roots.
92-100	3Oa1	black (10YR 2/1) muck, occasional plant macrofossils, massive, friable, noneffervescent, abrupt boundary, common fine krotovina filled with brown (10YR 4/3) silt loam.
100-108	3Oe	black (10YR 2/1) sapric peat, firm, noneffervescent, gradual boundary, common thin dark brown (7.5YR 3/2) accumulations along vertical pores, 4960 ±90 B.P. 105-110 cm (Beta-12590).
108-122	3Oa2	black (10YR 2/1) muck, massive, friable, noneffervescent, gradual boundary, abudant thin dark brown (7.5YR 3/2) accumulations along vertical pores.

Location: 08AB19
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
122-130	3Oa3	black (10YR 2/1) muck, massive, friable, noneffervescent, clear boundary, accumulations along vertical pores as above.
130-156	3Oa4	very dark gray (10YR 3/1) mucky silt loam, massive, friable, very weak effervescence, clear boundary, occasional medium light gray (10YR 6/1) "blobs", accumulations along vertical pores as above.
156-181	4C1	very dark gray (10YR 3/1) stratified silt loam with occasional very thin grayish brown (10YR 5/2) fine sand laminations, massive, friable, noneffervescent, abrupt boundary, accumulations in vertical pores as above, common gastropod shells; 9730 ±130 B.P. 175-180 cm (Beta-12591).
181-192	4C2	brown (10YR 5/3) dark grayish brown (10YR 3/1) and reddish brown (5YR 4/4) mixed silt loam with occasional thin black (10YR 2/1) organic silt bands, massive, friable, moderate effervescence, clear boundary, occasional gastropod shells.
192-235	4C3	dark gray to grayish brown (2.5Y 4/2-5/2) and dark gray (5Y 4/1) stratified loam and silt loam, massive, friable, moderate effervescence, clear boundary; 9300 ±100 B.P. 210-215 cm (Beta-12343).
235-266	4C4	very dark gray to dark olive gray (5Y 3/1-3/2) stratified silt loam and fine to medium sand (1 sand bed approximately 2 cm thick midway through horizon), massive and single grain, friable and loose, strong effervescence, abrupt boundary.
266-480	4C5	dark gray to olive gray (5Y 4/1-4/1) stratified loam and pebbly medium to coarse sand (sand beds range from 3 to 10 cm in thickness and dominate the horizon), massive and single grain, friable and loose, strong effervescence, abrupt boundary.

Location: 08AB19
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
		Des Moines Lobe Till
480-base (550)	5C UU	dark gray (5Y 4/1) loam with occasional zones of silty clay loam with grayish brown (10YR 5/2) laminations, occasional subangular pebbles in loamy zones, massive, firm, violent effervescence.

Location: 08AB20; NW 1/4 SW 1/4 SE 1/4 NW 1/4 Sec. 31 T84N R26W; 13BN40
Landscape position: Alluvial fan , upper midfan
Elevation: approximately 892 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: grass
Date described: 9/27/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-20	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak medium to fine granular, friable, noneffervescent, clear boundary, abundant roots.
20-36	A	very dark grayish brown, (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, abrupt boundary, common roots.
36-51	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate medium to fine granular, friable, noneffervescent, clear boundary, abundant roots.
51-68	2A2b	black to very dark grayish brown (10YR 2/1 - 3/2) loam, moderate to strong medium to coarse subangular blocky, friable, noneffervescent, clear boundary, abundant roots, common subrounded medium pebbles at base.
68-92	2EBb	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam with common subrounded fine to medium pebbles, moderate coarse columnar breaking to strong medium subangular blocky, firm, noneffervescent, clear boundary, very few fine iron concretions, common roots, common thin discontinuous grayish brown (10YR 5/2) silans.
92-113	2Bt1b	very dark grayish brown (10YR 3/2) loam, strong coarse columnar breaking to strong medium subangular blocky, firm, noneffervescent, gradual boundary, iron concretions as above, very few roots, common thin discontinuous very dark gray (10YR 3/1) cutans, few thin discontinuous grayish brown (10YR 5/2) silans.

Location: 08AB20
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
113-146	2Bt2b	very dark grayish brown (10YR 3/2) loam, strong coarse columnar breaking to moderate medium angular blocky, firm, noneffervescent, abrupt boundary, iron concretions as above, common thin almost continuous very dark gray (10YR 3/1) cutans.
146-172	2Bthb	black to very dark brown (10YR 2/1-2/2) gravelly loam, moderate medium subangular blocky, firm, weak effervescence, clear boundary, common medium yellowish brown (10YR 5/4) filled insect burrows, common medium oxides and iron concretions, oxides also coat pebbles and ped faces, common thin almost continuous very dark gray to very dark grayish brown (10YR 3/1 -3/2) cutans.
172-224	2BCb	yellowish brown (10YR 5/4) pebbly sandy loam, very weak medium subangular blocky, friable, strong effervescence, abrupt boundary, burrows as above, few fine iron concretions.
224-242	2C	yellowish brown (10YR 5/4) subrounded medium pebbles grading to medium loamy sand, single grain, loose, violent effervescence, abrupt boundary.
242-284	3C	brown (10YR 4/3) loam, massive, friable, strong effervescence, abrupt boundary, few fine iron concretions.
284-317	4Ab	dark grayish brown to brown (10YR 4/2-4/3) loam, weak medium subangular blocky, friable, moderate grading to weak effervescence, clear boundary, few fine soft carbonate concretions.
317-350	4C1	pale brown (10YR 6/3) loam, massive, friable, violent effervescence, abrupt boundary, abundant fine soft carbonate concretions.
350-400	4C2	pale brown (10YR 6/3) pebbly sandy loam, single grain, loose, violent effervescence, abrupt boundary, carbonate concretions as above.

Location: 08AB20
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
		Pre-Illinoian till
400-base (450)	5C (OU)	brown (10YR 4/3) loam to sandy loam with occasional pebbles, massive, friable, violent effervescence, common fine to medium iron concretions.

Location: 08AB21; SE 1/4 SE 1/4 SW 1/4 NW 1/4 Sec. 31 T84N R26W; 13BN40
Landscape position: Truncated Alluvial fan, lower midfan
Elevation: approximately 880 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 9/27/84
Described by: E. A. Bettis III
Remarks: the upper material is Historic alluvium

Depth (cm)	Soil Horizon (weathering zone)	Description
0-26	Ap1	black to very dark gray (10YR 2/1-3/1) loam, massive, friable, noneffervescent, abrupt boundary, common roots.
26-54	Ap2	black to very dark gray (10YR 2/1-3/1) loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, very few fine iron concretions, abundant roots.
54-74	C1	brown (10YR 5/3) stratified medium to coarse sand and loam, single grain and massive, loose and friable, nonefferescent, abrupt boundary.
74-101	C2	brown and very dark grayish brown (10YR 5/3 and 3/2) stratified loam and silt loam, massive, friable, moderate effervesence, abrupt boundary.
101-144	AC	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, weak fine granular, friable, weak effervescence, abrupt boundary, few fine dark yellowish brown (10YR 4/6) mottles, iron concretions and oxides as above, occasional charcoal flecks.
		Alluvial Fan
144-168	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam with occasional fine pebbles, moderate medium granular, friable, noneffervescent, gradual boundary.
168-198	2A2b	very dark grayish brown (10YR 3/2) heavy silt loam with occasional fine pebbles, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common charcoal flecks.

Location: 08AB21
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
198-228	2Bw1b	very dark grayish brown (10YR 3/2) silty clay loam with occasional fine pebbles, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
228-260	2Bw2b	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, few medium iron concretions.
260-279	2Btb	very dark grayish brown (10YR 3/2) silty clay loam, moderate medium columnar breaking to moderate fine subangular blocky, friable, noneffervescent, clear boundary, few fine iron concretions, common thin discontinuous very dark gray (10YR 3/1) cutans, occasional gastropod shells, common charcoal flecks.
279-317	2C	very dark grayish brown (10YR 3/2) silt loam with blobs of brown (10YR 4/3) silt loam, massive, friable, noneffervescent, abrupt boundary, few fine iron concretions.
317-337	3BCb	brown (10YR 4/3) silt loam, weak medium subangular blocky, friable, strong effervescence, abrupt boundary, common medium soft carbonate concretions, few thin discontinuous very dark grayish brown (10YR 3/2) coatings in root channels.
337-342	3C1	brown (10YR 4/3) medium sand, single grain, loose, strong effervescence, abrupt boundary.
342-360	3C2	brown (10YR 4/3) medium sand, single grain, loose, strong effervescence, abrupt boundary.
360-367	3C3	brown (10YR 4/3) medium sand, single grain, loose, strong effervescence, abrupt boundary.
367-393	4Ab	dark grayish brown (10YR 4/2) heavy silt loam, weak medium subangular blocky, friable, moderate effervescence, clear boundary, few medium grayish brown (2.5Y 5/2) mottles, common fine soft carbonate concretions.

Location: 08AB21
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
393-415	4Bwb	brown (10YR 4/3) silt loam with common coarse sand grains, massive, friable, very weak effervescence, clear boundary, mottles as above.
415-443	4C1	brown to dark yellowish brown (10YR 4/3-4/4) silt loam, massive, friable, strong effervescence, abrupt boundary, common medium grayish brown (2.5Y 5/2) mottles.
443-540	4C2	brown to dark yellowish brown (10YR 4/3-4/4) stratified silt loam and medium sand, massive and single grain, friable and loose, moderate to strong effervescence, abrupt boundary, common medium grayish brown (2.5Y 5/2) mottles.
540-base (600)	5C	brown (7.5YR 4/4) medium to coarse sand and fine pebbles, single grain, loose, noneffervescent.

Location: 08AB22; SW 1/4 SE 1/4 SW 1/4 NW 1/4 Sec. 31 T84N R26W; west of 13BN40
Landscape position: Intermediate Terrace
Elevation: approximately 877 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/1/84
Described by: E. A. Bettis III
Remarks: the upper material is Historic deposits, the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-3	+	very dark gray (10YR 3/1) clay loam, massive, firm, violent effervescence, abrupt boundary.
3-37	Ap	very dark grayish brown (10YR 3/2) loam, cloddy, friable, weak to moderate effervescence, clear boundary, abundant roots, occasional angular fine to medium limestone pebbles (ag. lime?).
37-56	C	very dark grayish brown and brown (10YR 3/2 and 5/3) stratified loam with occasional fine pebbles, massive, friable, strong effervescence, abrupt boundary.
		Intermediate Terrace
56-85	2Ab	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, weak to moderate medium granular, friable, noneffervescent, clear boundary, common roots.
85-114	2ACb	dark brown (10YR 3/3) silt loam, weak medium subangular blocky, friable, noneffervescent, few roots.
114-128	C1	dark brown to brown (10YR 3/3-4/3) silt loam, massive, friable, noneffervescent, abrupt boundary, occasional gastropod shells.
128-190	C2	brown (10YR 4/3) fine to medium loamy sand, single grain, loose, noneffervescent, abrupt boundary, stratified in lower 20 cm of horizon.
190-243	C3	dark brown to brown (10YR 4/3) fine to medium sand, single grain, loose, moderate to strong effervescence, abrupt boundary.
243-260	C4	brown (10YR 4/3) fine to medium sand, single grain, loose, moderate to strong effervescence, abrupt boundary.

Location: 08AB22
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
260-312	C5	dark grayish brown to brown (10YR 4/2-4/3) loam, massive, friable, violent effervescence, abrupt boundary, common medium iron concretions, few fine soft carbonate concretions, common krotovina filled with brown (10YR 4/3) fine sand.
312-base (570)	C6	brown (10YR 4/3) medium to fine sand grading to coarse sand, single grain, loose, moderate to strong effervescence, occasional <10 cm thick beds of brown (10YR 4/3) loam.

Location: 08AB23; NW 1/4 NW 1/4 NE 1/4 SW 1/4 Sec. 31 T84N R26W; 13BN106
Landscape position: colluvial slope, footslope
Elevation: approximately 880 ft.
Parent material: alluvium/colluvium
Slope: 5-9%
Vegetation: weeds
Date described: 10/1/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-21	+	brown (10YR 4/3) medium to coarse loamy sand, single grain, loose, noneffervescent, abrupt boundary, abundant roots.
21-47	Ap1	very dark grayish brown (10YR 3/2) sandy loam, massive, friable, noneffervescent, abrupt boundary, common roots.
47-57	Ap2	very dark grayish brown (10YR 3/2) loam, weak medium to fine granular, friable, noneffervescent, gradual boundary, common roots, common charcoal flecks.
57-74	A1	very dark gray (10YR 3/1) silt loam, moderate medium to fine granular, friable, noneffervescent, gradual boundary, common roots, common charcoal flecks.
74-91	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, moderate medium prismatic breaking to moderate fine angular blocky, friable, noneffervescent, gradual boundary, common roots, common charcoal flecks.
91-113	Bw	very dark grayish brown (10YR 3/2) silt loam, moderate medium prismatic, friable, noneffervescent, clear boundary.
113-147	2Bt1 (2A1b)	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, moderate medium to coarse subangular block breaking to moderate medium granular, friable, noneffervescent, gradual boundary, few fine oxides, very few fine iron concretions, few thin discontinuous black to very dark gray (10YR 2/1-3/1) cutans.

Location: 08AB23 13BN106
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
147-165	2Bt2 (2A2b)	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, moderate coarse prismatic breaking to moderate medium to fine granular, friable, noneffervescent, gradual boundary, oxides and iron concretions as above, common thin almost continuous black to very dark gray (10YR 2/1-3/1) cutans.
165-180	2Bt2 (2ABb)	very dark grayish brown (10YR 3/2) silty clay loam, moderate medium prismatic, friable, noneffervescent, clear boundary, few fine oxides, very few fine iron concretions, common thin almost continuous very dark gray (10YR 3/1) cutans.
180-235	2Bt4 (2Bw1b)	dark brown (10YR 3/3) silty clay loam, moderate medium to coarse prismatic with occasional angular fine pebbles, friable, noneffervescent, gradual boundary, oxides and iron concretions as above, common thin discontinuous very dark gray (10YR 3/1) cutans.
235-272	2BC (2Bw2b)	brown (10YR 4/3) silty clay loam with occasional angular fine pebbles, weak coarse subangular blocky breaking to moderate medium subangular blocky, friable, noneffervescent, abrupt boundary, oxides and iron concretions as above.
272-284	3ACb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) silt loam, weak to moderte fine subangular blocky, friable, noneffervescent, clear boundary, few fine oxides, occasional krotovina filled with brown (10YR 4/3) fine sand.
284-317	3C1	yellowish brown (10YR 5/4) sandy loam, massive, friable, weak effervescence, abrupt boundary, common fine iron concretions.
317-388	3C2	grayish brown and yellowish brown (2.5Y 5/2 and 10YR 5/4) stratified loam and medium to coarse sand, massive and single grain, friable and loose, violent effervescence, abrupt boundary, common medium dark yellowish brown (10YR 4/6) mottles.

Location: 08AB23 13BN106
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
388-395	3C3	grayish brown (2.5Y 5/2) loam, massive, friable, violent effervescence, abrupt boundary, dark olive gray (5Y 3/2) manganese accumulation at base of horizon.
395-base (730)	4C	brown (10YR 4/3) matrix supported gravelly loam with occasional beds of clast supported medium to coarse subrounded gravel, massive and single grain, friable and loose, violent effervescence.

Location: 08AB24 SW 1/4 NW 1/4 NE 1/4 SE 1/4 sec. 5 T82N R26W; 13BN105
Landscape position: Early Holocene? bench
Elevation: approximately 868 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks: this terrace is topographically above the High Terrace to the south

Depth (cm)	Soil Horizon (weathering zone)	Description
0-23	Ap	very dark gray (10YR 3/1) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
23-43	A1	very dark gray (10YR 3/1) silt loam, weak medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, gradual boundary, common roots.
43-66	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) heavy silt loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots, occasional pieces of decomposed granite.
66-78	Bt1	very dark gray to very dark grayish brown (10YR 3/1-3/2) heavy silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, few roots, common thin discontinuous black (10YR 2/1) cutans.
78-108	Bt2	very dark grayish brown (10YR 3/2) silty clay loam, moderate medium to coarse prismatic breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common thin discontinuous very dark gray (10YR 3/1) cutans.
108-135	Bt3	dark brown (10YR 3/3) clay loam, moderate medium to coarse prismatic, friable, noneffervescent, gradual boundary, very few coarse grayish brown (2.5Y 5/2) mottles around root channels, few fine oxides, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB24 13BN105 area
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
135-191	Bt4	dark brown (10YR 3/3) loam, moderate coarse prismatic, friable, noneffervescent, clear boundary, common fine oxides, few fine iron concretions, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
191-212	BC	dark grayish brown (10YR 4/2) loam, weak medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary, oxides and iron concretions as above.
212-225	2C	brown (10YR 5/3 - 7.5YR 4/4) pebbly coarse sand, single grain, loose, noneffervescent (matrix), abrupt boundary, common medium dark yellowish brown (10YR 4/6) mottles, common medium oxides, common fine soft carbonate concretions.
225-base (300)	R	light greenish gray (5BG 7/1) siltstone, massive, firm, moderate effervescence.

Location: 08AB25 SW 1/4 NW 1/4 NE 1/4 SE 1/4 sec. 5 T82N R26W; 13BN277
Landscape position: Intermediate Terrace, swale on terrace surface
Elevation: approximately 860 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-10	+	dark gray (10YR 4/1) loam, massive, friable, noneffervescent, abrupt boundary.
10-30	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, massive, friable, noneffervescent, abrupt boundary, common roots.
30-47	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, moderate medium granular, friable, noneffervescent, gradual boundary, common roots.
47-65	A2	very dark grayish brown (10YR 3/2) silt loam, weak to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots, common charcoal flecks.
65-86	Bw1	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few roots, occasional brown (10YR 4/3) fine to medium sand filled krotovina.
86-129	Bw2	very dark grayish brown (10YR 3/2) loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few thin discontinuous very dark gary (10YR 3/1) coatings in root channels.
129-204	C	very dark grayish brown to dark brown (10YR 3/2-3/3) sandy loam, massive, friable, noneffervescent, abrupt boundary.
204-244	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, weak to moderate medium granular, friable, noneffervescent, gradual boundary.

Location: 08AB25 13BN277
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
244-264	2A2b	very dark grayish brown (10YR 3/2) loam, weak fine subangular blocky, friable, noneffervescent, gradual boundary, very few fine oxides, very few fine iron concretions.
264-294	2Bwb	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary, oxides and iron concretions as above.
294-332	2C1	dark grayish brown (10YR 4/2) loam, massive, friable, noneffervescent, clear boundary, oxides and iron concretions as above.
332-354	2C2	dark grayish brown (10YR 4/2) loam, massive, friable, noneffervescent, abrupt boundary, common medium dark brown (10YR 3/3) mottles, oxides and iron concretions as above.
354-383	3ACb	dark grayish brown (10YR 4/2) loam, weak fine subangular blocky, friable, non-effervescent, abrupt boundary, abundant fine dark brown (10YR 3/3) mottles, oxides and iron concretions as above, occasional charcoal flecks.
383-467	3C1	dark grayish brown (10YR 4/2) sandy loam, massive, friable, noneffervescent, abrupt boundary, abundant medium dark yellowish brown (10YR 4/4) mottles, oxides and iron concretions as above.
467-base (520)	3C2	dark grayish brown to brown (10YR 4/2-4/2) coarse sand, single grain, loose, noneffervescent.

Location: 08AB26 SE 1/4 NE 1/4 SW 1/4 SE 1/4 sec. 5 T82N R26W; 13BN38 area
Landscape position: High Terrace
Elevation: approximately 862 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-20	+	dark grayish brown (10YR 4/2) fine to medium sand, single grain, loose, noneffervescent, abrupt boundary.
20-59	Ap	very dark gray (10YR 3/1) sandy loam, massive, friable, noneffervescent, abrupt boundary, common roots, this horizon consists of multiple superimposed plow layers.
59-86	Bw1	brown (10YR 4/3) loam, weak medium to coarse subangular blocky, friable, noneffervescent, clear boundary, few roots.
86-104	Bw2	brown (10YR 4/3) loam, weak medium to coarse subangular blocky, friable, noneffervescent, clear boundary, few roots.
104-133	2Atb	very dark grayish brown (10YR 3/2) loam, moderate coarse subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common thin almost continuous very dark gray (10YR 3/1) cutans.
133-174	2Btb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common thin almost continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.
174-192	2BCb	dark brown (10YR 3/3) loam, weak medium to coarse subangular blocky, friable, noneffervescent, clear boundary.
192-212	2C1	dark brown (10YR 3/3) loam, massive, friable, noneffervescent, abrupt boundary.

Location: 08AB26 13BN38 area
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
212-229	2C2	dark brown (10YR 3/3) loam, massive, friable, strong effervescence, abrupt boundary, common fine soft carbonate concretions.
229-350	2C3	brown (10YR 4/3) stratified fine sand, single grain, loose, noneffervescent, abrupt boundary.
350-386	2C4	brown (10YR 4/3) loam, massive, friable, strong effervescence, abrupt boundary, common fine soft carbonate concretions.
386-base (505)	2C5	light brownish gray to light gray (10YR 6/2-7/1) medium to coarse sand, single grain, loose, weak to moderate effervescence.

Location: 08AB27 SW 1/4 NW 1/4 SE 1/4 SE 1/4 Sec. 5, T82N R26W; 13BN38 area
Landscape position: shallow linear swale on High Terrace
Elevation: approximately 860 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-10	+	dark gray (10YR 4/1) medium sand, single grain, loose, noneffervescent, abrupt boundary.
10-34	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, massive, friable, noneffervescent, clear boundary, abundant roots.
34-58	A	very dark grayish brown (10YR 3/2) loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
58-78	Bw1	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, few roots.
78-106	Bw2	dark brown (10YR 3/3) fine sandy loam, moderate medium subangular blocky, friable, noneffervescent, abrupt boundary, very few roots.
106-125	2A1b	very dark grayish brown to very dark gray (10YR 3/2-3/1) loam, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary.
125-145	2A2b	very dark grayish brown (10YR 3/2) loam, moderate coarse subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary.
145-174	2Bwb	dark brown (10YR 3/3) silt loam, weak medium subangular blocky, friable, noneffervescent, clear boundary.

Location: 08AB27 13BN38 area
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
174-205	2C1	dark brown (10YR 3/3) silt loam, massive, friable, noneffervescent to weakly effervescent, abrupt boundary.
205-base (350)	2C2	light gray and brown (10YR 7/2 and 4/3) stratified medium to coarse sand and fine sandy loam, single grain loose, moderate to strong effervescence.

Location: 08AB28 NW 1/4 NW 1/4 NW 1/4 SE 1/4 Sec. 5, T82N R26W; 13BN38 area
Landscape position: depression on High Terrace
Elevation: approximately 861 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-17	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) fine sandy loam, massive, friable, noneffervescent, abrupt boundary, abundant roots.
17-30	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak medium subangular blocky, friable, noneffervescent, clear boundary, abundant roots.
30-55	A2	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
55-75	A3	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, clear boundary, few roots.
75-110	AB	very dark grayish brown (10YR 3/2) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary.
110-146	BE	dark brown to very dark grayish brown (10YR 3/3 -3/2) loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) coatings in root channels.
146-206	Bt	brown (10YR 4/3) loam, weak coarse columnar, friable, noneffervescent, clear boundary, few thin discontinuous dark grayish brown (10YR 4/2) cutans.
206-253	C1	brown (10YR 4/3) loam, massive, friable, noneffervescent, abrupt boundary.
253-base (500)	C2	brown to light gray (10YR 5/3-7/2) medium sand, grading downward to coarse sand, single grain, loose, weak to moderate effervescence.

Location: 08AB29 SE 1/4 SW 1/4 NE 1/4 SE 1/4 Sec. 5, T82N R26W; 13BN38 area
Landscape position: High Terrace
Elevation: approximately 863 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-8	+	dark gray (10YR 4/1) sandy loam, single grain, loose, noneffervescent, abrupt boundary, common roots.
8-32	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, cloddy, friable, non-effervescent, abrupt boundary, common roots.
32-46	A	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, clear boundary, common roots, occasional fragments of decomposed granite.
46-63	AB	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few roots.
63-93	Bw1	dark brown (10YR 3/3) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, very few roots.
93-122	Bw2	dark brown (10YR 3/3) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
122-142	BC	brown (10YR 4/3) loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary.
142-179	C1	brown (10YR 4/3) loam, massive, friable, noneffervescent, clear boundary.
179-238	C2	brown (10YR 4/3) loam, massive, friable, moderate to strong effervescence, abrupt boundary.

Location: 08AB29 13BN38 area
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
238-base (500)	C3	brown (10YR 4/3) medium grading downward to coarse sand, single grain, loose, moderate effervescence.

Location: 08AB30 SE 1/4 SW 1/4 NE 1/4 SE 1/4 Sec. 5 T82N R26W; 13BN38
Landscape position: valley wall margin of High Terrace, seep
Elevation: approximately 866 feet
Parent material: alluvium
Slope: 5-9%
Vegetation: weeds and sedges
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks: This area is very seepy, bedrock (Pennsylvanian shale and sandstone) outcrop immediately upslope.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-19	Ap	black (10YR 2/1) loam, massive, friable, noneffervescent, abrupt boundary, abundant roots.
19-48	A1	black (10YR 2/1) silt loam, weak coarse subangular blocky breaking to moderate fine grandular, friable, noneffervescent, gradual boundary, abundant roots.
48-67	A2	black to very dark gray (10YR 2/1-3/1) silt loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, abundant roots.
67-97	A3	black to very dark gray (10YR 2/1-3/1) silty clay loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, mottles as above.
97-147	Bg1	very dark grayish brown (2.5 Y 3/2) clay loam, moderate medium angular blocky, friable, noneffervescent, clear boundary, abundant medium dark reddish brown (5YR 3/3) mottles, common medium pipestems.
147-179	Bg2	very dark grayish brown (2.5Y 3/2) clay loam, moderate medium to coarse columnar, friable, noneffervescent, clear boundary, mottles and pipestems as above.
179-227	Cg1	very dark grayish brown to dark grayish brown (2.5Y 3/2-4/2) clay loam, massive, friable, noneffervescent, abrupt boundary, common medium dark reddish brown (5YR 3/3) mottles.
227-264	Cg2	dark grayish brown (2.5Y 4/2) stratified loam and medium sand, massive and singe grain, friable and loose, noneffervescent, abrupt boundary, abundant medium dark yellowish brown (10YR 4/6) mottles.

Location: 08AB30 13BN38
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
264-base (350)	Cg3	greenish gray (5G3/1) fine sandy loam, massive, nonsticky nonplastic, noneffervescent, mottles as above, auger rejected on rock.

Location: 08AB31; SE 1/4 SE 1/4 NE 1/4 NW 1/4 Sec. 9 T82N R26W
Landscape position: Intermediate Terrace, natural levee
Elevation: approximately 854 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/3/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-30	+	very dark grayish brown to very dark gray (10YR 3/2-3/1) sandy loam grading to silt loam, massive, friable, moderate to strong effervescence, abrupt boundary, organic mat at base.
30-96	C	grayish brown to light brownish gray (10YR 5/2-6/2) fine to medium sand, single grain, loose, moderate effervescence, abrupt boundary.
96-108	2Ap	very dark grayish brown (10YR 3/2) loamy sand, massive, friable, weak effervescence, abrupt boundary.
108-164	2C	dark grayish brown to grayish brown (10YR 4/2-5/2) fine to medium sand, single grain, loose, moderate effervescence, abrupt boundary.
164-200	3A1b	dark grayish brown (10YR 4/2) silt loam, weak to moderate medium granular, friable, noneffervescent, gradual boundary, very porous.
200-224	3ACb	dark grayish brown to grayish brown (10YR 4/2-5/2) sandy loam, weak medium granular, friable, weak effervescence, abrupt boundary, very porous.
224-242	3C	light brownish gray (10YR 6/2) fine to medium sand, single grain, loose, moderate effervescence, abrupt boundary.
242-274	4A1b	dark grayish brown (10YR 4/2) silt loam, weak medium granular, friable, moderate effervescence, clear boundary, common fine dark yellowish brown (10YR 4/6) mottles.

Location: 08AB31
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
274-306	4ACb	dark grayish brown (10YR 4/2) silt loam, weak medium granular, friable, moderate to strong effervescence, abrupt boundary.
306-base (395)	4C	grayish brown (10YR 5/2) sand, single grain, loose, moderate to strong effervescence.

Location: 08AB32 NW 1/4 SE 1/4 NE 1/4 NW 1/4 Sec. 9 T82N R26W; 13BN272
Landscape position: Late Wisconsinan bench
Elevation: approximately 877 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: alfalfa
Date described: 10/2/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-22	Ap	dark brown (10YR 3/3) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
22-40	BE	dark brown to brown (10YR 3/3-4/3) loam, weak to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots.
40-62	Bt1	brown (10YR 4/3) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, clear boundary, common roots.
62-88	Bt2	dark yellowish brown (10YR 4/4) clay loam, moderate medium to fine angular blocky, firm, noneffervescent, clear boundary, few fine iron concretions, common fine oxides, common thin almost continuous dark brown (10YR 3/3) cutans, common thin discontinuous light gray (10YR 6/1) silans.
88-104	Bt3	dark yellowish brown (10YR 4/4) heavy loam, moderate medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary, abundant coarse grayish brown (10YR 5/2) mottles, iron concretions and oxides as above, cutans and silans as above.
104-126	2Bt4	brown (7.5YR 4/4) pebbly loam, moderate coarse subangular blocky, friable, noneffervescent, clear boundary, abundant coarse dark brown (7.5YR 3/2) mottles, abundant medium iron concretions, abundant clay bridges and coatings.
126-base (320)	2C	medium to coarse sand and fine to medium pebbles grading to medium cobbles, single grain, loose, noneffervescent, auger rejected.

Location: 08AB33 SW 1/4 NE 1/4 NE 1/4 NE 1/4 Sec. 5 T82N R26W; 13BN203
Landscape position: Alluvial fan, midfan
Elevation: approximately 875 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/3/84
Described by: E. A. Bettis III
Remarks: C-14 date on organics 620-640 cm 13,980 ±170 B.P. (Beta-10833) date is too old (Des Moines Lobe ice covered area at that date).

Depth (cm)	Soil Horizon (weathering zone)	Description
0-32	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
32-46	A	very dark grayish brown (10YR 3/2) loam with occasional fine subrounded pebbles, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common roots.
46-57	AB	very dark grayish brown to dark brown (10YR 3/2-3/3) loam with occasional fine subrounded pebbles, moderate medium subangular blocky breaking to moderate fine angular blocky, friable, noneffervescent, gradual boundary, few roots.
57-87	EB	brown (10YR 5/3) loam, moderate medium subangular and angular blocky, friable, noneffervescent, gradual boundary, common thin continuous very dark gray (10YR 3/1) organs.
87-117	Bt1(Ab)	dark yellowish brown and yellowish brown (10YR 4/4 and 5/4) loam, strong coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, few fine oxides, common thin continuous dark grayish brown to brown (10YR 4/2 - 4/3) cutans.
117-151	Bt2(Bwb)	brown (10YR 4/3) loam, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common medium oxides, common thin discontinuous dark brown (10YR 3/3) cutans.

Location: 08AB33
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
151-213	BC(BCb)	brown (10YR 4/3) loam, weak coarse columnar, friable, noneffervescent, abrupt boundary, few fine oxides, very few thin discontinuous dark brown (10YR 3/3) cutans, common charcoal flecks, occasional gastropod shells.
213-227	C	brown to yellowish brown (10YR 5/3-5/4) sandy loam and fine pebbles, single grain, loose, noneffervescent, abrupt boundary.
227-285	2ACb	brown (10YR 5/3) loam, very weak fine subangular blocky, friable, moderate effervescence, abrupt boundary, common medium grayish brown (2.5Y 5/2) mottles, few fine oxides common fine soft carbonate concretions.
285-330	2C1	pale brown to very pale brown (10YR 6/3-7/3) coarse sand grading to medium subrounded pebbles, single grain, loose, noneffervescent, clear boundary.
330-435	2C2	dark grayish brown (10YR 4/2) silt loam, massive, friable, moderate to strong effervescence, abrupt boundary, common medium dark brown (10YR 3/1) mottles, few fine oxides.
435-450	3ACb	very dark grayish brown (10YR 3/2) fine sandy loam, massive, friable, moderate effervescence, clear boundary, common medium olive brown (2.5Y 4/4) mottles.
450-510	3C1	dark grayish brown (2.5Y 4/2) stratified silt loam and fine sandy loam, massive, slightly sticky nonplastic, moderate to strong effervescence, clear boundary, common coarse olive brown (2.5Y 4/4) mottles, common fine iron concretions.
510-550	3C2	gray (5Y 5/1) silt loam, massive, slightly sticky slightly plastic, violent effervescence, clear boundary, common coarse olive brown (2.5Y 4/4) mottles, common medium soft carbonate concretions.

Location: 08AB33
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
550-584	3C3	greenish gray (5GY 5/1-6/1) silty clay loam, massive, slightly sticky slightly plastic, violent effervescence, gradual boundary, common medium olive brown (2.5Y 4/4) mottles
584-640	3C4	dark greenish gray to greenish gray (5GY 4/1-5/1) silt loam, massive, slightly sticky slightly plastic, violent effervescence, clear boundary, abundant organics, C-14 date on organics 620-640 cm 13,980 ±170 B.P. (Beta-10883).
640-base (670)	3C5	dark greenish gray to greenish gray (5GY 4/1 -5/1) loamy sand, single grain, loose, violent effervescence, rock (gravel?) at base of hole.

Location: 08AB34 SE 1/4 NW 1/4 NE 1/4 NE 1/4 Sec. 5 T82N R26W; 13BN203
Landscape position: Alluvial fan, midfan
Elevation: approximately 871 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/3/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-7	+	light brownish gray (10YR 6/2) fine to medium sand, single grain, loose, noneffervescent, abrupt boundary.
7-25	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
25-39	A1	very dark grayish brown (10YR 3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, common roots.
39-54	A2	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) loam, moderate medium columnar breaking to moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, common roots, common thin discontinuous light brownish gray (10YR 6/2) silans.
54-75	Bt1	very dark grayish brown (10YR 3/2) heavy loam, moderate medium columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, few fine iron concretions, common thin discontinuous very dark gray (10YR 3/1) cutans.
75-104	Bt2	dark brown to brown (10YR 3/3-3/4) heavy loam, moderate medium prismatic, friable, noneffervescent, abrupt boundary, few fine oxides and iron concretions, common thin continuous very dark grayish brown (10YR 3/2) cutans.
104-108	Bt3	dark brown to brown (10YR 3/3-4/3) medium to coarse sandy, loam, massive to weak coarse subangular blocky, friable, noneffervescent, abrupt boundary, common clay bridges.

Location: 08AB34
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
108-150	2Bt4	dark brown (10YR 3/3) silty clay loam, moderate coarse columnar, friable, noneffervescent, abrupt boundary, very few fine oxides and iron concretions, common thin continuous very dark grayish brown (10YR 3/2) cutans.
150-157	2BC	dark brown (10YR 3/3) medium to coarse sand, massive to weak medium subangular blocky, friable, noneffervescent, abrupt boundary.
157-200	2CB1	brown (10YR 4/3) silt loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary, very few fine grayish brown (10YR 5/2) mottles, few fine oxides.
200-232	2CB2	brown (10YR 4/3) silt loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, common medium grayish brown (2.5Y 5/2) mottles, common fine oxides, few fine iron concretions.
232-265	2C1	brown to yellowish brown (10YR 5/3-5/4) fine to medium sand, single grain, loose, noneffervescent, clear boundary.
265-320	2C2	brown (10YR 5/3) fine to coarse sand, single grain, loose, noneffervescent, clear boundary, common medium grayish brown (2.5Y 5/2) mottles with dark yellowish brown (10YR 4/6) halos.
320-490	2C3	dark grayish brown (2.5Y 4/2) medium to coarse pebbly sand, single grain, loose, moderate to strong effervescence, abrupt boundary, common medium olive brown (2.5Y 4/4) mottles.
490-540	3ACb	very dark grayish brown (2.5Y 3/2) silt loam, massive, slightly sticky slightly plastic, weak effervescence, clear boundary.
540-base (575)	3C	grayish brown (2.5Y 5/2) silt loam, massive, slightly sticky slightly plastic, moderate to strong effervescence, abundant medium dark yellowish brown (10-YR 4/6) mottles, hole collapsed below water table.

Location: 08AB35; NE 1/4 NE 1/4 NE 1/4 NE 1/4 Sec. 5 T82N R26W
Landscape position: Alluvial fan; upper mid fan
Elevation: approximately 875 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/3/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-33	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak medium to coarse subangular blocky, friable, noneffervescent, clear boundary, few roots, altered by farmstead activity.
33-41	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, few roots.
41-53	AB	very dark grayish brown (10YR 3/2) heavy loam, moderate medium to coarse columnar breaking to moderate fine angular blocky, friable, noneffervescent, gradual boundary, very few roots.
53-73	Bt1	dark brown (10YR 3/3) silty clay loam with common medium well rounded pebbles, moderate coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
73-92	Bt2	dark brown to brown (10YR 3/3-4/3) silty clay loam with common medium pebbles, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary, common medium iron concretions, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
92-114	BC	dark brown (10YR 3/3) loam with occasional medium subrounded pebbles, very weak medium subangular blocky; very friable, noneffervescent, abrupt boundary, occasional clay bridges.

Location: 08AB35
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
114-145	2Bt1b	brown (10YR 4/3-5/3) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common fine oxides, common thin discontinuous dark brown (10YR 3/3) cutans, common charcoal flecks.
145-170	2Bt2b	brown (10YR 4/3-5/3) heavy loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common fine oxides, common thin discontinuous very dark grayish brown to dark brown (10YR 3/2-3/3) cutans, common charcoal flecks.
170-183	2BCb	brown (10YR 4/3) coarse sandy loam, weak medium subangular blocky, friable, noneffervescent, clear boundary.
183-198	2C	brown (10YR 4/3) fine to coarse pebbly sand, single grain, loose, noneffervescent, abrupt boundary.
198-218	3ACb	brown (10YR 4/3) loam, weak medium to fine subangular blocky, friable, weak effervescence, clear boundary, few fine oxides, common charcoal flecks.
218-243	3C1	brown (10YR 4/3-5/3) loam, massive, friable, moderate effervescence, abrupt boundary, few fine oxides.
243-385	3C2	brown to pale brown (10YR 5/3-6/3) medium to coarse sand with occasional medium to coarse subrounded pebbles; single grain, loose, moderate to strong effervescence, abrupt boundary.
385-431	4C	brown (10YR 4/3) silt loam, massive, friable, strong effervescence, clear boundary, abundant medium grayish brown (2.5Y 5/2) mottles.
431-445	4Ab	dark brown (10YR 3/3) silt loam, very weak medium to fine subangular blocky, friable, strong effervescence, gradual boundary, few medium grayish brown (2.5Y 5/2) mottles.

Location: 08AB35
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
445-457	4ACb	dark brown (10YR 3/3) silt loam; weak medium to fine columnar, friable, moderate effervescence, clear boundary.
457-base (580)	4C	brown (10YR 4/3) medium to coarse sand with abundant subrounded medium pebbles in lower 30 cm, single grain, loose, violent effervescence.

Location: 08AB36; NE 1/4 NE 1/4 NE 1/4 NE 1/4 Sec. 5 T82N R26W; east of 13BN203
Landscape position: Intermediate Terrace
Elevation: approximately 864 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/4/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-8	+	very dark gray to very dark grayish brown (10YR 3/1-3/2) fine to medium sand grading to silty clay loam, single grain to massive, loose to friable, noneffervescent, abrupt boundary.
8-36	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, common roots.
36-41	AC	very dark grayish brown (10YR 3/2) loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, few roots.
41-56	C1	dark brown (10YR 3/3) sandy loam with common fine subrounded pebbles, very weak medium subangular blocky to massive, friable, noneffervescent, abrupt boundary.
56-125	C2	stratified dark brown (10YR 3/3) loamy sand and pale brown (10YR 6/3) medium sand, beds range from 10 to 20 cm in thickness, massive and single grain, friable and loose, noneffervescent, abrupt boundary.
125-142	C3	very dark grayish brown to dark gray (10YR 3/2-4/1) loam, weak fine subangular blocky to massive, friable, noneffervescent, abrupt boundary, common fine brown (7.5YR 4/4) mottles.
142-181	C4	brown (10YR 4/3-5/3) medium to coarse sand, single grain, loose, noneffervescent, abrupt boundary
181-195	C5	grayish brown (2.5Y 5/2) stratified very fine sand, beds average 1-2 cm in thickness, massive, friable, noneffervescent, abrupt boundary, common brown (7.5YR 4/4) iron accumulation along bedding planes.

Location: 08AB36
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
195-203	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, weak medium granular, friable, noneffervescent, clear boundary, abundant fine olive brown (2.5Y 4/4) mottles.
203-219	2A2b	dark brown (10YR 3/3) silt loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common fine brown (7.5YR 4/4) mottles, very few fine oxides, occasional gastropod shells.
219-262	2ACb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) silt loam, very weak medium subangular blocky, friable, weak effervescence, abrupt boundary, few fine brown (7.5YR 4/4) mottles.
262-266	2C	grayish brown (10YR 5/2) stratified silt loam, beds are <1 cm in thickness, massive, friable, weak effervescence, abrupt boundary, brown (7.5YR 4/4) iron accumulation along bedding plane surfaces.
266-277	3A1b	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, weak medium to fine subangular blocky, friable, weak effervescence, clear boundary, common fine brown (7.5YR 4/4) mottles, occasional charcoal flecks.
277-298	3A2b	very dark grayish brown (10YR 3/2) loam with occasional fine subrounded pebbles, moderate medium to fine columnar breaking to moderate fine granular, friable, weak effervescence, clear boundary, mottles as above.
298-329	3C	dark brown to brown (10YR 3/3-4/3) loamy sand, massive, friable, moderate effervescence, abrupt boundary, few fine soft carbonate concretions.
329-339	4A1b	very dark grayish brown (10YR 3/2) silt loam, weak medium to fine subangular blocky, friable, weak effervescence, clear boundary, common fine brown (7.5YR 4/4) mottles.

Location: 08AB36
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
339-385	5AC1b	very dark grayish brown (2.5YR 3/2) silt loam, weak fine subangular blocky, friable, moderate effervescence, gradual boundary, abundant medium to fine brown (7.5YR 4/4) mottles, the top of this horizon may have been truncated prior to deposition of the overlying material.
385-392	5AC2b	very dark grayish brown (10YR 3/2) silt loam, moderate fine subangular blocky, friable, weak effervescence, gradual boundary, few fine brown (7.5YR 4/4) mottles.
392-439	5C1	dark brown (10YR 3/3) fine sandy loam, massive, nonsticky nonplastic, moderate effervescence, abrupt boundary, abundant medium brown (7.5YR 4/4) mottles.
439-451	5C2	dark grayish brown (2.5Y 4/2) silt loam, massive, slightly sticky slightly plastic, moderate to strong effervescence, abrupt boundary, mottles as above.
451-498	5C3	dark yellowish brown to yellowish brown (10YR 4/4-5/4) medium to coarse pebbly sand, single grain, loose, moderate effervescence, abrupt boundary.
498-520	5C4	dark grayish brown (10YR 4/2) silt loam, massive, slightly sticky slightly plastic, strong effervescence, abrupt boundary, abundant medium to coarse brown (7.5YR 4/4) mottles.
520-base (550)	6C	brown to grayish brown (10YR 4/3-5/2) medium to coarse pebbly sand, single grain, nonsticky nonplastic, moderate to strong effervescence, mottles as above.

Location: 08AB37 SE 1/4 NW 1/4 NE 1/4 NE 1/4 Sec. 5 T82N R26W; 13BN203
Landscape position: small drainage between alluvial fan and valley slope
Elevation: approximately 872 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/4/84
Described by: B. E. Hoyer
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-3	+	black (10YR 2/1) silty clay loam, strong fine angular blocky, firm, noneffervescent, abrupt boundary.
3-30	C	very dark brown (10YR 2/2) loamy sand, single grain, loose, noneffervescent, clear boundary.
30-60	Ap	black (10YR 2/1) sandy loam, massive, friable, noneffervescent, clear boundary.
60-100	A1	black (10YR 2/1) silty clay loam, strong fine angular blocky, friable, very weak effervescence, clear boundary.
100-126	Bt1	dark grayish brown (10YR 4/2) silty clay, moderate fine columnar, friable, noneffervescent, clear boundary, abundant thin discontinuous very dark grayish brown (10YR 3/2) cutans.
126-163	Bt2	dark brown (10YR 3/3) silty clay, strong fine columnar, firm, noneffervescent, thick continuous very dark grayish brown (10YR 3/2) cutans.
163-202	BC	brown and very dark grayish brown (10YR 4/3 and 3/2) loam, moderate fine subangular blocky, friable, noneffervescent, abrupt boundary.
202-354	C1	dark grayish brown (10YR 4/2) stratified silt loam and loamy fine sand, massive and single grain, friable, and loose, noneffervescent, clear boundary.
354-410	C2	yellowish brown (10YR 5/4) coarse sand and fine subrounded gravel, single grain, loose, moderate effervescence, abrupt boundary.

Location: 08AB37
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
410-455	C3	very dark gray (10YR 3/1) silt loam, massive, friable, strong effervescence, abrupt boundary, thin bed of loamy sand at base.
455-478	2ACb	greenish gray (5GY 5/1) loam, strong fine subangular blocky, friable, violent effervescence, gradual boundary, common fine olive (5Y 4/3) mottles.
478-base (525)	2C	gray (5Y 5/1) stratified silt loam, massive, friable, strong effervescence, common medium dark greenish gray (5G 4/1) mottles, auger rejected, oxidized hard medium sand on tip.

Location: 08AB38 SW 1/4 NE 1/4 SE 1/4 NE 1/4 Sec. 27 T84N R27W; 13BN182
Landscape position: High Terrace
Elevation: approximately 887 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/4/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-21	Ap	very dark grayish brown (10YR 3/2) fine sandy loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
21-40	A1	very dark grayish brown to dark brown (10YR 3/2-3/3) fine sandy loam, weak to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots.
40-63	AB	dark brown (10YR 3/3) fine sandy loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few roots.
63-76	2Ab	dark brown to very dark grayish brown (10YR 3/3-3/2) fine sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, very few thin discontinuous very dark gray to very dark grayish brown (10YR 3/1-3/2) organs.
76-122	2Bw1b	brown (10YR 4/3) fine sandy loam, moderate medium subangular blocky, friable, weak effervescence, gradual boundary, very few thin discontinuous very dark grayish brown (10YR 3/2) organs.
122-140	2Bw2b	dark brown to brown (10YR 3/3-4/3) loam, moderate medium columnar breaking to moderate medium subangular blocky, friable, weak effervescence, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) organs.
140-166	2Bw3b	brown (10YR 4/3) loam, moderate medium to fine columnar, friable, weak effervescence, abrupt boundary, common charcoal flecks.

Location: 08AB38 13BN182
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
166-181	3Ab	dark brown (10YR 4/3) loam, moderate fine columnar breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common charcoal flecks.
181-210	3BAb	dark brown (10YR 3/3) loam, moderate medium to fine subangular blocky, friable, weak effervescence, clear boundary.
210-246	3Btb	dark brown (10YR 3/3) loam, moderate coarse columnar, friable, weak effervescence, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
246-300	3BC1b	dark brown to dark yellowish brown (10YR 3/3-3/4) loam, moderate medium to coarse sub-angular blocky, friable, weak effervescence, gradual boundary.
300-367	3BC2b	dark brown (10YR 3/3) sandy loam, weak coarse subangular blocky, friable, weak effervescence, abrupt boundary.
367-384	4Ab	dark grayish brown (10YR 4/2) silt loam, moderate medium subangular blocky, friable, moderate to strong effervescence, clear boundary, common charcoal flecks, occasional gastropod shells.
384-469	4Bwb	dark brown (10YR 3/3) silt loam, weak medium to coarse subangular blocky, friable, strong effervescence, gradual boundary, occasional gastropod shells.
469-513	4BCb	dark brown (10YR 3/3) silt loam, weak medium subangular blocky, very friable, strong effervescence, clear boundary, weak stratification evident, occasional gastropod shells.
513-585	4C	brown (10YR 4/3) silt loam, massive, friable, strong effervescence, abrupt boundary, occasional gastropod shells.
585-base (610)	5C	brown (10YR 4/3) medium to coarse pebbly loamy sand, single grain, loose, violent effervescence.

Location: 08AB39 NW 1/4 SE 1/4 SE 1/4 NE 1/4 Sec. 27 T84N R27W; 13BN182
Landscape position: High Terrace
Elevation: approximately 886 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: alluvium
Date described: 10/4/84
Described by: B. E. Hoyer
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-30	Ap	very dark grayish brown (10YR 3/2) sandy loam, weak medium angular blocky, friable, noneffervescent, clear boundary.
30-77	BC	dark brown (10YR 3/3) loamy sand, massive, very friable, noneffervescent, clear boundary.
77-116	2Ab	very dark grayish brown (10YR 3/2) sandy loam, moderate fine to coarse prismatic, friable, noneffervescent, clear boundary.
116-173	2Bwb	dark brown (10YR 3/3) sandy loam, weak medium subangular blocky, friable, strong effervescence, clear boundary, few gastropod shells.
173-224	3Ab	very dark grayish brown (10YR 3/2) loam to sandy loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few charcoal flecks.
224-373	3Bwb	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, moderate effervescence, clear boundary.
373-420	4Ab	very dark grayish brown (10YR 3/2) silt loam, strong medium subangular blocky, firm, moderate effervescence, gradual boundary.
420-500	4Bwb	very dark grayish brown (10YR 3/2) silt loam, moderate medium subangular blocky, firm, moderate to strong effervescence, abrupt boundary.
500-base (560)	5C	yellowish brown (10YR 5/4) stratified medium sand with occasional loamy sand beds, single grain, loose, strong effervescence.

Location: 08AB40 SW 1/4 SE 1/4 SE 1/4 SW 1/4 Sec. 26 T84N R27W; 13BN30
Landscape position: High Terrace
Elevation: approximately 891 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: grass
Date described: 10/5/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-24	Ap	very dark grayish brown (10YR 3/2) fine sandy loam, moderate medium granular to moderate medium subangular blocky, friable, noneffervescent, abrupt smooth boundary, abundant roots.
24-32	A1	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, also breaks along large horizontal planes (compaction?), friable, noneffervescent, abrupt boundary, abundant roots.
32-45	A2	very dark grayish brown (10YR 3/2) fine sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, abundant roots, abundant medium dark yellowish brown (10YR 4/4) blobs (burned earth?)
45-70	EB	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots, common thin discontinuous very dark grayish brown (10YR 3/2) organs, common thin discontinuous light brownish gray (10YR 6/2) silans.
70-93	BE	dark brown (10YR 3/3) loam, moderate coarse columnar breaking to moderate coarse sub-angular blocky, friable, noneffervescent, clear boundary, few roots, common thin almost continuous light brownish gray (10YR 6/2) silans.

Location: 08AB40
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
93-123	Bt	dark brown (10YR 3/3) loam, moderate medium to coarse columnar, friable, noneffervescent, gradual boundary, few roots, common thin discontinuous very dark grayish brown (10YR 3/2) cutans, very few thin discontinuous light brownish gray (10YR 6/2) silans.
123-208	BCt	dark brown (10YR 3/3) loam, moderate medium to coarse columnar, friable, noneffervescent, gradual boundary, few roots, common thin discontinuous very dark grayish brown (10YR 3/2) cutans, very few thin discontinuous light brownish gray (10YR 6/2) silans.
208-230	CB	brown (10YR 4/3) loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary.
230-317	C1	brown (10YR 4/3) loam, massive, friable, noneffervescent, gradual boundary.
317-350	C2	brown (10YR 4/3) loam, massive, friable, very weak effervescence, abrupt boundary.
350-369	C3	yellowish brown (10YR 5/4) medium to fine sand, single grain, loose, very weak effervescence, abrupt boundary.
369-468	C4	dark grayish brown to brown (10YR 4/2-4/3) very fine sandy loam grading to silt loam, massive, friable, moderate effervescence, very few fine soft carbonate concretions.
468-482	C5	dark grayish brown to brown (10YR 4/2-4/3) medium to fine sand, single grain, loose, moderate effervescence, abrupt boundary.
482-523	C6	brown (10YR 4/3) silt loam, massive, friable, moderate effervescence, abrupt boundary.
523-550	2Ab	dark gray to dark grayish brown (10YR 4/1-4/2) silty clay loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary.

Location: 08AB40
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
550-613	2C	yellowish brown (10YR 5/4) silty clay loam, massive, friable, moderate effervescence, abrupt boundary, few fine grayish brown (2.5Y 5/2) mottles.
613-base (650)	3C	brown (7.5YR 4/4) coarse pebbly sand, single grain, loose, noneffervescent.

Location: 08AB41; NW 1/4 NE 1/4 NE 1/4 NW 1/4 Sec. 35 T84N R27W; west of 13BN30
Landscape position: Intermediate Terrace
Elevation: approximately 882 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/5/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-5	+	black to dark grayish brown (10YR 2/1-4/2) clay loam grading to fine sand, massive, friable, noneffervescent, abrupt boundary.
5-23	Ap	very dark grayish brown (10YR 3/2) fine sandy loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
23-45	Bw1	dark brown (10YR 3/3) fine sandy loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, few roots.
45-98	Bw2	brown (10YR 4/3) fine sandy loam, weak to moderate medium to coarse subangular blocky, very friable, noneffervescent, abrupt boundary, very few roots.
98-123	C	brown (10YR 4/3) fine sandy loam, single grain, loose, noneffervescent, abrupt boundary.
123-142	2Ab	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) fine sandy loam, moderate medium subangular blocky, friable, very weak effervescence, gradual boundary.
142-173	2BAb	very dark grayish brown (10YR 3/2) silt loam, moderate coarse columnar breaking to weak medium subangular blocky, friable, weak to moderate effervescence, gradual boundary, few fine soft carbonate concretions, very few thin discontinuous very dark gray (10YR 3/1) organs.
173-220	2Bwb	dark grayish brown (10YR 4/2) silt loam, weak coarse subangular blocky, very friable, moderate effervescence, gradual boundary.

Location: 08AB41
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
220-335	2C1	brown and light brownish gray (10YR 4/3-6/2) stratified fine sandy loam and medium to coarse sand, strata are 10-20 cm in thickness, single grain, loose, weak to moderate effervescence, abrupt boundary.
335-460	2C2	very dark grayish brown (2.5Y 3/2) silt loam with occasional thin fine sand beds, massive, slightly sticky nonplastic, moderate effervescence, abrupt boundary, abundant medium to fine brown (7.5YR 4/4) mottles.
460-base (525)	2C3	light brownish gray (10YR 6/2) medium to coarse sand, single grain, loose, moderate effervescence, abundant medium to coarse brown (7.5YR 4/4 & 4/2) mottles.

Location: 08AB42; SE 1/4 NW 1/4 NW 1/4 NE 1/4 Sec. 35 T84N R27W
Landscape position: Intermediate Terrace, level below that on which 08AB41 was drilled.
Elevation: approximately 876 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: fallow bean field
Date described: 10/5/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-10	Ap1	very dark gray (10YR 3/1) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
10-28	Ap2	very dark gray (10YR 3/1) loam, moderate medium granular, friable, noneffervescent, abrupt boundary, common roots.
28-48	AB	very dark grayish brown (10YR 3/2) loam to fine sandy loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
48-87	Bw	dark grayish brown (10YR 4/2) fine sandy loam, weak to moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, few roots, very few thin discontinuous very dark grayish brown (10YR 3/2) organs.
87-115	BC	dark brown to dark grayish brown (10YR 3/3-4/2) fine sandy loam, weak medium to coarse subangular blocky, friable, weak effervescence, clear boundary.
115-150	C1	brown (10YR 4/3) fine loamy sand, massive, friable, moderate effervescence, abrupt boundary.
150-300	C2	brown and pale brown (10YR 4/3 & 6/3) stratified loamy sand and medium sand, loamy sand beds are few and thin, single grain, loose, moderate effervescence, abrupt boundary.
300-321	C3	dark grayish brown (10YR 4/2) silt loam, massive, slightly sticky slightly plastic, strong effervescence, abrupt boundary, common fine brown (7.5YR 4/4) mottles, few fine oxides.

Location: 08AB42
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
321-base (340)	C4	brown (10YR 4/3) medium to coarse sand, single grain, loose, moderate effervescence.

Location: 08AB43; Honey Creek area; NW 1/4 NW 1/4 SE 1/4 SE 1/4 Sec. 7
T83N R26W; 13BN166
Landscape position: Alluvial fan
Elevation: approximately 875 ft.
Parent material: alluvium
Slope: 5-9%
Vegetation: wheat
Date described: 10/5/84
Described by: E. A. Bettis III
Remarks: This area has been cultivated after the 1984 flood. Surrounding uncultivated areas show 5-9 cm of the 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-15	Ap	very dark brown (10YR 2/2) loam, cloddy, friable, noneffervescent, abrupt boundary.
15-43	A1	black (10YR 2/1) loam, moderate medium to fine granular, friable, noneffervescent, abrupt boundary, common roots.
43-95	Bw	very dark gray (10YR 3/1) loam, massive (compacted?) firm, noneffervescent, abrupt boundary, common thin discontinuous light brownish gray (10YR 6/2) silans.
95-108	2A1b	very dark grayish brown (10YR 3/2) silty clay loam, strong medium to fine angular blocky, firm, noneffervescent, clear boundary, common thin continuous very dark gray (10YR 2/1) organs.
108-126	2ABb	very dark grayish brown (10YR 3/2) silty clay loam, strong medium to fine columnar breaking to strong medium subangular blocky, friable, firm, noneffervescent, gradual boundary, common thin continuous very dark gray (10YR 3/1) organs.
126-137	2Bt1b	dark brown (10YR 3/3) silty clay loam, strong medium columnar breaking to moderte medium granular, firm, noneffervescent, clear boundary, common thick continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans on columns.
137-194	2Bt2b	dark brown (10YR 3/3) silty clay loam, strong coarse columnar, friable, noneffervescent, gradual boundary, very few fine iron concretions and oxides, common thick continuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB43
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
194-259	2Bt3b	dark brown (10YR 3/3) silty clay loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, few medium to fine dark yellowish brown (10YR 3/4) mottles, common thin almost continuous very dark grayish brown (10YR 3/2) cutans, occasional charcoal flecks.
259-295	2Bt4b	dark brown (10YR 3/3) heavy sandy loam, weak coarse columnar, friable, very weak effervescence, abrupt boundary, mottles as above, few fine iron concretions and oxides.
295-308	3Ab	very dark grayish brown to dark brown (10YR 3/2-3/3) silty clay loam, weak medium subangular blocky, friable, noneffervescent, clear boundary, few fine iron concretions.
308-323	3Btb	brown (10YR 4/3) silt loam, weak to moderate fine subangualr blocky, friable, weak effervescence, clear boundary, few fine iron concretions and oxides, common thin discontinuous very dark grayish brown (10YR 3/2) cutans, common gastropod shells.
323-340	3C	brown (10YR 4/3) silt loam, massive, friable, moderate effervescence, abrupt boundary, abundant medium brown (7.5YR 4/4) mottles, abundant medium iron concretions, gastropod shells as above.
340-355	4Ab	dark gray to dark grayish brown (10YR 4/1-4/2) silty clay loam, moderate fine angular blocky, friable, noneffervescent, gradual boundary, few fine iron concretions.
355-379	4Bwb	brown (10YR 4/3) heavy silt loam, moderate fine angular blocky, friable, moderate effervescence, gradual boundary, common fine soft carbonate concretions.
379-409	4C1	grayish brown to brown (2.5Y 5/2 - 10YR 5/3) silt loam, massive, friable, strong to violent effervescence, abrupt boundary, few medium dark yellowish brown (10YR 4/6) mottles, abundant medium to fine soft carbonate concretions, common fine iron concretions.

Location: 08AB43
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
409-427	4C2	grayish brown to brown (2.5Y 5/2 - 10YR 5/3) fine sandy loam, single grain, loose, violent effervescence, abundant coarse dark yellowish brown (10YR 4/6) mottles, abundant medium soft carbonate concretions.
427-485	4C3	grayish brown to brown (2.5Y 5/2 - 10YR 5/3) medium sand, single grain, loose, strong effervescence, mottles as above.
485-520	4C4	grayish brown (2.5Y 5/2) stratified fine and coarse sand, single grain, loose, violent effervescence.
520-620	5C1	oxidized (10YR) subrounded coarse gravel, single grain, loose, violent effervescence, clear boundary, augered,
620-base (630)	5C2	grayish brown (2.5Y 5/2) pebbly silt loam, massive, friable, violent effervescence, auger rejected at base.

Location: 08AB44 Honey Creek area; NE 1/4 SE 1/4 SW 1/4 SE 1/4 Sec. 7
T83N R26W; 13BN128
Landscape position: High Terrace
Elevation: approximately 875 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: winter wheat
Date described: 10/9/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-30	Ap	black to very dark gray (10YR 2/1-3/1) fine sandy loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
30-42	A1	black to very dark gray (10YR 2/1-3/1) fine sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common roots.
42-51	A2	very dark grayish brown (10YR 3/2) fine sandy loam, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots, common thin discontinuous very dark gray (10YR 3/1) organs.
51-92	Bt1	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few roots, common thin discontinuous light gray (10YR 3/2) silans, few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
92-112	Bt2	dark brown to brown (10YR 3/3-3/4) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, abundant thin discontinuous very dark grayish brown (10YR 3/2) cutans.
112-165	BC	brown (10YR 4/3) loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary.
165-191	C1	brown to pale brown (10YR 5/3-6/3) loamy sand, single grain, loose, noneffervescent, abrupt boundary.

Location: 08AB44 Honey Creek area
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
191-201	C2	brown (10YR 4/3) fine sandy loam, massive, friable, noneffervescent, abrupt boundary.
201-241	C3	brown to pale brown (10YR 5/3-6/3) fine to medium sand, single grain, loose, noneffervescent, abrupt boundary.
241-259	C4	brown (10YR 4/3) fine sandy loam, massive, friable, weak effervescence, abrupt boundary.
259-325	C5	brown to pale brown (10YR 5/3-6/3) fine to medium sand, single grain, loose, noneffervescent, abrupt boundary.
325-396	2C1	dark grayish brown (10YR 4/2) silt loam, massive, friable, weak to moderate effervescence, abrupt boundary, common fine dark yellowish brown (10YR 4/6) mottles.
396-421	2C2	brown (10YR 4/3) medium sand, single grain, loose, moderate effervescence, abrupt boundary.
421-430	2C3	dark grayish brown (10YR 4/2) silt loam, massive, friable, moderate effervescence, abrupt boundary.
430-480	2C4	pale brown (10YR 6/3) medium to coarse sand, single grain, loose, moderate effervescence, abrupt boundary.
480-base (520)	2C5	dark gray to dark grayish brown (10YR 4/1-4/2) medium to coarse sand, nonsticky nonplastic, strong effervescence.

Location: 08AB45 Honey Creek area; SE 1/4 NE 1/4 SW 1/4 SE 1/4 Sec. 7
T83N R22W; 13BN128
Landscape position: Alluvial fan/High Terrace interface
Elevation: approximately 875 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/9/84
Described by: E. A. Bettis III
Remarks: the surface soil at this location may be two soils welded together

Depth (cm)	Soil Horizon (weathering zone)	Description
0-28	Ap	black (10YR 2/1) loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
28-43	A1	black to very dark gray (10YR 2/1-3/1) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common roots.
43-58	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
58-65	AB	very dark gray to dark grayish brown (10YR 3/1-4/2) loam, moderate coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, clear boundary, few roots.
65-85	Bt1	very dark grayish brown (10YR 3/2) heavy loam, moderate medium to coarse columnar, friable, noneffervescent, gradual boundary, very few roots, common thin discontinuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.
85-123	Bt2	dark brown (10YR 3/3) loam, moderate coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
123-142	Bt3	dark brown (10YR 3/3) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, cutans as above.

Location: 08AB45
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
142-215	Bt4	dark brown (10YR 3/3) loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
215-299	Bt5	dark grayish brown to brown (10YR 4/2-4/3) loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, abundant fine dark yellowish brown (10YR 4/6) mottles, common fine iron concretions and oxides, few thin discontinuous dark brown (10YR 3/3) cutans.
299-355	C1	brown (10YR 4/3) silt loam, massive, friable, noneffervescent, clear boundary, mottles, iron concretions, and oxides as above.
355-base (420)	C2	dark grayish brown to brown (10YR 4/2-4/3) fine sandy loam, massive, nonsticky nonplastic moderate effervescence, mottles, iron concretions, and oxides as above, hole collapsed.

Location: 08AB46 Honey Creek area; NE 1/4 SE 1/4 NE 1/4 NE 1/4 Sec. 18
T83N R26W; 13BN129
Landscape position: Alluvial fan, distal
Elevation: approximately 874 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/9/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-8	+	black (10YR 2/1) silty clay loam, massive, friable, noneffervescent, abrupt boundary.
8-32	Ap	black (10YR 2/1) silt loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
32-46	A1	black to very dark brown (10YR 2/1-2/2) silt loam, moderate medium to fine granular, friable, noneffervescent, clear boundary, abundant roots.
46-55	A2	black to very dark gray (10YR 2/1-3/1) silt loam, moderate medium to fine subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common roots.
55-76	BA	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, moderate medium angular blocky, friable, noneffervescent, gradual boundary, few roots, common thin almost continuous black (10YR 2/1) organs.
76-115	Bt1	dark brown to brown (10YR 3/3-4/3) silt loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, non-effervescent, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
115-139	Bt2	dark brown (10YR 3/3) silt loam to loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, non-effervescent, gradual boundary, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB46
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
139-173	Bt3	dark brown (10YR 3/3) silt loam, moderate medium to coarse columnar, friable, noneffervescent, clear boundary, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
173-218	Bt4	dark brown to dark grayish brown (10YR 3/3-4/2) silt loam, moderate coarse columnar, friable, noneffervescent, abrupt boundary, common fine iron concretions, few fine oxides, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
218-238	2At1b	very dark grayish brown (10YR 3/2) silty clay loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, abundant fine iron concretions, common fine oxides, common thin discontinuous very dark gray (10YR 3/1) cutans.
238-255	2At2b	dark grayish brown (10YR 4/2) silty clay loam, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, iron concretions and oxides as above, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
255-270	2Bt1b	brown (10YR 4/3) silty clay loam, moderate medium to coarse columnar, friable, non-effervescent, gradual boundary, iron concretions and oxides as above, few thin discontinuous dark brown (10YR 3/3) cutans.
270-324	2Bt2b	brown (10YR 4/3) silty clay loam, moderate medium to coarse columnar, friable, non-effervescent, gradual boundary, iron concretions and oxides as above, few thin discontinuous dark brown (10YR 3/3) cutans.
324-364	2BCb	dark yellowish brown (10YR 4/4) loam, weak coarse columnar, friable, noneffervescent, abrupt boundary, few fine iron concretions, very few fine oxides.

Location: 08AB46
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
364-371	3Ab	dark grayish brown to brown (10YR 4/2-4/3) silty clay loam, moderate medium to fine angular blocky, firm, noneffervescent, gradual boundary.
371-393	3ABb	dark brown (10YR 3/3) silty clay, moderate medium columnar, friable, noneffervescent, gradual boundary, common fine iron concretions, few fine oxides.
393-417	3Bt1b	dark grayish brown to brown (10YR 4/2-4/3) silty clay loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, common fine iron concretions, few fine oxides, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
417-452	3Bt2b	brown (10YR 4/3) silty clay loam, strong medium to fine angular blocky, firm, noneffervescent, gradual boundary, common fine iron concretions, few fine oxides, common thin almost continuous dark brown (10YR 3/3) cutans.
452-500	3Bt3b	brown (10YR 4/3) silty clay loam, strong medium angular blocky, firm, noneffervescent, clear boundary, few medium dark yellowish brown (10YR 4/6) mottles, iron concretions and oxides as above, cutans as above.
500-508	3BCb	brown (10YR 4/3) silt loam, weak coarse subangular blocky, friable, noneffervescent, abrupt boundary, abundant medium grayish brown (2.5Y 5/2) mottles, iron concretions and oxides as above.
508-base (540)	4C	brown (7.5YR 4/4) gravelly sandy loam, massive, firm, noneffervescent, auger rejected on coarse gravel.

Location: 08AB47 Honey Creek area; NW 1/4 NE 1/4 NE 1/4 NE 1/4 Sec. 18
T83N R26W
Landscape position: alluvial fan
Elevation: approximately 878 ft.
Parent material: alluvium
Slope: 5-9%
Vegetation: weeds
Date described: 10/9/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-44	Ap	very dark grayish brown (10YR 3/2) pebbly loam, cloddy, friable, weak effervescence, clear boundary, this horizon consists of several superimposed plow layers.
44-62	C	brown (10YR 5/3) medium to coarse pebbly sand, single grain, loose, noneffervescent, abrupt boundary.
62-78	2Apb	very dark gray to very dark grayish brown (10YR 3/1-3/2) loamy sand, weak medium subangular blocky, very friable, noneffervescent, abrupt boundary.
78-96	2A1b	black to very dark brown (10YR 2/1-2/2) loam, moderate fine granular, friable, noneffervescent, clear boundary, common roots.
96-111	2A2b	black to very dark brown (10YR 2/1-2/2) loam, moderate medium granular, friable, noneffervescent, clear boundary, common roots.
111-129	2ABb	very dark gray to very dark grayish brown (10YR 3/1-3/2) heavy loam, moderate medium to fine angular blocky, firm, noneffervescent, gradual boundary, common roots.
129-152	2BEtb	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, moderate medium to fine columnar, firm, noneffervescent, clear boundary, common thin discontinuous light gray (10YR 7/2) silans, common thin continuous dark gray (10YR 4/1) organs.

Location: 08AB47
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
152-180	2Bt1b	very dark grayish brown (10YR 3/2) clay loam, moderate coarse columnar breaking to moderate medium angular blocky, firm, noneffervescent, gradual boundary, few thin discontinuous light gray (10YR 7/2) silans, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
180-256	2Bt2b	very dark grayish brown to dark brown (10YR 3/2-3/3) heavy loam, moderate coarse columnar, friable, noneffervescent, abrupt boundary, common thin continuous very dark grayish brown (10YR 3/2) cutans.
256-281	3Atb	very dark grayish brown (10YR 3/2) heavy loam to silty clay loam, moderate medium to fine columnar, friable, noneffervescent, gradual boundary, common thin discontinuous very dark brown (10YR 2/2) cutans.
281-308	3Bt1b	very dark grayish brown to dark brown (10YR 3/2-3/3) heavy loam, moderate medium to coarse columnar, friable, noneffervescent, gradual boundary, common thin continuous very dark grayish brown (10YR 3/2) cutans.
308-376	3Bt2b	brown (10YR 4/3) silt loam, moderate coarse columnar, friable, noneffervescent, abrupt boundary, common thin discontinuous dark brown (10YR 3/3) cutans.
376-401	4Atb	brown (10YR 4/3) silty clay loam, moderate medium angular blocky, friable, noneffervescent, clear boundary, common thin continuous very dark grayish brown (10YR 3/2) cutans.
401-436	4Bt1b	brown (10YR 4/3) clay loam, moderate medium to coarse angular blocky, firm, noneffervescent, gradual boundary, few fine iron concretions, very few fine oxides, common thin discontinuous dark brown (10YR 3/3) cutans.

Location: 08AB47
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
436-490	4Bt2b	brown (10YR 4/3) clay loam, strong medium angular blocky, firm, noneffervescent, abrupt boundary, common fine iron concretions, common fine oxides, common thin almost continuous dark brown (10YR 3/3) cutans.
490-base (530)	5C	brown (7.5YR 4/4) stratified pebbly sand and loam, single grain and massive, loose and friable, noneffervescent.

Location: 08AB48 Honey Creek area; SW 1/4 SW 1/4 SE 1/4 SE 1/4 Sec. 7
T83N R26W
Landscape position: High Terrace
Elevation: approximately 876 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: winter wheat
Date described: 10/9/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-32	Ap	black to very dark brown (10YR 2/1-2/2) loam, cloddy, friable, moderate effervescence, abrupt boundary, common roots.
32-46	A1	black to very dark brown (10YR 2/1-2/2) fine sandy loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, common roots, horizon may be slightly compacted.
46-70	A2	black to very dark gray (10YR 2/1-3/1) fine sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, few roots.
70-93	AB	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak medium to coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, very few roots, common thin discontinuous very dark gray (10YR 3/1) organs.
93-123	Bt1	very dark grayish brown (10YR 3/2) loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
123-161	Bt2	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
161-204	BC	dark brown to dark yellowish brown (10YR 3/3-3/4) loam, weak to moderate coarse columnar, friable, noneffervescent, gradual boundary, very few thin discontinuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB48
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
204-306	CB	brown (10YR 4/3) loam, weak coarse subangular blocky, very friable, noneffervescent, gradual boundary.
306-321	C1	brown to dark yellowish brown (10YR 4/3-4/4) silt loam, massive, friable, weak to moderate effervescence, abrupt boundary.
321-398	C2	brown to dark yellowish brown (10YR 4/3-4/4) silt loam, massive, friable, weak to moderate effervescence, abrupt boundary.
398-534	2C	dark grayish brown (10YR 4/2) stratified silt loam with occasional 5-7 cm thick beds of medium to fine sand, massive, friable, moderate to strong effervescence, abrupt boundary, abundant medium to fine grayish brown (2.5Y 5/2) and dark yellowish brown (10YR 4/6) mottles, common medium iron concretions.
534-base (560)	3C	yellowish brown (10YR 5/6) coarse sand, single grain, loose, strong effervescence, hole collapsed.

Location: 08AB49 Honey Creek area; SE 1/4 SW 1/4 SE 1/4 SE 1/4 Sec. 7
T83N R26W
Landscape position: Footslope decending to High Terrace
Elevation: approximately 878 ft.
Parent material: alluvium/colluvium
Slope: 5-9%
Vegetation: winter wheat
Date described: 10/9/84
Described by: E. A. Bettis III
Remarks: the 2 material is pedisediment

Depth (cm)	Soil Horizon (weathering zone)	Description
0-41	Ap1	dark brown (10YR 3/3) sandy loam, cloddy, friable, noneffervescent, abrupt boundary, few roots, this horizon consists of several superimposed plow layers.
41-58	Ap2	dark grayish brown (10YR 4/2) sandy loam, weak medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary, few roots.
58-74	A1	black to very dark brown (10YR 2/1-2/2) loam, weak medium to fine subangular blocky, friable, noneffervescent, gradual boundary, few roots, occasional charcoal flecks.
74-87	A2	black to very dark brown (10YR 2/1-2/2) loam, moderate medium to fine granular, friable, noneffervescent, gradual boundary, very friable.
87-110	AB	black to very dark brown (10YR 2/1-2/2) loam, strong fine angular blocky, firm, noneffervescent, clear boundary.
110-134	Bt1	very dark gray to very dark grayish brown (10YR 3/1-3/2) heavy loam, strong medium angular blocky, friable, noneffervescent, gradual boundary, common thin discontinuous very dark brown (10YR 2/2) cutans, common thin discontinuous light gray (10YR 7/2) silans.
134-181	Bt2	very dark grayish brown (10YR 3/2) clay loam, moderate medium to coarse columnar breaking to strong medium angular blocky, friable, noneffervescent, gradual boundary, common thin almost continuous very dark gray (10YR 3/1) cutans, few thin discontinuous light gray (10YR 7/2) silans.

Location: 08AB49
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
181-203	Bt3	very dark grayish brown (10YR 3/2) clay loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, few fine iron concretions, very few fine oxides, common thin almost continuous very dark gray (10YR 3/1) cutans.
203-230	Bt4	very dark grayish brown to dark brown (10YR 3/2-3/3) clay loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, common fine iron concretions, common medium oxides, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
230-261	BC	dark brown to brown (10YR 3/3-4/3) loam, weak coarse subangular blocky, friable, noneffervescent, gradual boundary, abundant fine iron concretions, common medium oxides.
261-315	C1	brown to dark grayish brown (10YR 4/3-4/2) loam, massive, friable, noneffervescent, clear boundary, common medium grayish brown (2.5Y 5/2) mottles, iron concretions and oxides as above.
315-339	C2	brown (7.5YR 4/4) loam, massive, friable, noneffervescent, abrupt boundary, common coarse olive gray (5Y 5/2) mottles, iron concretions and oxides as above.
339-base (390)	2C	brown and grayish brown (7.5YR 4/4 and 2.5Y 5/2) stratified pebbly loam, massive, friable, noneffervescent, common medium iron concretions.

Location: 08AB50 Honey Creek area; SE 1/4 SW 1/4 SE 1/4 SE 1/4 Sec. 7
T83N R26W
Landscape position: Toeslope High Terrace
Elevation: approximately 874 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: winter wheat
Date described: 10/9/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-24	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) fine sandy loam, cloddy, friable, noneffervescent, abrupt boundary.
24-33	A1	very dark grayish brown (10YR 3/2) loam, moderate fine angular blocky, friable, noneffervescent, clear boundary, common roots.
33-40	A3	very dark grayish brown (10YR 3/2) fine sandy loam, moderate fine subangular blocky, friable, noneffervescent, clear boundary, common roots.
40-56	AB	very dark grayish brown (10YR 3/2) loam, strong fine angular blocky, friable, noneffervescent, clear boundary, common roots.
56-81	Bt1	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium to coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, few roots, common thin discontinuous very dark gray (10YR 3/1) cutans.
81-119	Bt2	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) clay loam, moderate medium columnar, friable, noneffervescent, gradual boundary, common thin continuous very dark grayish brown (10YR 3/2) cutans.
119-173	Bt3	very dark grayish brown to dark brown (10YR 3/2-3/3) heavy loam, moderate medium to fine columnar, friable, noneffervescent, gradual boundary, very few fine iron concretions, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.

Location: 08AB50
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
173-210	Bt4	dark brown (10YR3/3) heavy loam, moderate coarse columnar, friable, noneffervescent, clear boundary, iron concretions as above, cutans as above.
210-267	Bt5	dark brown to brown (10YR 3/3-4/3) heavy loam, moderate coarse columnar, friable, noneffervescent, abrupt boundary, common fine iron concretions, common fine oxides, cutans as above.
267-295	2Atb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) clay loam, moderate coarse columnar breaking to moderate fine angular blocky, friable, noneffervescent, gradual boundary, abundant fine iron concretions, abundant fine oxides, common thin almost continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.
295-340	2Btb	dark grayish brown to brown (10YR 4/2-4/3) clay loam, moderate coarse columnar, friable, noneffervescent, clear boundary, common medium grayish brown (2.5Y 5/2) mottles, iron concretions and oxides as above, cutans as above.
340-363	2C1	brown (10YR 4/3) sandy loam, massive, friable, noneffervescent, abrupt boundary, mottles as above.
363-base (404)	2C2	grayish brown (2.5Y 5/2) silt loam, massive, friable, noneffervescent, abrupt boundary, abundant medium brown and yellowish brown (7.5YR 4/4 and 10YR 5/6) mottles, common medium iron concretions, common medium oxides, auger rejected on coarse gravel.

Location: 08AB51 Honey Creek area; NW 1/4 SE 1/4 NE 1/4 NE 1/4 Sec. 18 T83N R26W
Landscape position: Intermediate Terrace, chute
Elevation: approximately 863 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/01/84
Described by: Matt Culp
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-20	+	very dark gray (10YR 3/1) loam with thin bed of medium sand at base, massive, friable, moderate effervescence, abrupt boundary.
20-70	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, weak medium to fine subangular blocky, friable, strong effervescence, clear boundary.
70-80	A2	dark brown (10YR 3/3) sandy loam, weak medium subangular blocky, friable, strong effervescence, abrupt boundary.
80-90	2A1b	very dark gray (10YR 3/1) silt loam, weak medium to fine subangular blocky, friable, strong effervescence.
90-150	2A2b	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak medium subangular blocky, friable, moderate effervescence to 100cm noneffervescent below, gradual boundary.
150-190	2ACb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) sandy loam, very weak medium subangular blocky, friable, noneffervescent, clear boundary.
190-215	2C1	dark gray to dark grayish brown (10YR 4/1-4/2) silt loam, massive, friable, moderate, effervescence.
215-255	2C2	brown (10YR 4/3) loamy sand, massive, non-sticky nonplastic, noneffervescent, clear boundary.
255-base (340)	2C3	brown and grayish brown (10YR 4/3 and 2.5Y 5/2) stratified coarse sand and fine sandy loam, single grain, loose, weak to moderate effervescence, hole collapsed.

Location: 08AB52 Honey Creek area; NW 1/4 SE 1/4 NE 1/4 NE 1/4 Sec. 18
T83N R26W
Landscape position: Intermediate Terrace, levee
Elevation: approximately 867 ft.
Parent material: alluvium
Slope: 5-9%
Vegetation: weeds
Date described: 10/10/84
Described by: Matt Culp
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-12	+	very dark gray (10YR 3/1) silt loam with thin fine sand lens at base, massive, friable, noneffervescent, abrupt boundary.
12-59	A	very dark grayish brown (10YR 3/2) silt loam, moderate medium to fine granular, friable, moderate effervescence, clear boundary.
59-190	AC	very dark grayish brown to dark grayish brown (10YR 3/2 - 4/2) sandy loam, weak medium subangular blocky, friable, strong effervescence, gradual boundary.
190-280	C1	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, very weak medium subangular blocky to massive, friable, strong effervescence, abrupt boundary.
280-base (345)	C2	brown (10YR 4/3) coarse sand, single grain, loose, strong effervescence, hole collapsed.

Location: 08AB53 SE 1/4 SE 1/4 NE 1/4 NE 1/4 sec. 18 T83N R26W; 13BN280
Landscape position: Intermediate terrace, downstream end of levee
Elevation: approximately 864 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/10 and 11/8 '84
Described by: Matt Culp and E. A. Bettis III
Remarks: upper 180 cm described from test pit wall; lower 80 cm decribed from core; C-14 horizon 104-112 cm - modern (Beta-11165).

Depth (cm)	Soil Horizon (weathering zone)	Description
0-9	C1	black (10YR 2/1) clay loam, moderate fine angular blocky when dry massive when wet, friable, very weak effervescence, abrupt wavy boundary, 1984 flood deposit.
9-10	C2	light brownish gray (10YR 6/2) fine sand, single grain, loose, weak effervescence, abrupt wavy boundary, 1984 flood deposit.
10-12	C3	very dark gray (10YR 3/1) clay loam, moderate fine angular blocky, when dry massive when wet, friable, moderate to strong effervescence, abrupt wavy boundary, recent flood deposits.
12-33	Ap1	very dark brown (10YR 2/2) loam, very weak fine subangular blocky to massive, friable, weak to moderate effervescence, abrupt wavy boundary, base of horizon exhibits discontinuous furrows filled with brown (10YR 5/3) fine sand.
33-59	Ap2	dark brown (10YR 3/3) silt loam, massive, friable, noneffervescent, abrupt wavy boundary.
59-67	Ap3	black and light brownish gray (10YR 2/1 and 6/2) clay loam and fine sand alternating and filling the bottom of furrows, massive and single grain, friable and loose, noneffervescent, abrupt wavy boundary in the north and south walls smooth in the east and west walls.
67-87	Alb	black and light grayish brown (10YR 3/2) silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear smooth boundary, occasional thin discontinuous gray (10YR 6/2) fine sand skiffs at base of horizon.

Location: 08AB53 13BN280
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
87-104	A2b	very dark grayish brown (10YR 3/2) silt loam, moderate medium granular, friable, noneffervescent, abrupt smooth boundary, sand at base of horizon as above.
104-112	A3b	very dark grayish brown (10YR 3/2) silt loam, moderate medium granular, friable, noneffervescent, gradual smooth boundary, abundant charcoal and burned earth, C-14 horizon-modern (Beta-11165).
112-180	A4b	very dark grayish brown (10YR 3/2) silt loam, moderate medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, gradual smooth boundary occasional gastropod shells.
180-215	AC	very dark grayish brown (10YR 3/2) loam, weak medium subangular blocky, friable, noneffervescent, clear smooth boundary.
215-base (260)	C	brown (10YR 5/3) fine sandy loam, massive, friable, weak to moderate effervescence, water table at 220 cm.

Location: 08AB54; NW 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 3 T81N R26W; 13DA156
Landscape position: Late Wisconsinan Terrace
Elevation: approximately 863 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/22/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-17	+	very dark grayish brown (10YR 3/2) loam, massive, friable, noneffervescent, abrupt boundary.
17-29	Ap	black to very dark brown (10YR 2/1-2/2) loam, cloddy, friable, noneffervescent, abrupt boundary, few roots.
29-39	AB1	very dark brown to very dark grayish brown (10YR 2/2-3/2) loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary.
39-50	AB2	very dark grayish brown (10YR 3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, common roots, common black (10YR 2/1) krotovina.
50-60	BA	dark brown to dark yellowish brown (10YR 3/3-3/4) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary.
60-73	Bt1	dark brown (10YR 3/3) loam, moderate medium columnar, friable, noneffervescent, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
73-99	Bt2	dark yellowish brown (10YR 4/4) silt loam, moderate coarse columnar breaking to weak medium angular blocky, friable, non-effervescent, gradual boundary, cutans as above.
99-120	Bt3	brown (10YR 4/3) silty clay loam, moderate medium columnar breaking to moderate medium to fine angular blocky, friable, noneffervescent, clear boundary, common thin continuous dark brown (10YR 3/3) cutans on angular blocks.

Location: 08AB54
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
120-135	BC	dark yellowish brown (10YR 4/4) sandy loam, weak medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary.
135-base (200)	2C	brown (7.5YR 4/4) matrix supported medium to coarse pebbles (occasional Pennsylvanian clasts), matrix is medium to coarse sand, single grain, loose, noneffervescent.

Location: 08AB55; NE 1/4 SE 1/4 NW 1/4 NE 1/4 Sec. 3 T81N R26W; 13DA156
Landscape position: High Terrace
Elevation: approximately 852 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/23/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-8	+	black (10YR 2/1) silty clay loam, massive, friable, weak effervescence, abrupt boundary.
8-43	Ap	black to very dark brown (10YR 2/1-2/2) loam, cloddy, friable, noneffervescent, abrupt boundary, few roots.
43-67	A1	black to very dark brown (10YR 2/1-2/2) loam, weak medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, gradual boundary, few roots.
67-82	A2	black to very dark gray (10YR 2/1-3/1) silty clay loam, moderate medium to fine granular, friable, noneffervescent, clear boundary.
82-97	AB	black to very dark gray (10YR 2/1-3/1) silty clay loam, moderate medium to fine angular blocky, friable, noneffervescent, gradual boundary, very few roots.
97-115	BA	black to very dark gray (10YR 2/1-3/1) silty clay loam, moderate medium angular blocky, friable, noneffervescent, clear boundary.
115-134	Bt1	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, moderate medium columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, common thin discontinuous very dark brown (10YR 2/2) cutans.
134-201	Bt2	very dark grayish brown (10YR 3/2) heavy loam, moderate coarse columnar, friable, noneffervescent, clear boundary, common thin discontinuous very dark brown (10YR 2/2) cutans.

Location: 08AB55
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
201-267	Bt3	very dark grayish brown to dark grayish brown (10YR 3/2) silty clay loam, moderate coarse columnar, friable, noneffervescent, clear boundary, common fine iron concretions, common thin continuous very dark brown (10YR 2/2) cutans.
267-293	Bt4	dark grayish brown (10YR 4/2 - 2.5YR 4/2) heavy loam, weak medium angular blocky, friable, noneffervescent, abrupt boundary, iron concretions as above, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
293-308	2A1b	dark gray to dark grayish brown (10YR 4/1-4/2) heavy loam with common coarse sand grains and occasional fine pebbles, moderate medium to fine angular blocky, friable, noneffervescent, gradual boundary.
308-322	2A2b	dark grayish brown (10YR 4/2) loam with occasional fine pebbles, moderate medium to fine granular, friable, noneffervescent, clear boundary.
322-359	2C1	grayish brown to light olive brown (2.5Y 5/2-5/4) loam with common fine pebble lines, massive, friable, noneffervescent, abrupt boundary, abundant fine iron concretions.
359-base (400)	2C2	stratified grayish brown (2.5Y 5/2) loam, coarse sand, and cobbles, massive and single grain, friable and loose, noneffervescent, common to abundant brown (7.5YR 4/4) stains and mottles.

Location: 08AB56; SW 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 3 T81N R26W; 13DA156
Landscape position: High Terrace
Elevation: approximately 851 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/23/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-13	+	very dark grayish brown (10YR 3/2) silt loam, massive friable, moderate effervescence, abrupt boundary, organic mat at base.
13-45	Ap	very dark grayish brown (10YR 3/2) silt loam, cloddy, friable, moderate to weak effervescence, abrupt boundary, common roots.
45-66	A1	black to very dark brown (10YR 2/1-2/2) silty clay loam, moderate fine granular, friable, noneffervescent, gradual boundary, common roots.
66-80	A2	black to very dark brown (10YR 2/1-2/2) silty clay loam, moderate medium granular, friable, noneffervescent, clear boundary, few roots.
80-95	A3	very dark brown (10YR 2/2) silty clay loam, moderate medium granular, friable, noneffervescent, gradual boundary, few roots.
95-117	AB	very dark brown (10YR 2/2) silty clay loam, moderate to strong medium subangular blocky, friable, noneffervescent, clear boundary.
117-138	Bt1	very dark brown (10YR 2/2) silty clay loam, moderate medium columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, common thin almost continuous black (10YR 2/1) cutans.
138-184	Bt2	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, abundant fine iron concretions, few thin discontinuous light gray (10YR 3/2) silans, common thin continuous black (10YR 4/1) cutans.

Location: 08AB56
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
184-235	Bt3	very dark gray to very dark grayish brown (10YR 3/1-3/2) silty clay loam, moderate coarse columnar, friable, noneffervescent, clear boundary, abundant fine iron concretions, common thin discontinuous black (10YR 2/1) cutans.
235-270	BC	very dark gray (10YR 3/1) loam, weak medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary, iron concretions as above.
270-332	2C1	grayish brown (2.5Y 5/2) silt loam, massive, nonsticky nonplastic, noneffervescent, abrupt boundary, abundant medium to coarse dark yellowish brown (10YR 4/6) mottles.
332-400	2C2	olive brown (2.5YR 4/4) fine sand, massive, nonsticky nonplastic, noneffervescent, abrupt boundary, abundant medium to coarse grayish brown (2.5Y 5/2) mottles.
400-base (430)	2C3	olive brown (2.5Y 4/4) sandy loam to loam single grain, loose, noneffervescent, hole collapsed.

Location: 08AB57; SW 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 3 T81N R26W; 13DA156
Landscape position: High Terrace
Elevation: approximately 851 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/23/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-6	+	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, massive, friable, noneffervescent, abrupt boundary.
6-22	Ap	very dark brown to very dark grayish brown (10YR 2/2-3/2) silt loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
22-35	A1	very dark brown to very dark grayish brown (10YR 2/2-3/2) silt loam, moderate medium to fine granular, friable, noneffervescent, gradual boundary, common roots.
35-49	A2	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, moderate medium to fine subangular blocky, friable, non-effervescent, clear boundary, few roots.
49-74	BA	very dark grayish brown (10YR 3/2) silt loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
74-120	Bt	dark brown (10YR 3/3) silt loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
120-145	BC1	dark brown (10YR 3/3) silt loam, weak to moderate coarse subangular blocky, friable, noneffervescent, gradual boundary.
145-168	BC2	dark brown (10YR 3/3) silt loam, weak coarse subangular blocky, friable, noneffervescent, clear boundary, abundant fine grayish brown (2.5Y 5/2) mottles, common fine iron concretions.

Location: 08AB57
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
168-200	CB1	brown (10YR 4/3-5/3) silt loam, weak medium to coarse subangular blocky, friable, moderate to strong effervescence, gradual boundary, mottles as above, iron concretions as above.
200-225	CB2	brown (12YR 4/3-5/3) silt loam, weak medium to coarse subangular blocky, friable, moderate to strong effervescence, abrupt boundary, mottles as above, iron concretions as above, very few thin discontinuous dark brown (10YR 3/3) coatings on vertical ped faces.
225-250	2ACb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) silt loam with occasional well rounded fine pebbles, moderate medium columnar breaking to moderate fine subangular blocky, friable, noneffervescent, gradual boundary, few fine brown (7.5YR 4/4) mottles.
250-285	2C1	light olive brown (2.5Y 5/4) sandy loam with common subrounded medium to coarse pebbles, massive, friable, noneffervescent, abrupt boundary, common medium brown (7.5YR 4/4) mottles.
285-base (310)	2C2	light olive brown (2.5Y 5/4) medium to coarse sand, single grain, loose, noneffervescent, abrupt boundary, abundant medium to coarse brown (7.5YR 4/4) mottles, auger rejected on coarse gravel.

Location: 08AB58; NW 1/4 NW 1/4 SE 1/4 NE 1/4 Sec. 3 T81N R26W 13DA156
Landscape position: Intermediate Terrace
Elevation: approximately 847 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/23/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits; possible buried cultural horizon 267-299.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-10	+	very dark gray to very dark grayish brown (10YR 3/1-3/2) sandy loam, massive, friable, moderte effervescence, abrupt boundary.
10-49	Ap	very dark grayish brown (10YR 3/2) silt loam, massive, friable, weak effervescence, abrupt boundary, common roots.
49-103	C1	very dark grayish brown (10YR 3/2) silt loam, very weak coarse subangular blocky to massive, friable, noneffervescent, gradual boundary, few roots.
103-135	C2	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, massive, friable, noneffervescent, abrupt bundary, very few roots.
135-157	A1b	black to very dark gray (10YR 2/1-3/1) silt loam, very fine granular, friable, non-effervescent, gradual boundary.
157-206	ACb	very dark gray (10YR 3/1) silt loam, moderate medium granular, friable, noneffervescent, gradual boundary, common fine iron concretions.
206-240	C1'	very dark gray (10YR 3/1) silt loam, massive, slightly sticky nonplastic, noneffervescent, gradual boundary, few fine dark yellowish brown (10YR 4/4) mottles.
240-267	C2'	dark grayish brown (2.5Y 4/2) silt loam, massive, slightly sticky nonplastic, non-effervescent, abrupt boundary, mottles as above.

Location: 08AB58
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
267-299	C3	dark grayish brown (2.5Y 4/2) silt loam, massive, slightly sticky nonplastic, noneffervescent, abrupt boundary, occasional charcoal flecks, abundant strong brown (7.5YR 5/6) burned earth, possible cultural horizon.
299-312	C4	olive brown (2.5Y 4/4) silt loam, massive, nonsticky nonplastic, noneffervescent, abrupt boundary, abundant fine to medium brown (7.5YR 4/.4) mottles, common medium iron concretions.
312-332	C5	dark grayish brown (2.5Y 4/2) silt loam, massive, nonsticky nonplastic, noneffervescent, abrupt boundary, few medium olive brown (2.5Y 4/4) mottles.
332-357	C6	dark gray (5Y 4/1) loam, massive, nonsticky nonplastic, noneffervescent, abrupt boundary, common organic streaks.
357-370	C7	dark grayish brown (2.5Y 4/2) loamy sand and gravel, single grain, loose, moderate effervescence, abrupt boundary.
370-base (380)	R	dark grayish brown and brown (2.5Y 4/2 and 7.5RY 4/4) Pennsylvanian siltstone.

Location: 08AB59; SW 1/4 SE 1/4 NE 1/4 NE 1/4 Sec. 3 T81N R26W
Landscape position: Late Wisconsinan Terrace
Elevation: approximately 864 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/23/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-20	Ap	very dark grayish brown (10YR 3/2) fine sandy loam, massive, friable, noneffervescent, abrupt boundary.
20-40	A	very dark grayish brown (10YR 3/2) fine sandy loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
40-56	AB	dark brown (10YR 3/3) fine sandy loam, moderate medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, clear boundary.
56-90	B1	dark yellowish brown (10YR 3/4) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
90-113	B2	dark yellowish brown to brown (10YR 3/4-4/3) clay loam, moderate medium to fine angular blocky, friable, noneffervescent, abrupt boundary, common fine iron concretions.
113-base (150)	2BC	dark brown to brown (10YR 3/3-4/3) pebbly loam, massive to single grain, friable, noneffervescent, abrupt boundary, common fine iron concretions.

Location: 08AB60 Xenia area, NW 1/4 SW 1/4 NW 1/4 SE 1/4 sec. 11 T81N R26W; 13DA162
Landscape position: High Terrace, levee
Elevation: approximately 861 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/24/84
Described by: E. A. Bettis III
Remarks: the Ap horizon is probably several superimposed plow layers

Depth (cm)	Soil Horizon (weathering zone)	Description
0-7	+	very dark grayish brown (10YR 3/2) sandy loam, massive, friable, noneffervescent, abrupt boundary, organic mat at base of horizon, 1984 flood deposits.
7-49	Ap	very dark grayish brown (10YR 3/2) loam, cloddy, friable, noneffervescent, abrupt boundary, few roots.
49-67	A	very dark grayish brown (10YR 3/2) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, few roots.
67-85	BE1	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium to coarse columnar, friable, noneffervescent, gradual boundary, few thin discontinuous very dark grayish brown (10YR 3/2) organs.
85-100	BE2	dark brown (10YR 3/3) loam, moderate coarse subangular blocky, friable, noneffervescent, clear boundary.
100-133	Bt	dark brown (10YR 3/3) silt loam, moderate coarse breaking to moderate medium subangular blocky, friable, noneffervescent, abrupt boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
133-159	2Ab	dark grayish brown (10YR 4/2) silt loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common krotovina.
159-191	2BE1b	dark grayish brown to brown (10YR 4/2-4/3) silt loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common medium to fine iron concretions.

Location: 08AB60
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
191-248	2BE2b	dark grayish brown to brown (10YR 4/2-4/3) silt loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common medium to fine iron concretions.
248-286	2BE3b	brown (10YR 4/3) silt loam, weak medium to coarse subangular blocky, friable, weak effervescence, clear boundary, common to abundant medium iron concretions, few fine oxides.
286-320	2Btb	brown (10YR 5/3) silt loam, moderate coarse columnar, friable, moderate to strong effervescence, gradual boundary, common fine grayish brown (2.5Y 5/2) mottles, iron concretions and oxides as above, common fine soft carbonate concretions.
320-374	2BCb	brown (10YR 5/3) silt loam, weak coarse columnar, friable, strong effervescence, abrupt boundary, common medium olive brown (2.5Y 4/4) mottles, common fine iron concretions, very few fine soft carbonate concretions.
374-386	3Ab	dark grayish brown to brown (10YR 4/2-4/3) silt loam, weak to moderate medium angular blocky, friable, moderate effervescence, clear boundary, common fine iron concretions, few fine oxides.
386-406	3Bw1b	brown to yellowish brown (10YR 5/3-5/4) silt loam, moderate medium subangular blocky, friable, strong effervescence, gradual boundary, iron concretions and oxides as above.
406-437	3Bw2b	brown to yellowish brown (10YR 5/3-5/4) silt loam, moderate medium to fine columnar, friable, strong effervescence, abrupt boundary, common fine grayish brown (2.5Y 5/2) mottles, iron concretions and oxides as above, common gastropod shells.

Location: 08AB60
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
437-468	4Ab	dark grayish brown (10YR 4/2) silt loam, weak to moderate medium to fine granular, friable, moderate effervescence, clear boundary, abundant charcoal flecks.
468-501	4Bw1b	brown to dark yellowish brown (10YR 4/3-4/4) silty clay loam, moderate fine angular blocky, friable, weak effervescence, clear boundary, few fine yellowish brown (10YR 5/6) mottles, common fine iron concretions, few fine oxides.
501-542	4Bw2b	brown (10YR 4/3) silt loam, weak medium angular blocky, friable, noneffervescent, abrupt boundary, abundant medium grayish brown (2.5Y 5/2) mottles, iron concretions and oxides as above, common medium soft carbonate concretions.
542-base (700)	5C	brown (7.5YR 4/4) stratified loam and silt loam with occasional well rounded pebbles, massive, friable, noneffervescent, abrupt boundary, auger rejected on coarse gravel.

Location: 08AB61 Xenia area; SW 1/4 SE 1/4 NE 1/4 SW 1/4 Sec. 11 T81N R26W;
13DA162
Landscape position: High terrace
Elevation: approximately 850 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/24/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-14	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, massive, friable, noneffervescent, abrupt boundary, few roots.
14-31	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
31-48	A2	very dark gray (10YR 3/1) loam, moderate fine granular, friable, noneffervescent, gradual boundary, common roots.
48-64	A3	very dark gray (10YR 3/1) loam, moderate medium granular, friable, noneffervescent, gradual boundary, few roots.
64-84	Bw1	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, moderate medium subangular blocky breaking to moderate fine angular blocky, friable, noneffervescent, gradual boundary.
84-122	Bw2	dark gray to dark grayish brown (10YR 4/1-4/2) loam, moderate medium columnar, friable, noneffervescent, clear boundary, very few fine iron concretions.
122-140	2A1b	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) heavy loam, weak medium to coarse subangular blocky breaking to weak medium granular, friable, noneffervescent, gradual boundary, iron concretions as above.
140-155	2A2b	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) loam, weak medium subangular blocky, friable, noneffervescent, clear boundary, common fine iron concretions, common fine oxides.

Location: 08AB61
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
155-182	2BE1b	dark grayish brown (10YR 4/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, iron concretions and oxides as above, common krotovina
182-230	2BE2b	grayish brown (10YR 5/2) silt loam, weak coarse columnar, friable, noneffervescent, clear boundary, common medium to fine iron concretions, few medium oxides.
230-280	2Btb	grayish brown (10YR 5/2) silt loam, moderate coarse columnar, friable, weak to moderate effervescence, abrupt boundary, iron concretions and oxides as above, common thin discontinuous dark grayish brown (10YR 4/2) cutans.
280-301	3Ab	dark grayish brown (10YR 4/2) silt loam, weak medium to fine granular, friable, moderate effervescence, gradual boundary, iron concretions and oxides as above, occasional charcoal flecks.
301-320	3Bwb	dark grayish brown to grayish brown (10YR 4/2-5/2) silt loam, moderate medium to fine columnar, friable, weak to moderate effervescence, abrupt boundary, common medium iron concretions.
320-342	3C1	brown to pale brown (10YR 5/3-6/3) medium to coarse sand, single grain, loose, weak effervescence, abrupt boundary, common medium yellowish brown (10YR 5/8) mottles.
342-376	3C2	dark grayish brown stratified silt loam (thinly bedded), massive, friable, moderate effervescence, abrupt boundary, common medium dark yellowish brown (10YR 4/4) mottles.
376-463	3C3	grayish brown (10YR 5/2) medium to coarse sand, single grain, loose, noneffervescent, abrupt boundary, few coarse dark yellowish brown (10YR 4/4) mottles.

Location: 08AB61
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
463-529	3C4	dark grayish brown (10YR 4/2) stratified silt loam with a thin fine sand bed 498-499cm, massive, friable, moderate effervescence, abrupt boundary, common medium to coarse dark yellowish brown (10YR 4/4) mottles.
529-550	3C5	dark grayish brown (10YR 4/4) loamy sand, massive, friable, moderate effervescence, abrupt boundary.
550-563	3C6	yellowish brown (10YR 5/4) fine sandy loam, massive, firm, noneffervescent, abrupt boundary, abundant pipestems.
		Late Wisconsinan Alluvium
563-578	4C1	dark greenish gray (5BG 4/1) silt loam, massive, very firm, noneffervescent, clear boundary.
578-base (878)	4C2	dark gray and dark grayish brown (10YR 4/1 and 4/2) stratified silt loam, massive, firm, noneffervescent, augered, hole collapsed.

Location: 08AB62 Xenia area, SE 1/4 SE 1/4 NE 1/4 SW 1/4 Sec. 11 T81N R26W; 13DA162
Landscape position: High terrace
Elevation: approximately 851 feet
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/24/84
Described by: E. A. Bettis III
Remarks: C-14 horizon 700-740 cm; 15,210 ±150 B.P. (Beta-11166).

Depth (cm)	Soil Horizon (weathering zone)	Description
0-30	Ap	very dark brown to very dark grayish brown (10YR 2/2-3/2) sandy loam, cloddy, friable, noneffervescent, abrupt boundary, common roots
30-46	AB	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
46-74	BE1	very dark grayish brown (10YR 3/2) fine sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, few roots.
74-110	BE2	very dark grayish brown (10YR 3/2) loam, moderate medium to coarse columnar, friable, noneffervescent, gradual boundary, occasional black (10YR 2/1) coatings in root channels.
110-158	Bt	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, moderate coarse columnar, friable, noneffervescent, clear boundary, common thick almost continuous very dark gray (10YR 3/1) cutans.
158-207	BC	dark brown to dark grayish brown (10YR 3/3-4/2) silt loam, weak coarse columnar, friable, noneffervescent, abrupt boundary, few fine iron concretions.
207-245	2Atb	dark grayish brown (10YR 4/2) silt loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common fine iron concretions, common thin almost continuous very dark gray (10YR 3/1) cutans.

Location: 08AB62
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
245-282	2Btb	dark grayish brown to brown (10YR 4/2-4/3) silt loam, moderate medium to coarse columnar, friable, noneffervescent, clear boundary, common fine yellowish brown (10YR 5/6) mottles, common medium iron concretions.
282-310	2BCb	brown (10YR 4/3) loam, weak coarse subangular blocky, friable, noneffervescent, clear boundary, common fine yellowish brown (10YR 5/6) mottles, common medium iron concretions.
310-417	2C1	brown (10YR 4/3) silt loam, massive, friable, weak to moderate effervescence, abrupt boundary, common fine yellowish brown (10YR 5/6) and few fine grayish brown (2.5Y 5/2) mottles, common medium iron concretions.
417-460	2AC	dark gray to dark grayish brown (10YR 4/1-4/2) silt loam, massive, friable, noneffervescent, gradual boundary, few fine iron concretions.
460-528	2C2	dark brown (10YR 3/3) silt loam, massive, friable, noneffervescent to weak effervescence, clear boundary, abundant medium dark yellowish brown (10YR 4/4) and common medium grayish brown (2.5Y 5/2) mottles.
528-590	2C3	dark grayish brown to grayish brown (2.5Y 4/2-5/2) silt loam, massive, slightly sticky slightly plastic, noneffervescent (matrix), abundant fine dark yellowish brown (10YR 4/4) mottles, abundant fine soft carbonate concretions, common fine iron concretions.
590-630	2C4	dark grayish brown to grayish brown (2.5 4/2-5/2) silty clay loam, massive, slightly sticky plastic, noneffervescent (matrix), abrupt boundary, common medium soft carbonate concretions, abundant medium iron concretions.
		Late Wisconsinan Alluvium
630-697	3C1	dark greenish gray (5GY 4/1) silt loam, massive, firm, weak to moderate effervescence, gradual boundary, abundant medium soft carbonate concretions at top of horizon.

Location: 08AB62
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
697-758	3C2	dark gray (5Y 4/1) stratified sandy loam (thinly bedded), massive, friable, weak to moderate effervescence, abrupt boundary, abundant organics, C-14 sample 700-740 cm, 15,210 ±150 B.P. (Beta-11166).
758-base (765)	4C	dark gray (5Y 4/1) medium to coarse sand, single grain, loose, noneffervescent, hole collapsed.

Location: 08AB63 Xenia area; SE 1/4 NW 1/4 SE 1/4 SW 1/4 Sec. 11 T81N R26W; 13DA163
Landscape position: Alluvial fan on High Terrace
Elevation: approximately 853 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/25/84
Described by: E. A. Bettis III
Remarks: heavy rain caused an abbreviated description

Depth (cm)	Soil Horizon (weathering zone)	Description
		Alluvial Fan
0-115		Hapludoll developed in loaey sand.
115-192		buried Cumulic Hapludoll developed in silt loam to silty clay loam alluvium.
		High Terrace
192-240		Entisol developed in silt loam, noneffervescent.
240-385		silt loam, noneffervescent.
385-base (407)		medium to coarse sand, moderate effervescence.

Location: 08AB64 Xenia area, SE 1/4 NW 1/4 SE 1/4 SW 1/4 Sec. 11 T81N R26W; 13DA163.
Landscape position: distal portion of fan mantling High terrace
Elevation: approximately 854 feet
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/25/84
Described by: E. A. Bettis III
Remarks: the soil developed into the 3 material is part of the surface soil on the High terrace to the east

Depth (cm)	Soil Horizon (weathering zone)	Description
		Alluvial Fan
0-22	Ap	very dark brown to very dark gray (10YR 2/2-3/1) loam, cloddy, friable, noneffervescent, abrupt boundary, occasional brick fragments.
22-44	A	dark yellowish brown to very dark grayish brown (10YR 3/4-3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, few roots.
44-70	Bw	very dark grayish brown to dark brown (10YR 3/2-3/3) loam with common coarse sand grains, moderate medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary, few roots.
		High Terrace
70-95	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) heavy loam, moderate fine prismatic, friable, noneffervescent, abrupt boundary
95-108	3A2b	very dark brown to very dark gray (10YR 2/2-3/1) clay loam, moderate medium to coarse prismatic, friable, noneffervescent, gradual boundary, few thin discontinuous organs.
108-138	3BEb	very dark gray to very dark grayish brown (10YR 3/1-3/2) heavy loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary.

Location: 08AB64
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
138-168	3Btb	very dark gray to very dark grayish brown (10YR 3/1-3/2) heavy loam, moderate coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, common thin discontinuous very dark brown (10YR 2/2) cutans.
168-210	3BCb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) loam with common fine pebbles and occasional thin coarse sand beds
210-280	4C1	dark gray to dark grayish brown (10YR 4/1-4/2) silt loam, massive, friable, noneffervescent, gradual boundary, few fine iron concretions.
280-315	4C2	dark grayish brown (10YR 4/2) silt loam with occasional small shale clasts, massive, friable, noneffervescent, clear boundary, iron concretions as above.
315-388	4C3	brown (10YR 4/3) silt loam, massive, friable, noneffervescent, gradual boundary, common fine iron concretions.
388-477	4C4	grayish brown (2.5YU 5/2) stratified silt loam and sandy loam, massive, friable, noneffervescent, abrupt boundary, common medium dark yellowish brown (10YR 4/4) mottles, common medium iron concretions.
477-base (530)	5C	grayish brown (2.5Y 5/2) medium to coarse sand with occasional fine pebbles, single grain, loose, very weak effervescence, hole collapsed.

Location: 08AB65 Xenia area; NW 1/4 SW 1/4 SE 1/4 SW 1/4 Sec. 11 T81N R26W; 13DA163
Landscape position: midfan--alluvial fan burying High terrace
Elevation: approximately 860 feet
Parent material: alluvium
Slope: 5-9%
Vegetation: weeds
Date described: 10/25/84
Described by: E. A. Bettis III
Remarks: the soil developed into the 3 material is part of the surface soil on the High terrace to the east.

Depth (cm)	Soil Horizon (weathering zone)	Description
		Alluvial Fan
0-18	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) sandy loam, weak medium to fine subangular blocky, friable, noneffervescent, abrupt boundary, common roots.
18-34	AB	very dark gray to very dark grayish brown (10YR 3/1-3/2) fine sandy loam, weak medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
34-57	Bw1	dark grayish brown (10YR 4/2) fine sandy loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, few roots.
57-76	Bw2	very dark grayish brown (10YR 3/2) sandy loam, moderate medium subangular blocky, friable, noneffervescent, abrupt boundary, few thin discontinuous light gray (10YR 7/2) silans.
76-108	2ABtb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) heavy loam, moderate medium prismatic breaking to moderate fine subangular blocky, friable, noneffervescent, clear boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans
108-150	2BCb	dark gray to dark grayish brown (10YR 4/1-4/2) loam with abundant coarse sand grains and fine pebbles, weak to moderate coarse columnar, friable, noneffervescent, abrupt boundary.

Location: 08AB65
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
		High Terrace
150-179	3Atb	very dark grayish brown (10YR 3/2) heavy loam with common medium to coarse sand grains, moderate coarse columnar, friable, noneffervescent, gradual boundary, common thin almost continuous very dark gray (10YR 3/1) cutans.
179-204	3Bt1b	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) clay loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, few fine iron concretions, common thick continuous very dark gray (10YR 3/1) cutans.
204-246	3Bt2b	very dark grayish brown (10YR 3/2) heavy loam, moderate medium to coarse columnar, friable, noneffervescent, clear boundary, common fine iron concretions, common thin discontinuous very dark gray (10YR 3/1) cutans.
246-292	3BCb	dark grayish brown (10YR 4/2) silt loam, weak coarse subangular blocky, friable, noneffervescent, clear boundary, iron concretions as above.
292-368	3C1	dark grayish brown to grayish brown (10YR 4/2-5/2) fine sandy loam, massive, friable, noneffervescent, clear boundary.
368-base (430)	3C2	dark grayish brown to grayish brown (10YR 4/2-5/2) stratified fine sand, medium to coarse sand and medium to coarse pebbles, single grain, loose, weak effervescence, auger rejected on coarse gravel.

Location: 08AB66 Xenia area; NW 1/4 NE 1/4 SW 1/4 NW 1/4 Sec. 14 T81N R26W
Landscape position: Alluvial fan on Late Wisconsinan Bench; midfan
Elevation: approximately 901 ft.
Parent material: alluvium/colluvium
Slope: 9-14%
Vegetation: alfalfa
Date described: 10/25/84
Described by: E. A. Bettis III
Remarks: the 2 material is late Wisconsinan alluvium

Depth (cm)	Soil Horizon (weathering zone)	Description
		Alluvial Fan
0-16	Ap1	black to very dark brown (10YR 2/1-2/2) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
16-31	Ap2	black (10YR 2/1) loam, weak medium columnar, friable, noneffervescent, abrupt boundary, abundant roots.
31-50	AB	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
50-78	BA	dark brown to brown (10YR 3/3-4/3) loam, moderate medium to fine angular blocky, friable, noneffervescent, gradual boundary, few thin discontinuous light brownish gray (10YR 6/2) coatings.
78-103	Bt1	brown (10YR 4/3) heavy loam, moderate medium to coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, few fine iron concretions, common thin discontinuous dark brown (10YR 3/8) cutans.
103-152	Bt2	brown to dark yellowish brown (10YR 4/3-4/4) clay loam, moderate coarse columnar, friable, noneffervescent, abrupt boundary, few medium grayish brown (2.5Y 5/2) mottles, common fine iron concretions, common medium oxides, thick continuous dark brown (10YR 3/3) cutans.

Location: 08AB66 Xenia area
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
		Late Wisconsinan Alluvium
152-237	2C1	dark yellowish brown (10YR 4/4) loamy sand with common 3-4 cm thick brown (7.5YR 4/4) lamallae, single grain, loose, noneffervescent, abrupt boundary, common medium to coarse brown (7.5YR 4/4) mottles.
237-base (302)	2C2	yellowish brown (10YR 5/4) stratified loamy sand and medium to coarse cobbles, single grain, loose, noneffervescent, lag of cobbles up to 10 cm in diameter at top of zone.

Location: 08AB67 Xenia area; NE 1/4 NE 1/4 SW 1/4 NW 1/4 Sec. 14 T81N R26W
Landscape position: swale on Late Wisconsinan Bench
Elevation: approximately 887 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: grass
Date described: 10/25/84
Described by: E. A. Bettis III
Remarks: the 2 material is Late Wisconsinan alluvium

Depth (cm)	Soil Horizon (weathering zone)	Description
		Holocene? Alluvium
0-18	Ap	black (10YR 2/1) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
18-40	A1	black (10YR 2/1) loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
40-60	A2	black (10YR 2/1) light silty clay loam, moderate medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, clear boundary, common roots.
60-88	Bt	black to very dark gray (10YR 2/1-3/1) light silty clay loam, moderate coarse columnar breaking to moderate medium angular blocky, friable, noneffervescent, gradual boundary, common medium very dark grayish brown (2.5Y 3/2) mottles, common fine iron concretions, few roots, common thin discontinuous very dark brown (10YR 2/2) cutans.
88-122	Btg	olive gray (5Y 5/2) heavy loam, moderate coarse prismatic breaking to moderate fine prismatic, friable, noneffervescent, abrupt boundary, abundant fine iron concretions, few thin discontinuous very dark brown (10YR 2/2) cutans.
122-140	BC	very dark gray (10YR 3/1) pebbly sandy loam, weak coarse subangular blocky, friable, noneffervescent, abrupt boundary.
140-base (300)	2C	brown (10YR 5/3) pebbly medium to coarse sand, single grain, loose, weak effervescence.

Location: 08AB68 Xenia area, SW 1/4 NE 1/4 NW 1/4 SW 1/4 Sec. 11 T81N R26W
Landscape position: Holocene drainageway on Late Wisconsinan Bench
Elevation: approximately 886 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/25/84
Described by: E. A. Bettis III
Remarks: the upper material is late Holocene in age while the 2 material is early to mid Holocene in age.

Depth (cm)	Soil Horizon (weathering zone)	Description
		Late Holocene Alluvium
0-21	Ap	very dark brown (10YR 2/2) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
21-38	A1	black (10YR 2/1) heavy loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
38-55	A2	black to very dark gray (10YR 2/1-3/1) loam, weak coarse subangular blocky breaking to moderate fine granular, friable, noneffervescent, clear boundary, few roots.
55-70	Bw	dark grayish brown (10YR 4/2) loam with occasional well rounded fine pebbles, weak medium columnar, friable, noneffervescent, gradual boundary.
70-113	C	dark grayish brown to grayish brown (10YR 4/2-5/2) loam with common subrounded fine pebbles, massive, friable, noneffervescent, abrupt boundary, few fine dark yellowish brown (10YR 4/4) mottles.
		Early-Mid Holocene Alluvium
113-155	2C1	dark grayish brown to grayish brown (10YR 4/2-5/2) silt loam, massive, friable, noneffervescent, gradual boundary, abundant medium light olive brown (2.5Y 5/6) mottles, common fine iron concretions.

Location: 08AB68
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
155-190	2C2	dark grayish brown to grayish brown (2.5Y 4/2-5/2) silt loam, massive, slightly sticky slightly plastic, noneffervescent, abrupt boundary, few fine light olive brown (2.5Y 5/6) mottles, common fine iron concretions, common medium oxides.
190-208	2C3	light olive brown (2.5Y 5/6) fine sand, single grain, loose, noneffervescent, abrupt boundary, common medium grayish brown (2.5Y 5/2) mottles.
208-273	2C4	stratified grayish brown (2.5Y 5/2) silt loam and dark grayish brown (2.5Y 4/2) medium sand, massive and single grain, friable and loose, noneffervescent, abrupt boundary, common medium light olive brown (2.5Y 5/6) mottles in silt loam beds.
273-base (330)	2C5	stratified greenish gray (5G 6/1) silt loam and medium to coarse sand, massive and single grain, friable and loose, noneffervescent grading to weak effervescence at base, abundant roots (cattails?), hole collapsed.

Location: 08AB69 Honey Creek area; SE 1/4 SE 1/4 NE 1/4 NE 1/4 Sec. 18 T83N R26W; 13BN280
Landscape position: Intermediate Terrace
Elevation: approximately 865 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-8	+	very dark gray (10YR 3/1) silty clay loam with lens of medium sand at base, massive, friable, noneffervescent, abrupt boundary.
8-38	Ap	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, massive, friable, weak to moderate effervescence, abrupt boundary.
38-73	AC	very dark grayish brown (10YR 3/2) loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, thin medium sand lens at base.
73-107	Ab	very dark gray to very darc grayish brown (10YR 3/1-3/2) heavy silt loam, weak medium subangular blocky breaking to moderate fine granular, friable, noneffervescent, gradual boundary, abundant burned earth, common charcoal.
107-150	Bwb	very dark grayish brown (10YR 3/2) silt loam, weak to moderate medium to coarse subangular blocky, friable, weak effervescence, gradual boundary, occasional medium iron concretions, occasional charcoal flecks.
150-184	BCb	dark grayish brown to brown (10YR 4/2-4/3) fine sandy loam, weak coarse subangular blocky, friable, moderate effervescence, clear boundary, few fine dark yellowish brown (10YR 4/6) mottles.
184-base (263)	C	dark grayish brown (10YR 4/2) stratified fine sandy loam and silt loam, massive, friable, moderate effervescence, few medium dark yellowish brown (10YR 4/6) mottles, water at 200 cm.

Location: 08AB70 Honey Creek area; NE 1/4 NE 1/4 SE 1/4 NE 1/4 Sec. 18
T83N R26W
Landscape position: swale on Intermediate Terrace
Elevation: approximately 863 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-10	+	very dark gray to black (10YR 3/1-2/1) clay loam, massive, friable, noneffervescent, abrupt boundary, thin lens of medium sand at base.
10-31	Ap	very dark gray (10YR 3/1) silt loam, cloddy, friable, weak effervescence, abrupt boundary.
31-50	A1	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, weak to moderate medium subangular blocky, friable, weak effervescence to noneffervescent, gradual boundary.
50-110	Bw	very dark grayish brown (10YR 3/2) silt loam, moderate medium subangular blocky, friable, moderate effervescence, gradual boundary, few fine oxides, few fine soft carbonate concretions.
110-150	C1	dark brown to brown (10YR 3/3-4/3) sandy loam, massive, friable, moderate effervescence, abrupt boundary, few fine dark yellowish brown (10YR 4/6) mottles, oxides as above.
150-base (200)	C2	pale brown and brown (10YR 6/3 and 4/3) stratified medium sand and fine sandy loam, massive, friable, moderate effervescence, water table at 160 cm.

Location: 08AB71 Honey Creek area; NE 1/4 NE 1/4 SE 1/4 NE 1/4 Sec. 18 T83N R26W
Landscape position: levee on Intermediate Terrace
Elevation: approximately 866 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-7	+	black to very dark gray (10YR 2/1-3/1) clay loam, massive, friable, noneffervescent, abrupt boundary.
7-40	Ap	very dark gray (10YR 3/1) silt loam, cloddy, friable, weak effervescence to noneffervescent, abrupt boundary.
40-55	AC	very dark gray (10YR 3/1) silt loam, weak medium to coarse subangular blocky, friable, weak effervescence to noneffervescent, clear boundary.
55-70	C1	dark grayish brown to brown (10YR 4/2-4/3) fine sandy loam, very weak medium subangular blocky, friable, noneffervescent, abrupt boundary.
70-102	C2	dark grayish brown to brown (10YR 4/2-4/3) loamy fine sand, massive, friable, noneffervescent, abrupt boundary.
102-162	C3	very dark grayish brown (10YR 3/2) silt loam, weak medium to coarse subangular blocky, friable, moderate effervescence, abrupt boundary, occasional gastropod shells.
162-188	C4	brown (10YR 4/3) loamy fine sand, massive, friable, noneffervescent, abrupt boundary.
188-220	2ACb	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) silt loam, weak to moderate medium subangular blocky, friable, weak to moderate effervescence, gradual boundary, common fine dark grayish brown (10YR 4/2) mottles.

Location: 08AB71 Honey Creek area
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
220-260	2C1	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) stratified silt loam, massive, friable, moderate effervescence, abrupt boundary common medium dark yellowish brown (10YR 4/6) and common fine grayish brown (2.5Y 5/2) mottles.
260-base (350)	2C2	dark grayish brown (10YR 4/2) medium sand, single grain, loose, weak effervescence, occasional thin grayish brown (2.5Y 5/2) silt loam beds with brown (7.5YR 4/4) iron accumulations on their upper surfaces in lower 20 cm.

Location: 08AB72 Honey Creek area; SW 1/4 NE 1/4 SE 1/4 NE 1/4 Sec. 18 T83N R26W
Landscape position: levee on Low Terrace
Elevation: approximately 866 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-6	+	black to very dark gray (10YR 2/1-3/1) silty clay loam, massive, friable, noneffervescent, abrupt boundary.
6-46	AC	very dark gray (10YR 3/1) silt loam, moderate medium granular, friable, noneffervescent, clear boundary.
46-57	C1	very dark grayish brown (10YR 3/2) loam, weak medium granular, friable, weak effervescence, abrupt boundary.
57-149	C2	pale brown to light gray (10YR 6/3-7/2) fine sand, single grain, loose, weak to moderate effervescence, abrupt boundary.
149-190	C3	dark gray and dark grayish brown (10YR 4/1 and 4/2) planar bedded silt loam with occasional thin grayish brown (10YR 5/2) beds of fine sand, massive, friable, moderate to strong effervescence, abrupt boundary.
190-257	C4	dark grayish brown and grayish brown (10YR 4/2 and 5/2) planar bedded silt loam and fine sand, massive and single grain, friable and loose, moderate to strong effervescence, abrupt boundary, common medium grayish brown (10YR 5/2) mottles.
257-315	C5	dark grayish brown and brown (10YR 4/2 and 4/3) stratified silt loam, massive, friable, moderate to strong effervescence, abrupt boundary, abundant medium grayish brown (2.5Y 5/2) and common medium brown (7.5YR 4/4) mottles, few fine iron concretions.
315-base (366)	C6	very dark gray (10YR 3/1) silt loam, weak medium to fine subangular blocky, friable, strong effervescence, abrupt boundary, mottles as above, auger rejected on coarse gravel at base.

Location: 08AB73 Honey Creek area; SE 1/4 SW 1/4 SW 1/4 SE 1/4 Sec. 7
T83N R26W
Landscape position: levee on Intermediate Terrace
Elevation: approximately 870 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-9	+	very dark gray (10YR 3/1) silty clay loam, massive, friable, noneffervescent, abrupt boundary.
9-36	Ap	very dark grayish brown to dark brown (10YR 3/2-3/3) sandy loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
36-46	AB	very dark grayish brown (10YR 3/2) sandy loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual boundary.
46-74	Bw1	dark brown (10YR 3/3) sandy loam, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary.
74-119	Bw2	dark brown (10YR 3/3) sandy loam, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary.
119-136	C1	brown (10YR 5/3) loamy sand, single grain, loose, noneffervescent, abrupt boundary.
136-189	BC1	dark brown (10YR 3/3) loam, moderate coarse subangular blocky, friable, noneffervescent, clear boundary.
189-240	BC2	dark brown (10YR 3/3) loam, moderate coarse subangular blocky, friable, weak to moderate effervescence, gradual boundary, common fine soft carbonate concretions.
240-305	C2	brown (10YR 4/3) loamy sand, weak coarse subangular blocky, friable, moderate effervescence, abrupt boundary, carbonate concretions as above.
305-base (415)	C3	light gray (10YR 7/2) medium to coarse sand, single grain, loose, moderate effervescence.

Location: 08AB74 Honey Creek area; NW 1/4 SE 1/4 SW 1/4 SE 1/4 Sec. 7
T83N R26W
Landscape position: swale on Intermediate Terrace
Elevation: approximately 864 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-22	+	black to very dark gray (10YR 12/1-3/1) clay loam, massive, friable, moderate effervescence, abrupt boundary, 3 cm thick lens of light gray (10YR 7/2) fine sand at base.
22-41	Ap	very dark gray (10YR 3/1) silt loam, cloddy, friable, weak effervescence, abrupt boundary.
41-68	AC	very dark grayish brown (10YR 3/2) loam, weak to moderate medium granular, friable, moderate effervescence, clear boundary.
68-167	C	very dark grayish brown (10YR 3/2) silt loam with common thin light gray (10YR 7/2) fine sand beds, massive, friable, moderate effervescence, abrupt boundary, few fine dark yellowish brown (10YR 4/6) mottles.
167-182	2A1b	very dark grayish brown to dark grayish brown (10YR 3/2 - 4/2) silt loam, moderate medium to fine granular, friable, weak effervescence, clear boundary, few fine brown (7.5YR 4/4) mottles, occasional gastropod shells.
182-218	2A2b	very dark grayish brown to dark grayish brown (10YR 3/2-4/2) silt loam, moderate medium to fine granular, friable, noneffervescent, gradual boundary, abundant medium to fine yellowish red (5YR 4/6) mottles.
218-258	2Bw1b	dark brown (10YR 3/3) silt loam, weak to moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, few fine yellowish red (5YR 4/6) mottles.

Location: 08AB74
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
258-285	2Bw2b	dark brown (10YR 3/3) silt loam, weak to moderate medium to fine subangular blocky, friable, weak to moderate effervescence, gradual boundary, common medium yellowish red (5YR 5/6) mottles.
285-327	2BCb	very dark gray to very dark grayish brown (10YR 3/1-3/2) loam, weak fine subangular blocky, friable, moderate effervescence, abrupt boundary, common medium dark yellowish brown (10YR 4/6) mottles.
327-base (370)	2C	very dark gray to very dark grayish brown (10YR 3/1-3/2) stratified fine sandy loam and medium to coarse sand, single grain, loose, weak effervescence.

Location: 08AB75 Honey Creek area; SE 1/4 SE 1/4 NW 1/4 SE 1/4 Sec. 7
T83N R26W
Landscape position: Low Terrace
Elevation: approximately 871 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks: the + material is 1984 flood deposits.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-14	+	black to very dark gray (10YR 2/1-3/1) clay loam, massive, friable, weak to moderate effervescence, abrupt boundary.
14-42	Ap	dark brown to dark grayish brown (10YR 3/3-4/2) sandy loam, massive, friable, noneffervescent, abrupt boundary.
42-54	AC	dark grayish brown (10YR 4/2) sandy loam, very weak medium subangular blocky, friable, weak effervescence, clear boundary.
54-98	C1	very dark gray (10YR 3/1) fine sandy loam, massive, friable, moderate effervescence, abrupt boundary, common fine yellowish red (5YR 5/6) mottles
98-base (180)	C2	very dark gray (10YR 3/1) fine sandy loam, massive, friable, moderate effervescence, abrupt boundary, common fine yellowish red (5YR 5/6) mottles.

Location: 08AB76 Ledges area; SE 1/4 NW 1/4 SW 1/4 NW 1/4 Sec. 21 T83N R26W
Landscape position: Intermediate Terrace
Elevation: approximately 863 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 10/30/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-30	Ap	very dark gray (10YR 3/1) silt loam, cloddy, friable, noneffervescent, abrupt boundary.
30-66	AC	very dark grayish brown (10YR 3/2) silt loam, moderate medium granular, friable, noneffervescent, clear boundary.
66-98	C	dark brown (10YR 3/3) silt loam, massive, friable, noneffervescent, abrupt boundary.
98-133	2Ab	very dark grayish brown (10YR 3/2) silt loam, moderate medium to fine granular, friable, noneffervescent, gradual boundary.
133-173	2Bw1b	dark brown (10YR 3/3) silt loam, weak to moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, very few fine oxides.
173-211	2Bw2b	dark brown (10YR 3/3) silt loam, weak medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, common fine oxides.
211-270	2C1	brown (10YR 5/3) stratified silt loam and fine sand, massive, friable, noneffervescent, abrupt boundary, abundant medium brown (7.5YR 4/4) mottles, occasional gastropod shells.
270-base (378)	2C2	very dark grayish brown and grayish brown (10YR 3/2 and 2.5Y5/2) stratified medium to coarse pebbly sand and silt loam, single grain and massive, loose and friable, noneffervescent, common medium brown (7.5YR 4/4) mottles in sandy beds.

Location: 08AB77 Fraser; NE 1/4 NE 1/4 NW 1/4 NW 1/4 Sec. 2 T84N R27W
Landscape position: High Terrace
Elevation: approximately 907 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: grass
Date described: 11/5/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-27	Ap	black to very dark gray (10YR 2/1-3/1) sandy loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
27-42	A1	black to very dark gray (10YR 2/1-3/1) sandy loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots.
42-79	A2	very dark grayish brown (10YR 3/2) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, clear boundary, common roots.
79-96	E1	grayish brown to brown (10YR 5/2-5/3) sandy loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, common roots, abundant light gray (10YR 7/2) silans.
96-113	E2	brown (10YR 5/3) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, abrupt boundary, few roots, silans as above.
113-135	Bw1	brown (10YR 4/3) sandy loam, moderate coarse columnar breaking to moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, few roots, common discontinuous light gray (10YR 7/2) silans.
135-188	Bw2	brown (10YR 4/3) sandy loam, moderate coarse subangular blocky, friable, noneffervescent, clear boundary, few roots, few discontinuous silans.
188-206	Bw3	brown (10YR 4/3) sandy loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary.

Location: 08AB77 Fraser
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
206-234	Bw4	brown (10YR 4/3) sandy loam, weak to moderate medium to coarse subangular blocky, friable, noneffervescent, abrupt boundary.
234-244	BC1	brown (10YR 4/3) sandy loam, very weak fine subangular blocky to single grain, friable to loose, noneffervescent, abrupt boundary.
244-300	Bw5	dark brown to brown (10YR 3/3-4/3) loam, moderate coarse columnar breaking to weak medium to fine subangular blocky, friable, noneffervescent, gradual boundary.
300-348	Bw6	brown (10YR 4/3) loam, weak coarse columnar, friable, noneffervescent, clear boundary.
348-373	BC2	brown (10YR 4/3) loamy sand, weak medium subangular blocky, friable, noneffervescent, gradual boundary.
373-454	Bw7	dark brown (10YR 3/3) sandy loam, weak coarse, subangular blocky, friable, noneffervescent, abrupt boundary.
454-474	2A1b	dark grayish brown to brown (10YR 4/2-4/3) sandy loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, very few fine grayish brown (10YR 5/2) mottles.
474-495	2A2b	brown (10YR 4/3) sandy loam, moderate medium to fine subangular blocky, friable, non-effervescent, clear boundary, mottles as above, common fine oxides.
495-512	2BAb	dark brown (10YR 3/3) loam, moderate fine subangular blocky, friable, noneffervescent, gradual boundary, common medium oxides, very few fine iron concretions.
512-533	2Bt1b	brown (10YR 4/3) loam, moderate fine angular blocky, friable, noneffervescent, clear boundary, common fine grayish brown (2.5Y 5/2) mottles, oxides and iron concre-tions as above, common thin discontinuous dark grayish brown (10YR 4/2) cutans.

Location: 08AB77 Fraser
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
533-583	2Bt2b	grayish brown (2.5Y 5/2) silt loam, moderate fine angular blocky, friable, noneffervescent, abrupt boundary, common medium brown (7.5YR 5/4) mottles, common medium oxides, common medium iron concretions, very few thin discontinuous dark grayish brown (10YR 4/2) cutans.
583-593	2BC	brown (7.5YR 4/4) loam, weak medium subangular blocky, friable, noneffervescent, abrupt boundary, common coarse grayish brown (2.5Y 5/2) mottles, oxides and iron concretions as above.
593-base (620)	R	black shale with thin coal seams, noneffervescent, augered.

Location: 08AB79 Fraser; NE 1/4 NE 1/4 NE 1/4 NW 1/4 Sec. 2 T84N R27W
Landscape position: Intermediate Terrace
Elevation: approximately 892 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: grass
Date described: 11/6/84
Described by: E. A. Bettis III and G. A. Miller
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-31	Ap	very dark grayish brown (10YR 3/2) fine sandy loam, cloddy, friable, noneffervescent, abrupt boundary, common roots.
31-48	A1	very dark grayish brown (10YR 3/2) loam moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, few roots, few thin discontinuous very dark gray (10YR 3/1) organs.
48-69	A2	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, gradual boundary, occasional roots.
69-97	A3	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, occasional roots.
97-118	AC	brown (10YR 4/3) fine sandy loam, weak medium subangular blocky, very friable, noneffervescent, abrupt boundary, occasional roots.
118-166	C	brown (10YR 4/3) fine sandy loam, very weak medium subangular blocky, very friable, noneffervescent, abrupt boundary, occasional roots, occasional very dark grayish brown (10YR 3/2) filled insect burrows.
166-190	2ACb	dark brown (10YR 3/3) loam, weak medium to moderate fine subangular blocky, friable, moderate effervescence, abrupt boundary, few fine oxides, abundant fine sand filled burrows in lower 10 cm.

Location: 08AB79 Fraser
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
190-201	3Ab	brown (10YR 4/3) silt loam, moderate medium breaking to moderate fine subangular blocky, friable, moderate to strong effervescence, gradual boundary, few fine oxides, common charcoal flecks, common gastropod shells.
201-226	3ACb	dark grayish brown to brown (10YR 4/2-4/3) loam, weak coarse subangular blocky, friable, moderate to weak effervescence, abrupt boundary.
226-260	3C	grayish brown to light gray (10YR 5/2-7/2) fine to medium sand, single grain, loose, weak effervescence, abrupt boundary.
260-277	4AC1b	brown (10YR 4/3) loam, weak medium subangular blocky, friable, moderate to strong effervescence, clear boundary, few fine dark gray to dark grayish brown (10YR 4/1-4/2) mottles, few fine iron concretions.
277-307	4AC2b	brown (10YR 4/3) silt loam, moderate medium subangular blocky, friable, strong effervescence, abrupt boundary, common fine dark gray to dark grayish brown (10YR 4/1-4/2) mottles, common fine iron concretions, common fine soft carbonate concretions.
307-base (353)	4C	grayish brown to light gray (10YR 5/2-7/2) medium to coarse sand, single grain, loose, weak effervescence.

Location: 08AB80; NW 1/4 SE 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W; 13BN27
Landscape position: Alluvial fan, upper midfan
Elevation: approximately 897 ft.
Parent material: alluvium
Slope: 5-9%
Vegetation: grass
Date described: 11/6/84
Described by: E. A. Bettis III and G. A. Miller
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-18	A1	black to very dark brown (10YR 2/1-2/2) loam with occasional fine subrounded pebbles, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, abundant roots.
18-31	A2	black to very dark brown (10YR 2/1-2/2) loam with occasional fine subrounded pebbles, moderate medium subangular blocky, friable, noneffervescent, clear boundary, abundant roots.
31-52	A3	very dark grayish brown (10YR 3/2) loam with occasional fine pebbles, moderate medium columnar breaking to moderate medium subangular blocky, friable, noneffervescent, clear boundary, abundant roots, few thin discontinuous very dark brown (10YR 2/2) organs.
52-74	BE	dark brown (10YR 3/3) loam, moderate medium to coarse columnar, friable, noneffervescent, clear boundary, common roots, common thin discontinuous light brownish gray (10YR 6/2) silans.
74-106	Bt1	brown (10YR 4/3) loam, moderate coarse columnar, friable, noneffervescent, clear boundary, abundant fine iron concretions, common roots, common thin almost continuous very dark grayish brown to dark brown (10YR 3/2-3/3) cutans, common thick continuous very dark gray (10YR 3/1) coatings in root channels, common insect burrows filled with medium to coarse sand.

Location: 08AB80
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
106-120	Bt2	dark yellowish brown (10YR 4/4) pebbly loam, moderate coarse columnar breaking to moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary, thick continuous very dark grayish brown (10YR 3/2) cutans in macro pores.
120-139	2Bt1b	dark brown (10YR 3/3) loam with common subrounded pebbles, moderate coarse columnar, friable, noneffervescent, gradual boundary, few fine oxides, common thin discontinuous very dark grayish brown (10YR 3/2) cutans, common charcoal flecks.
139-163	2BC1b	dark brown (10YR 3/3) loam, weak to moderate coarse subangular blocky, friable, noneffervescent, clear boundary, few fine oxides.
163-190	2BC2b	dark yellowish brown (10YR 4/4) loam to fine sandy loam with a lag of medium to coarse subrounded pebbles at base of horizon, weak medium to coarse subangular blocky, friable, weak effervescence, abrupt boundary.
190-215	3Bw1b	brown to dark yellowish brown (10YR 4/3-4/4) loam with common subrounded pebbles, moderate medium to coarse columnar, friable, moderate to strong effervescence, gradual boundary, few fine iron concretions, common fine soft carbonate concretions.
215-235	3Bw2b	dark brown (10YR 3/3) loam, moderate medium to coarse subangular blocky, friable, moderate effervescence, gradual boundary, very few fine iron concretions, common fine soft carbonate concretions, occasional charcoal flecks.
235-255	3Bw3b	brown (10YR 4/3) loam, moderate medium to coarse subangular blocky, friable, moderate effervescence, clear boundary, few fine iron concretions, common fine soft carbonate concretions, occasional gastropod shells.
255-264	3Bw4b	same as above but carbonate concretions abundant.

Location: 08AB80
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
264-298	3Bw5b	brown (10YR 4/3) loam, moderate medium subangular blocky, friable, moderate to strong effervescence, gradual boundary, concretions as above, very few thin discontinuous dark brown (10YR 3/3) cutans, occasional charcoal flecks.
298-317	3Bw6b	brown to dark yellowish brown (10YR 4/3-4/4) loam, moderate medium to coarse subangular blocky, friable, moderate effervescence, clear boundary, very few fine iron concretions, common fine soft carbonate concretions, cutans as above.
317-370	3C1	yellowish brown (10YR 5/4) stratified medium to coarse pebbly sand, single grain, loose, weak effervescence, abrupt boundary.
370-383	3C2	brown (10YR 4/3) loam, massive, friable, strong effervescence, abrupt boundary, abundant fine soft carbonate concretions, occasional charcoal flecks.
383-455	3C3	yellowish brown (10YR 5/4) stratified sand, loam, and medium to coarse subrounded pebbles (dominantly carbonate lithology), single grain, loose, strong effervescence, abrupt boundary.
455-470	4Ab	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, very weak medium subangular blocky, friable, moderate effervescence, gradual boundary.
470-492	4ABb	brown to yellowish brown (10YR 4/3-5/4) loam, moderate medium subangular blocky, friable, weak effervescence, gradual boundary, very few fine iron concretions, few fine oxides.
492-528	4Bwb	brown to yellowish brown (10YR 4/3-5/4) loam, moderate medium subangular blocky, friable, weak effervescence, gradual boundary, very few fine iron concretions, few fine oxides.

Location: 08AB80
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
528-694	4C1	brown (10YR 5/3) pebbly sandy loam, massive, friable, moderate to strong effervescence, abrupt boundary.
694-722	4C2	yellowish brown (10YR 5/4) loam, massive, friable, strong to violent effervescence, abrupt boundary, few fine iron concretions and oxides, abundant fine soft carbonate concretions.
722-760	4C3	yellowish brown (10YR 5/4-5/6) sandy loam with occasional fine to medium subrounded pebbles, massive, friable, weak effervescence, abrupt boundary.
760-771	4C4	brown (7.5YR 4/4) loam, massive, hard, moderate effervescence, abrupt boundary, iron band.
771-base (860)	5C1	grayish brown to light brownish gray (2.5Y 5/2-6/2) loam, grading to very fine pebbly sand, massive, slightly sticky nonplastic, moderate to strong effervescence, common brown (7.5YR 4/4) streaks, hole collapsed.

Location: 08AB81; SE 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W; 13BN27
Landscape position: High Terrace
Elevation: approximately 882 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: grass
Date described: 11/6/84
Described by: E. A. Bettis III and G. A. Miller
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-27	Ap	black (10YR 2/1) loam, cloddy, friable, noneffervescent, abrupt boundary, abundant roots.
27-38	A1	black (10YR 2/1) loam, moderate medium to fine subangular blocky, friable, noneffervescent, abrupt boundary, abundant roots.
38-52	A2	black (10YR 2/1) loam, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, clear boundary, abundant roots.
52-61	A3	black (10YR 2/1) loam, moderate medium to fine granular, friable, noneffervescent, clear boundary, common roots.
61-79	AB	very dark grayish brown (10YR 3/2) loam with occasional fine pebbles, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, common roots, abundant dark brown (10YR 3/3) filled insect burrows.
79-100	BA	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium columnar breaking to moderate fine prismatic, friable, noneffervescent, gradual boundary, common roots.
100-127	Bt1	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate coarse prismatic, friable, noneffervescent, gradual boundary, common roots, common thin discontinuous very dark grayish brown (10YR 3/2) cutans, occasional charcoal flecks.

Location: 08AB81
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
127-160	Bt2	dark brown (10YR 3/3) loam, moderate medium to coarse prismatic, friable, noneffervescent, gradual boundary, common thin almost continuous very dark grayish brown (10YR 3/2) cutans.
160-192	Bt3	dark brown (10YR 3/3) loam, moderate medium to coarse prismatic, friable, noneffervescent, gradual boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
192-250	BC	dark grayish brown to brown (10YR 4/2-4/3) loam, weak coarse subangular blocky, friable, noneffervescent, gradual boundary, occasional charcoal flecks.
250-310	C1	brown to yellowish brown (10YR 5/3-5/4) sandy loam, massive, friable, noneffervescent, clear boundary.
310-327	C2	brown to yellowish brown (10YR 5/3-5/4) with pockets of pale brown (10YR 6/3) sandy loam, massive, friable, very weak effervescence abrupt boundary.
327-397	C3	brown (10YR 5/3) loam, massive, friable, noneffervescent to weak effervescence, abrupt boundary, few medium grayish brown (10YR 5/2) mottles, very few fine iron concretions, occasional zones of common medium soft carbonate concretions.
397-443	C4	brown (10YR 4/3) stratified loam and sandy loam, massive, friable, weak to moderate effervescence, abrupt boundary, abundant fine dark yellowish brown (10YR 4/4) iron concretions, common medium to fine soft carbonate concretions.
443-454	C5	dark yellowish brown (10YR 4/4) sandy loam, massive, friable, noneffervescent, abrupt boundary.
454-474	C6	brown to pale brown (10YR 5/3-6/3) sandy loam, massive, friable, noneffervescent, abrupt boundary.

Location: 08AB81
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
474-495	2A1b	dark brown to brown (10YR 3/3-4/3) silt loam, moderate medium to fine subangular blocky, friable, moderate to strong effervescence, few fine oxides, abundant fine soft carbonate concretions, abundant charcoal flecks at top of horizon.
495-512	2A2b	brown (10YR 4/3) silt loam, moderate medium subangular blocky, friable, moderate effervescence, clear boundary, common fine oxides, common fine soft carbonate concretions, occasional gastropod shells.
512-530	2C1	brown (10YR 4/3) loam with common fine pebbles, massive, friable, noneffervescent, abrupt boundary, few fine oxides.
530-565	2C2	dark yellowish brown (10YR 4/4) sandy loam, massive, friable, noneffervescent, abrupt boundary, few medium light olive brown (2.5Y 5/4) mottles.
565-584	2C3	brown to dark yellowish brown (10YR 4/3-4/4) loam, massive, friable, noneffervescent, abrupt boundary, abundant medium light olive brown (2.5Y 5/4) mottles.
584-base (700)	2C4	brown (10YR 4/3) stratified loam and sandy loam grading downward to medium to coarse sand, massive, friable to loose, weak to moderate effervescence, common medium to coarse light yellowish brown (2.5Y 6/4) mottles with light olive brown (2.5Y 5/4) halos, hole collapsed.

Location: 08AB82; SE 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W; 13BN27
Landscape position: alluvial fan, midfan, along old fenceline
Elevation: approximately 880 ft.
Parent material: alluvium
Slope: 5-9%
Vegetation: grass
Date described: 11/7/84
Described by: E. A. Bettis III
Remarks: the 4 material is Des Moines River alluvium

Depth (cm)	Soil Horizon (weathering zone)	Description
0-10	A1	black (10YR 2/1) loam, moderate medium granular, friable, noneffervescent, gradual boundary, abundant roots.
10-30	A2	black (10YR 2/1) loam, moderate medium subangular blocky, friable, noneffervescent, clear boundary, abundant roots.
30-50	AB	dark grayish brown to brown (10YR 4/2-4/3) loam, moderate medium columnar breaking to moderate fine subangular blocky, friable, noneffervescent, gradual boundary, common roots.
50-75	BA	brown (10YR 4/3) sandy loam with occasional subrounded fine pebbles, moderate medium to coarse columnar, friable, noneffervescent, gradual boundary, very few fine iron concretions, few fine oxides, common roots.
75-106	Bt1	brown to yellowish brown (10YR 4/3-5/4) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual boundary, iron concretions and oxides as above, few roots, common thin discontinuous dark brown (10YR 3/3) cutans.
106-117	Bt2	dark yellowish brown (10YR 4/4) loam with occasional subrounded fine pebbles, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary, few fine oxides, few roots, few thin discontinuous dark brown (10YR 4/2) cutans.
117-131	2Bt1b	brown (10YR 5/3-5/4) silt loam with occasional well rounded fine pebbles, moderate medium columnar, friable, noneffervescent, gradual boundary, very few fine oxides, few roots, few thin discontinuous dark grayish brown (10YR 4/2) cutans.

Location: 08AB82
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
131-153	2Bt2b	brown to yellowish brown (10YR 5/3-5/4) loam, moderate medium to coarse columnar breaking to moderate medium subangular blocky, friable, noneffervescent, gradual boundary, few fine oxides, very few roots, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
153-179	2BCb	yellowish brown (10YR 5/4) loam with common medium subrounded pebbles, moderate coarse subangular blocky, friable, noneffervescent, abrupt boundary.
179-205	3ABb	yellowish brown (10YR 5/4) loam, moderate coarse columnar, friable, noneffervescent to weak effervescence, gradual boundary, very few fine oxides.
205-233	3Bw1b	yellowish brown (10YR 5/4) silt loam with common subrounded fine pebbles, moderate coarse columnar, friable, weak to moderate effervescence, gradual boundary, few fine soft carbonate concretions, few fine oxides, occasional gastropd shells.
233-262	3Bw2b	yellowish brown (10YR 5/4) loam, weak to moderate coarse columnar, friable, weak effervescence, clear boundary, very few fine soft carbonate concretions, few fine oxides.
262-273	3C1	yellowish brown (10YR 5/6) sandy loam with abundant fine well rounded pebbles, very weak medium subangular blocky, very friable, moderate to strong effervescence, abrupt boundary.
273-332	3C2	yellowish brown to light yellowish brown (10YR 5/4-6/4) silt loam, massive, friable, weak to moderate effervescence, abrupt boundary, abundant fine soft carbonate concretions, very few fine iron concretions.
		High Terrace
332-358	4Ab	brown (10YR 4/3) silt loam, moderate medium to fine subangular blocky, friable, moderate effervescence, gradual boundary, carbonate and iron concretions as above, common gastropod shells.

Location: 08AB82
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
358-379	4Bw1b	dark yellowish brown (10YR 4/4) loam, moderate medium subangular blocky, friable, weak to moderate effervescence, gradual boundary, few soft carbonate concretions.
379-406	4Bw2b	yellowish brown (10YR 5/6) loam, moderate fine angular blocky, friable, weak to moderate effervescence, gradual boundary, common thin discontinuous light gray (10YR 7/2) silans.
406-450	4Bw3b	yellowish brown (10YR 5/6) loam, moderate medium to fine angular blocky, friable, moderate effervescence, gradual boundary, silans as above.
450-480	4BCb	yellowish brown (10YR 5/6) loam, weak coarse subangular blocky, friable, noneffervescent, clear boundary.
480-518	4C1	yellowish brown (10YR 5/6) sandy loam, massive, friable, noneffervescent, abrupt boundary.
518-527	4C2	yellowish brown (10YR 5/6) silt loam, massive, friable, moderate effervescence, abrupt boundary, common medium grayish brown (2.5Y 5/2) mottles.
527-604	4C3	dark yellowish brown (10YR 4/4) sandy loam, massive, friable, noneffervescent, abrupt boundary.
604-617	4C4	dark yellowish brown (10YR 4/4) silt loam, massive, friable, weak to moderate effervescence, abrupt boundary, abundant medium light olive brown (2.5Y 5/4) mottles, few fine soft carbonate concretions.
617-base (660)	4C5	dark yellowish brown (10YR 4/4) stratified sandy loam, massive, friable, noneffervescent.

Location: 13BN27 trench profile 1 12.65 m west of east end of trench
SE 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W
Landscape position: High Terrace; backswamp
Elevation: approximately 875 ft.
Parent material: loamy alluvium/colluvium burying loamy terrace deposits
Slope: 2-5%
Vegetation: grass
Date described: 5/24/85
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
		Colluvium/alluvium
0-38	Ap	very dark grayish brown (10YR 3/2) silt loam, cloddy, friable, noneffervescent, abrupt smooth boundary, abundant roots, occasional fine pebbles and artifacts, this horizon appears to be several superimposed Aps.
38-51	A1	very dark grayish brown (10YR 3/2) silt loam, moderate medium subangular blocky breaking to moderate medium to fine granular, friable, non-effervescent, clear smooth boundary, abundant roots, thin continuous very dark gray (10YR 3/1) organs on ped faces.
51-58	A2	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, moderate medium to fine angular blocky, friable, noneffervescent, abrupt smooth boundary, abundant roots, organs as above.
		High Terrace
58-81	2A1b	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, moderate medium to fine granular, friable, noneffervescent, gradual smooth boundary, abundant roots.
81-105	2ABb	very dark grayish brown (10YR 3/2) silt loam, moderate medium subangular blocky breaking to moderate fine subangular blocky, friable, non-effervescent, gradual smooth boundary, few roots.
105-123	2BAb	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, weak coarse columnar breaking to moderate medium subangular blocky, friable, non-effervescent, gradual wavy boundary, abundant krotovina filled with dark grayish brown to brown (10YR 4/2-4/3) loam, very few thin discontinuous very dark gray to very dark grayish brown (10YR 3/1-3/2) cutans.

Location: 13BN27 trench profile 1
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
123-146	2Bt1b	dark grayish brown to brown (10YR 4/2-4/3) loam, moderate medium subangular blocky, friable, non-effervescent, clear smooth boundary, common thin discontinuous very dark grayish brown to dark brown (10YR 3/2-3/3) cutans, thin continuous very dark gray (10YR 3/1) organs in macropores, few to common small krotovina filled with very dark grayish brown to dark brown (10YR 3/2-3/3) loam.
146-166	2Bt2b	dark grayish brown to brown (10YR 4/2-4/3) silt loam, moderate medium subangular blocky, friable, noneffervescent, abrupt smooth boundary, common thin discontinuous dark brown (10YR 3/3) cutans, organs in macropores as above, very few fine oxides.
166-182	3BAtb	very dark grayish brown to dark brown (10YR 3/2-3/3) heavy silt loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual smooth boundary, abundant thin almost continuous dark brown (10YR 3/3) cutans, occasional small gastropod shells, occasional charcoal flecks, few fine oxides, this horizon may have originally been an A horizon.
182-197	3Btb	dark brown to dark grayish brown (10YR 3/3-4/2) silt loam, friable, noneffervescent, gradual smooth boundary, cutans as above, occasional charcoal flecks.
197-217	3BCb	dark grayish brown to brown (10YR 4/2-4/3) silt loam, very weak medium subangular blocky, friable, noneffervescent, gradual smooth boundary, very few thin discontinous dark brown (10YR 3/3) cutans.
217-253	3CB1b	grayish brown (2.5 5/2-10YR 5/2) silt loam, very weak medium subangular blocky to massive, friable, noneffervescent, gradual smooth boundary, common fine oxides, very few fine iron concretions, occasional charcoal flecks.
253-base of trench (283)	3CB2b	brown to dark yellowish brown (10YR 4/3-4/4) silt loam to loam, massive, friable, noneffervescent occasional fine pebbles, abundant fine oxides, large fire-cracked rock at base of profile.

Location: 13BN27 profile 2 8.5 m west of east end of trench
SE 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W
Landscape position: High Terrace/Alluvial Fan transition
Elevation: approximately 877 ft.
Parent material: loamy colluvium/alluvium burying loamy High Terrace/alluvial fan transition deposits
Slope: 2-5%
Vegetation: grass
Date described: 5/24/85
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
		Colluvium/Alluvium
0-23	Ap	very dark grayish brown (10YR 3/2) loam, cloddy, friable, noneffervescent, abrupt smooth boundary, abundant medium to fine pebbles, common roots.
23-41	A1	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, non-effervescent, clear smooth boundary, thin continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) organs on ped faces, common pebbles, abundant roots.
41-52	A2	very dark grayish brown (10YR 3/2) loam, non-effervescent, moderate medium subangular blocky, friable, abrupt smooth boundary, thin continuous very dark gray (10YR 3/1) organs, abundant roots.
		High Terrace/Fan
52-74	2AB	very dark gray to very dark grayish brown (10YR 3/1-3/2) silt loam, moderate medium to fine granular, friable, noneffervescent, clear smooth boundary, organs as above, abundant roots.
74-90	2ABb	very dark grayish brown (10YR 3/2) silt loam, moderate medium subangular blocky breaking to moderate medium to fine granular, friable, non-effervescent, gradual smooth boundary, organs as above, common roots.

Location: 13BN27 profile 2
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
90-108	2BAb	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, moderate medium subangular blocky breaking to moderate fine subangular blocky, friable, noneffervescent, clear wavy boundary, very few thin discontinuous very dark gray (10YR 3/1) cutans, occasional very fine pebbles.
108-133	2Bt1b	very dark grayish brown to dark brown (10YR 3/2-3/3) silt loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual smooth boundary, common thin discontinuous very dark grayish brown (10YR 3/2) cutans, few fine krotovina, very few roots.
133-159	2Bt2b	dark brown to brown (10YR 3/3-4/3) silt loam, moderate to strong medium angular blocky, friable, noneffervescent, gradual smooth boundary, common thin almost continuous very dark grayish brown (10YR 3/2) cutans--continuous and thick in macropores, few fine oxides, fire-cracked rock at top of horizon, occasional krotovina
159-178	2Bt3b	brown (10YR 4/3) silt loam, moderate medium to coarse subangular blocky, friable, noneffervescent, clear smooth boundary common thin discontinuous very dark grayish brown (10YR 3/2) cutans--thick and continuous in macropores, common medium to fine pebbles.
178-194	2BCb	brown (10YR 4/3) loam, moderate medium to coarse subangular blocky, friable, noneffervescent, gradual smooth boundary, few thin discontinuous dark brown (10YR 3/3) cutans, common medium to fine pebbles, common fine oxides.
194-222	2CB1	brown to dark yellowish brown (10YR 4/3-4/4) loam, weak to moderate coarse subangular blocky, friable, noneffervescent, abundant medium to fine pebbles, common coarse oxides, occasional thin dark brown (10YR 3/3) cutans in macropores.
222-base (232)	2CB2	yellowish brown (10YR 5/4) loam to silty clay loam, weak to moderate medium subangular blocky, friable, noneffervescent, oxides as above, cutans in macropores as above.

Location: 13BN27 profile 3, 6.7 m east of eastern wall of Block B,
SE 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W
Landscape position: High Terrace; levee edge of backswamp
Elevation: approximately 877 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: grass
Date described: 5/24/85 and 5/27/85
Described by: E. A. Bettis III
Remarks: another buried soil, welded to the 1st buried soil described in this profile (178-211) is evident just east of this profile.

Depth (cm)	Soil Horizon (weathering zone)	Description
0-28	Ap	very dark grayish brown (10YR 3/2) silt loam, cloddy, friable, noneffervescent, abrupt smooth boundary, thin continuous very dark gray (10YR 3/1) organs.
28-53	A1	very dark gray (10YR 3/1) silt loam, moderate medium to fine subangular blocky, breaking to moderate fine granular, friable, noneffervescent, clear smooth boundary, abundant roots.
53-65	A2	very dark grayish brown (10YR 3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual smooth boundary, abundant roots.
65-90	AB	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, abundant roots.
90-126	Bw	dark brown (10YR 3/3) loam, weak to moderate medium subangular blocky, friable, non-effervescent, gradual smooth boundary, common krotovina filled with brown (10YR 4/3) loam.
126-164	BC	dark brown to brown (10YR 3/3-4/3) loam, weak coarse subangular blocky, friable, noneffervescent, clear smooth boundary, few roots.
164-178	Bt	brown to dark yellowish brown (10YR 4/3-4/4) silt loam, weak fine subangular blocky, friable, noneffervescent, abrupt smooth boundary, common thin discontinuous dark grayish brown (10YR 4/2) cutans-almost continuous in macropores.

Location: 13BN27 profile 3
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
178-193	2Atb	dark grayish brown to brown (10YR 4/2-4/3) silt loam, weak to moderate medium to fine subangular blocky, friable, noneffervescent, clear smooth boundary, common thin discontinuous dark gray to dark grayish brown (10YR 4/1-4/2) cutans, common fine iron concretions and oxides, occasional charcoal flecks.
193-211	2Btb	dark grayish brown (10YR 4/2) silt loam, weak fine subangular blocky, friable, noneffervescent, gradual smooth boundary, common thin discontinuous dark gray to dark grayish brown cutans, concretions as above.
211-249	2BCb	dark grayish brown to brown (10YR 4/2-5/3) silt loam, very weak medium subangular blocky to massive, friable, noneffervescent, gradual smooth boundary, common fine oxides.
249-277	2C1	brown (10YR 4/3-5/3) silt loam, very weak medium subangular blocky to massive, friable, weak to moderate effervescence, gradual smooth boundary, common fine soft carbonate concretions, common gastropod shells.
277-307	2C2	brown (10YR 4/3-5/3) silt loam, very weak medium subangular blocky to massive, friable, moderate effervescence, abrupt smooth boundary, few fine soft carbonate concretions, gastropod shells as above.
307-324	3ABtb	dark grayish brown to brown (10YR 4/2-4/5) silt loam, moderate medium to fine subangular blocky, friable, moderate effervescence, clear smooth boundary, few thin discontinuous very dark grayish brown (10YR 3/2) cutans - thick and continuous in macropores, common fine oxides.
324-339	3BCb	brown (10YR 4/3) silt loam, weak medium to fine subangular blocky, friable, moderate effervescence, clear smooth boundary, few fine oxides, very few fine iron concretions, common fine grayish brown (2.5Y 5/2) mottles.

Location: 13BN27 profile 3
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
339-366	3C3	brown (10YR 4/3-5/3) loam, massive, friable, moderate effervescence, abrupt smooth boundary, few fine oxides, few medium grayish brown (2.5Y 5/2) mottles in lower 10 cm.
366-377	3C4	dark grayish brown (2.5Y 4/2) silt loam, massive, friable, moderate effervescence, clear smooth boundary, oxides as above, common medium iron concretions, abundant medium to fine grayish brown (2.5Y 5/2) mottles, thin discontinuous bed of fine sand on top and bottom of horizon.
377-399	3C5	dark grayish brown (2.5Y 4/2) silt loam, massive, friable, moderate effervescence, clear smooth boundary, abundant medium grayish brown (2.5Y 5/2) mottles, common fine iron concretions, thin discontinuous sand lens at top and bottom of horizon.
399-base of trench (417)	3C6	dark grayish brown (2.5Y 4/2) silt loam, massive, very friable, moderate effervescence, common medium to fine grayish brown (2.5Y 5/2) mottles, occasional fine iron concretions, occasional charcoal flecks.

Location: 13BN27 trench profile 4, 46 cm east of east wall of block A
SE 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W
Landscape position: High Terrace, natural levee
Elevation: approximately 877 ft.
Parent material: alluvium
Slope: 0-2%
Vegetation: grass
Date described: 5/24/85
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-20	Ap	very dark grayish brown (10YR 3/2) loam, cloddy, friable, noneffervescent, abrupt smooth boundary, thin continuous very dark gray to very dark grayish brown (10YR 3/1-3/2) organs on peds, abundant roots.
20-38	A1	very dark grayish brown (10YR 3/2) loam, moderate medium subangular blocky, friable, noneffervescent, clear smooth boundary, common thin discontinuous organs as above, abundant roots.
38-62	A2	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, occasional organs as above, abundant roots.
62-90	Bw1	dark brown to brown (10YR 3/3-4/3) sandy loam, weak to moderate medium subangular blocky, friable, noneffervescent, gradual smooth boundary, common roots, common krotovina.
90-144	BC	brown (10YR 4/3-5/3) loam, weak medium subangular blocky, friable, noneffervescent, clear smooth boundary, occasional thin discontinuous very dark gray to dark grayish brown (10YR 3/1-3/2) coatings in macropores, occasional roots.
144-156	Bw2	brown (10YR 4/3) loam, weak medium to fine subangular blocky, friable, noneffervescent, abrupt smooth boundary, few roots.
156-175	2Ab	brown (10YR 4/3) silt loam, weak fine subangular blocky, friable, noneffervescent, clear smooth boundary, occasional krotovina, occasional fire-cracked rocks.

Location: 13BN27
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
175-189	2AC1b	brown (10YR 4/3) silt loam, weak medium subangular blocky, friable, weak effervescence, clear smooth boundary, few fine soft carbonate concretions.
189-215	2AC2b	dark grayish brown to brown (10YR 4/2-4/3) silt loam, very weak fine subangular blocky, friable, moderate to strong effervescence, gradual smooth boundary, common fine soft carbonate concretions, common gastropod shells.
215-265	2C1	brown (10YR 4/3-5/3) silt loam, massive, friable, strong effervescence, gradual smooth boundary, common fine soft carbonate concretions.
265-291	2C2	brown (10YR 4/3-5/3) silt loam, very weak fine subangular blocky to massive, friable, strong effervescence, clear smooth boundary, common fine soft carbonate concretions.
291-317	2C3	brown to yellowish brown (10YR 5/3-5/4) sandy loam, massive, very friable, strong effervescence, clear smooth boundary.
317-331	2C4	brown (10YR 5/3) silt loam, massive, friable, strong effervescence, abrupt smooth boundary, few fine grayish brown (2.5Y 5/2) mottles.
331-354	2ACb	brown (10YR 4/3) loam, weak medium to fine subangular blocky, friable, moderate effervescence, gradual wavy boundary, common fine grayish brown (2.5Y 5/2) mottles, few fine iron concretions.
354-366	2C5	brown (10YR 4/3-5/3) loam, massive, friable, moderate to strong effervescence, clear smooth boundary, few fine grayish brown (2.5Y 5/2) mottles, occasional krotovina, few fine soft carbonate concretions.
366-378	2C6	dark grayish brown to olive brown (2.5Y 4/2-4/4) silt loam, massive, friable, strong effervescence, abrupt smooth boundary, common pockets of fine to medium sand.

Location: 13BN27
CONTINUED

Depth (cm)	Soil Horizon (weathering zone)	Description
378-390	2C7	dark grayish brown 92.5Y 4/2) silt loam, very weak medium subangular blocky, friable, moderate effervescence, clear smooth boundary, abundant medium grayish brown (2.5Y 5/2) mottles, common fine iron concretions, krotovina as above.
390-405	2C8	dark grayish brown (2.5Y 4/2) silt loam, weak medium to fine subangular blocky, very friable, moderate effervescence, common brown (10YR 4/3) mottles, iron concretions as above, discontinuous sand skiffs at base of horizon, abrupt smooth boundary.
405-base (423)	2C9	dark grayish brown (2.5Y 4/2) silt loam, massive, friable, strong effervescence, mottles and iron concretions as above, occasional fine carbonate concretions.

Location: 13BN27 SE 1/4 SW 1/4 NE 1/4 NE 1/4 Sec. 36 T84N R27W
Landscape position: Intermediate Terrace
Elevation: approximately 873 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 5/22/85
Described by: E. A. Bettis III
Remarks: the + material is post-Salorville Dam closing deposits

Depth (cm)	Soil Horizon (weathering zone)	Description
0-2.5	+	very dark gray (10YR 3/1) loam, massive, friable, noneffervescent, abrupt boundary.
2.5-10	+	brown (10YR 4/3) sandy loam, massive, friable, noneffervescent, clear boundary.
10-63	A	very dark grayish brown to dark brown (10YR 3/2-3/3) loam, weak medium subangular blocky, friable, moderate effervescence, gradual boundary, common roots, common charcoal flecks 46-51 cm.
63-84	AC	brown (10YR 4/3) fine sandy loam, very weak medium subangular blocky, friable, moderate effervescence, gradual boundary.
84-168	C1	brown (10YR 4/3-5/3) fine to medium sand, single grain, loose, moderate to strong effervescence, abrupt boundary.
168-190	C2	light brownish gray to pale brown (10YR 6/2-6/3) medium to coarse sand, single grain, loose, weak effervescence, abrupt boundary.
190-206	C3	dark brown (10YR 3/3) sandy loam, massive, friable, strong effervescence, clear boundary.
206-287	C4	dark grayish brown to grayish brown (10YR 4/2-5/2) medium sand, single grain, loose, strong effervescence, clear boundary.
287-320	C5	dark gray to dark grayish brown (10YR 4/1-4/2) loam, weak fine subangular blocky, friable, strong effervescence, common fine light olive brown (2.5Y 5/4) mottles, clear boundary.
320-base (526)	C6	brown and dark grayish brown (10YR 4/3 and 4/2) stratified medium to coarse sand and gravel, strong effervescence, auger rejected.

Location: 08AB83 Ledges area; SE 1/4 NW 1/4 SW 1/4 NW 1/4 Sec. 21
T83N R26W
Landscape position: alluvial fan, distal
Elevation: approximately 875 ft.
Parent material: alluvium
Slope: 2-5%
Vegetation: weeds
Date described: 11/7/84
Described by: E. A. Bettis III
Remarks:

Depth (cm)	Soil Horizon (weathering zone)	Description
0-17	A1	black (10YR 2/1) loam, moderate medium to fine granular, friable, noneffervescent, gradual boundary, abundant roots.
17-33	A2	black (10YR 2/1) loam, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, gradual boundary, abundant roots.
33-48	A3	very dark brown to very dark grayish brown (10YR 2/2-3/2) loam, moderate medium subangular blocky breaking to moderate medium granular, friable, noneffervescent, clear boundary, abundant roots.
48-59	AB	very dark grayish brown (10YR 3/2) loam, moderate medium to fine subangular blocky, friable, noneffervescent, gradual boundary, common roots.
59-75	Bt1	brown (10YR 4/3) loam, moderate medium to fine columnar, friable, noneffervescent, gradual boundary, common roots, common thin discontinuous very dark grayish brown (10YR 3/2) cutans.
75-129	Bt2	brown (10YR 4/3) loam, moderate coarse columnar, friable, noneffervescent, gradual boundary, few roots, few thin discontinuous very dark grayish brown (10YR 3/2) cutans.
129-167	BC1	brown (10YR 4/3) loam, moderate medium to coarse subangular blocky, friable, weak effervescence, clear boundary, few fine iron concretions, few roots.
167-178	BC2	yellowish brown (10YR 5/4) sandy loam, weak coarse subangular blocky, friable, weak to moderate effervescence, abrupt boundary, few fine carbonate concretions.

Location: 08AB83 Ledges area
CONTINUED

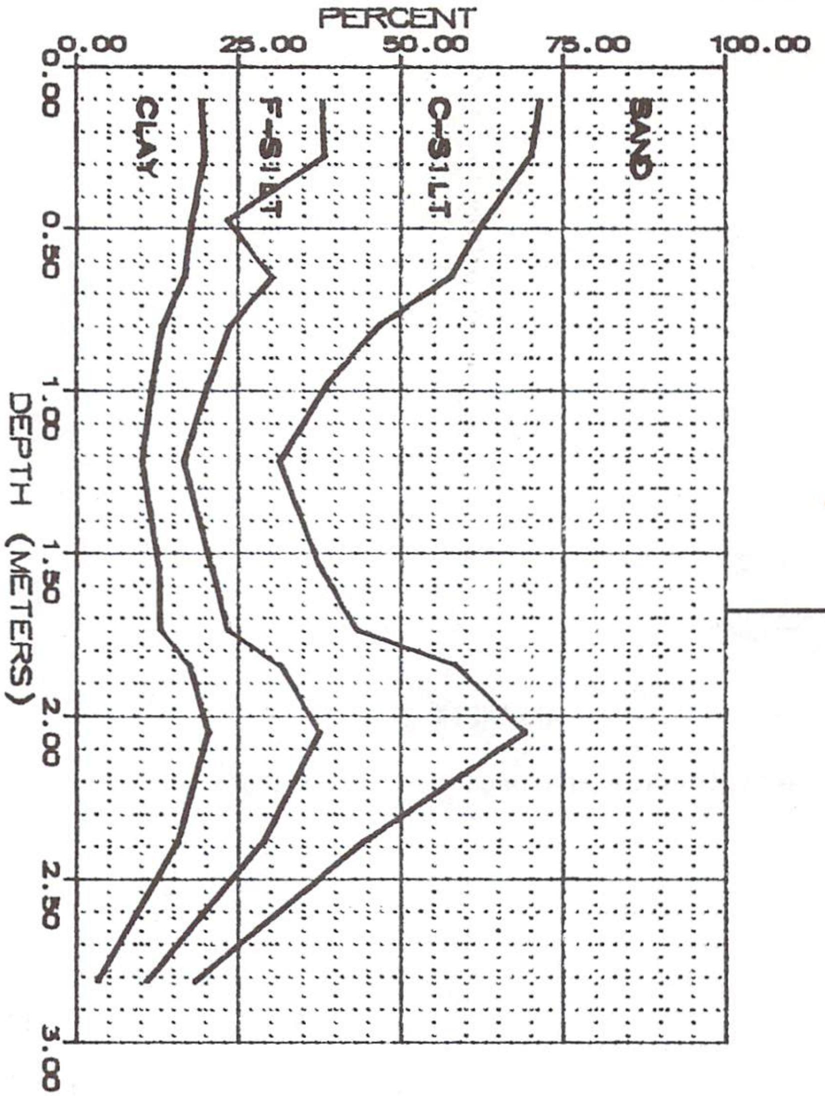
Depth (cm)	Soil Horizon (weathering zone)	Description
178-201	2Ab	dark grayish brown (10YR 4/2) loam, moderate medium subangular blocky, friable, moderate effervescence, gradual boundary, common charcoal flecks, occasional gastropod shells.
201-226	2Bwb	yellowish brown (10YR 5/4) loam with occasional fine pebbles, moderate medium to coarse subangular blocky, friable, weak effervescence, clear boundary, few fine oxides.
226-239	2C1	yellowish brown (10YR 5/4) sandy loam, massive, friable, noneffervescent, abrupt boundary, oxides as above.
239-259	2C2	yellowish brown (10YR 5/4) loam with common fine pebbles, weak medium subangular blocky, friable, weak effervescence, gradual boundary, common fine dark yellowish brown (10YR 4/6) mottles, common fine oxides, few fine iron concretions.
259-292	2C3	brown (10YR 5/3) loam, massive, friable, moderate effervescence, abrupt boundary, common fine oxides, few fine iron concretions, common fine soft carbonate concretions.
292-345	2C4	yellowish brown to light brownish gray (10YR 5/4-6/2) medium to coarse sand with stone line at base of horizon, single grain, loose, weak effervescence, abrupt boundary.
345-369	3Ab	dark grayish brown (10YR 4/2) loam, weak fine subangular blocky, friable, moderate effervescence, gradual boundary.
369-base (450)	3C	brown and light brownish gray (10YR 4/3 and 6/2) stratified silt loam and medium to coarse sand, massive and single grain, friable and loose, moderate and weak effervescence, abundant medium brown (7.5YR 4/4) mottles, auger rejected on coarse gravel.

APPENDIX B

Particle-size and Organic Carbon Profiles

08AB1 TH

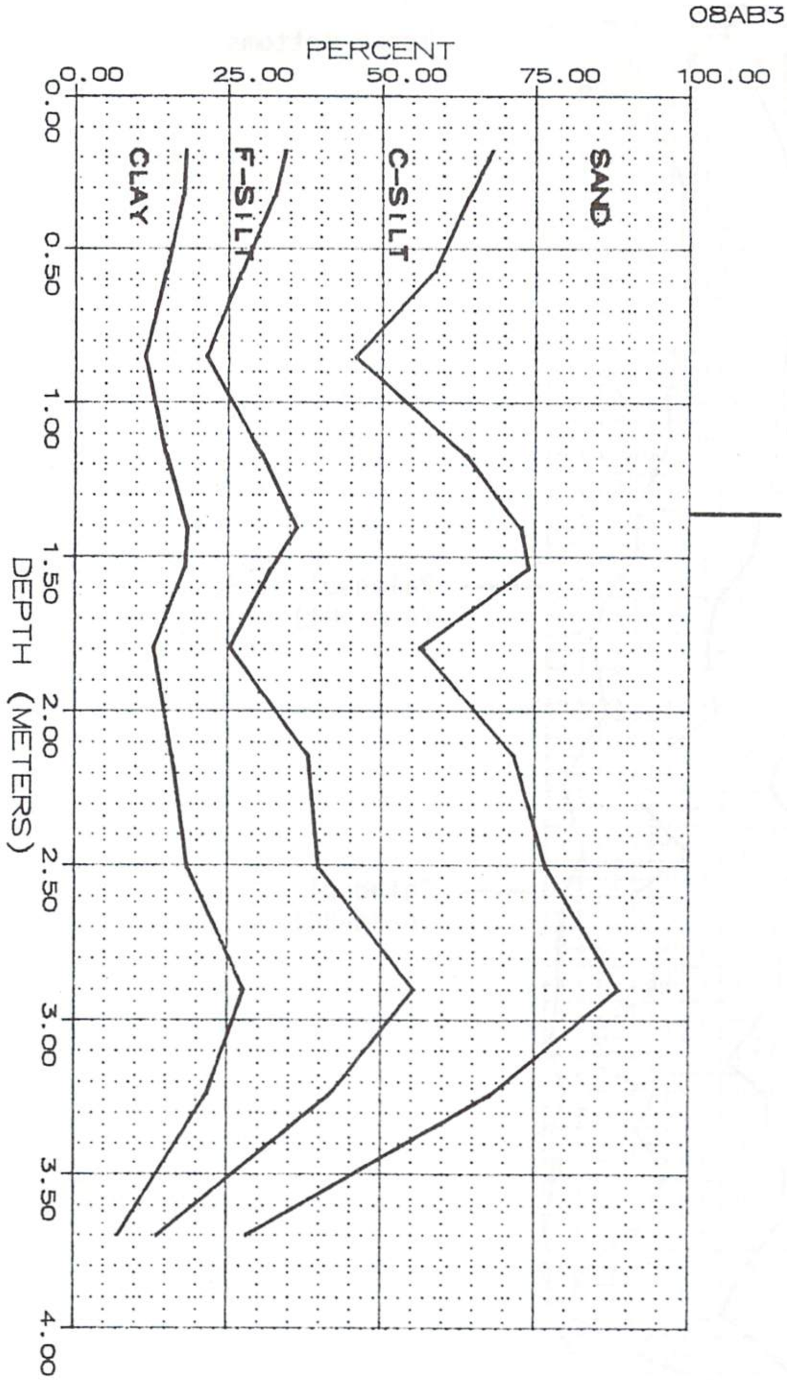
Boone Bottoms



Paleosol
(A-Bt-BC)

TI

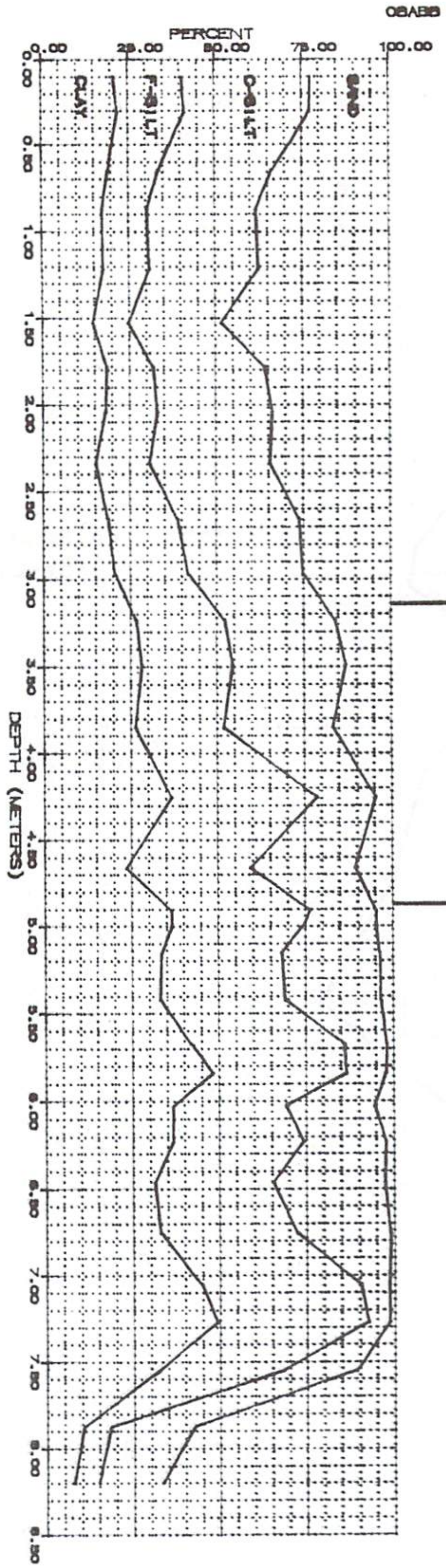
Boone Bottoms



Paleosol
(A-Bw-C)

TH

Boone Bottoms

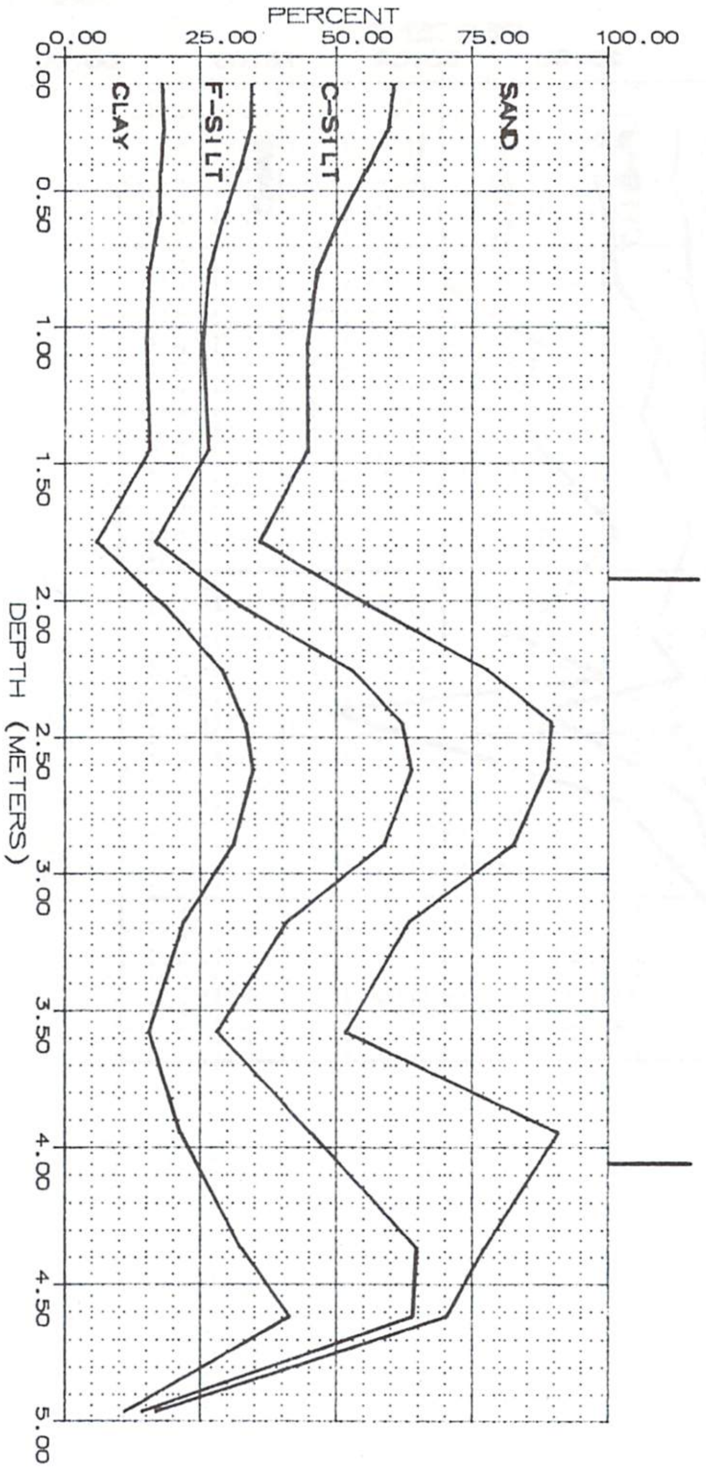


Paleosol
(A-BE-Bt)

Paleosol
(A-Bt-BC)

08AB10 TH

Boone Bottoms

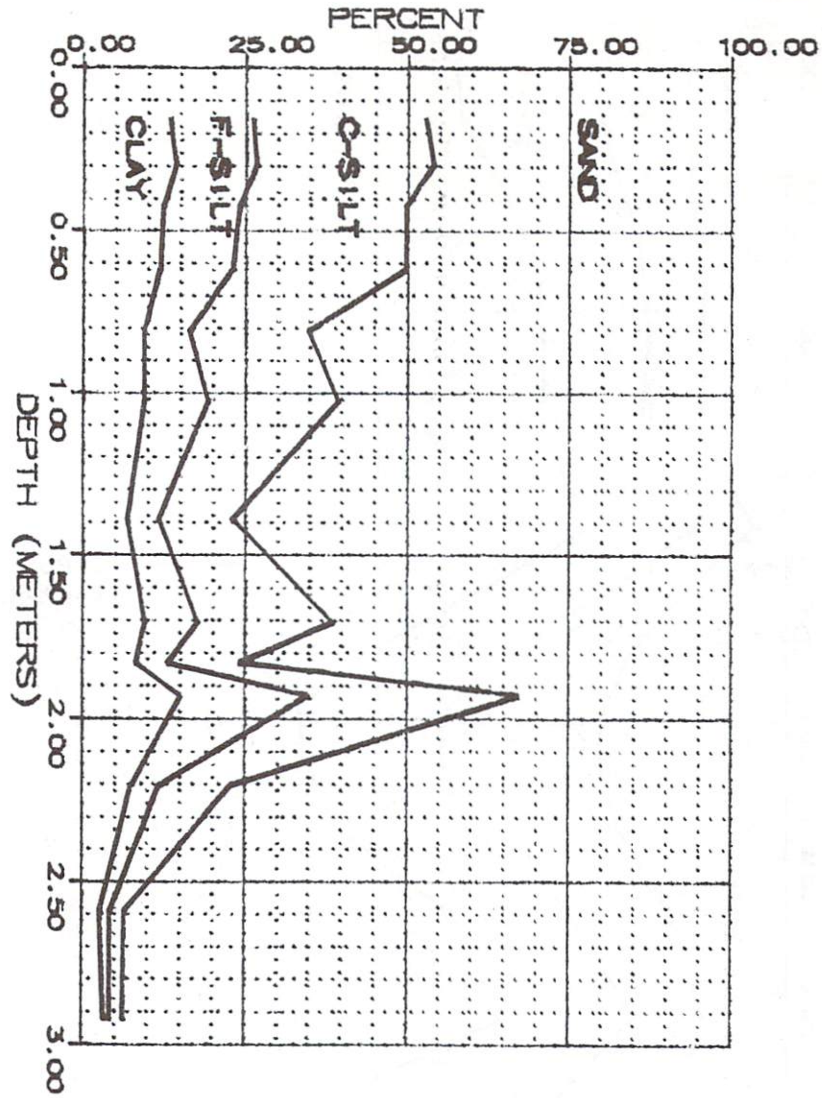


Paleosol
(A-Bt-BC)

Paleosol
(A-Bw-C)

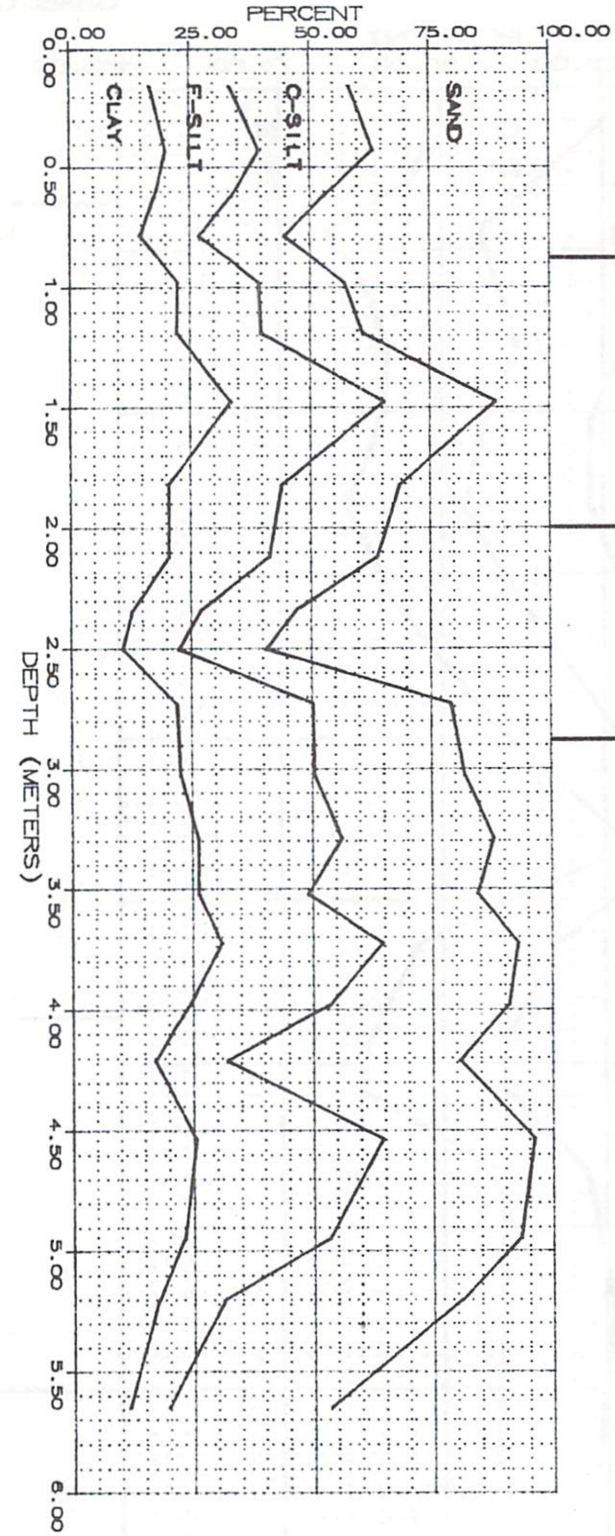
08AB13 TI

Boone Bottoms



08AB17 TH

Boone Bottoms



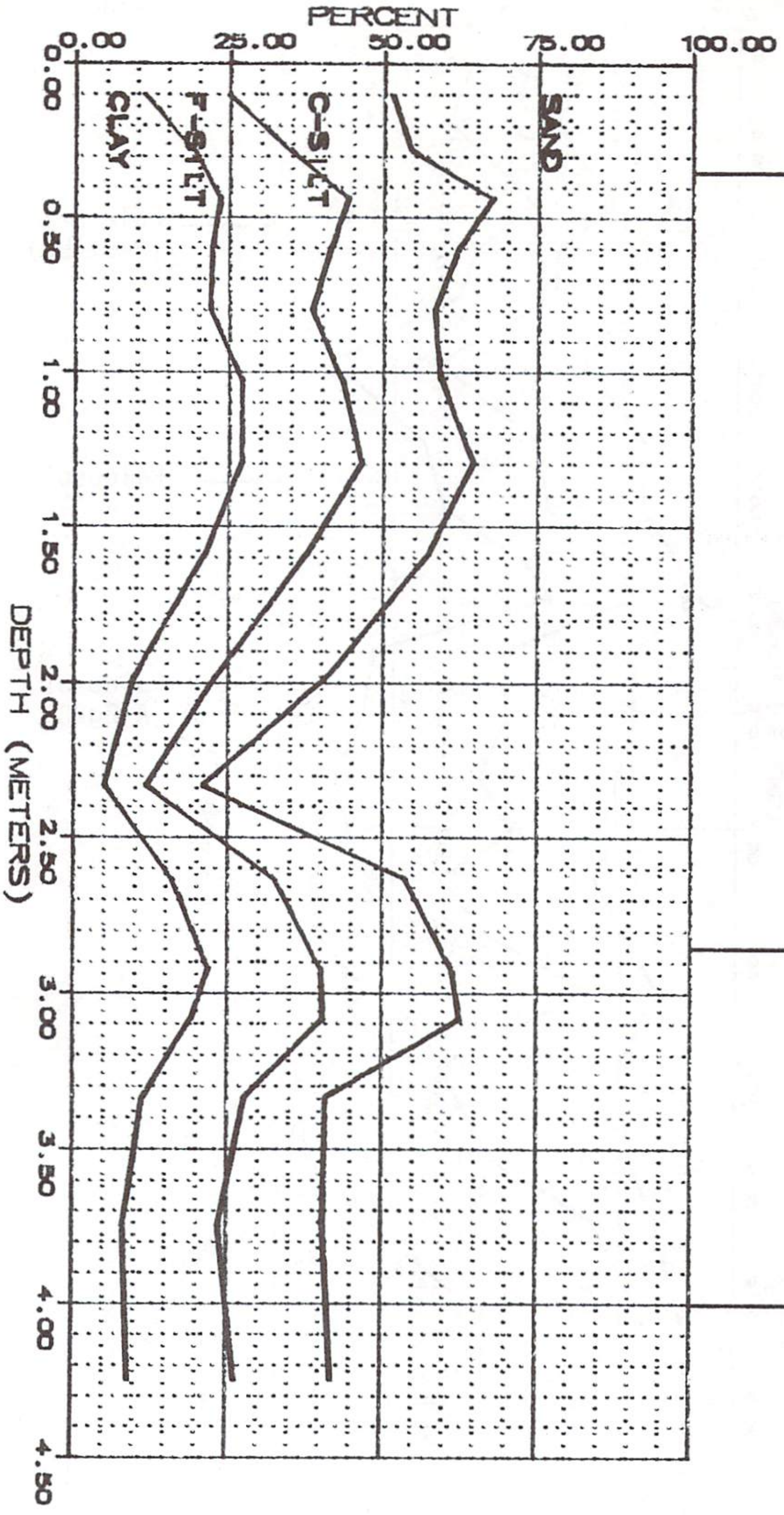
Paleosol (A-Bt-BC)

Paleosol (A-C)

Paleosol (A-Bg-C)

08AB20 ALLUVIAL FAN

Boone Bottoms



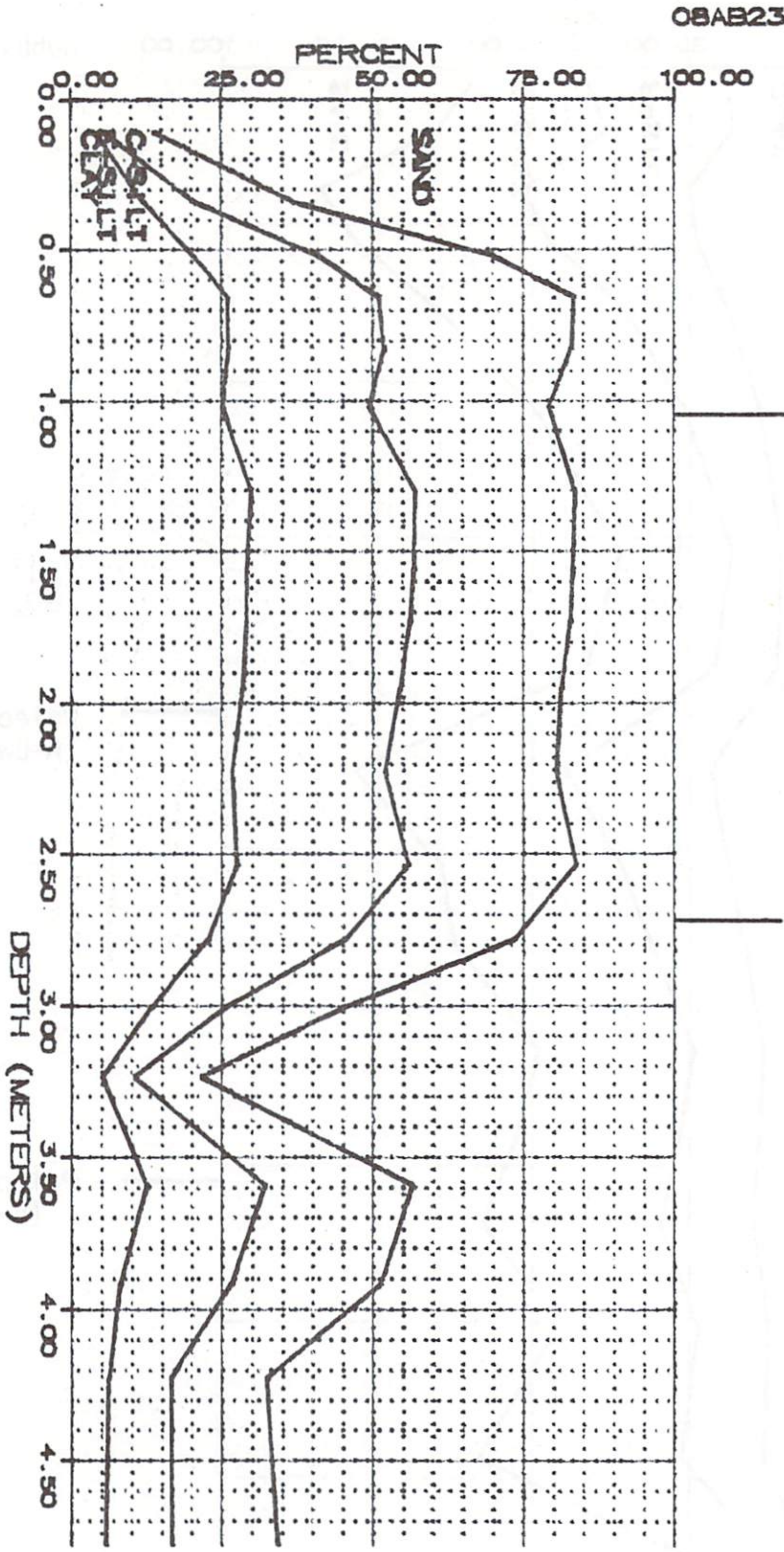
Paleosol
(A-EB-Bt-Bth-BC)

Paleosol
(A-C)

PRE-ILLINOIAN TILL

COLLUVIAL SLOPE

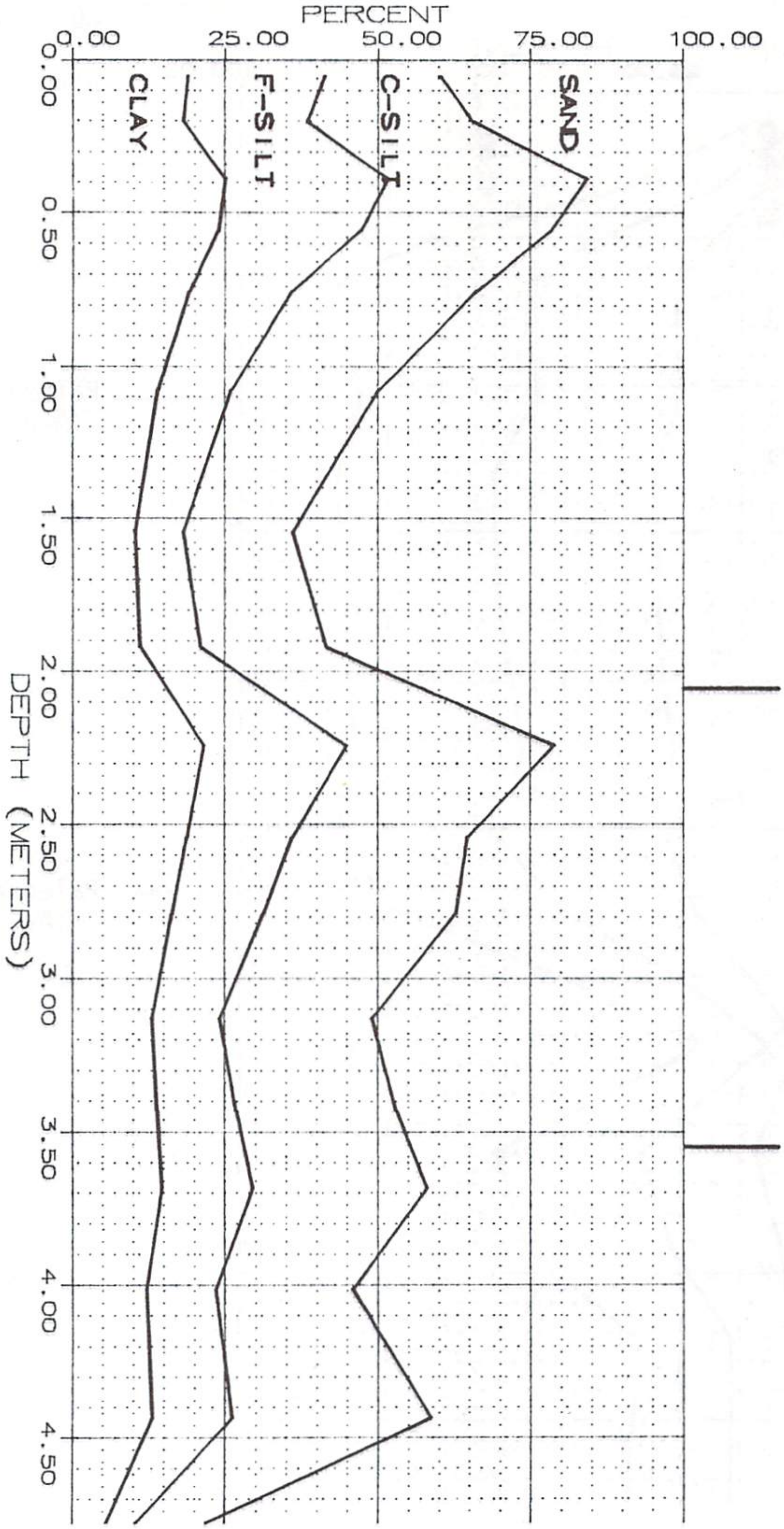
Boone Bottoms



Paleosol
(A-Bw)

Paleosol
(A-C)

Hubby Bridge

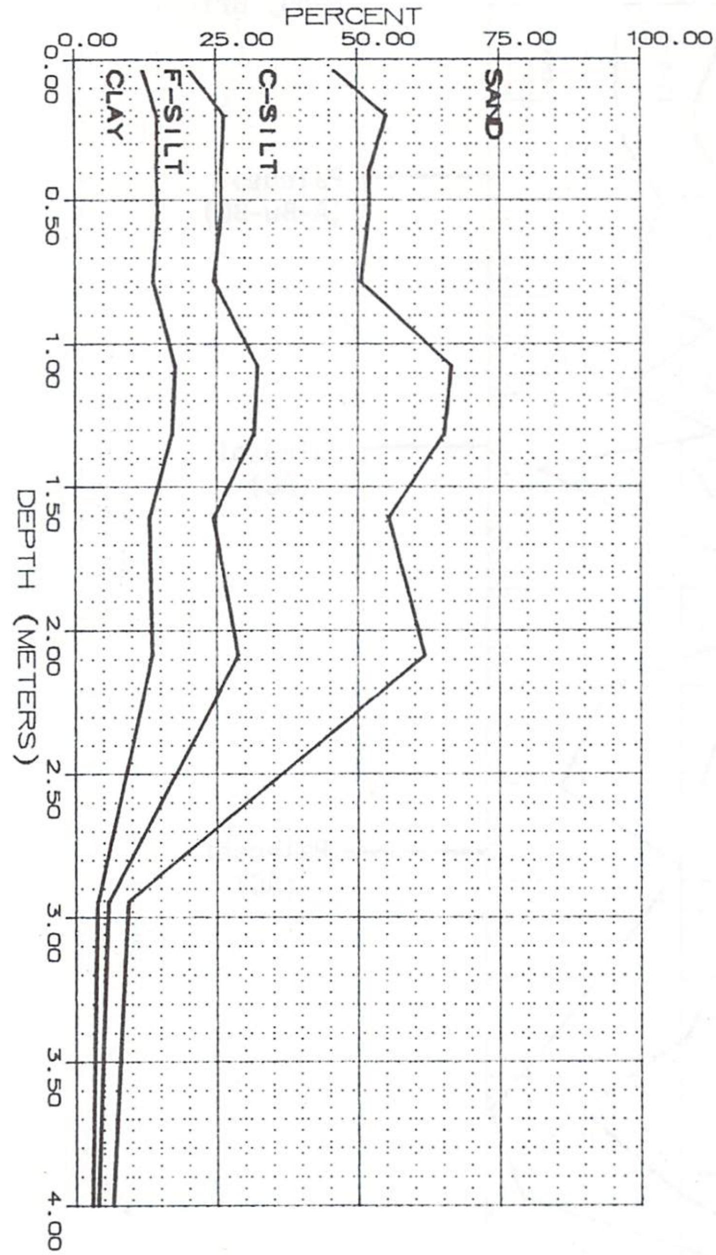


Paleosol
(A-Bw-C)

Paleosol
(A-C)

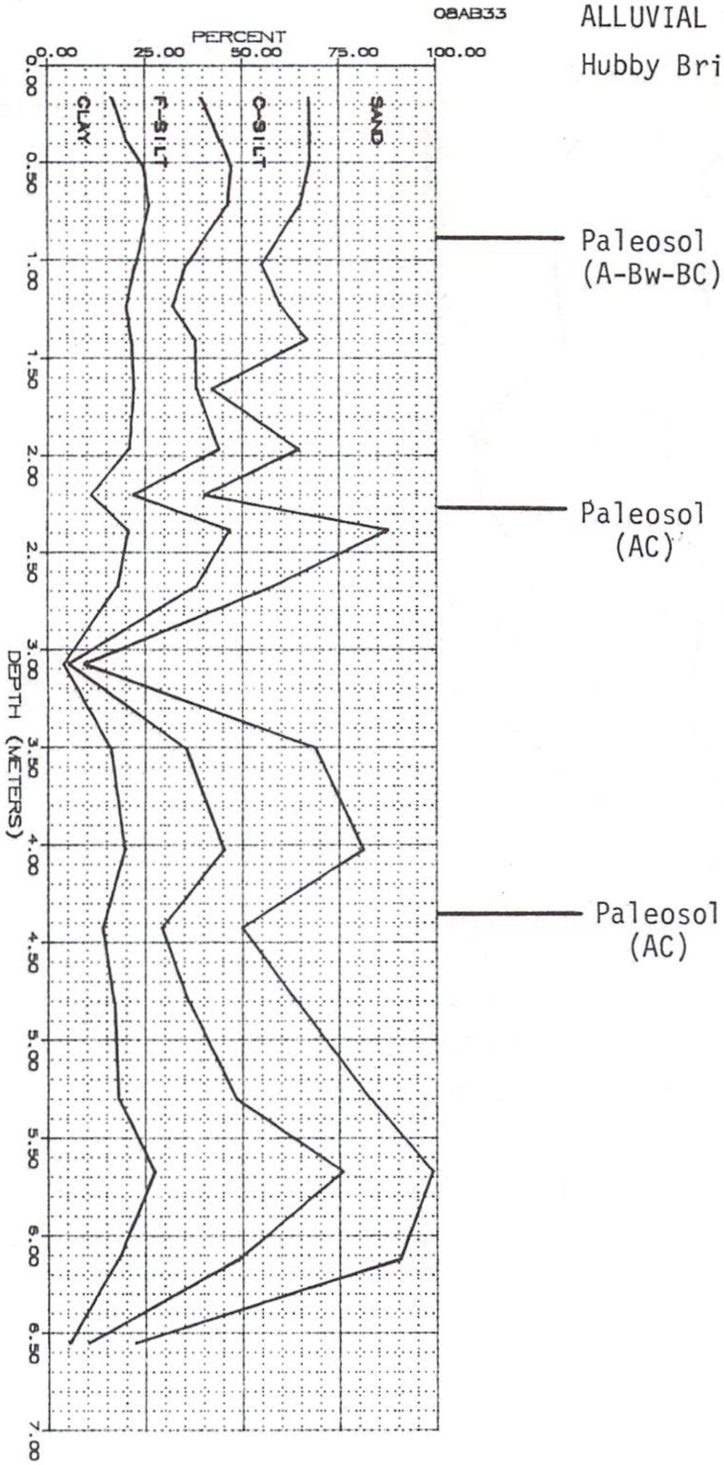
08AB29 TH

Hubby Bridge



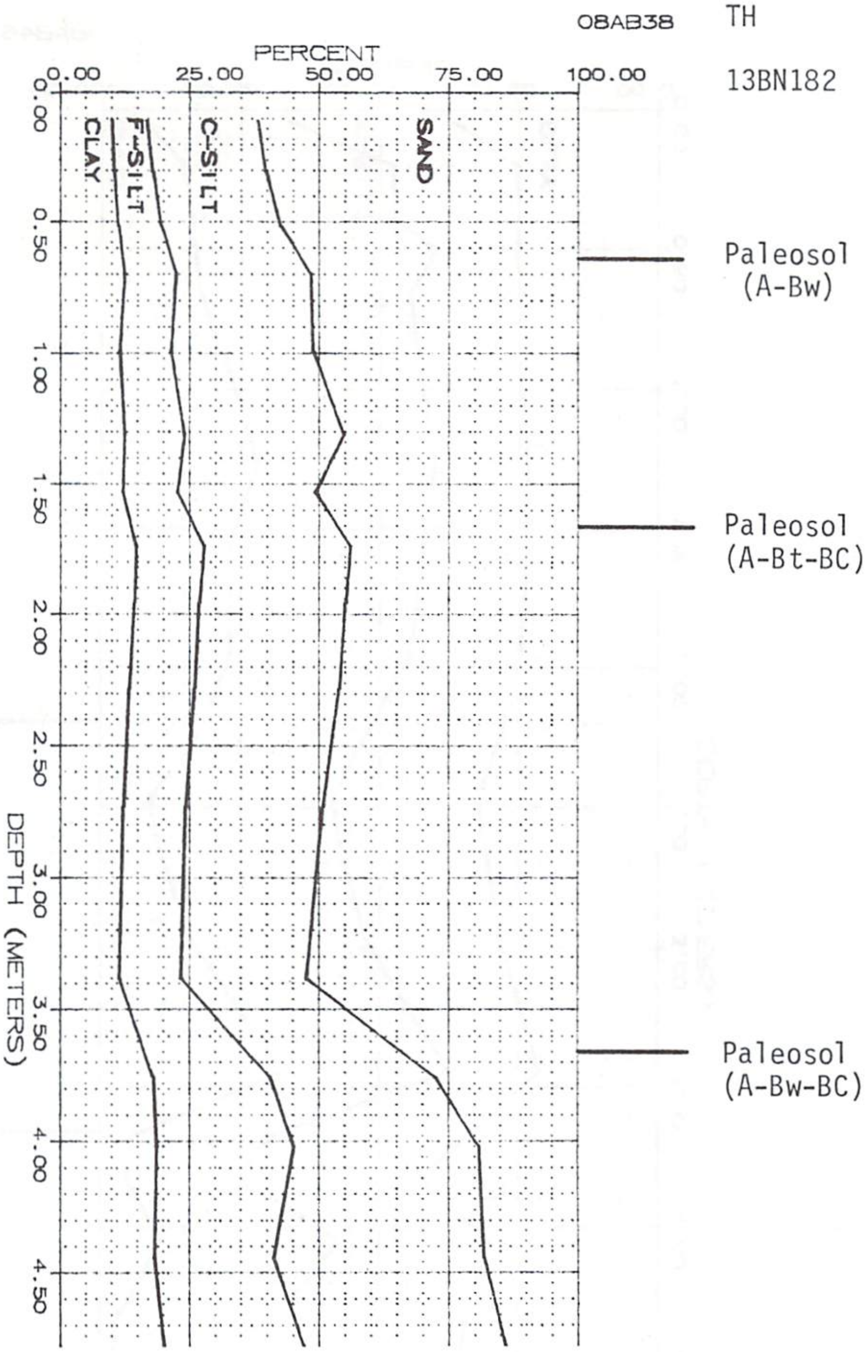
ALLUVIAL FAN

Hubby Bridge



TH

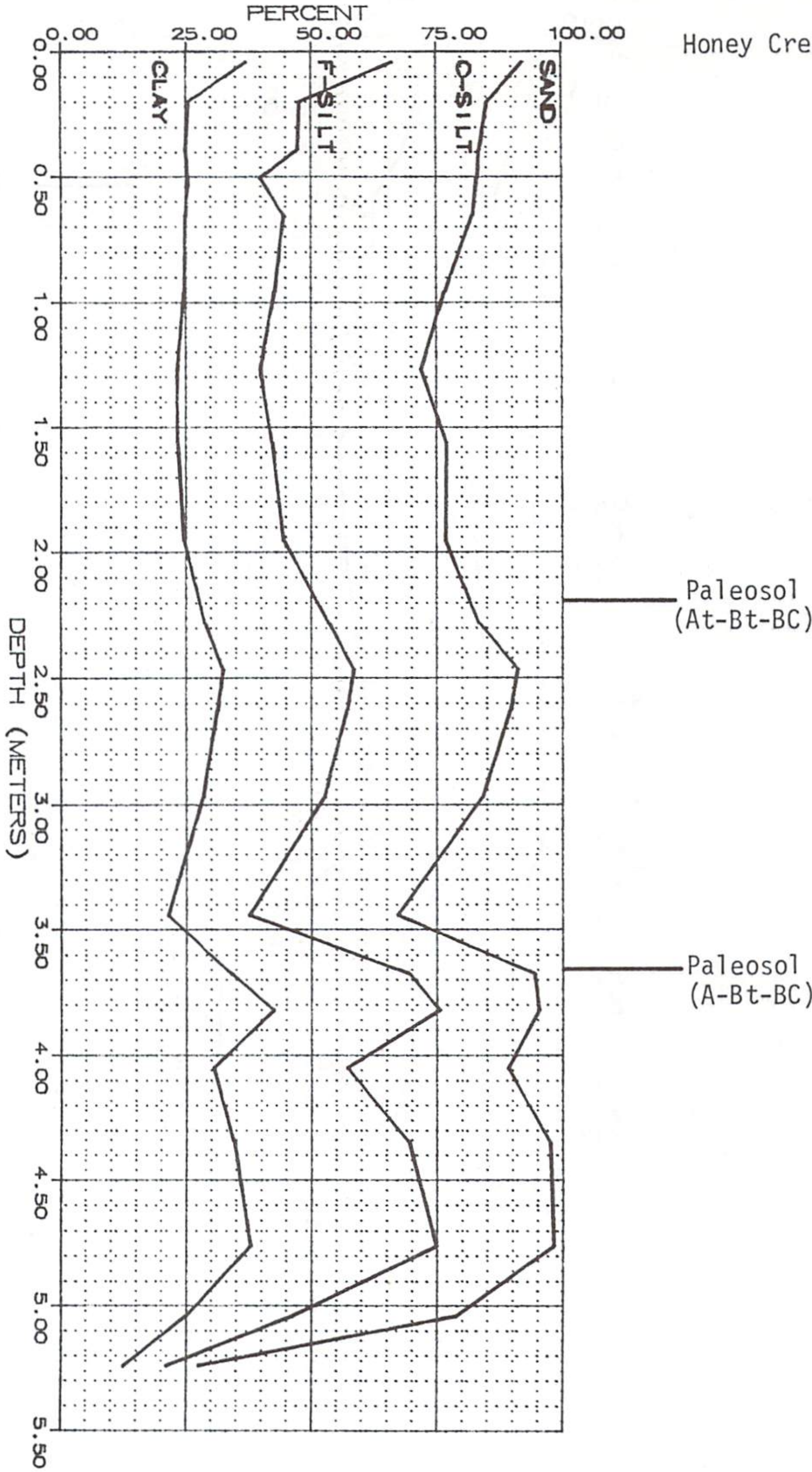
13BN182



08AB38
PERCENT
0.00
25.00
50.00
75.00
100.00
CLAY
F-SILT
C-SILT
SAND
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50
DEPTH (METERS)
Paleosol
(A-Bw)
Paleosol
(A-Bt-BC)
Paleosol
(A-Bw-BC)

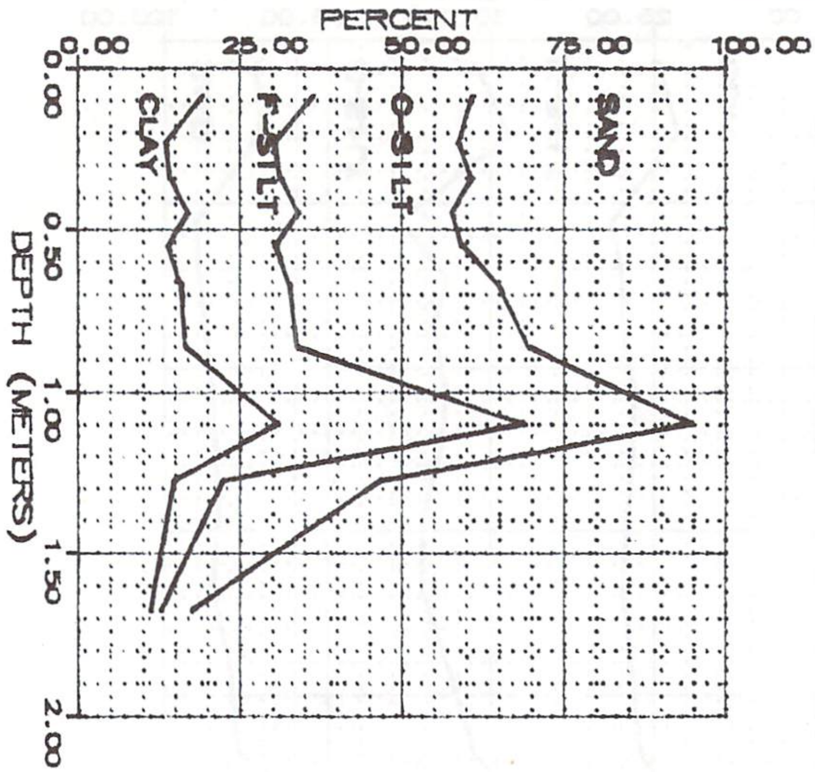
08AB46 ALLUVIAL FAN

Honey Creek



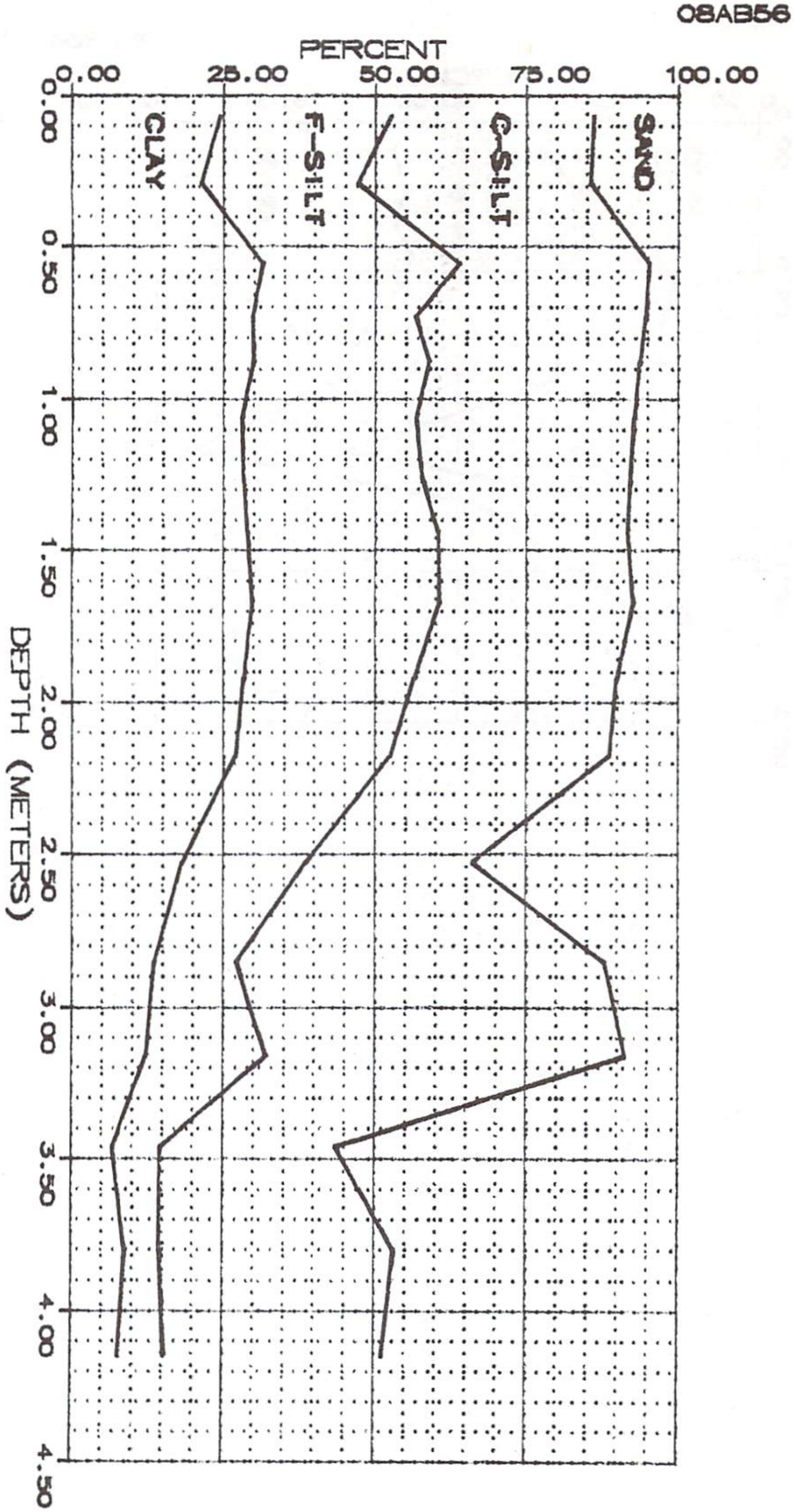
08AB54 LWT

13DA56



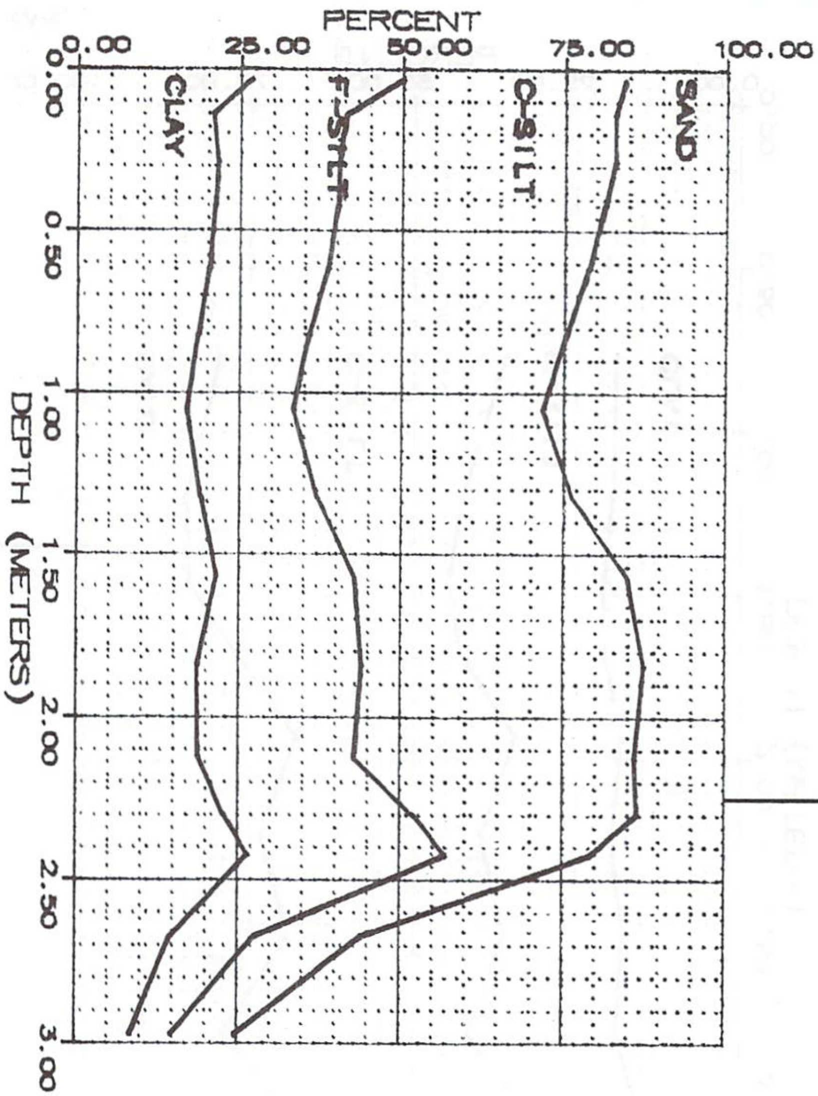
TH

13DA156


08AB56
PERCENT
0.00
25.00
50.00
75.00
100.00
CLAY
F-SILT
C-SILT
SAND
DEPTH (METERS)
0.00
0.50
1.00
1.50
2.00
2.50
3.00
3.50
4.00
4.50

08AB57 TH

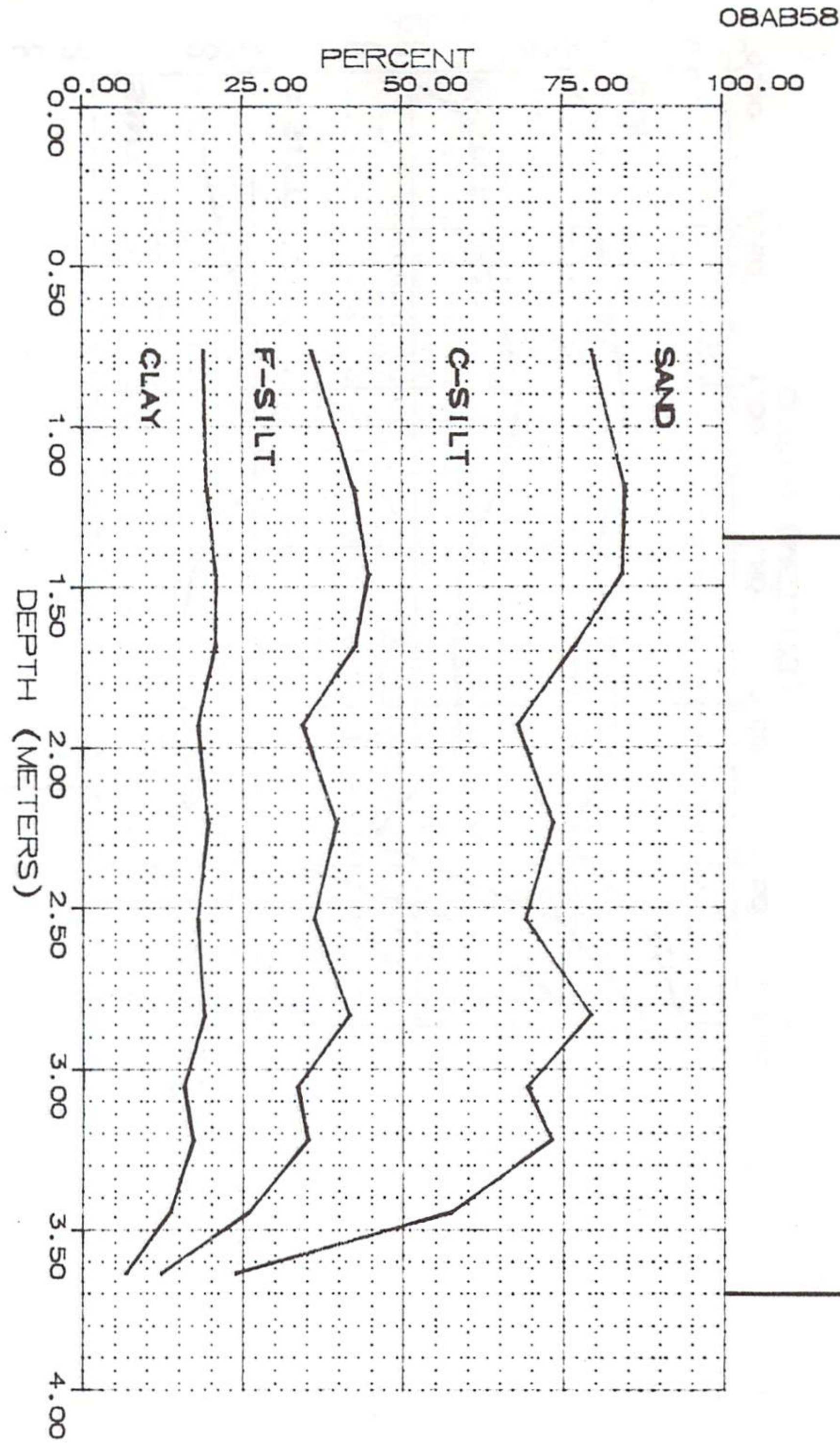
13DA156



Paleosol
(AC)

TI

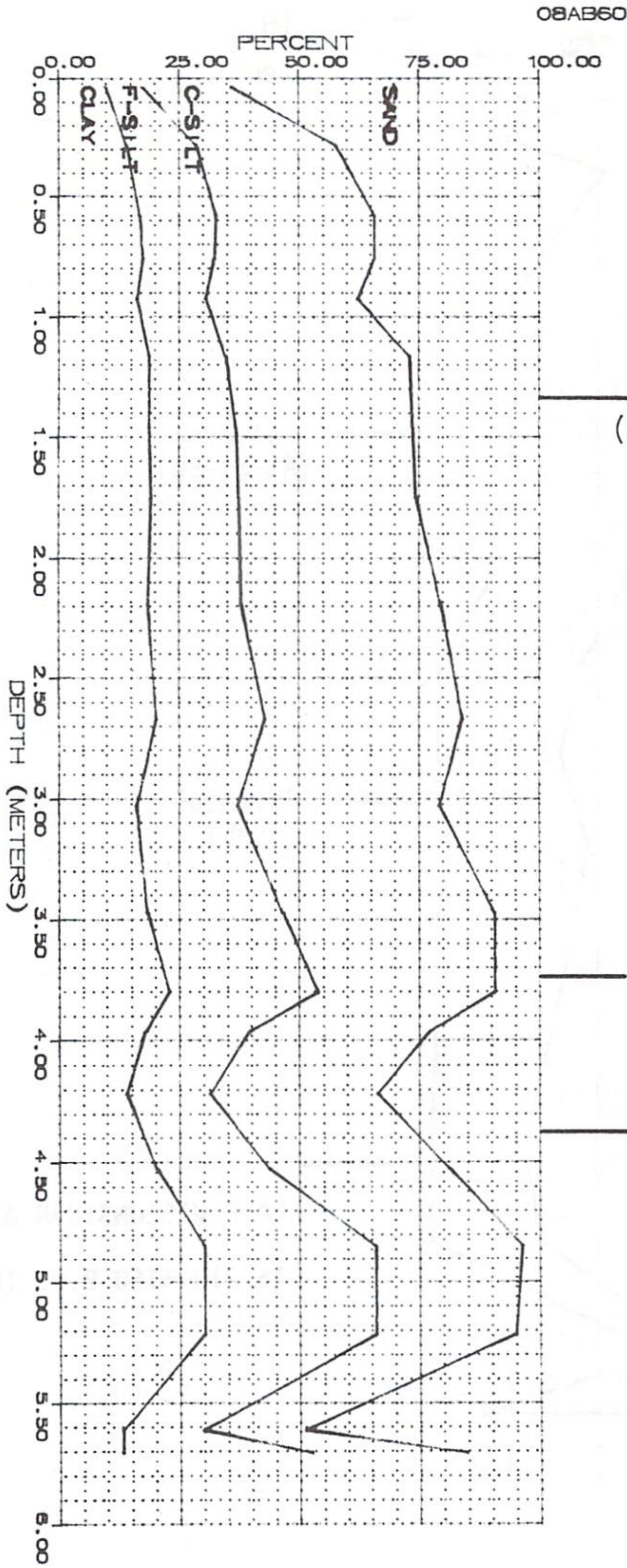
13DA156



Paleosol
(A-AC-C)

Pennsylvanian
siltstone

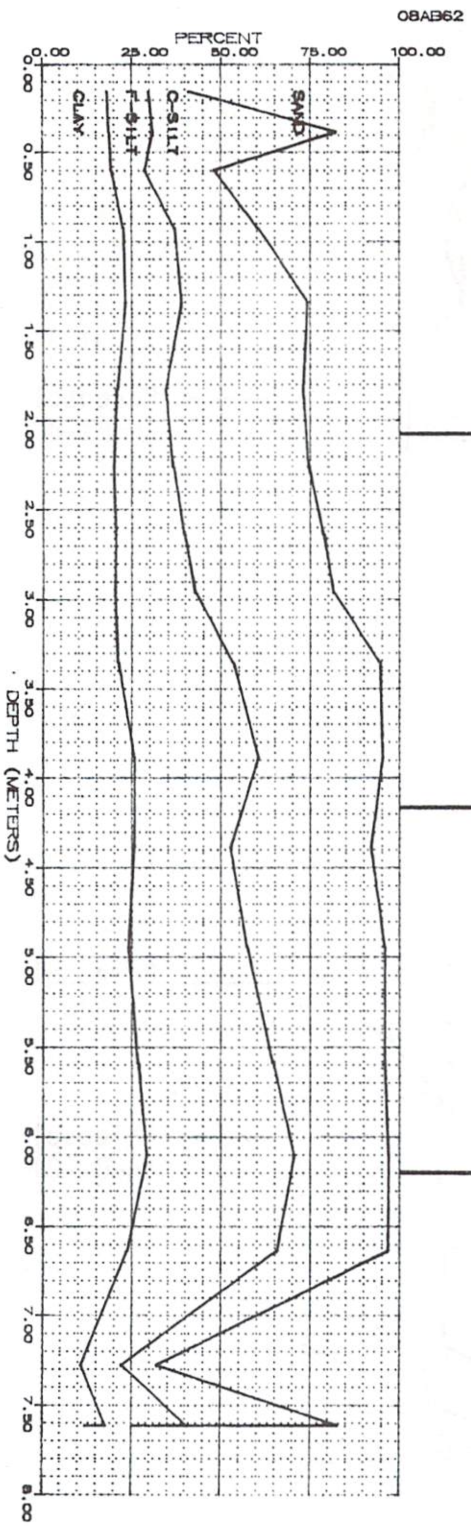
TH
Xenia



Paleosol
(A-BE-Bt-BC)

Paleosol
(A-Bw)

Paleosol
(A-Bw-C)



TH

Xenia

Paleosol
(At-Bt-BC)

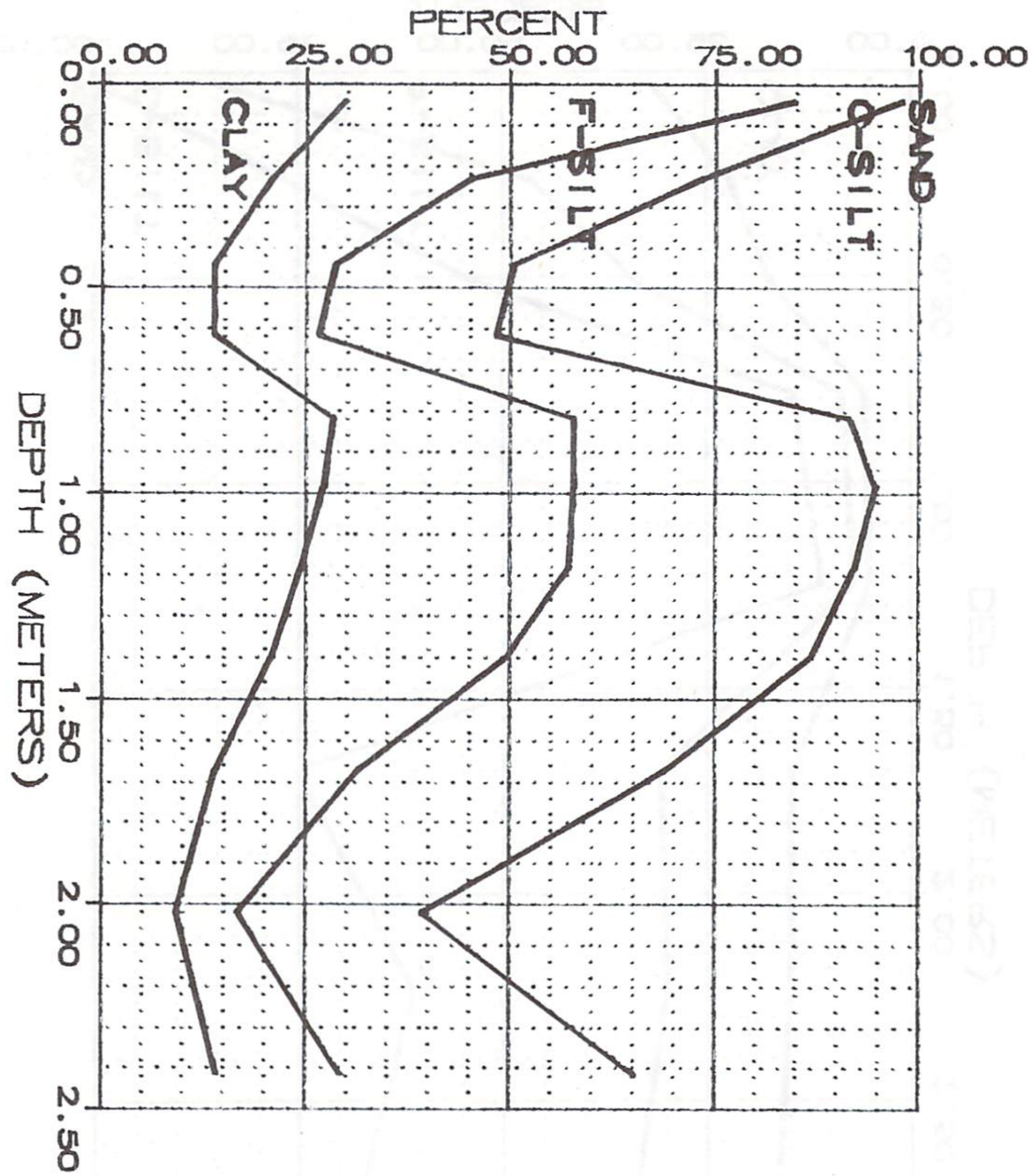
Paleosol
(AC)

LATE WISCONSINAN ALLUVIUM

15,210 ±150 B.P. (Beta-11166)

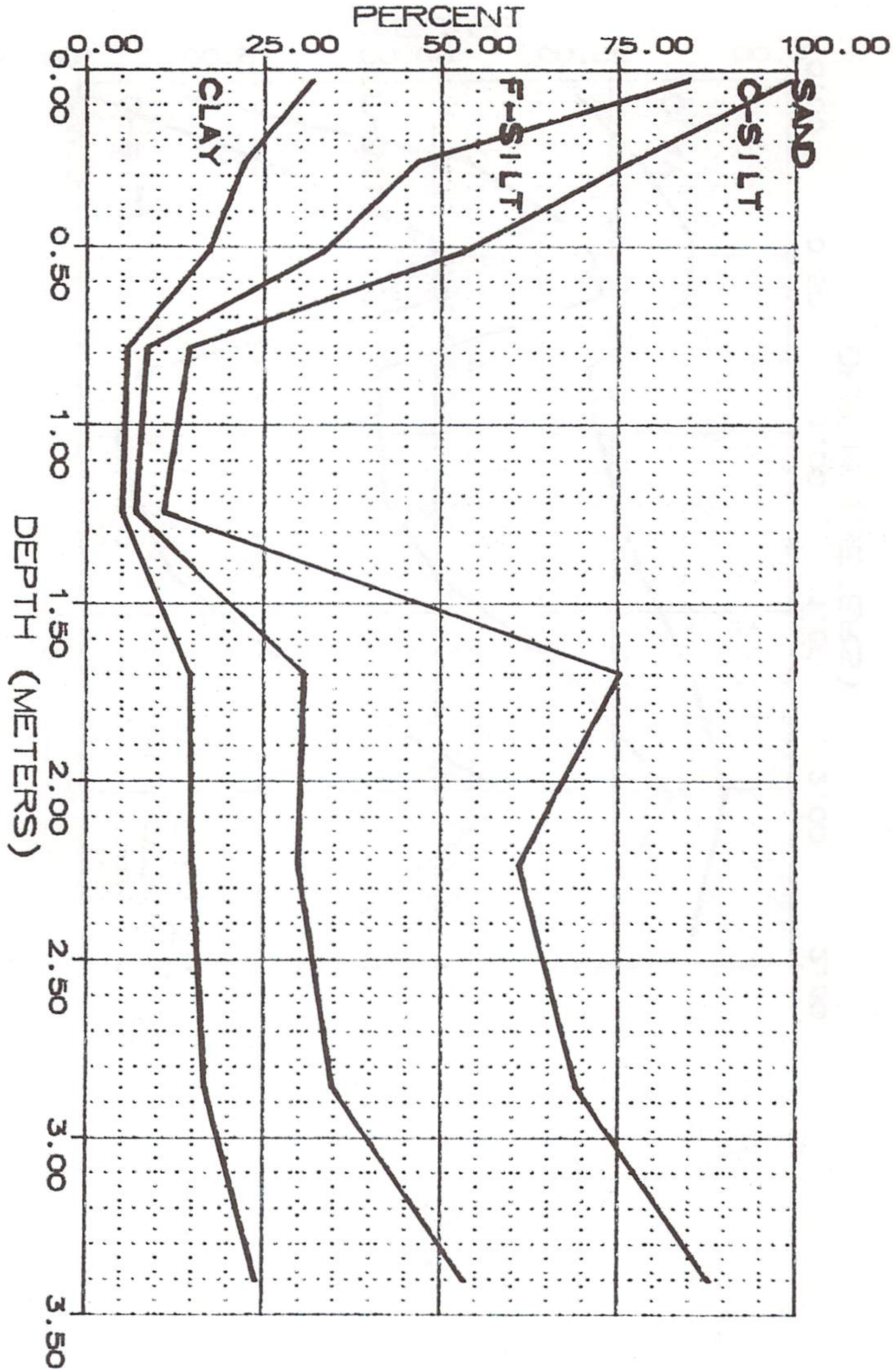
08AB69 TI

Honey Creek



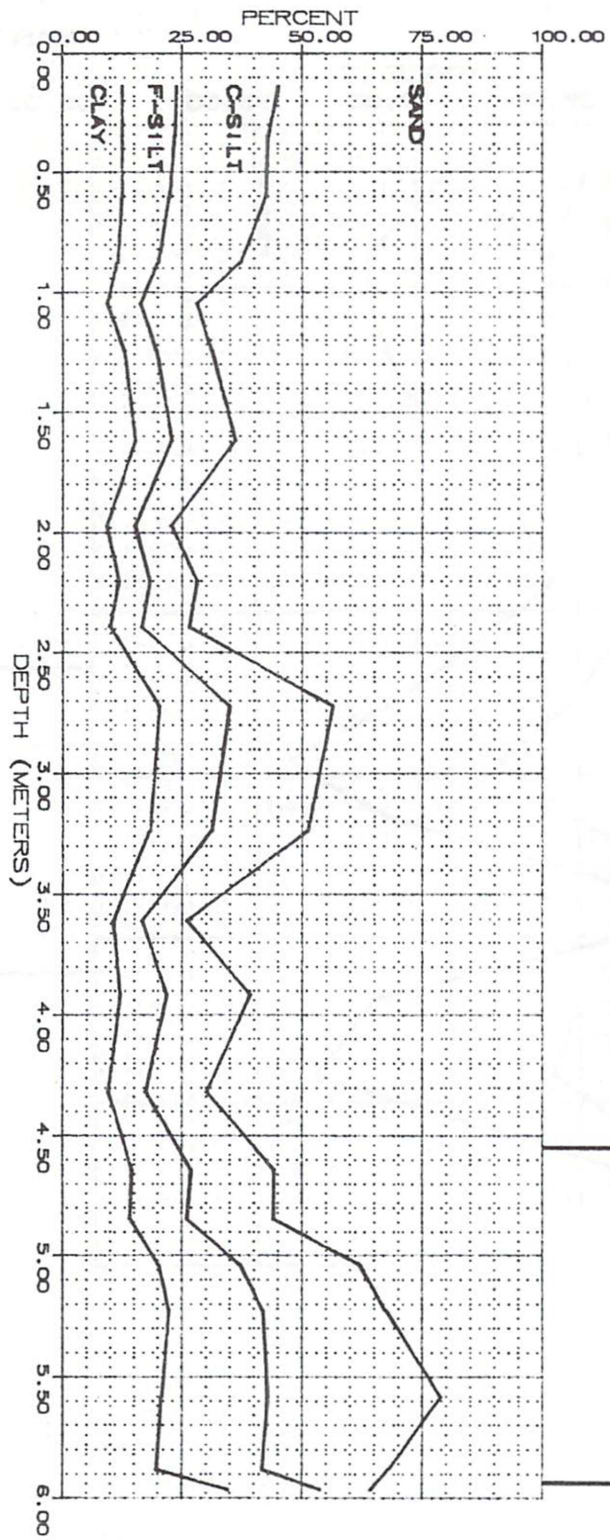
08AB72 TL

Honey Creek



08AB77 TH

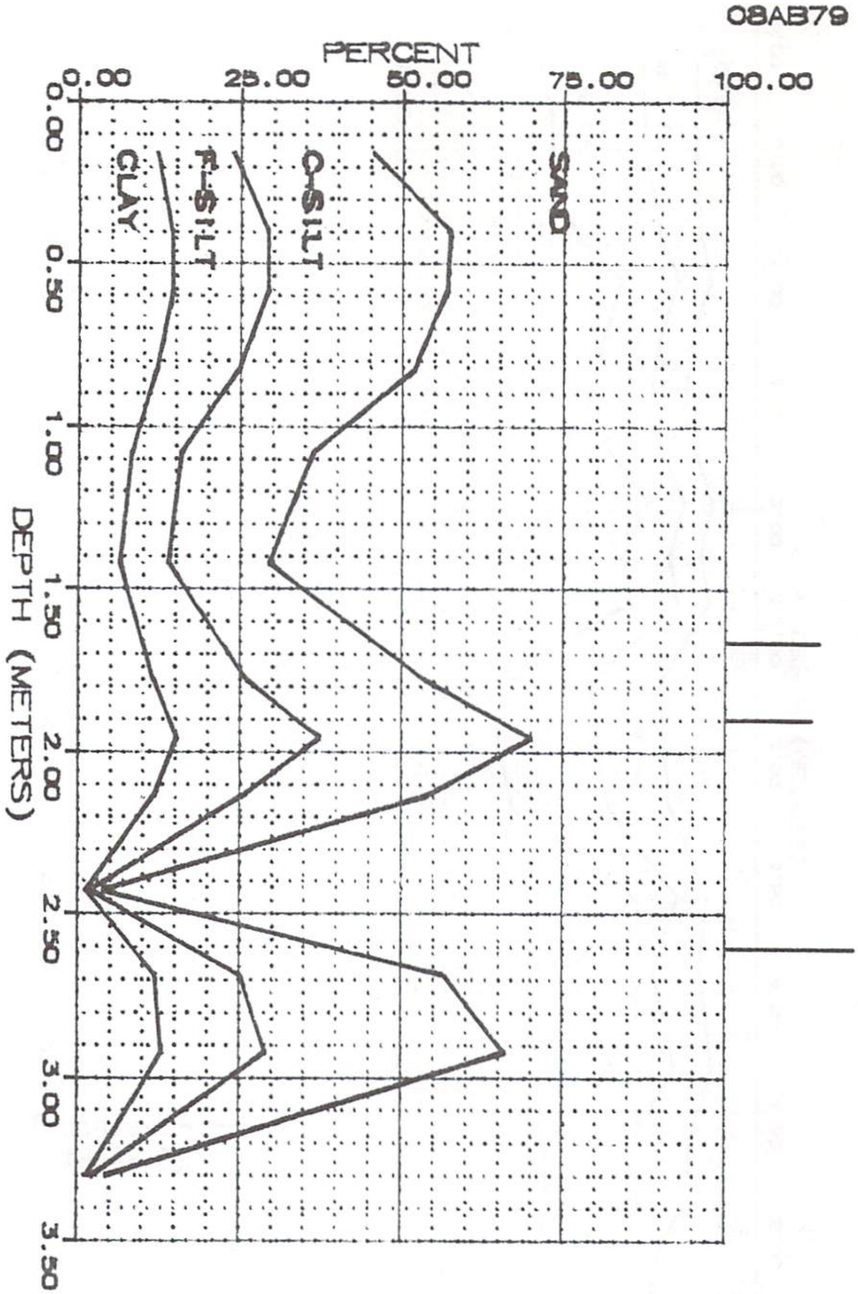
Fraser



Paleosol
(A-BA-Bt-BC)

PENNSYLVANIAN SHALE

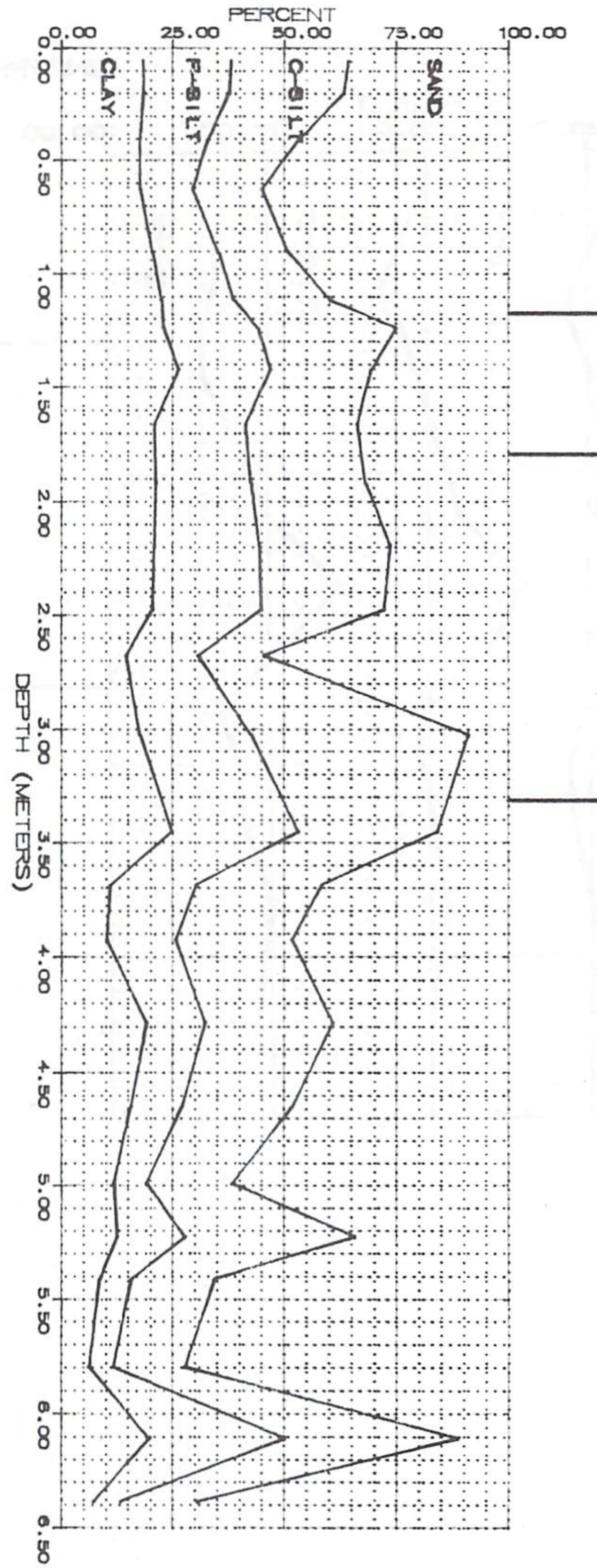
TI
Fraser



Paleosol
(AC)

Paleosol
(A-AC)

Paleosol
(AC)



ALLUVIAL FAN

Boone Bottoms

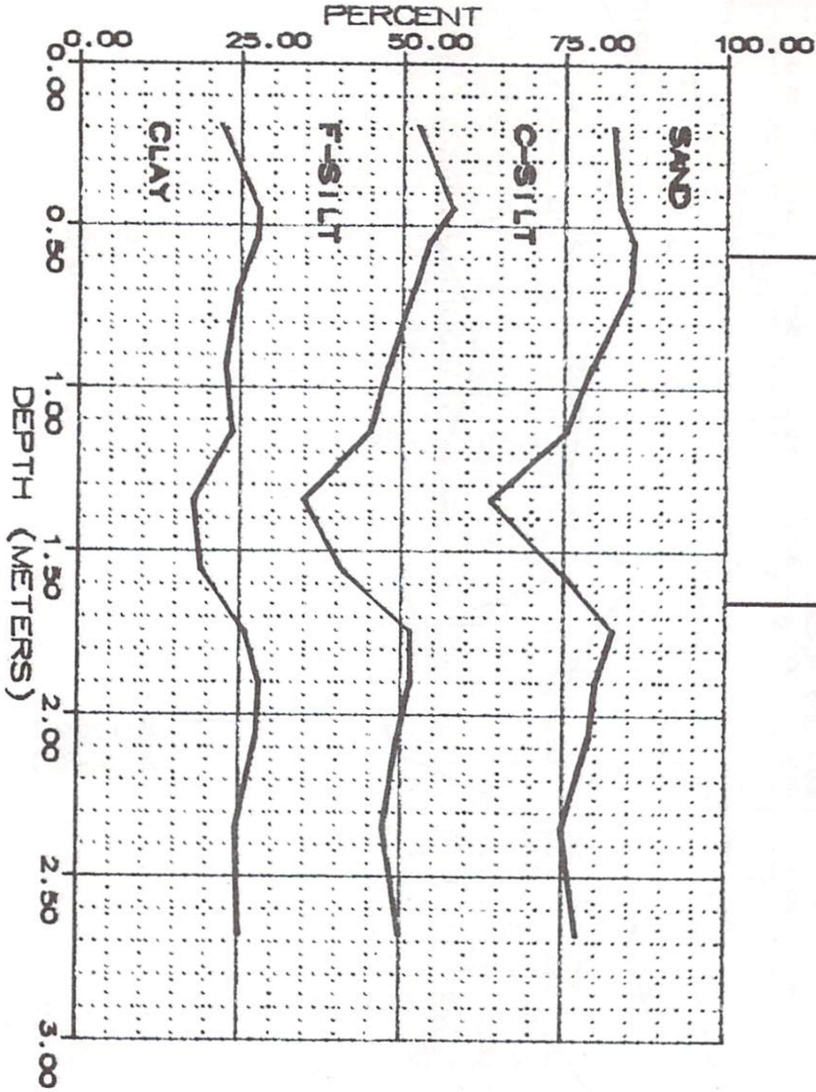
Paleosol
(Bt-BC)

Paleosol
(AB-Bw-C)

Paleosol
(A-Bw-BC)

BN27PR01 TH

Boone Bottoms

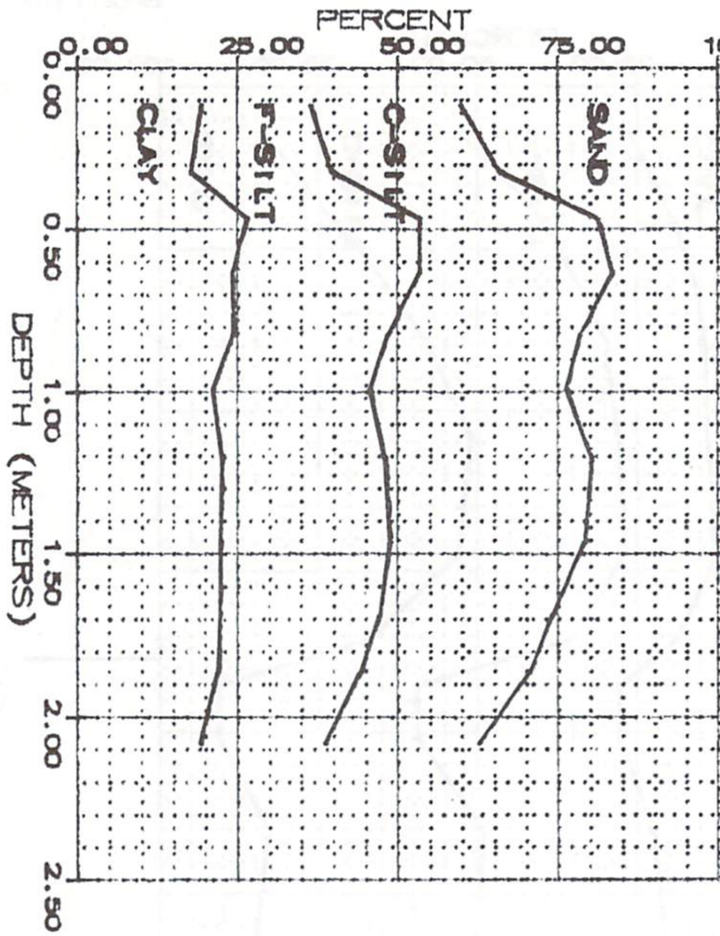


Paleosol
(A-AB-BA-Bt)

Paleosol
(BAt-Bt-BC)

BN27PR02 TH

Boone Bottoms

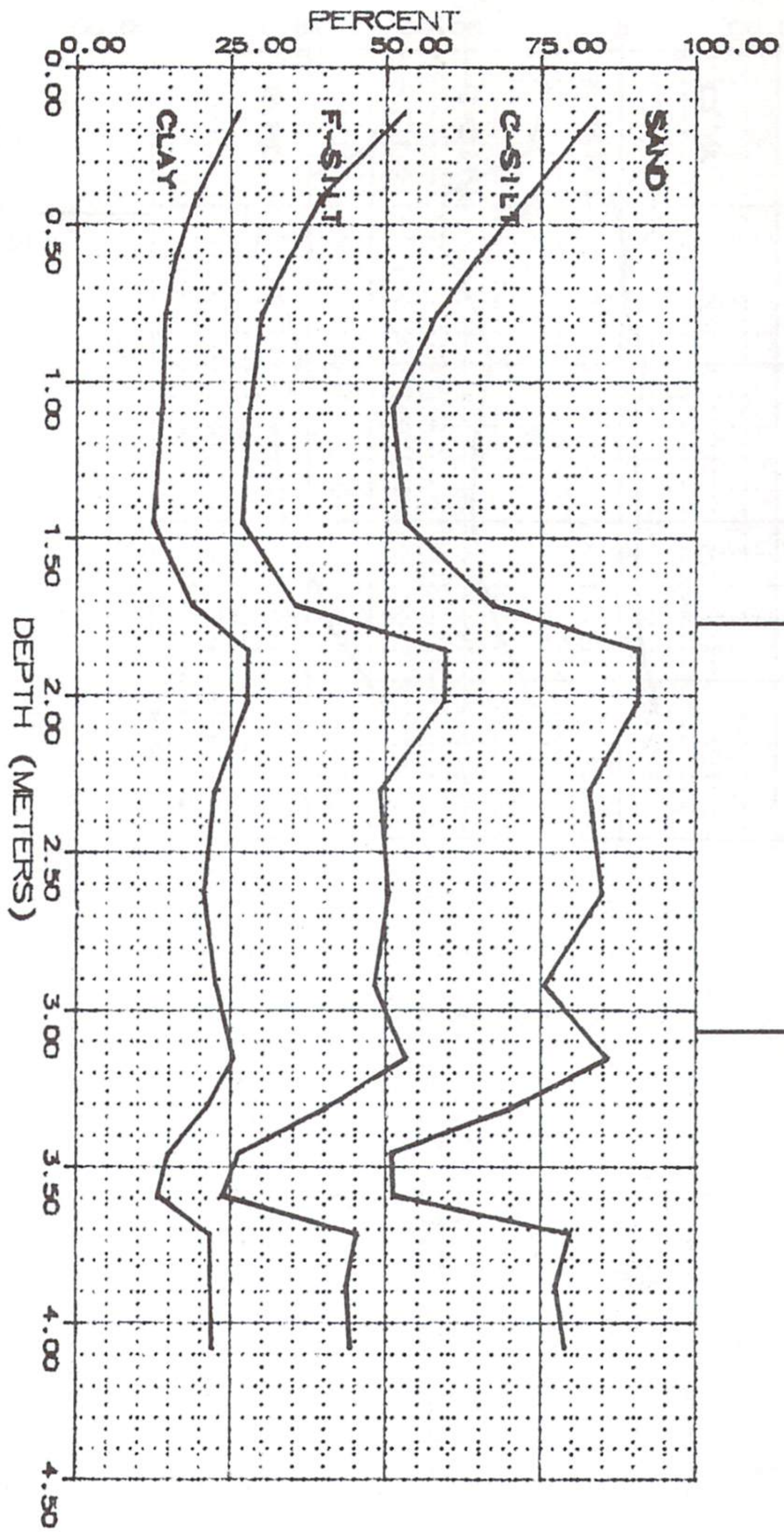


COLLUVIUM

Paleosol
(AB-BA-Bt-BC)

BN27PR03 TH

Boone Bottoms

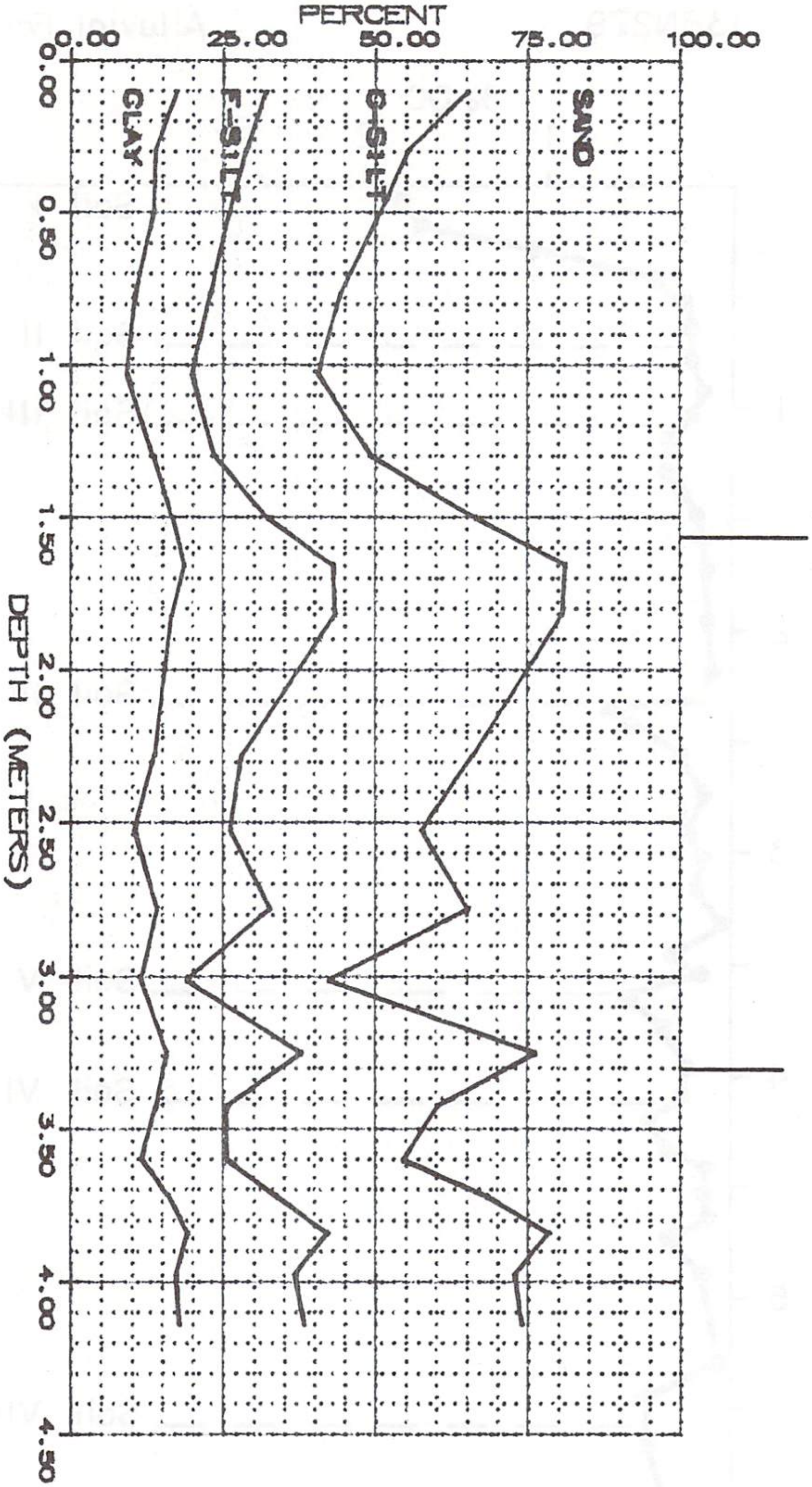


Paleosol
(At-Bt-BC)

Paleosol
(ABt-BC)

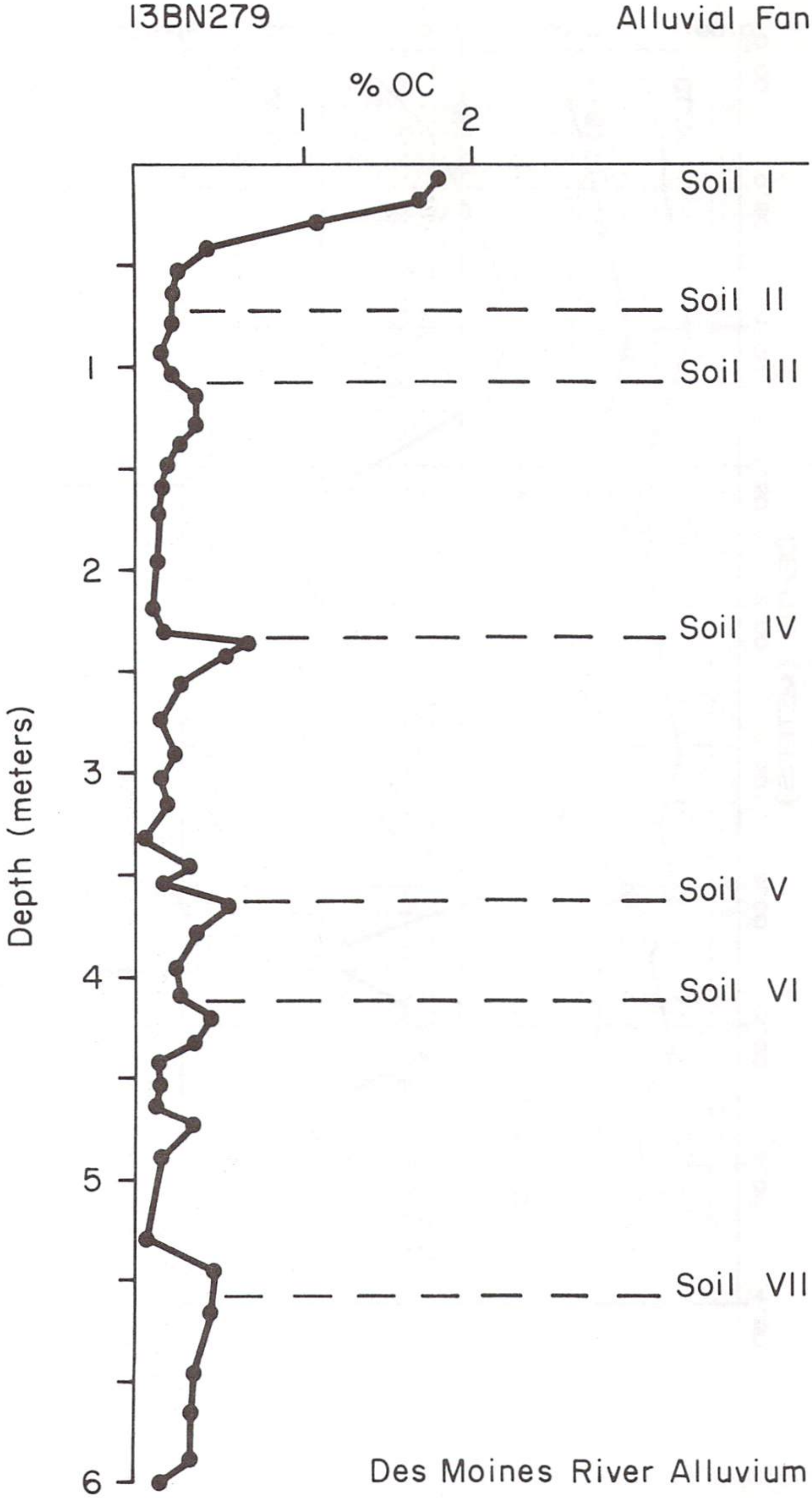
BN27PR04 TH

Boone Bottoms

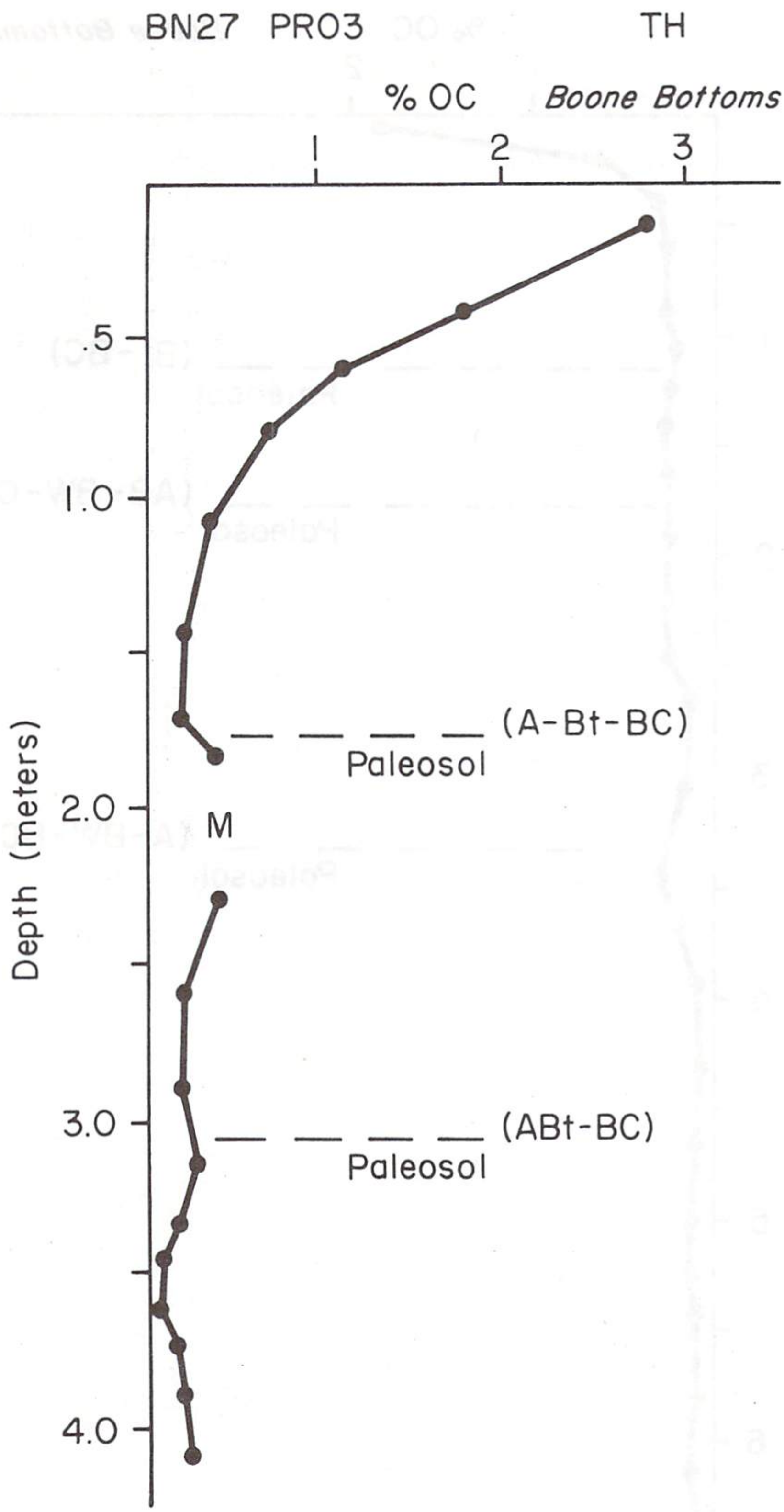


Paleosol
(A-AC)

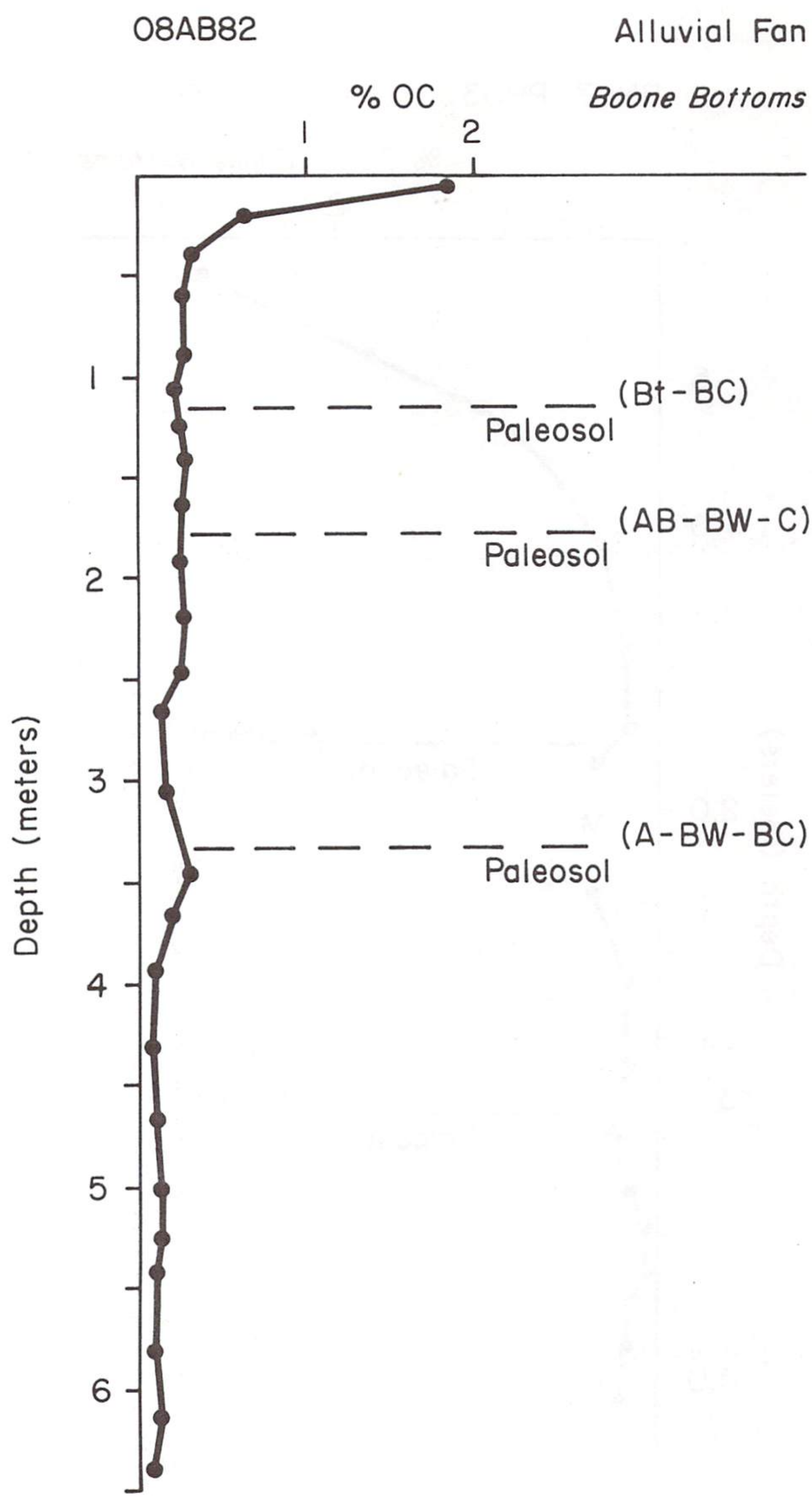
Paleosol
(AC)

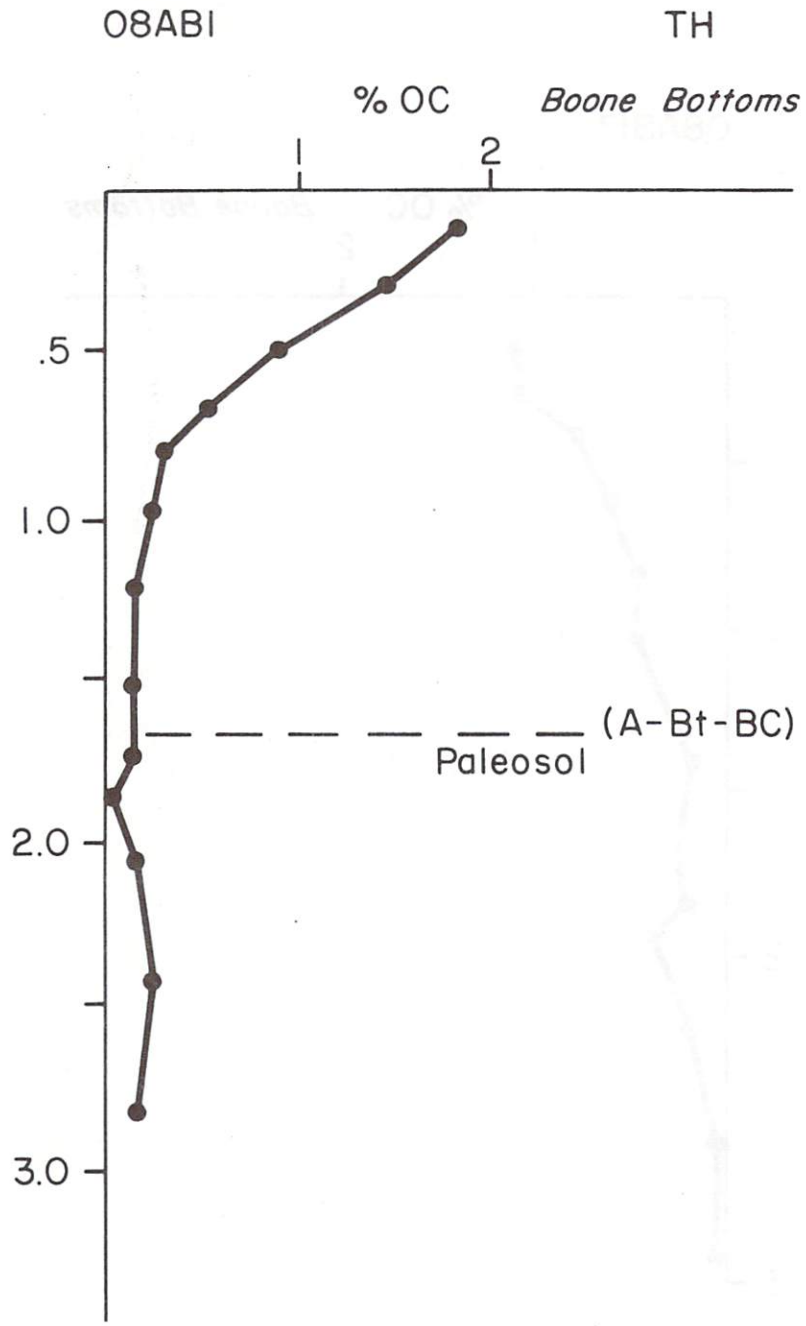


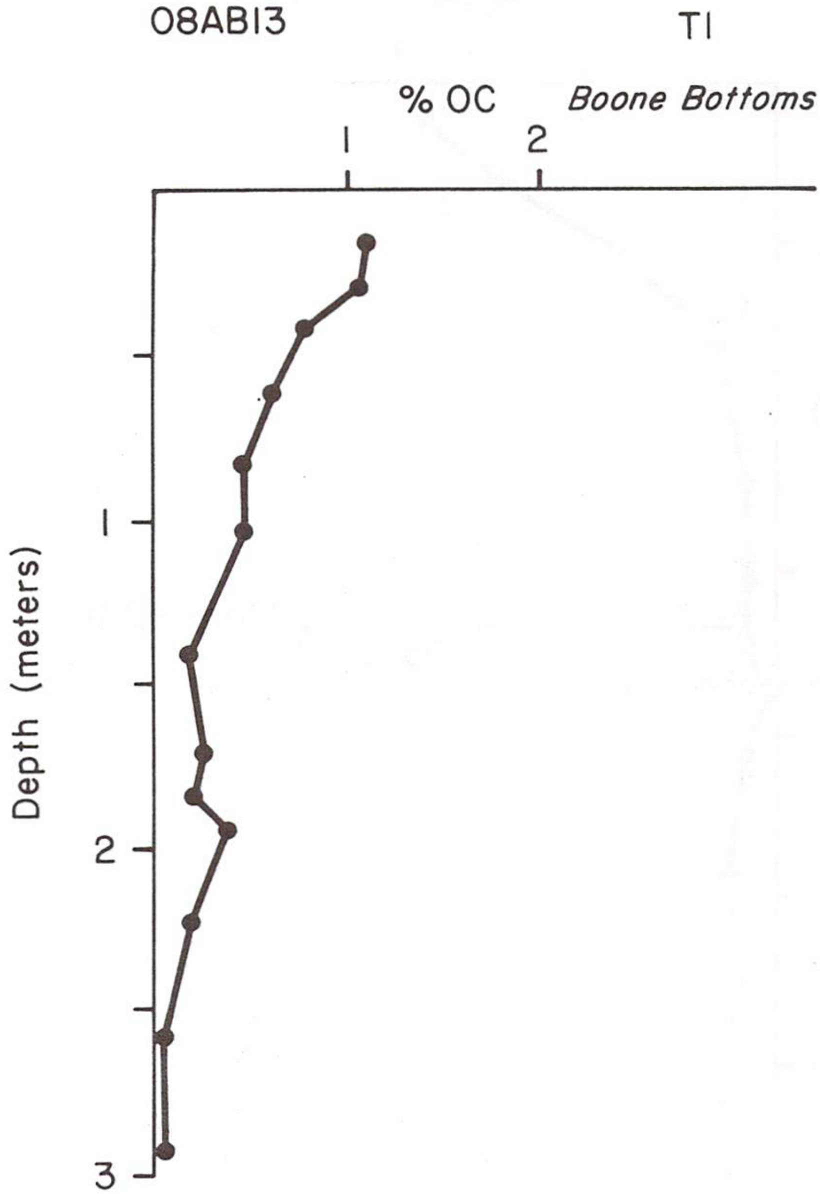
13BN279
Alluvial Fan
% OC
1
2
Soil I
Soil II
Soil III
Soil IV
Soil V
Soil VI
Soil VII
Depth (meters)
1
2
3
4
5
6
Des Moines River Alluvium

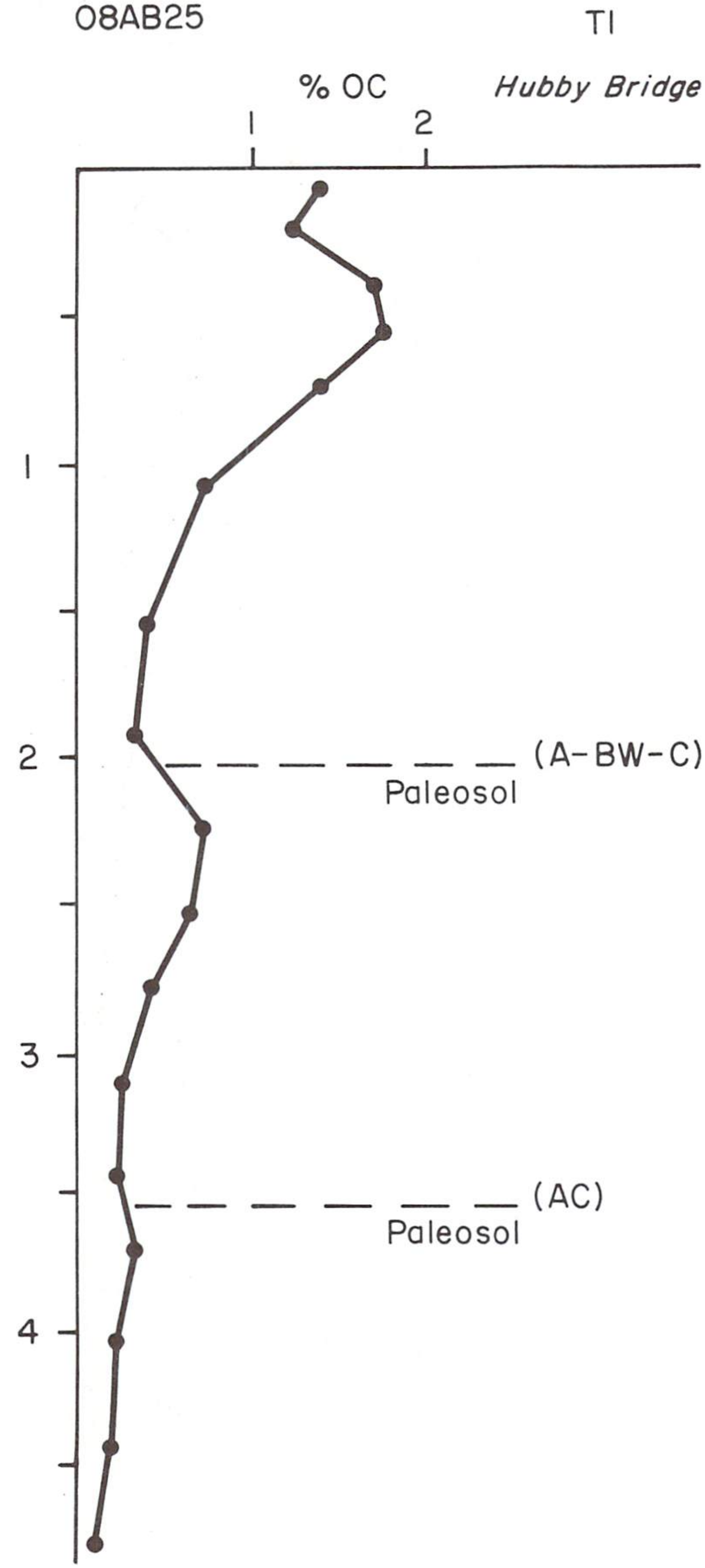


BN27 PRO3
TH
% OC
Boone Bottoms
1
2
3
.5
1.0
2.0
3.0
4.0
Depth (meters)
(A-Bt-BC)
Paleosol
M
(ABt-BC)
Paleosol


08AB82
Alluvial Fan
Boone Bottoms
% OC
1
2
Depth (meters)
1
2
3
4
5
6
(Bt - BC)
Paleosol
(AB - BW - C)
Paleosol
(A - BW - BC)
Paleosol


08ABI
TH
% OC
Boone Bottoms
1
2
.5
1.0
2.0
3.0
(A-Bt-BC)
Paleosol


08AB13
T1
% OC
Boone Bottoms
1
2
Depth (meters)
1
2
3



O8AB25
TI
% OC
Hubby Bridge
1
2
1
2
3
4
(A-BW-C)
Paleosol
(AC)
Paleosol

APPENDIX C

Radiocarbon and Thermoluminescence Dates from the Saylorville Lake Area

APPENDIX C

RADIOCARBON AND THERMOLUMINESCENCE DATES,
SAYLORVILLE PROJECT

Site	Context	B.P. (corrected)*	Calendar (corrected)*	Laboratory	Discussion
13PK111	lev. 2	1440±140	510 A.D.	(Alpha-1279)	TL date on trailed sherd, probably too late (Stanley & Benn 1985)
	fea. 2 40-50 cm	2630±250	680 B.C.	(Alpha-1280)	TL date on burned rock from roasting pit (Stanley & Benn 1985)
13PK112	fea. 2 40-50 cm	4130±430	2180 B.C.	(Alpha-1281)	date on burned rock from roasting pit (Benn 1985)
13PK149	fea. 58 DUII	840±50 (839)	1110 A.D. (1111)	(Wis-879)	carbon from Late Woodland context (Osborn & Gradwohl 1981:131)
	fea. 55 DUII	1575±55 (1557)	375 A.D. (393)	(Wis-899)	assoc. included Madrid ware (Ibid.)
	fea. 12 DUII	1605±55 (1590)	345 A.D. (360)	(Wis-902)	assoc. included Madrid ware (Ibid.)
	fea. 8 DUII	1605±60 (1590)	345 A.D. (360)	(Wis-904)	assoc. included Madrid ware (Ibid.)
	DUIII	2820±65 (3015)	870 B.C. (1065)	(Wis-905)	assoc. L. Archaic pt. type SN16 (Ibid.)
	fea. 68 DUIV	3045±65 (3302)	1095 B.C. (1362)	(Wis-880)	no diagnostics (Ibid.)
	DUIV	3095±65 (3367)	1145 B.C. (1417)	(Wis-901)	same (Ibid.)
13PK251 bench	fea. 7 lev. VI-7	4100±70 (4675)	2150 B.C. (2725)	(Wis-1083)	roasting pit below Woodland zone (unpublished; see Thies 1979:139)

Site	Context	B.P. (corrected)*	Calendar (corrected)*	Laboratory	Discussion
13PK251W	stratum I	>300 <700		(Alpha-1282)	poor TL result on Madrid ware sherd (Benn 1985)
	fea. 1 stratum II	2400±110 (2488)	450 B.C. (538)	(Beta-10691)	carbon from roasting pit, Early Wood.(?) (Benn 1985)
	stratum III	3240±400	1290 B.C.	(Alpha-1517)	rock from fcr midden (Benn 1985)
13PK274	20-30 cm	210±150	1740 A.D.	(Beta-6275)	scattered carbon, too late for Woodland context (Emerson et al. 1983:372)
13PK315	hearth 30 cm	2110±330 (2146)	160 B.C. (196)	(Beta-10048)	carbon assoc. with McBride ware (Emerson & Finney 1983: 81-3)
13PK404	log	12160±80	10210 B.C.	(Beta-2632)	Late Wisconsinan outwash (Benn & Bettis 1981)
13PK405	upper soil	210±50	1740 A.D.	(Beta-5230)	carbon from mixed contexts assoc. Woodland deposits (Benn & Harris 1983)
13PK407	1 m below Ap	1130±80 (1110)	820 A.D. (840)	(Beta-2633)	carbon from possible Woodland component (Benn & Bettis 1981)
	fea. 3 TU #1	700±140 (710)	1250 A.D. (1240)	(Beta-5231)	carbon from 100 cm in Oneota midden (Benn & Harris 1983)
	TU #9	235±95	1715 A.D.	(Beta-4925)	assoc. w/ Oneota vessel, too late (Ibid.)
	fea. 10 hearth	modern		(Beta-7834)	locus I Oneota, too late (Benn 1984)
	fea. 14 ash dump	modern		(Beta-7835)	locus IV Oneota, too late (Ibid.)
	fea. 25 hearth	90±70	1860 A.D.	(Beta-7836)	locus I Oneota, too late (Ibid.)

Site	Context	B.P. (corrected)*	Calendar (corrected)*	Laboratory	Discussion
13PK414	buried soil	5190±100 (5987)	3240 B.C. (4037)	(Beta-2634)	assoc. w/ 3/4 ax, TH terrace (Benn & Bettis 1981)
	above buried soil	1830±240 (1831)	120 A.D. (119)	(Beta-6781)	Th terrace, too late (small sample)
13PK424	buried soil	420±50 (456)	1530 A.D. (1494)	(Beta-4734)	TL terrace (Benn & Bettis 1981)
77RC1	log in Des Moines Lobe till	13560±90	11560 B.C.	(Beta-2749)	wood identified as <u>Pinus</u> <u>banksiana</u>
13DA162	below TH terrace	15210±150	13260 B.C.	(Beta-11166)	Wisconsinan alluvium (Bettis & Hoyer 1985)
13BN27	1st TH paleosol	3920±80 (4445)	1970 B.C. (2495)	(Beta-12911)	dispersed charcoal from Archaic midden (ca. 200 cm, block C)
	1st TH paleosol	3410±440	1460 B.C.	(Alpha-2071)	TL date on fcr from Archaic midden, 200 cm depth (date represents ave. of two TL plateaus)
	6th TH paleosol	6170±170 (6997)	4220 B.C. (5047)	(Beta-12912)	dispersed charcoal from non-cultural sources (block A-C)
13BN30	34 cm	2300±60 (2368)	350 B.C. (418)	(Beta-2810)	Middle Woodland assoc., also Late Archaic present (Osborn & Gradwohl 1982:114)
13BN103	fea. 7 buried soil	3560±80 (3973)	1610 B.C. (2023)	(Wis-1220)	171 cm deep, below Woodland levels (Osborn & Granwohl 1981:579)
13BN110	midden	950±55 (940)	1000 A.D. (1010)	(Wis-498)	Great Oasis village (Gradwohl 1975:123)
	midden	870±60 (867)	1080 A.D. (1083)	(Wis-501)	same (Ibid.)

Site	Context	B.P. (corrected)*	Calendar (corrected)*	Laboratory	Discussion
	midden	975±55 (872)	975 A.D. (978)	(Wis-502)	same (Ibid.)
13BN114	1st TI paleosol	1670±175 (1657)	280 A.D. (293)	(Beta-12909)	wood charcoal below 1st paleosol (1 m depth) in backhoe trench
	1st TH paleosol	2080±60 (2112)	130 B.C. (162)	(Beta-12910)	wood charcoal in cultural fea. (?) ca. 30 cm in TU#1
13BN121	midden	1600±55 (1583)	350 A.D. (367)	(Wis-517)	Middle Woodland, structure assoc., (Gradwohl 1975:120)
	pits	1670±55 (1657)	280 A.D. (293)	(Wis-630)	same (Osborn & Gradwohl 1982:114)
13BN123	midden	940±60 (932)	1010 A.D. (1018)	(Wis-906)	Middle Woodland assoc. (too late) (Osborn & Gradwohl 1982:202)
13BN182	fea. 1	1820±60 (1819)	130 A.D. (131)	(Beta-2811)	Middle Woodland assoc. (Osborn & Gradwohl 1982:258)
	fea. 2	2490±80 (2599)	540 B.C. (649)	(Beta-2812)	Middle Woodland assoc. (too early) (Osborn and Gradwohl 1982:251)
13BN203	base of fan (drill core)	13980±170	12030 B.C.	(Beta-10883)	(too early) probable coal contamination
	tributary terrace	2950±70 (3178)	1000 B.C. (1228)	(Beta-11164)	terrace correlates w/ fan (Ibid.)
	same	3070±140 (3334)	1120 B.C. (1384)	(Beta-11162)	same (Ibid.)
	same	7390±250	5440 B.C.	(Beta-11163)	same (Ibid.)
13BN277	rock bench	4200-1300	2250 B.C.	(Alpha-2072)	TL date on burned rock from shell midden on bedrock bench below TI; TL date is a maximum--no plateau present

Site	Context	B.P. (corrected)*	Calendar (corrected)*	Laboratory	Discussion
13BN278	1.9 m deep	4190±100 (4792)	2240 B.C. (2842)	(Beta-11115)	clam & fcr midden in TH terrace (Benn 1985)
Coal Valley	drill hole	3930±120 (4455)	1980 B.C. (2505)	(Beta-10881)	dates earliest TI channel next to TH
	drill hole	11000±290	9050 B.C.	(Beta-10882)	base of TH terrace
13BN279	fan head trench	2260±70 (2323)	310 B.C. (373)	(ISGS-1361)	wood in lower part of alluvium filling fan head trench
	paleosol II	3190±190 (3491)	1240 B.C. (1541)	(Beta-11116)	below stratum I with Woodland material (Benn 1985)
	paleosol III	3760±80 (4236)	1810 B.C. (2286)	(ISGS-1358)	top of paleosol III
	IIIB	3900±70 (4418)	1950 B.C. (2468)	(Beta-11117)	(Ibid.)
	IV	4610±80 (5312)	2660 B.C. (3362)	(Beta-11118)	(Ibid.)
	VI	6200±260 (7026)	4250 B.C. (5076)	(Beta-11119)	assoc. with Archaic midden, block G (Ibid.)
	VI	5490±80 (6310)	3540 B.C. (4360)	(ISGS-1359)	wood charcoal from Archaic midden, block H (Ibid.)
	VII	5430±100 (6248)	3480 B.C. (4298)	(Beta-11120)	non-cultural carbon from trench A1, Des Moines R. alluvium below fan deposits.
	VII	5680±90 (6508)	2730 B.C. (4558)	(Beta-10884)	non-cultural carbon in fan deposits
	VII	6200±100 (7026)	4250 B.C. (5076)	(ISGS-1357)	carbon from natural burn in Des Moines R. alluvium below fan deposit, trench A
	fan south of 13BN279	1490±80 (1470)	460 A.D. (480)	(Beta-11167)	from fan-TI interface

Site	Context	B.P. (corrected)*	Calendar (corrected)*	Laboratory	Discussion
13BN280	buried soil	modern		(Beta-11165)	non-cultural, charcoal in TI terrace topsoil (Benn 1985)
08AB19 (Pilot Mound Pollen Core)	35-40 cm	2500±70 B.P. (2611)	550 B.C. (661)	(Beta-12589)	within fibric peat; pollen zone V
	65-70 cm	3250±60 B.P. (3567)	1300 B.C. (1617)	(Beta-12342)	base of fibric peat; base of pollen zone V
	105-110 cm	4960±90 B.P. (5727)	3010 B.C. (3777)	(Beta-12590)	sapric peat; pollen zone IV
	175-180 cm	9730±130 B.P.	7780 B.C.	(Beta-12591)	wood within stratified silt loam; top of pollen zone III.
	210-215 cm	9300±100 B.P.	7350 B.C.	(Beta-12343)	wood within stratified silt loam; base of pollen zone II.
U.S. 30 cut	within sub-Des Moines Lobe loess	16100±1000 B.P.	14150 B.C.	(I-1270)	spruce wood within loess (Ruhe 1969)
Ledges 1	within sub-Des Moines Lobe loess	15775±145 B.P.	13825 B.C.	(Beta-4807)	wood within loess buried by Des Moines Lobe till

* date corrections calculated using correction tables in Damon et al., 1974.

Laboratory Abbreviations:

Alpha - Alpha-Analytic, Inc.
Beta - Beta-Analytic, Inc.
I - Isotopes, Inc.
ISGS - Illinois State Geological Survey
Wis - University of Wisconsin

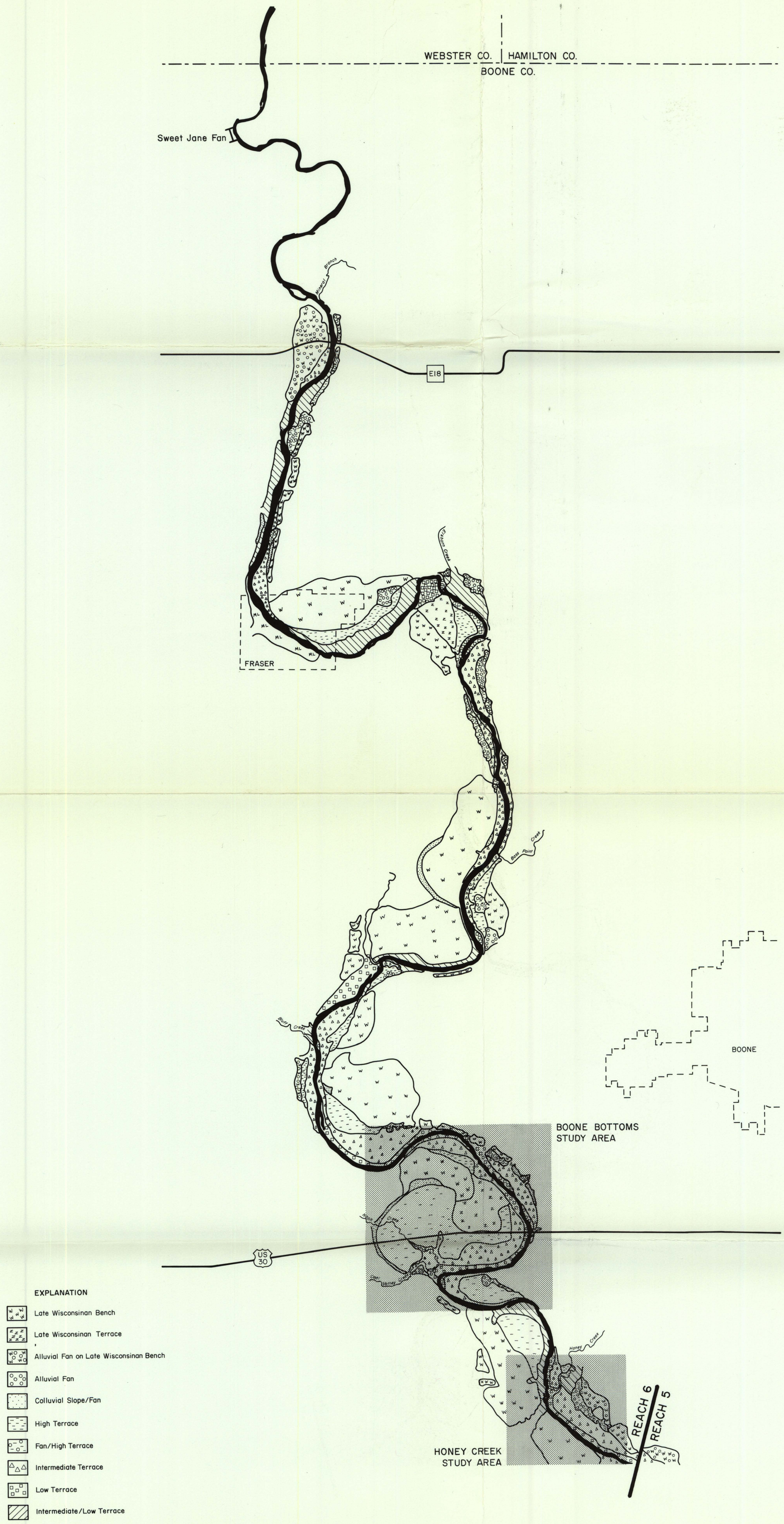


Figure 15. Map of reach 6 showing distribution of landform/sediment assemblages.

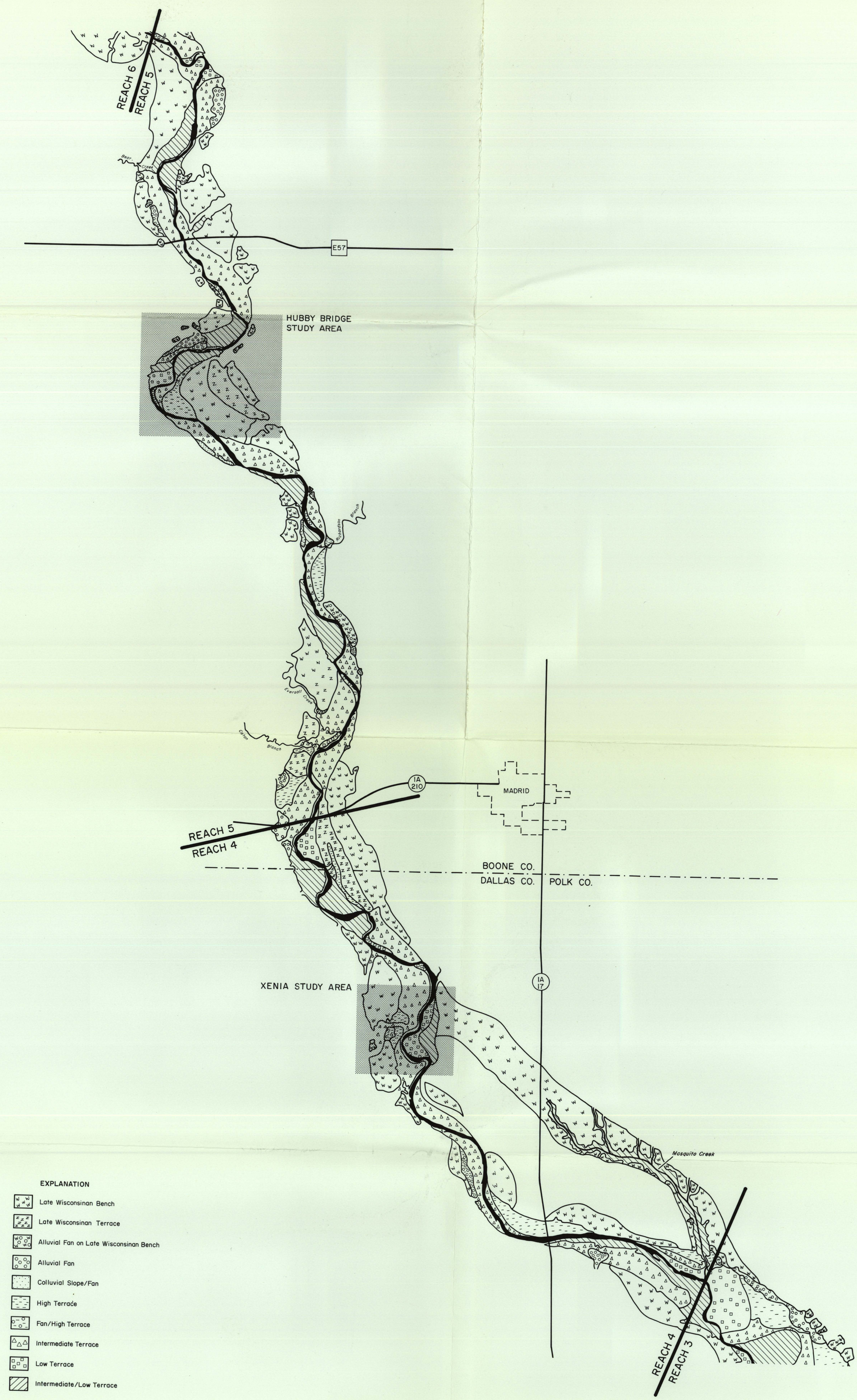


Figure 17. Map of reaches 4, 5, and the northern portion of reach 3 showing distribution of landform/sediment assemblages.

Figure 20. Map showing distribution of landform/sediment assemblages in reaches 1, 2, and 3.