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Late Quaternary fluvial stratigraphy of the St. Albans archeologic site (46KA27), West Virginia

Courtney Andreas Nugent
West Virginia University

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Late Quaternary Fluvial Stratigraphy
of the St. Albans Archeologic
Site (46KA27), West Virginia

Thesis

Submitted to the Eberly College
of Arts and Sciences

of

West Virginia University

in partial fulfillment of the requirements for the
Degree of Master of Science
in Geology

by

Courtney A. Nugent

Morgantown

West Virginia

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Abstract

Late Quaternary Fluvial Stratigraphy of the St. Albans Archeologic Site (46KA27), West Virginia

The St. Albans archeologic site, West Virginia(46KA27), occurs on a low terrace of the Kanawha River. Archeologic investigations have been conducted at the site since 1964. Geologic investigation techniques have included core drilling, sediment texture analyses and magnetic susceptibility analyses. Data from these analyses have provided a better understanding of the stratigraphy, magnetic susceptibility and artifact distribution at the site and has lead to the development of a model that predicts the potential for recovery of cultural resources. The model should help planning future excavations at the site.

The geomorphology of the Kanawha River valley at St. Albans is related to the geologic history of the Ohio River valley. Late Pleistocene glaciation brought excess sediments into the Ohio River causing aggradation. Later, much of this sediment was transported down the Ohio River during an incision event. These Ohio River events were responsible for altering Kanawha River baselevel, causing a complex response that may be the principal mechanism for the aggradation and subsequent degradation of both a late Wisconsin terrace (610 ft elevation) and the younger St.

Albans terrace (590 ft elevation).

Most of the St. Albans terrace is a landform that apparently began to aggrade before 12,900 B.P.. The St. Albans Archeologic Site is located on a newer landform that consists of a 8.9 m overbank facies overlying a 7.8 m channel-sand facies. Radiocarbon dates indicate overbank facies sedimentation began between 9,900 B.P. and 13,750 B.P., with typical floodplain sedimentation rates suggesting a time closer to 9,900 B.P.. The channel facies should be archeologically sterile.

Charcoal fragments, reddened soils and fire-cracked rocks indicate that most high magnetic susceptibility readings are produced by fire. The association of artifacts in many of these high magnetically susceptible sediments indicates they are cultural fire hearths. High susceptibilities can also be related to forest fire, pedogenesis, and fermentation of organic wastes. The later two of which can also be indicators of buried occupational surfaces. When executed early in an archeological study, magnetic susceptibilities profiles on cores should aid in locating more productive excavations.

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INTRODUCTION

Communities commonly developed adjacent to life-sustaining water bodies. Given this tendency, most archeological sites in the Eastern United States occur along floodplains and terraces of waterways. The St. Albans archeological site (46KA27), located on a terrace adjacent to the Kanawha River, serves as an archetype to geoarcheologic investigations of deep stratified site's. In addition to conventional archeological investigative techniques, sediment texture and magnetic susceptibility analyses have been applied to cores taken from and profiles cut into the sites strata. Supplemented by radiocarbon dates and archeological data from previous investigations, the textural and magnetic susceptibility analyses have provided a four dimensional (north-south, east-west, depth and time) view of the site. A clear understanding of the stratigraphy, magnetic susceptibility and artifact distributions has great potential to enhance future archeological excavations at the site.

In addition to providing archaeological insights, the investigation at St. Albans has provided a regional perspective on the geomorphic development of the Appalachian Plateaus during the Pleistocene. Pleistocene glaciation scoured northern landscapes and transported much sediment into the Appalachian Plateau north of the study area, postglacial fluvial processes have further transported much of these glacial deposits

downstream. During the Late Pleistocene, the quantity of these deposits exceeded the competence of the Ohio River system, resulting in an aggradational event that raised base-level for its tributaries. After the influx of extra-basin glacial deposits decreased, the Ohio River system began to erode into the stored valley deposits, initiating an incision event that lowered base-level for the tributaries. These base-level adjustments had a strong influence on the development of the lower Kanawha River terraces.

PURPOSE

The St. Albans Archeological site, first excavated in the 1960's, is located on a low terrace of the Kanawha River. Archeologists have discovered occupational zones within these deposits to a depth of 24 ft (Broyles, 1971). The exceptional depth and complex fluvial stratigraphy of the site warrant further geological investigation. The aim of the investigation is to acquire data from the site that will lead to the development of a geoarcheological model. This model will allow prediction of the potential for recovery of cultural resources so that the most productive excavation locations within the site can be predicted. This model will be important to planning future excavations at the study area and similar sites within the Kanawha River Valley.

This project, in conjunction with past and future studies,

will add pieces to a much larger puzzle: the Quaternary fluvial history of the Appalachian Plateaus. In addition to the model, the second purpose of the study is to explore base-level adjustment as possibly the principal control over the development of the St. Albans site terrace, thereby documenting a fluvial mechanism that should be found as a similar control on the development of terraces of other nearby tributaries to the Ohio River. This fluvial mechanism may be extended to help explain the development and incision of aggradational terraces in many glacially influenced drainage basins in the Appalachian Plateaus.

OBJECTIVES

The objectives of this project are based on two separate and distinct sets of expectations:

Geoarcheology

1. To describe in detail the stratigraphy of the St. Albans archeological site and to construct cross-sections using continuous split-spoon samples from test borings.
2. Describe and trace high magnetic susceptible horizons both vertically and horizontally; determine the applicability of magnetic susceptibility meters in delineating potential occupational zones
3. Develop a stratigraphic model for the prediction of productive archeological excavations within the site.

Quaternary Geology

1. Establish an alluvial chronology for the site including sedimentation rates.
2. Construct a general late Quaternary paleoenvironmental interpretation for the Kanawha River. The interpretation will focus on the following: channel aggradation vs. degradation, river-bank stability, channel morphology, etc.
3. Look for patterns in the paleoenvironmental interpretations for the Kanawha that reflect glacial meltwater influences upon the Ohio River.

STUDY AREA

The St. Albans site is located on a low terrace of the Kanawha River in St. Albans, West Virginia. The site is approximately 24 km (15 mi) west of the state capitol, Charleston, and 65 km (40 mi) upstream from the Kanawha River-Ohio River junction (Fig. 1). The upper surface at the site was last inundated during the record historic flood, 29 September 1861 (Doll and others, 1960).

The terrace had an average elevation of about 590 ft, or about 45 ft above the normal high water level before construction of U.S. Route 60 and the Winfield Lock Dam (Barlow, 1971). The terrace surface has been lowered by as much as 6 ft from the construction of Route 60 and the normal pool water level is now 20 ft higher than the normal high water level due to the dam construction (Barlow, 1971).

PREVIOUS WORKS

The first study at the St. Albans Archeological Site (Price and others, 1964) tested the applicability of core drilling at archeological sites in alluvial valleys. Aside from providing sediment samples useful for stratigraphic interpretations, the core drilling provided insight to the location of successful excavations. Core samples containing charcoal, burned earth or artifacts were assumed to be more indicative of past human

Figure1. Map Showing the locations of St. Albans and Gallipolis study sites (After Broyles, 1971)

occupation than cores absent of these materials. Of six cores taken in a 91 m by 23 m area, the two or three cores most indicative of human occupation were assumed to delineate the lateral extent of the site. However, this assumption was only partially accurate. Although the cores did help to delineate a focus of past human occupation, this was only one of many locations of past human occupation at the site. The site, as it is known today (Anslinger, 1998), occupies a greater expanse of the terrace than was interpreted by Price and others (1964). Nevertheless, their study demonstrated core drilling to be a practical and relatively noninvasive first step to help in the decision of where to locate excavations. The most successful of all excavations at the site was located in the area of the three cores most indicative of human occupation.

Price and others (1964) proposed the site to have been an island. Their interpretation stemmed from the presence of a blue-grey clay found in the most upstream core and a peat-like material found in a core taken 23 m south of the river. Price and others, interpreted the blue-grey clay to represent quiet water sediments, and the peat-like material to have formed in a slough or oxbow between the island and mainland. A full explanation of how these two findings supported their island hypothesis was not provided.

Broyles (1971) summarizes methods and results of four

summers of archeological work at the site, including important descriptions and diagrams of site stratigraphy. From Broyles's work came many period-specific artifacts and radiocarbon dates to aid in developing an alluvial and cultural chronology for the St. Albans terrace. Broyles's excavations showed upper strata that gently sloped away from the river (Fig. 2). From these observations Broyles interpreted the site to have been on a levee.

Olafson (1971) summarized the possible influence that late Pleistocene climates had on the development of the site. Although Olafson stated that the type of floodplain aggradation that formed the St. Albans terrace is common in streams in the glaciated regions, he disclaimed the possibility of a similar development for the St. Albans terrace due to lack of glacial meltwater in the Kanawha basin. Instead, Olafson described the glacial history of regions north of the study area and proposed climatic changes for the study area in response to events to the north. Rates of aggradation or incision for the St. Albans terrace were inferred from the proposed climactic changes.

Barlow (1971), expanded on Olafson's work by coupling the same climatic controls with stratigraphic observations to speculate on specific sedimentation and erosion events and the topography of the site. Barlow (1971, in Table 3), referenced Schumm's work (1965): Quaternary fluvial processes as controlled

NORTH

SOUTH

Figure 2. Broyles's excavation showing upper stratigraphy of a levee (After Broyles, 1971). Note: None of the cores in this study are a part of this cross-section.

by climatic fluctuations, to partially support his interpretations.

Barlow matched radiocarbon dates with stratigraphic intervals to calculate discrete rates of sediment accumulation or erosion to further support the proposed aggradation and erosion events. In turn, these proposed aggradation and erosion events were matched to regional glacial retreats or advances respectively, thereby suggesting glacial influence on local climate as the principal control on the geomorphic development of the site.

Because the site stands above its immediate surroundings, Barlow (1971) also interpreted the site to have been an island. He interpreted the depression that separates the site from the valley wall as a remnant bifurcation of the Kanawha that he termed "old south channel," (Fig.3). Barlow stated that, in order for the ancient peoples to have continually reoccupied the site for thousands of years, the site would have to be a distinguishable feature of the landscape, such as an island.

The studies of Hand and others (1988) at Winfield Lock and Dam, West Virginia and Mandel (1988) at Gallipolis Lock and Dam, West Virginia, are similar to this study. Both of these studies use geomorphologic interpretations to predict zones of high and low cultural resources recovery potential. These studies also suggest the Ohio River to have a strong base-level influence on

Figure 3. A map showing the archeologic site and Barlow's proposed island with "old south channel" (After Barlow, 1971).

the alluvial development of the Kanawha River during the Quaternary.

Rogers and others (1989), Rogers (1990), and Kite and others (1990) research at the Gallipolis Lock and Dam replacement project (Fig. 1) was based on over 200 exploratory borings into two low terraces of the upper Ohio River (surfaces S2 and S3; Fig. 4) and an excavation of a canal into the lower of these terraces (S2). Sediments just above the bedrock base of these two surfaces were deposited around 22,000 yr. B.P., and 27 m of sedimentation occurred on this base between 22,000 and >13,000 yr B.P. to produce surface S3. Sand unit B1, deposited near the beginning of S3 sedimentation, has sedimentary structures indicative of braided channel origin. Boulder horizons beneath S3 show evidence of two possible large paleofloods with discharges more than ten times greater than the maximum historic flood at Gallipolis. Between <21,000 and 13,000 yr B.P. surface S3 was incised 21 m to produce a major unconformity about 3.5 m to 4 m above bedrock. Between 13,000 yr B.P. and the present, about 15 m of sedimentation occurred on this unconformity to produce surface S2. Sand unit B2, deposited just above the unconformity, also has sedimentary structures indicative of braided origin.

The large-scale nature of the excavations involved in the studies at Gallipolis expose a thorough view of the Quaternary alluvium. This alluvium is also well radiocarbon dated. The

Figure 4. Roger's cross-section of surfaces 2 and 3 with radiocarbon dates at the Gallipolis Lock and Dam study site (After Rogers, 1990).

information from Gallipolis is a valuable resource to this study because the findings of these studies directly support much of the alluvial history interpreted in this study. The age and geometry of surfaces S2 and S3 at Gallipolis are similar to the St. Albans and Wisconsin terraces in this study. Therefore, two correlations are suggested: The first between surface S2 and the St. Albans terrace, and second, between surface S3 and the Wisconsin terrace. Magnetic resistivity studies employed at the site displayed nothing but a gradual increase in conductivity with depth. Clay (personal communication, 1993) suggests that this occurrence is probably the influence of the water table. A Geonics GN38 surface magnetic susceptibility meter was also tested at the site with no success.

Magnetic susceptibility attenuates in very short distances, so surface magnetic susceptibility surveys are not likely to delineate anomalies below 0.5 m depth (Kite and others, 1993). Surface magnetometers have less signal attenuation with depth, however, and are poor at delineating broad features with ill-defined margins such as those generated by buried soil horizons, fire hearths, or sedimentary layers (Kite and others, 1993). Therefore, it appears that the hand-held magnetic susceptibility meter is a highly suitable geophysical instrument for the aid in developing deeply-stratified archeological sites. The meter appears to have potential as a stratigraphic correlation tool and

for delineating potential occupation zones.

Personnel from Cultural Resource Analysts, Inc. monitored two bank-stabilization projects for the Huntington District Corps between 1994 and 1996 (Anslinger, 1998). These projects occurred in or partially within the existing National Register boundaries for the site. Sections of the river bank were studied to document stratigraphic relationships between sediment units, soils and archeological inclusions during the project. River bank profiles in the upstream reaches of this study displayed sediments and archeology similar to previous studies by Broyles (1971) and Brashler (1994). However, further downriver, profiles revealed massive, fine grained sediments with little discrete strata that contained far fewer artifacts. Anslinger (1998) interpreted these sediments to represent a lower energy depositional environment located behind a levee that has since been eroded and is no longer present. A sample that dated to 12,910 +/- 60 B.P. (Beta 102187) came from a depth of 4.8 m (Anslinger, 1998). This date is roughly three thousand years earlier than dates obtained at comparable depth at the archeologic site. This age discrepancy suggests the presence of two landforms and will be explained in more detail in the alluvial history section.

FIELD METHODS

The H.C. Nutting Company made 12 test borings using a CME-55 rig with an automatic hammer. Continuous split-spoon samples were taken the entire length of the borings; however, portions of some sediment samples were lost down the bore holes. Seven of the test borings were made with a 2-inch diameter split-spoon sampler, with about 90 percent sediment recovery. Five borings were made with a 3-inch diameter split-spoon sampler, with more than 75 percent recovery. All of the split-spoon samples were stored in the West Virginia University Quaternary Geology Lab after being sealed in 2-foot sections of split PVC pipe. Plate B shows the core drilling locations.

Magnetic susceptibility measurements were taken on vertical profiles at the site. These profiles were cut into the river bank face with shovels and then scraped clean with trowels to prepare smooth surfaces for consistent magnetic susceptibility measurements. A fiberglass metric tape measure was hung down the vertical face and magnetic susceptibility measurements were taken at 2-cm intervals down the profile. The standard procedure was to take two magnetic susceptibility measurements at each interval, however, if the second magnetic susceptibility measurement was not within 10 percent of the value of the first magnetic susceptibility measurements, three or more readings were taken until the last reading fell within 10 percent of the previous

measurement. The averages of these readings were reported for each of the 2-cm intervals. Brief sediment descriptions were also recorded during magnetic susceptibility measuring.

LABORATORY METHODS

Magnetic susceptibility measurements were made on the 12 split-spoon sediment samples. The procedures were essentially the same as those used to take magnetic susceptibility measurements in the field, except that care was taken not to allow metallic laboratory objects to influence the meter. Experimentation showed interference from metallic objects declined to unmeasurable levels beyond one foot distance. For security, a distance of two feet from metallic objects was maintained during measurement.

The split-spoon samples acquired in this study displayed considerable distortion. Cohesive sediments induce friction upon the inner surface of the split-spoon as it is driven down. This friction causes the outer portions of the sample to be dragged downward with the penetrating split-spoon. Coarse sediments, do not adhere well to the inner split-spoon surface due to lack of cohesion and tend to fall out of the sampler when brought up to the surface. The water table at St. Albans is located near the transition between the overlying fine-grained overbank sediments and the lower coarse-grained channel sands. Fine-grained overbank sediments occur above the water table where there is little water

to reduce the friction that causes the drag type of distortion. Coarse-grained channel sands occur below the water table, where slipping may be enhanced by the presence of water.

If sediment in a particular 2-foot section had been compressed during sampling, all magnetic susceptibility measurement intervals taken from that particular section were recalculated so as to expand the retained sample to fill the entire 2-foot section. For example, if a two-foot section was 20 percent shortened, the measurements that initially were taken at 2 cm intervals were recalculated to represent 2.4 cm intervals. If sample stretching occurred during sample retrieval, the reverse procedure was taken so as to shrink the sample down to a two-foot section. For example, if a two-foot section was 5 percent stretched, the initial 2 cm intervals were recalculated to represent 1.9 cm intervals. In these examples, an adjustment was made in each case so that the sample is represented in its original dimension prior to distortion.

Textural analyses were conducted on sediment samples from the 12 test borings and vertical profiles in the field. Most of the dry-sieve and pipette methodology of the textural analyses came directly from Bell (1986), however, minor adjustments were made in the sequence of screens used in the dry-sieve methods. Essentially, the screens with larger mesh openings were omitted due to the fine texture of the sediments in this study. The

sampling interval for textural analyses was based on textural estimations. Textural estimations were made after observing the following properties: appearance, tactile properties, plasticity of rolled threads and friability of dry samples. The textural estimations were used to assign textures to the sediments. These examinations lead to the recognition of many different textural changes in each core and bank profile. All the cores and bank profiles displayed fluctuating trends in sediment texture for the length of the core or profile. Textural estimations revealed too many textural changes for each of those changes to be tested by textural analysis. Textural analysis samples were taken at the peak of each rising trend in sediment coarseness and trough of each falling trend in sediment coarseness for each core or profile. Results of textural estimations and textural analyses were described according to USDA soil texture classification (Fig. 5) based on percent sand, silt, and clay (Soil Survey Division Staff, 1993).

Stratigraphic columns were generated from textural classifications with the use of the graphic software program Adobe Illustrator 88 and 7.0 on a personal computer. The same procedure that was used to recalculate magnetic susceptibility measurement intervals in their original dimensions, were used in generating stratigraphic columns.

Figure 5. U.S.D.A. textural classification ternary plot (Soil Survey Division Staff, 1993) showing results of St. Albans textural analyses; particles greater than 2.0 mm not represented.

GEOMORPHOLOGY

The Kanawha River valley in the vicinity of St. Albans has about 500 ft of relief between the normal pool elevation at 566 ft and the surrounding highlands. A terrace that is a remnant of the Teays River exists on the south valley wall between 660 ft and 700 ft elevation. The Teays River (Fig. 6) headwaters were near Blowing Rock, North Carolina, and the river flowed along the course of the present New and Kanawha rivers upstream from the site (Hansen, 1998). Just downstream from St. Albans, at the location of Scary, the Teays River course departs from the Kanawha River valley and tracks westward into Ohio (Kite, 1992; Hansen, 1998). Between 0.79 and 0.88 m.y. ago, glacial advances blocked the Teays drainage system near Chillicothe, Ohio forming Lake Tight (Bonnett and others, 1991). Lake Tight extended from this glacial dam southeastward to near Hawk's Nest, West Virginia (Bonnett and others, 1991). Eventually the lake waters were pirated, initiating a drainage modification that marked the beginning of the development of the upper Ohio River system (Bonnett and others, 1991).

The remnants of a younger, paired terrace exist at an elevation of about 610 ft. The remnants of this terrace are conveniently outlined by the 600 ft topographic contour in areas outlying the archeologic site (Fig. 7). Although this terrace is paired, it has been eroded completely along one or both sides of

Figure 6. Map of the ancient Teays drainage system (from Hansen, 1998).

the valley in many reaches of the valley. This terrace has been interpreted as Wisconsin in age (Kite, 1992).

The St. Albans terrace is located in an alluvial valley bottom that ranges from 1.0 to 1.5 km (0.7 to 1.0 mi) in width. The St. Albans terrace occupies most of the valley bottom except for the Wisconsin terrace, which is only about twenty feet higher. The width of the terrace is about 0.7 km on the south side of the river and about 0.3 km on the north side of the river. About 150 m to 275 m inland from the present south river bank is an elongated ridge that may be an inland remnant of a previous levee. This elongated ridge may represent the channel margin when the Kanawha River channel was located more to the south.

STRATIGRAPHY

Sediments retrieved by split-spoon methods do not yield a distinct view of individual beds due to either bioturbation, distortion during sampling and lack of lateral exposure. Upon first appearance, the sediments in the cores looked rather homogeneous for most of their length. However, textural descriptions of the cores, confirmed by grain-size analyses, allowed breaking out more stratigraphic units than appeared during initial visual examination. The description by texture, however, may have lead to some over-generalization of the

stratigraphy by representing sediments of separate beds as the same bed because they fell into the same USDA textural classification. This over-generalization is believed to be rare because the sampling strategy was oriented so that adjacent samples would come from sediments contrasting in texture. Stratigraphic division may have occurred if grain size analyses yielded different textures for samples taken from distant portions of a single, thick, graded bed. However, the distance interval between sampling was sufficiently large that it would be unlikely for two samples to be taken from the same bed, considering few of the beds are particularly thick. To further support the improbability of stratigraphic division, it should be noted that the presence of well-developed graded bedding at the site has not been confirmed.

The first and deepest of the 12 test borings in this study has revealed two stratigraphic units (Plate A): a 8.9 m thick overbank unit, overlying a 7.8 m thick channel sand unit. Only the overbank unit is known to bear artifacts (Broyles 1971), so the remaining 11 test borings were terminated upon reaching the sand unit. All 12 borings show the overbank and channel facies transition between 8.2 m and 9.0 m depth.

Weathered, pinkish, shale bedrock is encountered at 54.6 ft deep in core #1. This shale bedrock has been reported as often having a blue-grey color (Doll, 1960). A 0.6 m gravely sand bed

lies on top of the weathered bedrock. The textural analysis determination of gravely sand for this bed could be inaccurate because a 2 inch diameter split-spoon does not have the potential to retrieve larger clasts that may be present in that bed. Therefore, due to the limitations of the split-spoon, this bed may be undetectably more coarse. A 7.0 m thick sand unit occurs above this gravely sand. The bottom 1.4 m of the 7.0 m thick sand is actually a loamy sand. This loamy sand coarsens upward to sand, which also becomes progressively more coarse upward.

An overbank facies occurs on top of the sands. Most of the overbank facies can be broken into two general textural units: silt loam and loam. The lower of these units is a 2 to 5 m thick silt loam. Generally, this silt loam thickens to the east and thins to the west. A thin, but continuous, loam bed runs the length of the site through the middle of this silt loam. Other discontinuous, lens-like, loam beds occur within the silt loam unit. In general, these lens-like loams are more abundant to the east end of the site.

The contact between the lower silt loam unit and the overlying loam unit is somewhat irregular and suggests erosion. Floods may have eroded part of the top of the lower silt loam unit or tributaries draining from the valley wall toward the river may be responsible for some dissection of the top of the silt loam. Some of this contact irregularity may be an artifact

of stratigraphic misrepresentation due to delineating the stratigraphy only by texture. However, stratigraphy at the west end of this study beneath core #8 (Plate A) suggests a cut-and-fill structure at this elevation. One of Broyles's (1971) excavations exposed a cut-and-fill structure at a depth similar to a possible cut-and-fill structure beneath core #8 (Fig. 8). Broyles's (1971) cut-and-fill structure displays thin, convex upward stratigraphy. The structure also displays the thalweg of the channel migrating vertically and horizontally as the depth of the convexity decreases, indicating the channel shallowed. This stratigraphy suggests a slow southward migration during infill that would have required a persistent flow in the channel for a greater duration than a flood scour. This cut-and-fill structure may also have been created by one of the small tributaries draining from the south valley wall toward the river. Again, the structure is too small to have been created by the entirety of the Kanawha's main channel. Therefore, an unconformity may exist between the lower silt loam unit and the loam unit just above.

The upper, overbank unit is a loam, 3 to 5 m in thickness. This loam unit tends to thicken to the west. The possible cut-and-fill structure beneath core #8 at the west end of the site will be considered a part of this upper loam unit, although it would be more appropriate to break the cut-and-fill structure into a separate unit if its development were more conclusive. A

Figure 8. Broyles excavation showing cut-and-fill structure (After Broyles, 1971).
Note: None of the cores in this study are a part of this cross-section.

silt loam bed occurs within the middle of this loam unit but pinches out before reaching the east or west ends. The loam unit grades into a sandy loam east of core #7.

A 5 to 50 cm thick sand bed, lies above the upper loam unit. This sand bed runs most of the length of the site but grades into a loamy sand at the eastern end. Because the bed is thin, it has a coarse texture indicative of high energy and this texture is anomalous to the sediments above and below, this bed is interpreted to be a single, large-magnitude flood deposit. The uppermost 50 to 150 cm of the stratigraphy at the site is dominated by a mixture of loams and sandy loams that have been truncated by highway construction. Generally, the sandy loams of this uppermost stratigraphy occur to the east and west ends of the site and the loams occur in the central reaches.

The stratigraphy in the river bank is largely consistent with that in the cores. However, the stratigraphy in the river bank is more coarse-grained, and the beds are thinner and more prominent. Numerous thin sand beds must pinch out away from the river, as they are not present in the cores. Beds that correlate between the river bank and the cores occur at shallower depths in the river bank because the river bank sediments were deposited closer to the crest of the levee deposits and are up-dip from sediments deposited farther inland. The overbank sediments at the bottom of the west river bank profile display a transition from

lower stratigraphy dipping gently toward the river to upper stratigraphy dipping gently away from the river. This reverse in dip was also observed at comparable depths by Broyles (1971). The depth of this transition in dip is about the same depth as the transition from silt loam to loam in the cores. The stratigraphy above this transition is interpreted to be indicative of single-channel flood-related levee deposits.

Little can be said about the nature of the fluvial regime responsible for the deposition of these overbank sediments due to the lack of sedimentary structures in both the cores and river bank. Perhaps any sedimentary structures have been destroyed by bioturbation. The particular fluvial environment responsible for the deposition of the underlying channel sands is also not supported by sedimentary structures. The channel sands are not exposed in the river bank and the slit-spoon samples are too small and distorted to yield good sedimentary structures. However, cores taken in this study and cores documented in other papers (Doll, 1960; Barlow, 1971) show sands at depth in all cores taken on the lower terrace of the valley. These sands suggest that the lower stratigraphy across most of the valley, except under the Wisconsin terrace, is a laterally continuous sand sheet. According to Walker (1984), laterally continuous, extensive sand sheets may be indicative of braided system deposits.

RADIOCARBON DATES

Many new radiocarbon dates have been acquired since Broyles's (1971) report (Table 1). Four of these dates come from excavation units, one comes from a core sample and another comes from a West Virginia Department of Highways river-bank stabilization project. Radiocarbon dates of $8,720 \pm 250$ B.P. (Beta-50422), $8,570 \pm 130$ B.P. (Beta-50424) and $8,160 \pm 100$ B.P. (Beta-50723) come from features 2, 4, and 8 respectively (Brashler and others, 1994). Another date of $9,110 \pm 120$ B.P. (Beta-52904), comes from the bank profile approximately 60 cm below feature 4 which produced the $8,570 \pm 130$ B.P. (Beta-50424) date. A fifth date of $5,500 \pm 450$ B.P. (Pitt-1053) came from core #3. And the final date of $12,910 \pm 60$ B.P. (Beta-102187) comes from the WVDOH river-bank project approximately one-half mile downstream from the western end of the site.

The first four of these dates correlate well with Broyles published dates for St. Albans. However, the $8,160 \pm 100$ B.P. (Beta-50723) date is relatively recent considering its depth. The $5,500 \pm 450$ B.P. (Pitt-1053) date is extremely recent considering its depth of 4.3 to 4.4 m. This sample, collected from a 2 in diameter core, was too small to be fully pretreated to remove "young carbon." This date should not cause alarm because its accuracy is highly suspect (Stuckenrath, Robert, personal communication to Kite, 1992).

Lab Number	Date	Provenience	Depth m*	Source
M-1827	9850 +/- 500	Charleston Horizon Zone 36	4.8-5.1	Broyles: 1971
Y-1538	8390 +/- 160	Lower Kirk Horizon Zone 20	3-3.24	Broyles: 1971
M-2294	8850 +/- 320	Mid. Kirk Horizon Zone 18	2.7-3.0	Broyles: 1971
M-2289	8800 +/- 320	Upper Kirk Horizon Zone 16	2.6	Broyles: 1971
M-1821	8830 +/- 700	Lower St. Albans Zone 12	2.1-2.4	Broyles: 1971
M-1820	8820 +/-500	Upper St. Albans 11	1.7-2.1	Broyles: 1971
Y-1539	8250 +/- 100	Upper Le Croy Zone 6	1.0-1.3	Broyles: 1971
Y-1540	8160 +/- 100	Kanawha Horizon Zone 4	0.7-.098	Broyles: 1971
M-2288	8470 +/- 300	Zone 24, Intermediate Horizon	3.5-3.8	Anslinger: 1998
M-2291	9330 +/- 330	Zone 20, Lower Kirk Horizon	3.0-3.2	Anslinger: 1998
M-2295	8560 +/- 600	Zone 19A, Kirk Horizon	3.0-3.2	Anslinger: 1998
M-1824	8520 +/- 300	Zone 20, Lower Kirk Horizon	3.0-3.2	Anslinger: 1998
M-2292	8240 +/- 300	Zone 12, Lower St. Albans Horizon	2.1-2.4	Anslinger: 1998
M-2293	9000 +/- 600	Zone 11, upper St. Albans Horizon	1.7-2.1	Anslinger: 1998
M-1818	7700 +/- 450	Zone 6, Upper LeCroy Horizon	1.0-1.3	Anslinger: 1998
BETA-50422	8720 +/- 250	St. Albans (?) F.2 ('91) Excavation Unit 7N15E	2.5-2.6	Brashler <i>et al.</i> :1992
BETA-50424	8570 +/- 130	St. Albans (?) F.4 ('91) Profile- Area A	2.9-3.0	Brashler <i>et al.</i> :1992
BETA-50723	8160 +/- 100	Kanawha (?) F.8 ('91) Profile Area B	3.6	Brashler <i>et al.</i> :1992
BETA-52904	9110 +/- 120	Profile Area A	3.6	Brashler <i>et al.</i> :1992
PITT-1053	5500 +/- 450	Core Drill 3	4.3-4.4	Brashler <i>et al.</i> :1992
BETA-54201	7930 +/- 90	Unit 3N110W (L.5)	2.05-2.12	Freidin: 1993 pers. comm.
BETA-102187	12,910 +/- 60	D.O.H. Bank stabilization Project	4.8	Anslinger: 1998
BETA-102188	7890 +/- 50	D.O.H. Bank stabilization Project	4.2	Anslinger: 1998

*Depths for Broyles dates are reconstructed from Figure 37 (Broyles, 1971:49)

Table 1. Radiocarbon dates from the St. Albans vicinity (Anslinger, 1998; Brashler, 1993).

The 12,910 $\pm$ 60 B.P. is extremely old considering its depth of 4.7 to 5.4 m. This date comes from an area downstream that was not considered part of the site prior to Anslinger (1998).

Because there is no reason to suspect that this date comes from a reworked sample, this date may represent a deposit from an older landform.

It should be noted that Broyles did not publish seven radiocarbon dates from her site. Apparently these dates were not reported because of the order in which they were returned from two different laboratories; the dates obtained after 1966 being slightly inconsistent with the chronology established from the earlier dates (Brashler and others, 1994; Hemmings, 1985). It has been suggested that Broyles might have only accepted dates that supported a developing trend where occupationally sterile zones separated zones that averaged 80 years occupation (Brashler and others, 1994; Hemmings, 1985). These dates were published later by Anslinger (1998). All but one of the seven dates fit within the age bracket of the reported dates. The seventh date is relatively close in age to this bracket. It appears that the dating of the site was not as consistent as reported by Broyles (1971). Despite the inconsistency, the dating of the sediment sequence as a whole still seems to be legitimate. Moreover, dates obtained from new excavations at the site are in good agreement with Broyles's reported dates.

ALLUVIAL HISTORY

Although local climate was a factor in the development of the Kanawha River low terraces, as proposed by Olafson (1971) and Barlow (1971), an apparent mimicking of alluvial events on the Ohio River suggests that formation of the Kanawha low terraces was largely controlled by preceding events on the Ohio River. Specifically, incision and aggradation events on the Ohio (Rogers, 1990) were responsible for lowering and raising base level of the Kanawha River. The Kanawha River's complex response to these base-level adjustments is the proposed mechanism by which the Kanawha's two lowest terraces formed.

The Ohio River, was responding to dramatic shifts in sediment supply and glacial meltwaters in addition to local climate changes during the glacial advances and retreats. Glacial meltwater brought in large amounts of outwash from completely different terrains and probably produced large floods, perhaps catastrophic jolkulups (Rogers, 1990). Therefore, the Ohio River was experiencing the direct effects a global climatic phenomenon while it was responsible for establishing base level for the Kanawha.

Before 22,000 B.P., the Ohio River incised to a bedrock (fig. 4) elevation of 152 m (498 ft) in the vicinity of Gallipolis Lock and Dam (Rogers, 1990; Kite and others, 1990).

This incision was probably associated with large floods as glaciers advanced into the upper Ohio River basin (Rogers, 1990). Around 22,000 to 21,000 B.P. the full-glacial Ohio River began to experience an aggradation; the thickness would ultimately reach a minimum of 25 m (Rogers, 1990). This aggradation was probably rapid until 19,000-18,000 B.P., when glaciers began to retreat. Although glacial ice was not completely gone from the basin until about 12,900 B.P. (Kite, 1993), the amount of outwash sediment contributed to the basin by this ice may have been insignificant by as early as 14,500 B.P. As the climate became warmer, increasing vegetation may have further stabilized slopes that produced much sediment in the Ohio River Basin (Kite, 1992).

The late Wisconsin aggradation on the Ohio River raised local base-level, causing an aggrading event on the Kanawha River. Perhaps the aggradation on the Kanawha followed that of the Ohio with a lag time in the neighborhood of a few hundred years. This aggradation produced high terraces in both the Ohio and Kanawha Valleys. This aggradation is documented as surface 3 at Gallipolis, Ohio (Fig. 4), which is underlain by 25 m (88 ft) of alluvial fill, the upper most 2.5 m (8 ft) of which are overbank deposits (Rogers, 1990). The corresponding St. Albans terraces are approximately 610 ft in elevation (Fig. 7).

After this aggradational event, the Ohio River experienced 21 m of incision (Fig.4), which was nearly complete before 13,000

B.P. (Rogers,1990). This down-cutting caused a dramatic lowering of Kanawha River base-level, which, in turn, initiated a complex response in the Kanawha River basin. The complex response is best expressed by Schumm (1973), describing observations he made following a base-level lowering on an experimental 9 m x 15 m drainage system:

"Incision occurred first at the mouth of the system, and then progressively upstream, successively rejuvenating tributaries and scouring the alluvium previously deposited in the valley. As erosion progressed upstream, the main channel became a conveyor of upstream sediment in increasing quantities, and the inevitable result was that aggradation occurred in the newly cut channel. However, as the tributaries eventually became adjusted to the new base levels, sediment loads decreased, and a new phase of channel incision occurred."

The 9 m x 15 m "system" in the above quotation is analogous to the Kanawha River; however, it should be noted that although the Ohio River may not have experienced a base-level lowering during the late Quaternary, it did experience much of the same phenomenon. Large scale Ohio River aggradation and incision events were largely the result of variations in glacial sediment and meltwater, rather than base-level changes. Therefore, rejuvenated tributaries must have transported much sediment to the Ohio in response to large scale incision on the Ohio River. So, the Ohio River was probably involved in a different, but similar complex response.

In this complex response to Ohio River incision, incision began at the mouth of the Kanawha as sediment was transported

into and down the actively incising Ohio River. As the incision progressed upstream, more and more tributaries became rejuvenated, producing increasing quantities of sediment. Eventually, the supply of sediment to the Kanawha, from all tributaries enveloped in this response, exceeded transport capacity. The Kanawha system became sediment choked and renewed aggradation slowly began to build the present St. Albans Site terrace. For some time, aggradation probably occurred at the mouth of the Kanawha River, while simultaneously, still under the drive of the previous incision event, headward incision continued at the upstream reaches of the Kanawha. Eventually, the wave of incision that worked its way up the Kanawha would be followed by a wave of deposition that produced the St. Albans terrace.

The effect on the landscape at St. Albans from this series of events was: first, incision of the channel removed much of the underlying support of the late Wisconsin low terrace scarp. As incision progressed, the scarp would begin to slump and cave into the channel, releasing valley alluvium from storage and transporting it downstream. An estimate of the amount of scarp erosion can be established by viewing the amount of late Wisconsin terraces left behind along the valley walls. Assuming most of the distance between the remnants of this terrace was due to the river eroding its scarps; subtracting a channel width comparable to the present day Kanawha River, a maximum value of

650 m to 900 m of scarp erosion is calculated for the St. Albans vicinity (Fig. 9, A&B). These terraces have probably continued to erode until present time due to surficial processes. Additionally, the previous channel width may not have been comparable to the present channel and therefore the actual amount of widening that took place prior to 13,000 B.P. is uncertain. The amount of widening greatly increases downstream from St. Albans and decreases upstream. For example, except for a small remnant of the late Wisconsin terrace near the mouth of the Kanawha River, few remains of the terrace can be found between the mouth and 36 km (22.5 mi) upstream from the mouth. At distances greater than 32 km (20 mi) upstream from St. Albans, the late Wisconsin terrace can not be resolved topographically from the St. Albans terrace.

The lower limit of this incision set the boundary for an unconformity that should exist somewhere in the channel sand deposits seen in the lower portions of core #1 (Plate A). No data are available to support a depth determination for this unconformity. Because the Kanawha River incision was only a response and did not have the large magnitude flooding that is suspected to have aided in the 21 m of Ohio River incision (Rogers, 1990), incision of the Kanawha River during this event would be expected to be significantly less than 21 m. If this incision event was great enough to reach bedrock as proposed

Figure 9. Alluvial history of Kanawha valley at St. Albans.
A. Time - less than 21,000 B.P. greater than 14,500 B.P.
B. Time - less than 14,500 B.P. greater than 12,900 B.P.
C. Time - less than 8,000 B.P.
D. Time - present, channel has incised and an additional
1 to 2 m of sedimentation since time C.

(Barlow, 1971), then all 7.8 m of the channel sand unit underlying the archaeologic site would have to be considered a part of the following aggradational event.

After the incision event was complete a new aggradational event occurred. A radiocarbon date of 12,910 $\pm$ 60 B.P. (Beta-102187) was obtained from the river bank at a depth of 4.8 m, approximately one half a mile downstream from the site (Anslinger, 1998). Because this depth is roughly 4 m above the channel\overbank facies transition that has been established for most of the valley in the St. Albans vicinity including the archaeologic site, this aggradational event must have begun significantly before 12,910 B.P. in order to account for the deposition of this underlying 4 m of overbank sediments and any additional channel facies sediments above the lower limit of the previous incision event. Additionally, dates from this depth at the archaeologic site, approximately one half mile up-stream, would be roughly three thousand years younger. Therefore, this 12,910 $\pm$ B.P. (Beta-102187) date is interpreted to have come from an older and different landform than the landform of the archaeologic site (Fig. 10). Most of the radiocarbon date control for this terrace comes from sediments at, or close to, the present river bank. Therefore, to explain the age discrepancy among the 12,910 $\pm$ 60 (Beta-102187) date and the dates established at the archaeologic site, both of which come from

Figure 10. Possible channel migration that could explain a landform at the St. Albans Site that is younger than the landform that produced radiocarbon date 12,910 +/- 60 B.P. (Beta-102187).

sediments very close to the present river bank: it is interpreted that the sediments of the archaeologic site were deposited later, on the inside of a slight meander bend as the channel migrated to the north. The older, downstream area of the terrace was in a location that did not experience erosion from the channel migrating toward it or experience lateral accretion from the channel moving away from it. Part of the stratigraphy in the older landform was preserved in the present river bank position as the younger sediments of the archaeologic site were deposited during a slight channel migration to the north.

There is an elongated ridge-like feature approximately 150 m to 275 m inland from the present river bank. A 590 ft contour line conveniently outlines this feature (fig. 7). This ridge-like feature may represent the inland expression of the older landform. This ridge-like feature may have been a levee, much like the levee at the archaeologic site. If so, then it appears that at some time during overbank deposition for the St. Albans terrace, the river channel in the St. Albans vicinity was positioned centrally with respect to the valley walls.

Sometime after 12,910 BP, sedimentation on the older landform would have continued as sedimentation began on the new landform. Broyles's (1971) two deepest reported radiocarbon dates for the new landform are 9850 +/- 500 B.P. at 4.8 m - 5.1 m and 8930 +/- 160 B.P. at 3.0 m - 3.24 m. These dates represent

1.83 m of sedimentation that could have occurred in as little as 260 years or up to 1580 years. Using the lowest and highest sedimentation rates that can be calculated from these values, the deposition of the 8.9 m of overbank sediments could have begun as early as 13,750 B.P. or as late as 9,900 B.P.. Both of these dates are probably unrealistic because they represent extremes. Because overbank sedimentation rates at the site appear to be greater at the beginning of overbank deposition, a significant bias toward the 9,900 B.P. date exists.

It appears that the new landform overbank deposition began between 9,900 B.P. and 13,750 B.P. and continued to within 2 m to 3 m of total aggradation by roughly 8,000 B.P.. The remaining aggradation occurred over the last 8,000 years. The depth of this 8,000 B.P. horizon is difficult to determine because up to 6 ft of sediment was removed during construction of Route 60 (Barlow, 1971). Upon visual inspection of the terrain, the amount of this sediment removal was apparently not entirely consistent throughout the site.

The cross-section (Plate A) shows evidence of a possible cut-and-fill structure at depths comparable to the cut and fill structure in Broyles's (1971) excavation (fig. 8). The strata overlying the 12,910 $\pm$ 60 B.P. radiocarbon date also displayed a cut-and-fill structure. These structures may represent the old paths of the small streams that drain from the valley wall. The

deepest part of the first two of these structures occur near the transition where stratigraphy starts to dip away from the river. So they existed as the levee began to form but later changed course. The existence of a levee on the older landform is inconclusive. Before levee formation the floodplain topography probably sloped gradually from the valley wall to the Kanawha channel. The small streams would flow down this gradient in a more direct route to the Kanawha. After the levee developed, these small streams may have become blocked and forced to flow like typical yazoo streams until encountering a weak or low spot in the levee, such as a crevasse splay. In other cases, these streams may have been able to maintain their course by preventing levee build up. Because these small cut-and-fill structures have been discovered in several exposures in the St. Albans vicinity, it is possible that the two significant tributaries that drain from the valley wall produced these cuts because they had to adjust their course several times during aggradation of the terrace levee. Currently, these two tributaries follow highly lateral routes to the Kanawha River. Topographic maps of the valley, show many streams taking these highly lateral routes, while others take more direct routes, bisecting apparent levees.

The resulting overbank deposits of the new landform make up a coarsening-upward sequence up to 9 m thick. Part of the reason that the sequence coarsens-up may be that fines were the first

sediment to be flushed downriver during the new entrenching episode. Also, the overbank surface was building higher, making an ever deepening channel, requiring progressively higher magnitude floods to inundate the floodplain. Higher-magnitude floods had more energy to carry and deposit more coarse sediment. Eventually, the site became a levee. Levee development would further act to confine flood waters that would otherwise quietly spill out onto the floodplain. A confined flood has to compensate restricted cross-sectional channel area by an increase in velocity that would increase energy and competence. Therefore, progressive levee development could result in a coarsening upward overbank sequence. Consequently, silt loam makes up the bulk of the lower portions of the overbank sequence and loam makes up the bulk of the upper portions.

The sediments of the new landform represent roughly 9,900 to 13,750 years of aggradation. Because these sediments display stratigraphy indicating a levee, the sediments must have been deposited in a position immediately adjacent to the river. It appears that the present channel position with respect to its placement between the valley walls has not significantly changed during this time. Therefore, the river system has expended little energy into lateral channel adjustment during the deposition of the new landform. According to Barlow (1971), the channel bottom is approximately 50 ft below the present terrace surface. This

depth is approximately 20 ft below the channel/overbank facies interface and 5 ft above bedrock. The size of the Kanawha River drainage basin at St. Albans is roughly 11,000 square miles (Ward and others, 1997). A typical river channel in an eastern U.S. basin of this size has a bank-full depth of about 25 ft (Dunne and others, 1978). Therefore, as overbank deposition of the newer landform progressed, entrenching into the channel sands that underlie the overbank sediments has produced a channel that is roughly twice as deep as would be expected (Fig. 9,D.) This new episode of entrenching would probably not be as aggressive as the previous episode because it was not being driven by a glacially dictated base-level drop. Instead, part of this incision was in response to a decline in sediment yield. Much of the sediment that had been put into the system from the previous incision event had been put back into valley storage as the new terrace aggraded. The volume of sediment deposited since the beginning of the last aggradation to approximately 8,000 B.P. greatly exceeds that which has been deposited after 8,000 B.P.. The amount of energy the stream had to expend in transporting all of this sediment greatly declined. Also, the channel was established on top of a thick sequence of noncohesive, relatively clean, fine sands, some of the most easily erodible of sediments, according to the Hulstrom diagram. Therefore, the Kanawha River prior to lock and dam construction, probably was experiencing active

Radiocarbon years B.P.	Event
> 8,000 to present	entrenching into channel sands
> 12,900 to present	deposition of overbank sediments
< 14,500 to > 13,000	deposition of channel sands
< 21,000 to > 14,000	incision of Wisconsin terrace
< 22,000 to > 14,000	aggradation of Wisconsin terrace

Table 2. Summary of the geologic history of the St. Albans and Wisconsin terraces, adapted from Rogers (1990).

incision with little lateral channel adjustment.

MAGNETIC SUSCEPTIBILITY

Magnetic susceptibility is "a measure of the degree to which a substance may be magnetized" (Sheriff, 1991). Magnetic susceptibility measurements are made by applying a low-intensity alternating magnetic field and measuring changes in the frequency of this field in response to the magnetic minerals in the sample (Clark, 1990).

Five general causes for high susceptibilities in transported soil are the following:

Fire: The low-oxygen, high-temperature conditions at the base of a fire cause low-susceptibility hematite to alter to high-susceptibility magnetite. Incomplete reoxidation of magnetite during cooling produces intermediate-susceptibility oxides, such as maghemite (Tite and Mullins, 1971).

Fermentation: During decay of organic matter in anaerobic conditions, fermentation can produce intermediate-susceptibility oxides (Tite and Mullins, 1971).

Pedogenesis: Iron sesqueoxides created during pedogenesis include maghemite and other intermediate-susceptibility minerals (Mullins, 1977).

Provenance: Proportions of magnetic minerals differ with changing source-area geology (Tite, 1972; Clark, 1990). Anomalies

of the provenance type may be most useful as marker beds for correlation.

Particle size: Magnetic minerals are not uniformly distributed with respect to particle size. Relationships between susceptibility and particle size vary with mineralogy; quartz-rich sands give low readings, but mafic sands give high susceptibilities.

Buried horizons indicative of soil-profile development were the initial target of the magnetic susceptibility investigations at St. Albans. The magnetic susceptibility meter has proved useful in delineating buried soil horizons in Midwest loess deposits (Lowell, 1991). If the meter could delineate well-developed buried soil profiles at St. Albans, these horizons would have a high probability of containing artifacts due to the long-term stability required for soil-profile development. This stability would allow accumulation of artifacts in concentrated horizons that would be productive for excavation. However, no buried soil horizons were found at the site. The lack of buried soil-profiles could reflect either rapid and consistent sedimentation or the erosion of any soil profiles.

The Bartington MS-2F magnetic susceptibility meter gave high readings on reddened soils that are believed, in most cases, to be cultural fire hearths because of the associated occurrence of charcoal, fire-cracked rock, flint flakes, and artifacts. Most of

these cultural remains occurred in sediments exposed along the river bank or in test pits where exposure was extensive enough to show the lateral extent of a particular hearth.

The cause of high susceptibility readings in the cores is more difficult to verify due to lack of lateral exposure. High readings commonly occur in horizons within the cores lacking reddened soil, charcoal, fire-cracked rock or other cultural associations. The lack of these associations in the cores could be explained by the limited lateral extent of exposure of horizons in the cores. Essentially, the cores only provide a tiny window into the features they penetrate. A core might intersect a horizon in a weakly developed portion of a hearth and thereby give a relatively high reading from a sample that is not visually distinct. Furthermore, a test boring may "just miss" several nearby hearths and give an erroneous impression of sterility of the horizon.

The other causes of high magnetic susceptibilities in transported soils further complicate the picture. Fermentation-caused highs may reflect cultural or noncultural sources depending on the material decaying. Fermentation may have taken place on human waste or natural leaf mats and organic flood debris.

Sediment source area changes could be a factor in the susceptibilities. For example, the iron contained in a source

rock may exist as a stable nonmagnetic silicate that would not easily be converted to a strongly ferrimagnetic iron oxide (Tite, 1972). Conversely, the source rock may contain strongly ferrimagnetic minerals that are high in magnetic susceptibility without the need for conversion (Tite, 1972). However, sediment source area it is not likely to be significant factor at the site because of the relative homogenous appearance of sediments. In other words, no key provenance indicative marker beds seem to occur at the site. Particle size does have a control on the susceptibility of the site's soils, however, this influence is most likely subtle and is not believed to overprint fire-induced susceptibilities in the overbank facies. Gravelly sand, sand and loamy sand textured sediments have notably lower magnetic susceptibility than sandy loam, loam and silt loam textured sediments (Plate A). These more coarse textured sediments are from channel facies that are not significant to the cultural importance of magnetic susceptibility. Because the Kanawha River bedload includes very little mafic sediment, quartz content is the delimiting factor with respect to particle-size control of the susceptibility of the site's sediment. Quartz is the predominant mineral in the coarse sediments at the site. Because quartz contains almost no iron, it is not magnetically susceptible when exposed to high heat. Sediments with more fines and less quartz have more potential to become magnetically

susceptible because there is a greater chance these sediments will have iron-bearing minerals, such as hematite, maghemite and magnetite.

Forest fire is a possible cause of increased magnetic susceptibility at the site. Any reddened soil that does not display some form of cultural relation cannot be confidently assumed to be culturally related. On the other hand, cultures may have engaged in widespread burning. If they did practice widespread burning, there may be no way to distinguish this practice from a natural forest fire as the cause of high-magnetic susceptibility. To be confidently attributed to culture, a hearth should be relatively small, lens shaped, and contain some associated artifacts. A forest fire would be expected to produce an extensive blanket of high magnetically susceptible sediments.

Lowell (unpublished data) has shown that the approximate minimum volume required for the meter to give a full strength reading is a sample that would occupy a typical 35mm film canister. The smaller core samples in this study have a larger diameter than a 35mm film canister, therefore, readings taken on the 2 inch and 3 inch cores should be comparable to those taken on the test pits and riverbank. Because the sediments in the riverbank are somewhat more coarse than the core sediments, background magnetic susceptibility values in the riverbank are a little lower.

Soils at the surface of the site consistently yield high-magnetic susceptibility readings (Plate A). These high readings are the result of soil-profile development and the generation of iron sesquioxides through pedogenesis (Mullins, 1997), and the subsequent horticultural practices upon the soil (Brashler, 1994). The site was used for gardening and fires were built on the soil in the recent past. These practices definitely would increase the magnetic susceptibility of the soil. Below the surface, magnetic susceptibility measurements are as high as 220 CGS units for burnt earth, compared to values of 14 to 30 CGS units for unburnt silty loam, and 10 or less for unburnt sand (Plate A).

All cores show peaks in magnetic susceptibility between 1 m and 7 m depth (Plate A). In most instances, these peaks do not correlate to delineate artifact-bearing horizons, however, many peaks probably reflect recurring occupation of the site. Magnetic susceptibility values tend to decrease below a depth of 4.5 m, in spite of a coarsening upward trend in the overbank alluvium. This tendency may reflect less human activity in older deposits or alteration of magnetic minerals by soil or groundwater. Furthermore, some peaks occur in sediments that appear to have never been burnt. In these cases, reworking, bioturbation or foot traffic through old hearths may have destroyed hearth integrity beyond recognition, or small portions of hearths may have been

transported or dispersed away from the original hearth to the area of sampling. In other cases, as expected of the peak in the bottom of core # 11, iron-rich groundwater precipitates may be responsible for highs not linked to burning. In spite of these complications, most highs in magnetic susceptibility are most likely cultural in origin.

SEDIMENTOLOGIC AND MAGNETIC SUSCEPTIBILITY MODEL

This model links radiocarbon, sedimentological and magnetic susceptibility data for the purpose of aiding archeological investigations of the site. The model will bring together these data to evaluate the cultural resources potential of the site in three dimensions.

In the vertical dimension, levels below the overbank facies are assumed to be completely sterile as these sands have been interpreted to be channel facies. It is doubtful occupation occurred within a channel and any artifacts found there would be reworked from original context. Because the transition from channel to overbank deposition for the new landform is believed to have occurred between 13,750 and 9,900 B.P., it is unlikely that archeological development will lead to discoveries of occupation before this time. In this context, it is suggested that future archeological investigations should not be conducted below 9 to 10 meters as it would be expensive and dangerous to

excavate below the water table in probable sterile sediments.

Of the upper 9 meters of overbank sediments, the upper loam unit is probably going to be the most archeologically productive of the site's stratigraphy. Magnetic susceptibility levels drop off below 4.5 m depth, and this loam unit occupies most of the upper 4.5 m (Plate A). In spite of this trend, magnetic susceptibility peaks do occur much below 4.5 and previous excavations (Broyles, 1971) have discovered artifacts at 5.5 m and a possible hearth at 7.3 m. The deepest occupations are the most interesting because they will tend to put a more specific dating constraint on the initial occupation of the site, while possibly proving the site to be one of the region's deepest and most consistently occupied through time.

In the north-south dimensions, the site's greatest potential most likely occurs at the northernmost extent of the site, in the levee deposits on the south bank of the Kanawha River. Recent riverbank erosion has removed those parts of the terrace that would have been closest to the river during times of occupation in the past. Assuming a desire for proximity to the river during times of occupation, the levee sediments should yield the most artifacts. Also assuming a desire for the highest ground available for reasons of defense and dryness, the levee crest would also be expected to produce the most archeology. Unfortunately, it appears that most of the levee crest has been

lost to erosion. More than 20 ft of riverbank erosion has occurred between the years 1964 and 1974 (Henderson, 1991). Deep or shallow, east or west, the greatest potential for cultural resources occurs in the northernmost limit of the site, the riverbank. However, U.S. Route 60 is precariously close to the present south riverbank (Fig. 7), especially in the western end of the site where a riverbank stabilization project has been completed to increase the stability of this highway. Large-scale riverbank excavations would cause great concern for the endangerment this highway.

In the east-west dimension, magnetic susceptibility trends indicate that great potential exists at both ends of the site. Core #10, taken at the easternmost end of the site, displays the highest average susceptibility for the upper 5 m of all cores taken at the site (Plate A). This end of the site would be expected to produce the most artifacts for the first 5 m interval. Core #11, taken at the western most end of the site, displays high magnetic susceptibility peaks between 6 and 7.5 meters depth. This depth may correlate to a Paleo-Indian time of 10,000 B.P. or earlier (Broyles, 1971). Alternately, the Archaic Kirk interval may be lower at this end because US Route 60 construction did not include scraping this surface. This end of the site has already produced the most Woodland Indian artifacts (Brashler, 1994). The peak in this core below 9 meters is a iron-

oxide precipitate and not of cultural importance.

Core #13 displays the highest magnetic susceptibility peaks just above the channel facies. If this peak is culturally related, this would be an excellent place to excavate to determine the earliest date of occupation. Ironically, this location is adjacent to the Broyles' excavations of the 1960's, which have displayed the deepest occupations identified at the site thus far.

The highest magnetic susceptibility peak of the entire core survey occurs at 2.8 m depth in core #3. This may indicate an archeological "hot spot" worth excavating. This peak correlates well with a hearth found at 2.84 m depth in adjacent square 7N15E.

Because of the lens shape of the hearths, it is unlikely that they can be correlated over long distances. Therefore, unless extremely strong trends develop, high magnetic susceptibility readings are probably only representative of sediments in close proximity to the cores. No trends of this strength seem to appear in the data. The data produced from the magnetic susceptibility meter is probably most useful on a case-by-case basis. Rather than locating a new excavation by interpreting a correlation between cores, new excavations should be located in the exact location from which a core was taken, targeting a specific peak of interest.

DISCUSSION

It cannot be determined from present data how deep the Kanawha River incised during the time between 21,000 B.P. and 14,000 B.P. because the lower sandy unit beneath the St. Albans terrace is not dated. The aggradation on the Kanawha River to form the St. Albans terrace would have probably started at least 1,000 years earlier than 12,910 B.P. to account for the deposition of the 4 m to 12 m of sediment before that date.

A date of 12,940 $\pm$ 90 B.P. was obtained from just above the unconformity that post dates 21 m of incision into surface S3 at Gallipolis (Fig. 4). Because this date was obtained just above the unconformity, deposition of terrace S2 above this unconformity must have begun very close to 12,940 B.P. Therefore, in contrast to the aggradation and following incision of the Kanawha River Wisconsin terrace or reactions to Ohio River events, it appears that the deposition of the St. Albans terrace started independently, well before the deposition of Surface S2 at Gallipolis.

The channel morphology during the aggradation of the St. Albans terrace is still unknown. The "old south channel" proposed by Barlow (1971) is now occupied by the two small tributaries that drain from the south valley wall (Fig. 3). One stream flows eastward, opposite Kanawha flow, and enters the Kanawha upstream from the site, while the other stream flows westward, parallel to

the Kanawha and enters downstream from the site. According to Barlow (1971), these streams flow in the depression conveniently created by the "old south channel"(Fig. 3). Barlow (1971), proposed that the "old south channel" has since been blocked because one of the streams that drain from the valley wall dumped its bed load in the "old south channel."

Evidence from this study suggests that the site was not an island during the Holocene, but simply a vertically accreting floodplain that eventually developed a levee. For the site to have been an island, the river would have split in an area upstream from the site that is bounded by Wisconsin terraces. The location of these terraces would require the river to split around the upstream end of the island such that the proposed second, now-abandoned channel would have made a nearly right angle bend (Fig. 3). This would give the channel a highly unnatural morphology. Although the island hypothesis cannot be disproved with existing data, most evidence suggests the site was a levee and the proposed "old south channel" (Barlow, 1971) was a slough inundated only by flooding and possibly maintained by tributary stream erosion.

Barlow (1971) and Olafson (1971) theorize that climate in the Kanawha drainage basin is the primary control on the development of the Kanawha low terraces. These authors explain Kanawha terraces formed by adjusting to changes in the climate

caused by the advance and retreat of glaciers to the north. In these theories, the principal mechanisms for terrace development are the changes in sediment supply and stream flow related to temperature and precipitation within the Kanawha drainage basin in reaction to the global glaciation events.

If the Kanawha River were instead a tributary to a non-glacially influenced trunk, as it is today, then climate local to Kanawha drainage could be a significant control. The opinion that nearby regional glaciation could change the climate of a drainage basin enough to impose a new dictating, geomorphic control should not be denied, but recommended for basins not draining into rivers under such great glacial influence. Under unaltered flow, local climate has probably become a greater geomorphic control on the St. Albans landscape now that the Ohio River is relieved of further glacial influence and made major adjustments to past glacial influence.

Archeological sites have great potential in aiding Quaternary geochronology studies. The fact that ancient peoples inhabited the St. Albans Site accounts for most of the radiocarbon dates obtained from the site. Ancient people built the fires that produced most of the dateable charcoal. Although, archeological sites do not always occur at localities of geologic interest, any new archeological sites occurring in alluvial valleys within the Appalachian Plateaus will add pieces

to the regional Quaternary puzzle.

The Bartington MS-2F magnetic susceptibility meter appears to be a useful but limited prospecting tool. The tool would probably be of little use in shallow excavations but more valuable when applied to cores at deep sites where excavations can be expensive and dangerous. The tool might also be used in test pits to detect buried soil horizons that might yield artifacts that have accumulated during periods stable to erosion or sedimentation. Although no excavations have been done at the exact location of the cores to investigate the cause of high magnetic susceptibility readings, it appears that at least one test pit feature occurs at the same level that produced high readings in each of two adjacent cores. Because most of the test pits were excavated prior to the magnetic susceptibility reading of the cores, the real success of this instrument as a predictor of occupational layers is still largely untested. If this meter is used as a predevelopment investigative tool at deep stratified sites, excavation time and cost might be saved if productive strata are identified. It is highly suggested that some future St. Albans test pits be located at the exact core locations with the intent to discover if magnetic susceptibility highs are archeologically meaningful and to further test the applicability of the meter.

Cultural fires probably are the main cause of high magnetic

susceptibility readings at the site but apparently fires are not uniformly distributed over the site. Core drilling can just miss nearby cultural fire hearths and return no signal of occupation. Conversely, wild fires might return magnetic susceptibility highs that are mistaken for cultural signals. Cultures may even have engaged in setting forest fires. The spatial geometry of fire-caused magnetic susceptibility highs is poorly understood because evidence comes from cores and excavation faces and not excavation floors. How these highs are affected by weathering, pedogenesis, bioturbation and the reworking by flood waters and foot traffic needs more study.

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Textural analysis data for St. Albans

SAMPLE	DEPTH(FT)		PIPETTE COLOR (WET CLAY)		OTHER NOTES	
	HUE		V/ C			
	TOP	BOT.			DRY WT.	
CD	1	2.90	3.10	10 YR	6 6	47.51
CD	1	6.85	6.95	10 YR	5 4	18.88
CD	1	8.30	8.40	10 YR	5 4	18.43
CD	1	13.05	13.15	10 YR	6 4	34.35
CD	1	19.70	19.80	10 YR	6 6	16.13
CD	1	20.70	20.80	10 YR	6 4	57.29
CD	1	27.35	27.45	10 YR	6 6	15.13
CD	1	29.00	29.20	10 YR	5 8	60.54 2000ml GC
CD	1	31.80	32.00	10 YR	6 4	86.09
CD	1	34.00	35.50	10 YR	6 8	77.99
CD	1	43.50	44.00	10 YR	6 6	69.41
CD	1	49.90	51.10	10 YR	5 3	79.52
CD	1	53.40	53.60	2.5 Y	5 4	81.42
CD	2	1.55	1.65	10 YR	5 6	38.08
CD	2	3.25	3.45	10 YR	5 6	69
CD	2	7.10	7.20	10 YR	5 6	34.01
CD	2	9.82	9.95	10 YR	5 6	44.98
CD	2	15.35	15.45	10 YR	6 6	29.94
CD	2	21.42	21.52	10 YR	6 6	32.26
CD	2	27.65	27.80	10 YR	6 6	18.51
CD	3	2.35	2.75	10 YR	3 2	77.39
CD	3	3.90	4.00	10 YR	5 6	24.46
CD	3	5.12	5.30	10 YR	5 6	39.68
CD	3	9.54	9.63	10 YR	5 6	25.32
CD	3	10.70	10.80			31.93
CD	3	12.90	13.00			37.21
CD	3	18.70	18.82	10 YR	6 6	20.37
CD	3	20.60	20.70			31.57
CD	3	24.68	24.80			37.14
CD	3	29.45	29.60			33.92
CD	4	3.30	3.42	10 YR	4 4	69.06
CD	4	6.91	6.96	10 YR	5 6	30.3
CD	4	7.05	7.15			34.04
CD	4	11.63	11.77	5 YR	5 6	35.77 color
CD	4	18.90	19.00	5 YR	5 6	30.72 by
CD	4	22.48	22.62	7.5 YR	6 6	33.21 kieth
CD	4	23.10	23.22	5 YR	5 6	26.92 "
CD	6	2.55	2.75	5 YR	6 6	82.86 "
CD	6	4.87	5.00	7.5 YR	5 6	29.44 "
CD	6	11.70	11.90	10 YR	5 6	48.16
CD	6	13.80	13.90	10 YR	6 4	33.01
CD	6	15.90	16.00	10 YR	5 6	32.07
CD	6	16.63	16.83	10 YR	6 4	33.93
CD	6	20.60	20.80	10 YR	5 4	39.05
CD	6	23.10	23.25	10 YR	5 4	37.31
CD	7	1.18	1.32	10 YR	6 6	30.03
CD	7	5.35	5.50	10 YR	5 4	23.56

Assumptions: 20 ml pipette, 1000 ml grad cylinder										
RAW DRY SIEVE DATA										
RAW PIPE										
ENG	| .GVL. |	| .....	SAND.....	|	|	|	|	|	|	.....SILT...
SCS	| ..GRAVEL..	| .....	SAND.....	|	|	|	|	|	|	.....SILT
GEO	| ..GRAVEL..	| .....	SAND.....	|	|	|	|	|	|	.....SILT...
	>4.75	4.75-								
PHI	mm	2.00mm	-1-0	0-1	1-2	2-3	3-4	*4-5*	5-6	
	GVL	FGVL	VCSD	CSD	MSd	FSd	VFSd	VCSt	CSt	
CD#	DEPTH(FT)									
1	2.9	0.00	0.03	0.07	0.39	14.07	15.93	5.60	0.2800	0.2100
1	6.9	0.00	0.00	0.00	0.03	1.71	2.46	3.20	0.2400	0.1800
1	8.3	0.00	0.04	0.05	0.02	0.03	0.38	2.29	0.3600	0.2900
1	13.1	0.00	0.00	0.00	0.01	0.05	1.95	7.31	0.4800	0.3800
1	19.7	0.00	0.00	0.02	0.01	0.01	0.19	1.46	0.3300	0.3000
1	20.7	0.00	0.00	0.00	0.02	0.1	2.39	6.03	0.5500	0.4500
1	27.4	0.00	0.00	0.00	0.01	0.06	0.69	1.21	0.3200	0.2900
1	29.0	0.00	0.00	0.19	4.39	19.97	4.77	3.08	0.2900	0.2400
1	31.8	0.00	0.35	1.47	20.25	51.16	8.16	1.60	0.1100	0.1000
1	34.0	0.20	0.34	1.33	12.21	48.28	9.06	2.12	0.1200	0.0900
1	43.5	1.33	0.24	0.74	5.44	35.68	12.96	3.75	0.2300	0.1800
1	49.9	0.75	0.82	3.32	11.64	34.2	13.28	2.80	0.2800	0.2400
1	53.4	24.42	4.18	2.86	10.49	18.45	8.25	3.71	0.2000	0.1500
2	1.6	0.00	0.00	0.00	0.04	2.35	4.78	5.67	0.5058	0.4154
2	3.3	0.00	0.00	0.00	0.27	19.6	24.97	7.58	0.3226	0.2827
2	7.1	0.00	0.00	0.00	0.00	0.08	1.65	6.14	0.4984	0.4393
2	9.8	0.00	0.00	0.00	0.00	0.08	11.59	12.71	0.4214	0.3289
2	15.4	0.00	0.00	0.00	0.00	0.01	0.72	4.73	0.4975	0.4084
2	21.4	0.00	0.00	0.00	0.00	0.14	3.79	5.17	0.4545	0.4017
2	27.7	0.00	0.00	0.00	0.00	0.01	0.08	0.74	0.3801	0.3442
3	2.4	0.00	0.00	0.00	1.28	36.86	23.97	4.95	0.2200	0.1700
3	3.9	0.00	0.00	0.00	0.00	0.28	2.48	4.75	0.3420	0.2802
3	5.1	0.00	0.00	0.00	0.00	0.13	1.41	7.41	0.5300	0.4700
3	9.5	0.00	0.00	0.00	0.00	0.05	1.96	6.44	0.3240	0.2638
3	10.7	0.00	0.00	0.00	0.01	0.03	2.98	8.50	0.3938	0.3208
3	12.9	0.00	0.00	0.00	0.00	0.08	4.11	6.41	0.5552	0.4590
3	18.7	0.00	0.00	0.00	0.00	0	0.1	2.23	0.3643	0.3093
3	20.6	0.00	0.00	0.00	0.00	0.01	0.5	3.42	0.5515	0.4817
3	24.7	0.00	0.00	0.00	0.00	0.03	3.58	7.25	0.5273	0.4358
3	29.5	0.00	0.00	0.02	0.01	0.22	3.31	6.67	0.4515	0.3986
4	3.3	0.00	0.00	0.00	0.24	22.37	27.81	7.77	0.2236	0.1869
4	8.9	0.00	0.00	0.00	0.00	0.04	1.31	5.78	0.4644	0.3728
4	7.1	0.00	0.00	0.01	0.03	0.09	2.60	6.84	0.4889	0.3999
4	11.6	0.00	0.00	0.00	0.00	0.09	7.17	8.77	0.4437	0.3614
4	18.9	0.00	0.00	0.00	0.00	0.01	0.37	3.30	0.5938	0.5213
4	22.5	0.00	0.00	0.00	0.00	0.19	4.36	6.09	0.5077	0.4154
4	23.1	0.00	0.00	0.08	0.03	0.03	0.47	1.78	0.5447	0.4856
6	2.6	0.00	0.00	0.00	0.27	26.49	35.54	9.15	0.2657	0.2214
6	4.9	0.00	0.00	0.00	0.01	0.33	1.72	5.67	0.4904	0.3873
6	11.7	0.00	0.00	0.00	0.00	0.20	10.04	13.19	0.5134	0.3883
6	13.8	0.00	0.00	0.00	0.01	0.07	5.00	9.31	0.3811	0.3122
6	15.9	0.00	0.00	0.00	0.00	0.04	0.93	4.61	0.5440	0.4689
6	16.6	0.00	0.00	0.00	0.00	0.07	2.82	6.04	0.5260	0.4308
6	20.6	0.00	0.00	0.02	0.01	0.20	5.45	8.40	0.5187	0.4145
6	23.1	0.00	0.00	0.00	0.00	0.03	1.56	6.98	0.5935	0.4873
7	1.2	0.00	0.00	0.02	0.03	1.26	3.52	4.40	0.4200	0.3400
7	5.4	0.00	0.00	0.00	0.01	0.05	1.06	3.91	0.3919	0.3190

nder										
TTE DATA					DERIVATIVE PIPE					
.....|					ENG	SILT.....				
.....|					SCS	WT.	SILT..			
.....|					GEO	DISP.	SILT...			
					1+AM66+|					
6-7	7-8	8-9	9-10	>10	PHI	20ml	*4-5*	5-6	6-7	
MSt	FSt	VFSt	CCl	FCl			VCSt	CSt	MSt	
CD# DEPTH										
0.1900	0.1900	0.1100	0.1000	0.1200	1	2.9	0.06	3.5	1 0	
0.1400	0.1200	0.1100	0.1100	0.1200	1	6.9	0.03	3	2 1	
0.2500	0.2000	0.1600	0.1500	0.0700	1	8.3	0.06	3.5	2 2.5	
0.3200	0.2600	0.2000	0.1500	0.1000	1	13.1	0.03	5	3 3	
0.2400	0.2000	0.1800	0.1500	0.1300	1	19.7	0.06	1.5	3 2	
0.3600	0.2900	0.2400	0.1900	0.1500	1	20.7	0.06	5	4.5 3.5	
0.2500	0.2000	0.1600	0.1200	0.0800	1	27.4	0.06	1.5	2 2.5	
0.2000	0.1500	0.1200	0.1000	0.0800	1	29.0	0.015	5	4 5	
0.1100	0.1000	0.0800	0.0900	0.1300	1	31.8	0.06	0.5	-0.5 0.5	
0.0800	0.0700	0.0600	0.0500	0.0500	1	34.0	0.03	1.5	0.5 0.5	
0.1700	0.1400	0.1200	0.1000	0.0900	1	43.5	0.06	2.5	0.5 1.5	
0.1900	0.1300	0.1100	0.1000	0.0600	1	49.9	0.03	2	2.5 3	
0.1000	0.0800	0.0600	0.0600	0.0400	1	53.4	0.03	2.5	2.5 1	
0.3489	0.2795	0.2285	0.1886	0.1546	2	1.6	0.03	4.52	3.325 3.47	
0.2381	0.2000	0.1683	0.1427	0.1190	2	3.3	0.03	1.995	2.23 1.905	
0.3563	0.2731	0.2155	0.1735	0.1444	2	7.1	0.03	2.955	4.15 4.16	
0.2719	0.2277	0.1906	0.1608	0.1370	2	9.8	0.03	4.625	2.85 2.21	
0.3309	0.2295	0.2008	0.1661	0.1443	2	15.4	0.03	4.455	3.875 5.07	
0.3284	0.2581	0.2071	0.1664	0.1364	2	21.4	0.03	2.64	3.665 3.515	
0.2969	0.2331	0.1815	0.1442	0.1202	2	27.7	0.03	1.795	2.365 3.19	
0.1300	0.1300	0.1000	0.0800	0.0900	3	2.4	0.03	2.5	2 0	
0.2327	0.1862	0.1518	0.1233	0.1057	3	3.9	0.03	3.09	2.375 2.325	
0.3600	0.2800	0.2300	0.1800	0.1500	3	5.1	0.03	3	5.5 4	
0.2164	0.1744	0.1383	0.1113	0.0903	3	9.5	0.03	3.01	2.37 2.1	
0.2498	0.2019	0.1605	0.1331	0.1135	3	10.7	0.03	3.65	3.55 2.395	
0.3560	0.2545	0.2043	0.1630	0.1345	3	12.9	0.03	4.81	5.15 5.075	
0.2509	0.2048	0.1569	0.1250	0.0993	3	18.7	0.03	2.75	2.92 2.305	
0.4018	0.3107	0.2429	0.1927	0.1602	3	20.6	0.03	3.49	3.995 4.555	
0.3505	0.2745	0.2176	0.1749	0.1458	3	24.7	0.03	4.575	4.265 3.8	
0.3207	0.2464	0.1932	0.1577	0.1321	3	29.5	0.03	2.645	3.895 3.715	
0.1564	0.1277	0.1033	0.0845	0.0665	4	3.3	0.03	1.835	1.525 1.435	
0.3030	0.2267	0.1706	0.1338	0.1122	4	6.9	0.03	4.58	3.49 3.815	
0.3226	0.2435	0.1911	0.1538	0.1179	4	7.1	0.03	4.45	3.865 3.955	
0.2937	0.2365	0.1981	0.1653	0.1462	4	11.6	0.03	4.115	3.385 2.86	
0.4258	0.3319	0.2674	0.2087	0.1769	4	18.9	0.03	3.625	4.775 4.695	
0.3487	0.2787	0.2339	0.1931	0.1641	4	22.5	0.03	4.615	3.335 3.5	
0.4097	0.3244	0.2558	0.2037	0.1732	4	23.1	0.03	2.955	3.795 4.265	
0.1880	0.1586	0.1376	0.1186	0.1019	6	2.6	0.03	2.215	1.67 1.47	
0.3138	0.2528	0.2126	0.1788	0.1547	6	4.9	0.03	5.155	3.675 3.05	
0.3065	0.2438	0.1970	0.1616	0.1345	6	11.7	0.03	6.255	4.09 3.135	
0.2517	0.1991	0.1783	0.1384	0.1164	6	13.8	0.03	3.445	3.025 2.63	
0.3767	0.2852	0.2228	0.1781	0.1452	6	15.9	0.03	3.755	4.61 4.575	
0.3474	0.2695	0.2368	0.1727	0.1434	6	16.6	0.03	4.76	4.17 3.895	
0.3299	0.2590	0.2107	0.1732	0.1430	6	20.6	0.03	5.21	4.23 3.545	
0.3978	0.3036	0.2404	0.1902	0.1553	6	23.1	0.03	5.31	4.475 4.71	
0.2800	0.2300	0.1900	0.1500	0.1200	7	1.2	0.03	4	3 2.5	
0.2565	0.1984	0.1636	0.1292	0.1148	7	5.4	0.03	3.645	3.125 2.905	

FTE DATA: INTERVAL				CALCULATED PARTICLE SIZE DISTR								
.....	.....	.....	.....	ENG	.GVL.	.....	SAND	.....	.....	.....	.....	.....
.....	.....	.....	CLAY	SCS	.....	GRAVEL	.....	SAND	.....	.....	.....	.....
.....	.....	.....	CLAY	GEO	.....	GRAVEL	.....	SAND	.....	.....	.....	.....
#				>4.75 4.75-								
7-8	8-9	9-10	>10	PHI	mm	2.0 mm	-1-0	0-1	1-2	2-3	3-4	*4-5*
FSt	VFSt	CCl	FCI		GVL	FINEGVL	VCSd	CSD	MSd	FSd	VFSD	VCSt
4	0.5	-1	3			0 0.063145	0.1473	0.8209	29.615	33.53	11.787	8.2509
0.5	0	-0.5	4.5			0	0	0 0.1589	9.0572	13.03	16.949	21.081
2	0.5	4	0.5			0 0.217037	0.2713	0.1085	0.1628	2.0619	12.425	22.355
3	2.5	2.5	3.5			0	0	0 0.0291	0.1456	5.6769	21.281	21.921
1	1.5	1	3.5			0	0 0.124	0.062	0.062	1.1779	9.0515	15.127
2.5	2.5	2	4.5			0	0	0 0.0349	0.1746	4.1718	10.525	51.056
2	2	2	1			0	0	0 0.0661	0.3966	4.5605	7.9974	10.972
3	2	2	6.5			0	0 0.3138	7.2514	32.986	7.8791	5.0875	9.3162
1	-0.5	-2	3.5			0 0.406551	1.7075	23.522	59.426	9.4785	1.8585	1.2777
0.5	0.5	0	1			0.2564	0.435953	1.7053	15.656	61.905	11.617	2.7183
1	1	0.5	1.5			1.9162	0.345772	1.0661	7.8375	51.405	18.672	5.4027
1	0.5	2	1.5			0.9432	1.031187	4.1751	14.638	43.008	16.7	3.5211
1	0	1	0.5			29.993	5.133874	3.5127	12.884	22.66	10.133	4.5566
2.55	1.995	1.7	6.23			0	0	0 0.105	6.1712	12.553	14.89	15.678
1.585	1.28	1.185	4.45			0	0	0 0.3913	28.406	36.188	10.986	5.7174
2.88	2.1	1.455	5.72			0	0	0 0.2352	4.8515	18.054	16.686	
1.855	1.49	1.19	5.35			0	0	0 0.1779	25.767	28.257	12.572	
1.435	1.735	1.09	5.715			0	0	0 0.0334	2.4048	15.798	18.57	
2.55	2.035	1.5	5.32			0	0	0 0.434	11.748	16.026	14.182	
2.58	1.865	1.2	4.51			0	0	0 0.054	0.4322	3.9978	10.643	
1.5	1	-0.5	3			0	0	0 1.654	47.629	30.973	6.3962	4.3029
1.72	1.425	0.88	3.785			0	0	0 1.1447	10.139	19.419	18.152	
2.5	2.5	1.5	6			0	0	0 0.3276	3.5534	18.674	22.001	
1.805	1.35	1.05	3.015			0	0	0 0.1975	7.7409	25.434	20.458	
2.07	1.37	0.98	4.175			0	0	0 0.0313	0.094	9.3329	26.621	18.384
2.51	2.065	1.425	5.225			0	0	0 0.215	11.045	17.227	13.867	
2.395	1.595	1.285	3.465			0	0	0 0	0 0.4909	10.947	20.005	
3.39	2.51	1.625	6.51			0	0	0 0.0317	1.5838	10.833	16.012	
2.845	2.135	1.455	5.79			0	0	0 0.0808	9.6392	19.521	16.128	
2.66	1.775	1.28	5.105			0	0 0.059	0.0295	0.6486	9.7583	19.664	15.507
1.22	0.94	0.9	1.825			0	0	0 0.3475	32.392	40.269	11.251	4.3802
2.805	1.84	1.08	4.11			0	0	0 0.132	4.3234	19.076	19.901	
2.62	1.865	1.795	4.395			0	0 0.0294	0.0881	0.2644	7.6381	20.094	17.553
1.92	1.64	0.955	5.81			0	0	0 0.2516	20.045	24.518	8.8622	
3.225	2.935	1.59	7.345			0	0	0 0.0326	1.2044	10.742	8.0566	
2.24	2.04	1.45	6.705			0	0	0 0.5721	13.129	18.338	9.9368	
3.43	2.605	1.525	7.16			0	0 0.2972	0.1114	0.1114	1.7459	6.6122	6.5007
1.05	0.95	0.835	3.595			0	0	0 0.3259	31.97	42.892	11.043	2.2206
2.01	1.69	1.205	6.235			0	0	0 0.034	1.1209	5.8424	19.26	13.06
2.34	1.77	1.355	5.225			0	0	0 0.4153	20.847	27.388	14.151	
1.04	1.995	1.1	4.32			0	0	0 0.0303	0.2121	15.147	28.204	13.663
3.12	2.235	1.645	5.76			0	0	0 0.1247	2.8999	14.375	14.172	
1.635	3.205	1.465	5.67			0	0	0 0.2063	8.3112	17.801	14.618	
2.415	1.875	1.51	5.65			0	0 0.0512	0.0256	0.5122	13.956	21.511	14.712
3.16	2.51	1.745	6.265			0	0	0 0.0804	4.1812	18.708	15.746	
2	2	1.5	4.5			0	0 0.0666	0.0999	4.1958	11.722	14.652	17.649
1.74	1.72	0.72	4.24			0	0	0 0.0424	0.2122	4.4992	16.596	17.317

IBUTIONS						CUMULATIVE PARTICL						
.....SILT.....|.....CLAY.....|						ENG|.GVL.|	.....SAND.....					
.....SILT.....|.CLAY|						SCS|.....G|RAVEL...|	.....SAND.....					
.....SILT.....|.....CLAY.....|						GEO|.....G RAVEL...|	.....SAND.....					
						# >4.75 4.75-						
5-6	6-7	7-8	8-9	9-10	>10	PHI	mm	2.0 mm	-1-0	0-1	1-2	2-3
CSt	MSt	FSt	VFSt	CCl	FCl		GVL	FINEGVL	VCSd	CSd	MSd	FSd
2.1048	0	8.4193	1.0524	-2.105	6.3145		0	0.063145	0.2105	1.0314	30.646	64.176
10.593	5.2966	2.6483		0	-2.648	23.835	0	0	0	0.1589	9.2161	22.246
10.852	13.565	10.852	2.713	21.704	2.713		0	0.217037	0.4883	0.5969	0.7596	2.8215
8.7336	8.7336	8.7336	7.278	7.278	10.189		0	0	0	0.0291	0.1747	5.8515
18.599	12.399	6.1996	9.2994	6.1996	21.699		0	0	0.124	0.186	0.248	1.4259
7.8548	6.1093	4.3638	4.3638	3.491	7.8548		0	0	0	0.0349	0.2095	4.3812
13.219	16.523	13.219	13.219	13.219	6.6094		0	0	0	0.0661	0.4627	5.0231
6.6072	8.259	4.9554	3.3036	3.3036	10.737		0	0	0.3138	7.5652	40.552	48.431
-0.581	0.5808	1.1616	-0.581	-2.323	4.0655		0	0.406551	2.1141	25.636	85.062	94.541
0.6411	0.6411	0.6411	0.6411		0	1.2822	0.2564	0.692396	2.3977	18.054	79.959	91.576
0.7204	2.1611	1.4407	1.4407	0.7204	2.1611		1.9162	2.261922	3.3281	11.166	62.57	81.242
3.1439	3.7726	1.2575	0.6288	2.5151	1.8863		0.9432	1.974346	6.1494	20.787	63.795	80.495
3.0705	1.2282	1.2282		0	1.2282	0.6141	29.993	35.1265	38.639	51.523	74.183	84.316
8.7316	9.1124	6.6964	5.239	4.4643	16.36		0	0	0	0.105	6.2763	18.829
3.2319	2.7609	2.2971	1.8551	1.7174	6.4493		0	0	0	0.3913	28.797	64.986
12.202	12.232	8.4681	6.1747	4.2782	16.819		0	0	0	0	0.2352	5.0867
6.3361	4.9133	4.1241	3.3126	2.6456	11.894		0	0	0	0	0.1779	25.945
12.943	16.934	4.7929	5.7949	3.6406	19.088		0	0	0	0	0.0334	2.4382
11.361	10.896	7.9045	6.3081	4.6497	16.491		0	0	0	0	0.434	12.182
12.777	17.234	13.938	10.076	6.483	24.365		0	0	0	0	0.054	0.4862
2.5843	0	1.9382	1.2922	-0.646	3.8765		0	0	0	1.654	49.283	80.256
9.7097	9.5053	7.0319	5.8258	3.5977	15.474		0	0	0	0	1.1447	11.284
13.861	10.081	6.3004	6.3004	3.7802	15.121		0	0	0	0	0.3276	3.881
9.3602	8.2938	7.1288	5.3318	4.1469	11.908		0	0	0	0	0.1975	7.9384
11.118	7.5008	6.4829	4.2906	3.0692	13.075		0	0	0	0.0313	0.1253	9.4582
13.84	13.639	6.7455	5.5496	3.8296	14.042		0	0	0	0	0.215	11.26
14.335	11.316	11.757	7.8301	6.3083	17.01		0	0	0	0	0	0.4909
12.654	14.428	10.738	7.9506	5.1473	20.621		0	0	0	0	0.0317	1.6155
11.484	10.232	7.6602	5.7485	3.9176	15.59		0	0	0	0	0.0808	9.72
11.483	10.952	7.842	5.2329	3.7736	15.05		0	0	0.059	0.0884	0.737	10.495
2.2082	2.0779	1.7666	1.3611	1.3032	2.6426		0	0	0	0.3475	32.74	73.009
11.518	12.591	9.2574	6.0726	3.5644	13.564		0	0	0	0	0.132	4.4554
11.354	11.619	7.6968	5.4788	5.2732	12.911		0	0	0.0294	0.1175	0.3819	8.02
9.4632	7.9955	5.3676	4.5848	2.6698	16.243		0	0	0	0	0.2516	20.296
15.544	15.283	10.498	9.554	5.1758	23.91		0	0	0	0	0.0326	1.237
10.042	10.539	6.745	6.1427	4.3662	20.19		0	0	0	0	0.5721	13.701
14.097	15.843	12.741	9.6768	5.6649	26.597		0	0	0.2972	0.4086	0.5201	2.266
2.0154	1.7741	1.2672	1.1465	1.0077	4.3386		0	0	0	0.3259	32.295	75.187
12.483	10.36	6.8274	5.7405	4.0931	21.179		0	0	0	0.034	1.1549	6.9973
8.4925	6.5096	4.8588	3.6752	2.8135	10.849		0	0	0	0	0.4153	21.262
9.1639	7.9673	3.1506	6.0436	3.3323	13.087		0	0	0	0.0303	0.2424	15.389
14.375	14.266	9.7287	6.9691	5.1294	17.961		0	0	0	0	0.1247	3.0246
12.29	11.48	4.8187	9.4459	4.3177	16.711		0	0	0	0	0.2063	8.5175
10.832	9.0781	6.1844	4.8015	3.8668	14.469		0	0	0.0512	0.0768	0.589	14.545
11.994	12.624	8.4696	6.7274	4.677	16.792		0	0	0	0	0.0804	4.2616
9.99	8.325	6.66	6.66	4.995	14.985		0	0	0.0666	0.1665	4.3623	16.084
13.264	12.33	7.3854	7.3005	3.056	17.997		0	0	0	0.0424	0.2547	4.7538

E SIZE DISTRIBUTIONS											
.....|.....SILT.....|....CLAY.....|										%	
.....|.....SILT.....|....CLAY|										TOTAL	
...|.....SILT.....|....CLAY.....|								METH	PIP-	SAMPLE	
								OF	ETTE	LOST	
3-4	4-5	5-6	6-7	7-8	8-9	9-10	>10	DIFF		SOME-	
VFSd	VCSt	CSt	MSt	FSt	VFSt	CCl	FCl	VCSt	VCSt	WHERE	
75.963	84.214	86.319	86.319	94.738	95.79	93.686	100	8.2509	7.3669	0.9	
39.195	60.275	70.869	76.165	78.814	78.814	76.165	100	21.081	15.89	5.2	
15.247	37.602	48.454	62.018	72.87	75.583	97.287	100	22.355	18.991	3.4	
27.132	49.054	57.787	66.521	75.255	82.533	89.811	100	21.921	14.556	7.4	
10.477	25.604	44.203	56.603	62.802	72.102	78.301	100	15.127	9.2994	5.8	
14.907	65.963	73.817	79.927	84.29	88.654	92.145	100	51.056	8.7275	42.3	
13.02	23.992	37.211	53.734	66.953	80.172	93.391	100	10.972	9.9141	1.1	
53.518	62.834	69.442	77.701	82.656	85.96	89.263	100	9.3162	8.259	1.1	
96.399	97.677	97.096	97.677	98.838	98.258	95.934	100	1.2777	0.5808	0.7	
94.294	96.153	96.794	97.436	98.077	98.718	98.718	100	1.8592	1.9233	-0.1	
86.645	91.356	92.076	94.237	95.678	97.119	97.839	100	4.7111	3.6018	1.1	
84.017	86.796	89.94	93.712	94.97	95.599	98.114	100	2.7792	2.5151	0.3	
88.873	92.631	95.701	96.93	98.158	98.158	99.386	100	3.7583	3.0705	0.7	
33.718	49.396	58.128	67.24	73.936	79.175	83.64	100	15.678	11.87	3.8	
75.971	81.688	84.92	87.681	89.978	91.833	93.551	100	5.7174	2.8913	2.8	
23.14	39.827	52.029	64.261	72.729	78.903	83.181	100	16.686	8.6886	8.0	
54.202	66.774	73.11	78.024	82.148	85.46	88.106	100	12.572	10.282	2.3	
18.236	36.807	49.749	66.683	71.476	77.271	80.912	100	18.57	14.88	3.7	
28.208	42.39	53.751	64.647	72.551	78.859	83.509	100	14.182	8.1835	6.0	
4.4841	15.127	27.904	45.138	59.076	69.152	75.635	100	10.643	9.6975	0.9	
86.652	90.955	93.539	93.539	95.477	96.77	96.124	100	4.3029	3.2304	1.1	
30.703	48.855	58.565	68.07	75.102	80.928	84.526	100	18.152	12.633	5.5	
22.555	44.556	58.417	68.498	74.798	81.099	84.879	100	22.001	7.5605	14.4	
33.373	53.831	63.191	71.485	78.614	83.945	88.092	100	20.458	11.888	8.6	
36.079	54.463	65.581	73.082	79.565	83.855	86.925	100	18.384	11.431	7.0	
28.487	42.354	56.195	69.833	76.579	82.128	85.958	100	13.867	12.927	0.9	
11.438	31.443	45.778	57.094	68.851	76.681	82.99	100	20.005	13.5	6.5	
12.449	28.461	41.115	55.543	66.281	74.232	79.379	100	16.012	11.055	5.0	
29.241	45.369	56.852	67.084	74.744	80.493	84.41	100	16.128	12.318	3.8	
30.159	45.666	57.149	68.101	75.943	81.176	84.95	100	15.507	7.7978	7.7	
84.26	88.64	90.849	92.926	94.693	96.054	97.357	100	4.3802	2.6571	1.7	
23.531	43.432	54.95	67.541	76.799	82.871	86.436	100	19.901	15.116	4.8	
28.114	45.667	57.021	68.64	76.337	81.816	87.089	100	17.553	13.073	4.5	
44.814	53.676	63.14	71.135	76.503	81.088	83.757	100	8.8622	11.504	-2.6	
11.979	20.036	35.579	50.863	61.361	70.915	76.09	100	8.0566	11.8	-3.7	
32.039	41.975	52.017	62.556	69.301	75.444	79.81	100	9.9368	13.896	-4.0	
8.8782	15.379	29.476	45.319	58.061	67.738	73.403	100	6.5007	10.977	-4.5	
86.23	88.45	90.466	92.24	93.507	94.654	95.661	100	2.2206	2.6732	-0.5	
26.257	39.317	51.8	62.16	68.988	74.728	78.821	100	13.06	17.51	-4.4	
48.65	62.801	71.294	77.803	82.662	86.337	89.151	100	14.151	12.988	1.2	
43.593	57.255	66.419	74.387	77.537	83.581	86.913	100	13.663	10.436	3.2	
17.399	31.572	45.946	60.212	69.941	76.91	82.039	100	14.172	11.709	2.5	
26.319	40.937	53.227	64.707	69.525	78.971	83.289	100	14.618	14.029	0.6	
36.056	50.768	61.601	70.679	76.863	81.665	85.531	100	14.712	13.342	1.4	
22.97	38.716	50.71	63.334	71.804	78.531	83.208	100	15.746	14.232	1.5	
30.736	48.385	58.375	66.7	73.36	80.02	85.015	100	17.649	13.32	4.3	
21.35	38.667	51.931	64.261	71.647	78.947	82.003	100	17.317	15.471	1.8	

MAJOR SIZE CLASSES

MAJOR SIZE CLASSES

MAJOR SIZE CLASSES
EXCLUDING GRAVEL

ENGINEERING SIZE BREAKS

GEOLOGY SIZE BREAKS

GEOL SIZE BREAKS

GRAVEL	SAND	SILT	CLAY	GRAVEL	SAND	SILT	CLAY	SAND	SILT	CLAY
0	73.794	21.72	4.486	0.06314	75.9	19.827	4.2096	75.9478	19.84	4.2123
0	36.076	42.737	21.186		0	39.195	39.619	21.186	39.1949	39.619
0	12.961	61.91	25.129	0.21704	15.03	60.336	24.417	15.0625	60.468	24.47
0	23.217	57.405	19.379		0	27.132	55.4	17.467	27.1325	55.4
0	8.8119	60.847	30.341		0	10.477	61.624	27.898	10.4774	61.624
0	12.97	74.538	12.492		0	14.907	73.748	11.346	14.9066	73.748
0	11.549	65.151	23.3		0	13.02	67.151	19.828	13.0205	67.151
0	52.582	32.51	14.908		0	53.518	32.441	14.04	53.5183	32.441
0	96.057	2.353	1.5898	0.40655	95.993	1.8585	1.7424	96.3844	1.8661	1.7495
0.25644	93.538	4.7554	1.4506	0.6924	93.602	4.4236	1.2822	94.2544	4.4545	1.2912
1.91615	83.734	11.09	3.2598	2.26192	84.383	10.474	2.8814	86.3355	10.716	2.9481
0.94316	82.426	12.065	4.5665	1.97435	82.042	11.582	4.4014	83.6947	11.815	4.4901
29.9926	58.041	10.124	1.8423	35.1265	53.746	9.2852	1.8423	82.8474	14.313	2.8398
0	30.979	46.821	22.2		0	33.718	45.457	20.825	33.7185	45.457
0	73.95	17.396	8.6539		0	75.971	15.862	8.1667	75.971	15.862
0	19.818	57.463	22.718		0	23.14	55.763	21.097	23.1403	55.763
0	49.003	35.588	15.41		0	54.202	31.258	14.54	54.2019	31.258
0	15.33	60.42	24.251		0	18.236	59.035	22.729	18.2365	59.035
0	25.26	51.943	22.797		0	28.208	50.651	21.141	28.2083	50.651
0	3.7485	62.757	33.494		0	4.4841	64.668	30.848	4.48406	64.668
0	85.475	10.955	3.5697		0	86.652	10.118	3.2304	86.652	10.118
0	27.13	52.268	20.602		0	30.703	50.225	19.072	30.7032	50.225
0	19.119	60.325	20.556		0	22.555	58.543	18.901	22.5554	58.543
0	28.693	53.852	17.455		0	33.373	50.573	16.055	33.3728	50.573
0	31.181	51.548	17.272		0	36.079	47.776	16.145	36.0789	47.776
0	25.317	55.354	19.329		0	28.487	53.641	17.872	28.487	53.641
0	9.4241	65.201	25.375		0	11.438	65.243	23.319	11.4384	65.243
0	10.455	61.689	27.856		0	12.449	61.783	25.768	12.4485	61.783
0	25.649	53.334	21.017		0	29.241	51.252	19.507	29.2407	51.252
0	26.541	53.261	20.198		0	30.159	51.017	18.824	30.1592	51.017
0	82.19	13.507	4.3033		0	84.26	11.794	3.9458	84.2601	11.794
0	20.021	61.255	18.724		0	23.531	59.34	17.129	23.5314	59.34
0	24.417	55.96	19.623		0	28.114	53.702	18.184	28.114	53.702
0	40.303	39.581	20.117		0	44.814	36.273	18.912	44.8141	36.273
0	10.003	58.403	31.594		0	11.979	58.936	29.085	11.9792	58.936
0	28.664	45.167	26.169		0	32.039	43.406	24.556	32.0385	43.406
0	7.6615	57.535	34.804		0	8.8782	58.86	32.262	8.87816	58.86
0	84.198	10.155	5.6475		0	86.23	8.4238	5.3464	86.2298	8.4238
0	22.713	50.508	26.779		0	26.257	48.471	25.272	26.2568	48.471
0	43.611	41.761	14.628		0	48.65	37.687	13.663	48.6503	37.687
0	38.403	43.59	18.006		0	43.593	39.988	16.419	43.5929	39.988
0	14.754	60.325	24.92		0	17.399	59.51	23.09	17.3994	59.51
0	23.043	53.447	23.509		0	26.319	52.653	21.029	26.3189	52.653
0	32.098	48.305	19.596		0	36.056	45.608	18.335	36.0563	45.608
0	19.527	57.237	23.236		0	22.97	55.562	21.469	22.9697	55.562
0	28.04	50.231	21.729		0	30.736	49.284	19.98	30.7359	49.284
0	18.296	58.734	22.97		0	21.35	57.598	21.053	21.3497	57.598

MAJOR SIZE CLASSES
EXCLUDING GRAVEL

USDA-SCS SIZES			SCS	CD #	DEPTH	
SAND	SILT	CLAY	SIZE CLASS		ft	meters
79.1437	14.538	6.3184	LOAMY SAND	1	2.90	0.884
47.3551	28.81	23.835	LOAM	1	6.85	2.088
23.7348	73.546	2.7189	SILT LOAM	1	8.30	2.53
35.6182	54.193	10.189	SILT LOAM	1	13.05	3.978
16.333	61.968	21.699	SILT LOAM	1	19.70	6.005
34.6702	57.475	7.8548	SILT LOAM	1	20.70	6.309
17.2676	76.123	6.6094	SILT LOAM	1	27.35	8.336
57.1246	32.139	10.737	SANDY LOAM	1	29.00	8.839
96.881	-0.963	4.0821	SAND	1	31.80	9.693
94.9791	3.7298	1.2912	SAND	1	34.00	10.36
88.2014	9.5875	2.2111	SAND	1	43.50	13.26
84.7922	13.284	1.9243	LOAMY SAND	1	49.90	15.21
85.09	13.963	0.9466	GRAVELY SAND	1	53.40	16.28
39.7872	43.853	16.36	LOAM	2	1.55	0.472
78.1842	15.367	6.4493	LOAMY SAND	2	3.25	0.991
29.5995	53.582	16.819	SILT LOAM	2	7.10	2.164
59.0685	29.037	11.894	SANDY LOAM	2	9.82	2.993
25.425	55.487	19.088	SILT LOAM	2	15.35	4.679
33.698	49.811	16.491	LOAM	2	21.42	6.529
8.60389	67.031	24.365	SILT LOAM	2	27.65	8.428
88.3177	7.8059	3.8765	SAND	3	2.35	0.716
37.7298	46.796	15.474	LOAM	3	3.90	1.189
31.072	53.807	15.121	SILT LOAM	3	5.12	1.561
41.2921	46.8	11.908	LOAM	3	9.54	2.908
43.1953	43.729	13.075	LOAM	3	10.70	3.261
33.8549	52.103	14.042	SILT LOAM	3	12.90	3.932
19.1822	63.807	17.01	SILT LOAM	3	18.70	5.7
18.6467	60.732	20.621	SILT LOAM	3	20.60	6.279
35.4839	48.926	15.59	LOAM	3	24.68	7.522
36.1619	48.788	15.05	LOAM	3	29.45	8.976
85.9556	11.402	2.6426	SAND	4	3.30	1.006
31.235	55.201	13.564	SILT LOAM	4	6.91	2.106
34.9086	52.18	12.911	SILT LOAM	4	7.05	2.149
48.2446	35.513	16.243	LOAM	4	11.63	3.545
15.0979	60.993	23.91	SILT LOAM	4	18.90	5.761
35.885	43.925	20.19	LOAM	4	22.48	6.852
11.3946	62.008	26.597	SILT LOAM	4	23.10	7.041
87.0894	8.572	4.3386	SAND	6	2.55	0.777
31.3125	47.509	21.179	LOAM	6	4.87	1.484
54.128	35.023	10.849	SANDY LOAM	6	11.70	3.566
48.8816	38.031	13.087	LOAM	6	13.80	4.206
22.8854	59.154	17.961	SILT LOAM	6	15.90	4.846
31.9776	51.312	16.711	SILT LOAM	6	16.63	5.069
41.7513	43.78	14.469	LOAM	6	20.60	6.279
29.0651	54.143	16.792	SILT LOAM	6	23.10	7.041
37.5678	47.447	14.985	LOAM	7	1.18	0.36
28.0533	53.95	17.997	SILT LOAM	7	5.35	1.631

CD	7	8.47	8.65	10 YR	5	4	47.56	
CD	7	10.25	10.40	10 YR	6	6	69.8	2000ml GC
CD	7	12.60	12.77	10 YR	5	4	27.06	
CD	7	19.33	19.47	10 YR	6	6	35.98	
CD	7	21.12	21.28	10 YR	6	6	27.21	
CD	7	22.84	22.98	10 YR	6	6	33.79	
CD	7	24.35	24.45	10 YR	6	6	25.9	
CD	7	27.55	27.80	10 YR	6	6	98.11	
CD	8	2.82	3.08	10 YR	3	2	78.45	
CD	8	6.80		10 YR	5	4	35.6	
CD	8	11.10		10 YR	5	4	38.16	
CD	8	15.07	15.30	10 YR	5	4	38.06	
CD	8	21.10		10 YR	5	4	27.43	
CD	8	23.60		10 YR	5	4	38.84	
CD	9	1.50		10 YR	5	4	27	
CD	9	3.20		10 YR	5	4	44.38	
CD	9	5.90		10 YR	5	4	37.53	
CD	9	9.38	9.50	10 YR	5	6	58.48	
CD	9	12.90	13.20	10 YR	5	6	55.58	
CD	9	13.10		10 YR	5	4	38.79	
CD	9	23.20		10 YR	5	4	39.8	
CD	9	27.08	27.2	10 YR	6	6	30.73	
CD	9	31.20	31.35	10 YR	6	6	88.34	
CD	10	1.30		10 YR	4	3	48.82	
CD	10	6.40		10 YR	5	4	43.37	
CD	10	13.15		10 YR	5	4	27.1	
CD	10	16.38		10 YR	5	4	30.39	
CD	10	17.25		10 YR	5	4	53.01	
CD	10	18.80		10 YR	5	6	27.8	
CD	10	19.70		10 YR	5	4	41.65	
CD	10	20.80		10 YR	5	6	24.08	
CD	10	24.10		10 YR			29.99	
CD	11	3.90		10 YR	4	4	72.39	
CD	11	7.30		10 YR	5	4	38.14	
CD	11	8.85		10 YR	5	4	50.48	
CD	11	10.60		10 YR	5	4	37.88	
CD	11	16.50		10 YR	5	4	45.59	
CD	11	20.80		10 YR	5	4	41.63	
CD	11	25.35		10 YR	5	4	35.28	
CD	11	27.55		10 YR	5	4	35.89	
CD	12	0.60		10 YR	5	3	34.05	2000 ml GC
CD	12	3.40		10 YR	7	4	41.07	
CD	12	9.55		10 YR	5	4	30.89	
CD	12	11.45		10 YR	6	4	38.36	
CD	12	15.30		10 YR	6	6	37.01	
CD	12	21.40		10 YR	6	6	60.79	
CD	12	24.55		10 YR	6	3	48.86	
CD	12	25.80		10 YR	4	3	81.87	
CD	13	4.65		10 YR	6	4	36.37	
CD	13	8.60		10 YR	5	6	34.02	
CD	13	13.40		10 YR	5	4	40.37	
CD	13	15.80		10 YR	5	6	45.29	
CD	13	19.15		10 YR	5	4	50.37	
CD	13	21.55		10 YR	5	4	66.78	
CD	13	21.80		10 YR	5	6	29.97	
CD	13	24.80		10 YR	6	6	33.15	

7	8.5	0.00	0.00	0.00	0.01	5.03	18.47	6.66	0.3664	0.3027
7	10.3	0.00	0.00	0.00	0.03	5.09	20.91	11.11	0.3000	0.2500
7	12.6	0.00	0.00	0.02	0.08	0.07	3	6.95	0.3581	0.2924
7	19.3	0.00	0.00	0.00	0.01	0.12	3.39	7.34	0.5232	0.4243
7	21.1	0.00	0.00	0.00	0.00	0.01	1.05	4.82	0.4300	0.3700
7	22.8	0.00	0.00	0.01	0.01	0.08	5.44	6.53	0.4400	0.3600
7	24.4	0.00	0.00	0.00	0.00	0.02	0.33	2.03	0.4900	0.4200
7	27.6	0.00	0.04	0.46	10.18	64.39	13.13	2.02	0.1800	0.1600
8	2.8	0.00	0.00	0.00	0.74	38.04	28.12	4.62	0.1659	0.1361
8	6.8	0.00	0.00	0.00	0.01	0.72	2.6	7.15	0.5204	0.4180
8	11.1	0.00	0.00	0.00	0.00	0.08	3.84	8.83	0.5471	0.4269
8	15.1	0.00	0.00	0.00	0.00	0.11	4.66	9.27	0.5055	0.4119
8	21.1	0.00	0.00	0.00	0.00	0.11	1.15	2.15	0.5017	0.4335
8	23.6	0.00	0.00	0.00	0.00	0.08	5.45	9.01	0.5041	0.3969
9	1.5	0.00	0.00	0.00	0.02	0.83	2.73	4.91	0.4058	0.3220
9	3.2	0.00	0.00	0.00	0.00	0.64	6.5	10.88	0.5473	0.4248
9	5.9	0.00	0.00	0.00	0.00	0.15	3	8.50	0.5409	0.4263
9	9.4	0.00	0.00	0.02	0.03	0.38	11.13	15.54	0.6100	0.4400
9	12.9	0.00	0.00	0.00	0.01	0.19	11.07	15.71	0.5400	0.4300
9	13.1	0.00	0.00	0.00	0.00	0.1	2.32	6.09	0.6297	0.5323
9	23.2	0.00	0.00	0.00	0.00	0.17	6.9	9.61	0.4691	0.3833
9	27.1	0.00	0.00	0.00	0.00	0.13	2.26	3.65	0.5009	0.4280
9	31.2	0.00	0.11	0.52	12.20	53.42	15.57	2.03	0.1100	0.0900
10	1.3	0.00	0.00	0.00	0.02	2.34	13.12	11.22	0.4496	0.3630
10	6.4	0.00	0.00	0.00	0.00	0.74	6.54	9.66	0.5394	0.4440
10	13.2	0.00	0.00	0.00	0.00	0.07	1.01	2.90	0.4931	0.4201
10	16.4	0.00	0.00	0.00	0.00	0.05	1.92	3.06	0.5299	0.4718
10	17.3	0.00	0.00	0.00	0.01	4.97	26.41	4.88	0.3692	0.3227
10	18.8	0.00	0.00	0.00	0.01	0.03	0.67	2.40	0.5255	0.4561
10	19.7	0.00	0.00	0.00	0.02	3.43	16.62	7.01	0.3154	0.2563
10	20.8	0.00	0.00	0.00	0.00	0.04	0.5	1.25	0.4683	0.4247
10	24.1	0.00	0.00	0.00	0.00	0.14	1.41	3.81	0.5211	0.4346
11	3.9	0.00	0.00	0.00	1.82	37.87	20.22	4.10	0.1905	0.1606
11	7.3	0.00	0.00	0.00	0.02	0.56	4.7	10.15	0.4813	0.3675
11	8.9	0.00	0.00	0.00	0.06	2.84	7.2	10.24	0.6336	0.4967
11	10.6	0.00	0.00	0.00	0.00	0.06	4.49	9.04	0.5016	0.3965
11	16.5	0.00	0.00	0.00	0.00	0.57	10.99	11.53	0.4736	0.3797
11	20.8	0.00	0.00	0.00	0.00	0.06	1.71	4.78	0.7060	0.6012
11	25.4	0.00	0.00	0.00	0.00	0.06	2.51	7.15	0.5132	0.4366
11	27.6	0.00	0.00	0.00	0.00	0.02	0.77	2.91	0.6551	0.5886
12	0.6	1.83	1.37	0.39	0.38	0.69	0.94	1.69	0.2756	0.2420
12	3.4	0.00	0.00	0.13	0.42	0.2	0.45	1.56	0.7751	0.7293
12	9.6	0.00	0.08	0.16	0.11	0.1	0.21	0.91	0.6143	0.5747
12	11.5	0.00	0.03	0.35	0.36	0.31	0.72	1.17	0.7289	0.6917
12	15.3	0.00	0.00	0.00	0.02	0.04	0.58	3.99	0.6662	0.5790
12	21.4	0.00	0.00	0.00	0.00	3.48	25.17	11.86	0.4245	0.3368
12	24.6	0.00	0.00	0.00	0.00	0.03	0.31	2.82	0.9221	0.7829
12	25.8	0.00	0.07	0.40	6.92	40.77	18.21	5.55	0.2270	0.1794
13	4.7	0.00	0.00	0.00	0.00	1.05	9.71	8.46	0.3470	0.2818
13	8.6	0.00	0.00	0.00	0.00	0.01	1.54	5.43	0.5526	0.4631
13	13.4	0.00	0.17	0.00	0.00	0.04	2.58	6.59	0.6562	0.5236
13	15.8	0.00	0.00	0.00	0.00	0.1	7.09	12.01	0.5453	0.4338
13	19.2	0.00	0.00	0.00	0.00	0.01	0.53	3.61	0.9425	0.8401
13	21.6	0.00	0.00	0.00	0.02	1.87	29.67	7.90	0.5645	0.4930
13	21.8	0.00	0.00	0.00	0.00	0.07	2.42	1.56	0.5127	0.4776
13	24.8	0.00	0.00	0.00	0.00	0.02	0.9	3.19	0.5716	0.5320

0.2488	0.1961	0.1597	0.1307	0.1087	7	8.5	0.03	3.185	2.695	2.635
0.2200	0.1600	0.1300	0.1000	0.0900	7	10.3	0.015	5	3	6
0.2323	0.1794	0.1496	0.1163	0.0991	7	12.6	0.03	3.285	3.005	2.645
0.3333	0.2585	0.2091	0.1635	0.1429	7	19.3	0.03	4.945	4.55	3.74
0.2900	0.2300	0.1800	0.1500	0.1300	7	21.1	0.03	3	4	3
0.3000	0.2400	0.2000	0.1500	0.1200	7	22.8	0.03	4	3	3
0.3500	0.2600	0.2000	0.1600	0.1400	7	24.4	0.03	3.5	3.5	4.5
0.1500	0.1500	0.1500	0.1300	0.1300	7	27.6	0.03	1	0.5	0
0.1135	0.0947	0.0798	0.0658	0.0567	8	2.8	0.03	1.49	1.13	0.94
0.3303	0.2601	0.2155	0.1757	0.1512	8	6.8	0.03	5.12	4.385	3.51
0.3359	0.2706	0.2243	0.1862	0.1617	8	11.1	0.03	6.01	4.55	3.265
0.3260	0.2510	0.1992	0.1600	0.1336	8	15.1	0.03	4.68	4.295	3.75
0.3538	0.2742	0.2189	0.1771	0.1500	8	21.1	0.03	3.41	3.985	3.98
0.3257	0.2533	0.2081	0.1715	0.1473	8	23.6	0.03	5.36	3.56	3.62
0.2603	0.2117	0.1790	0.1686	0.1324	9	1.5	0.03	4.19	3.085	2.43
0.3326	0.2603	0.2122	0.1722	0.1475	9	3.2	0.03	6.125	4.61	3.615
0.3340	0.2612	0.2149	0.1752	0.1488	9	5.9	0.03	5.73	4.615	3.64
0.3700	0.2900	0.2400	0.1700	0.1800	9	9.4	0.03	8.5	3.5	4
0.3600	0.2700	0.2200	0.1700	0.1300	9	12.9	0.03	5.5	3.5	4.5
0.4232	0.3274	0.2603	0.2096	0.1783	9	13.1	0.03	4.87	5.455	4.79
0.3046	0.2405	0.1975	0.1612	0.1376	9	23.2	0.03	4.29	3.935	3.205
0.3496	0.2674	0.2045	0.1576	0.1275	9	27.1	0.03	3.645	3.92	4.11
0.0700	0.0700	0.0500	0.0500	0.0500	9	31.2	0.03	1	1	0
0.2953	0.2444	0.2087	0.1775	0.1483	10	1.3	0.03	4.33	3.385	2.545
0.3686	0.3010	0.2475	0.2042	0.1703	10	6.4	0.03	4.77	3.77	3.38
0.3461	0.2709	0.2163	0.1749	0.1410	10	13.2	0.03	3.65	3.7	3.76
0.4038	0.3265	0.2651	0.2122	0.1726	10	16.4	0.03	2.905	3.4	3.865
0.2829	0.2430	0.2106	0.1810	0.1552	10	17.3	0.03	2.325	1.99	1.995
0.3788	0.2993	0.2409	0.1970	0.1631	10	18.8	0.03	3.47	3.865	3.975
0.2204	0.1819	0.1559	0.1343	0.1129	10	19.7	0.03	2.955	1.795	1.925
0.3490	0.2488	0.1878	0.1511	0.1248	10	20.8	0.03	2.18	3.785	5.01
0.3517	0.2703	0.2164	0.1802	0.1512	10	24.1	0.03	4.325	4.145	4.07
0.1389	0.1187	0.1043	0.0941	0.0854	11	3.9	0.03	1.495	1.085	1.01
0.2887	0.2318	0.1930	0.1605	0.1365	11	7.3	0.03	5.69	3.94	2.845
0.3985	0.3172	0.2595	0.2158	0.1793	11	8.9	0.03	6.845	4.91	4.065
0.3148	0.2487	0.2035	0.1688	0.1429	11	10.6	0.03	5.255	4.085	3.305
0.3061	0.2440	0.2022	0.1716	0.1452	11	16.5	0.03	4.695	3.68	3.105
0.4788	0.3661	0.2869	0.2331	0.1904	11	20.8	0.03	5.24	6.12	5.635
0.3501	0.2720	0.2166	0.1802	0.1501	11	25.4	0.03	3.83	4.325	3.905
0.4799	0.3518	0.2726	0.2168	0.1762	11	27.6	0.03	3.325	5.435	6.405
0.2011	0.1517	0.1215	0.0920	0.0752	12	0.6	0.015	3.36	4.09	4.94
0.6344	0.5168	0.4157	0.3249	0.2710	12	3.4	0.03	2.29	4.745	5.88
0.5114	0.4089	0.3191	0.2406	0.1944	12	9.6	0.03	1.98	3.165	5.125
0.6150	0.4940	0.3882	0.2828	0.2300	12	11.5	0.03	1.86	3.835	6.05
0.4721	0.3699	0.2956	0.2406	0.2007	12	15.3	0.03	4.36	5.345	5.11
0.2745	0.2253	0.1913	0.1629	0.1422	12	21.4	0.03	4.385	3.115	2.46
0.5833	0.4290	0.3334	0.2660	0.2239	12	24.6	0.03	6.96	9.98	7.715
0.1478	0.1189	0.1016	0.0821	0.0696	12	25.8	0.03	2.38	1.58	1.445
0.2318	0.1870	0.1551	0.1335	0.1154	13	4.7	0.03	3.26	2.5	2.24
0.3646	0.2807	0.2231	0.1808	0.1512	13	8.6	0.03	4.475	4.925	4.195
0.4244	0.3318	0.2685	0.2203	0.1866	13	13.4	0.03	6.63	4.96	4.63
0.3450	0.2673	0.2162	0.1774	0.1491	13	15.8	0.03	5.575	4.44	3.885
0.6741	0.5103	0.3880	0.3021	0.2455	13	19.2	0.03	5.12	8.3	8.19
0.4075	0.3181	0.2505	0.2020	0.1879	13	21.6	0.03	3.575	4.275	4.47
0.3948	0.3014	0.2352	0.1884	0.1598	13	21.8	0.03	1.755	4.14	4.67
0.4372	0.3423	0.2673	0.2135	0.1810	13	24.8	0.03	1.98	4.74	4.745

1.82	1.45	1.1	3.935	0	0	0	0.021	10.576	38.835	14.003	7.8953
3	3	1	7.5	0	0	0	0.043	7.2923	29.957	15.917	13.123
1.49	1.665	0.86	3.455	0	0	0.0739	0.2956	0.2587	11.086	25.684	14.117
2.47	2.28	1.03	5.645	0	0	0	0.0278	0.3335	9.4219	20.4	15.022
2.5	1.5	1	5	0	0	0	0	0.0368	3.8589	17.714	15.913
2	2.5	1.5	4.5	0	0	0.0296	0.0296	0.2368	16.099	19.325	15.448
3	2	1	5.5	0	0	0	0	0.0772	1.2741	7.8378	15.521
0	1	0	5	0	0.040771	0.4689	10.376	65.63	13.383	2.0589	1.4168
0.745	0.7	0.455	1.335	0	0	0	0.9433	48.489	35.844	5.8891	2.0714
2.23	1.99	1.225	6.06	0	0	0	0.0281	2.0225	7.3034	20.084	16.067
2.315	1.905	1.225	6.585	0	0	0	0	0.2096	10.063	23.139	14.583
2.59	1.96	1.32	5.18	0	0	0	0	0.289	12.244	24.356	12.94
2.765	2.09	1.355	6	0	0	0	0	0.401	4.1925	7.8381	14.017
2.26	1.83	1.21	5.865	0	0	0	0	0.206	14.032	23.198	15.332
1.635	0.52	1.81	5.12	0	0	0	0.0741	3.0741	10.111	18.185	14.481
2.405	2	1.235	5.875	0	0	0	0	1.4421	14.646	24.516	14.917
2.315	1.985	1.32	5.94	0	0	0	0	0.3997	7.9936	22.649	16.16
2.5	3.5	-0.5	7.5	0	0	0.0342	0.0513	0.6498	19.032	26.573	18.605
2.5	2.5	2	5	0	0	0	0.018	0.3418	19.917	28.266	15.473
3.355	2.535	1.565	7.415	0	0	0	0	0.2578	5.9809	15.7	13.315
2.15	1.815	1.18	5.38	0	0	0	0	0.4271	17.337	24.146	13.706
3.145	2.345	1.505	4.875	0	0	0	0	0.423	7.3544	11.878	15.587
1	0	0	1	0	0.124519	0.5886	13.81	60.471	17.625	2.2979	1.6867
1.785	1.56	1.46	5.915	0	0	0	0.041	4.7931	26.874	22.982	11.204
2.675	2.165	1.695	7.015	0	0	0	0	1.7062	15.08	22.273	13.212
2.73	2.07	1.695	5.55	0	0	0	0	0.2583	3.7269	10.701	13.339
3.07	2.645	1.98	7.13	0	0	0	0	0.1645	6.3179	10.069	10.76
1.62	1.48	1.29	6.26	0	0	0	0.0189	9.3756	49.821	9.2058	3.9709
2.92	2.195	1.695	6.655	0	0	0	0.036	0.1079	2.4101	8.6331	12.176
1.3	1.08	1.07	4.145	0	0	0	0.048	8.2353	39.904	16.831	7.8151
3.05	1.835	1.315	4.74	0	0	0	0	0.1661	2.0764	5.191	10.61
2.695	1.81	1.45	6.06	0	0	0	0	0.4668	4.7016	12.704	14.672
0.72	0.51	0.435	2.77	0	0	0	2.5142	52.314	27.932	5.6638	2.5556
1.94	1.625	1.2	5.325	0	0	0	0.0524	1.4683	12.323	26.612	15.299
2.885	2.185	1.825	7.465	0	0	0	0.1189	5.626	14.263	20.285	13.481
2.26	1.735	1.295	5.645	0	0	0	0	0.1584	11.853	23.865	15.747
2.09	1.53	1.32	5.76	0	0	0	0	1.2503	24.106	25.291	11
3.96	2.69	2.135	8.02	0	0	0	0	0.1441	4.1076	11.482	15.662
2.77	1.82	1.505	6.005	0	0	0	0	0.1701	7.1145	20.266	14.824
3.96	2.79	2.03	7.31	0	0	0	0	0.0557	2.1454	8.1081	11.87
3.02	2.95	0.84	6.02	5.3744	4.023495	1.1454	1.116	2.0264	2.7606	4.9633	11.924
5.055	4.54	5.39	12.05	0	0	0.3165	1.0226	0.487	1.0957	3.7984	8.1446
4.49	3.925	2.31	8.22	0	0.258983	0.518	0.3561	0.3237	0.6798	2.9459	6.7498
5.29	5.27	2.64	10	0	0.078206	0.9124	0.9385	0.8081	1.877	3.0501	6.0871
3.715	2.75	1.995	8.535	0	0	0	0.054	0.1081	1.5671	10.781	13.321
1.7	1.42	1.035	5.61	0	0	0	0	5.7246	41.405	19.51	8.1263
4.78	3.37	2.105	9.695	0	0	0	0	0.0614	0.6345	5.7716	16.486
0.865	0.975	0.625	1.98	0	0.085501	0.4886	8.4524	49.798	22.243	6.779	3.0292
1.595	1.08	0.905	4.27	0	0	0	0	2.887	26.698	23.261	12.538
2.88	2.115	1.48	6.06	0	0	0	0	0.0294	4.5267	15.961	15.829
3.165	2.41	1.685	7.83	0	0.421105	0	0	0.0991	6.3909	16.324	15.63
2.555	1.94	1.415	5.955	0	0	0	0	0.2208	15.655	26.518	13.027
6.115	4.295	2.83	10.775	0	0	0	0	0.0199	1.0522	7.167	11.346
3.38	2.425	0.705	7.895	0	0	0	0.0299	2.8002	44.429	11.83	6.2444
3.31	2.34	1.43	6.49	0	0	0	0	0.2336	8.0747	5.2052	11.812
3.75	2.69	1.625	7.55	0	0	0	0	0.0603	2.7149	9.6229	11.885

5.6665	5.5404	3.8267	3.0488	2.3129	8.2738	0	0	0	0.021	10.597	49.432
4.298	8.596	4.298	4.298	1.4327	10.745	0	0	0	0.043	7.3352	37.292
11.105	9.7746	5.5063	6.153	3.1781	12.768	0	0	0.0739	0.3695	0.6282	11.715
12.646	10.395	6.8649	6.3369	2.8627	15.689	0	0	0	0.0278	0.3613	9.7832
14.7	11.025	9.1878	5.5127	3.6751	18.376	0	0	0	0	0.0368	3.8956
8.8784	8.8784	5.9189	7.3986	4.4392	13.318	0	0	0.0296	0.0592	0.2959	16.395
13.514	17.375	11.583	7.722	3.861	21.236	0	0	0	0	0.0772	1.3514
0.5096	0	0	1.0193	0	5.0963	0	0.040771	0.5096	10.886	76.516	89.899
1.4404	1.1982	0.9496	0.8923	0.58	1.7017	0	0	0	0.9433	49.433	85.277
12.317	9.8596	6.264	5.5899	3.441	17.022	0	0	0	0.0281	2.0506	9.3539
11.923	8.5561	6.0666	4.9921	3.2102	17.256	0	0	0	0	0.2096	10.273
11.285	9.8529	6.805	5.1498	3.4682	13.61	0	0	0	0	0.289	12.533
14.528	14.51	10.08	7.6194	4.9398	21.874	0	0	0	0	0.401	4.5935
9.1658	9.3203	5.8187	4.7116	3.1153	15.1	0	0	0	0	0.206	14.238
11.426	9	6.0556	1.9259	6.7037	18.963	0	0	0	0.0741	3.1481	13.259
10.388	8.1456	5.4191	4.5065	2.7828	13.238	0	0	0	0	1.4421	16.088
12.297	9.6989	6.1684	5.2891	3.5172	15.827	0	0	0	0	0.3997	8.3933
5.985	6.8399	4.275	5.985	-0.855	12.825	0	0	0.0342	0.0855	0.7353	19.767
6.2972	8.0964	4.498	4.498	3.5984	8.996	0	0	0	0.018	0.3598	20.277
14.063	12.349	8.6491	6.5352	4.0345	19.116	0	0	0	0	0.2578	6.2387
9.8869	8.0528	5.402	4.5603	2.9648	13.518	0	0	0	0	0.4271	17.764
12.756	13.375	10.234	7.631	4.8975	15.864	0	0	0	0	0.423	7.7774
1.132	0	1.132	0	0	1.132	0	0.124519	0.7132	14.523	74.994	92.619
6.9336	5.213	3.6563	3.1954	2.9906	12.116	0	0	0	0.041	4.8341	31.708
8.6926	7.7934	6.1679	4.9919	3.9082	16.175	0	0	0	0	1.7062	16.786
13.653	13.875	10.074	7.6384	6.2546	20.48	0	0	0	0	0.2583	3.9852
11.188	12.718	10.102	8.7035	6.5153	23.462	0	0	0	0	0.1645	6.4824
3.754	3.7634	3.056	2.7919	2.4335	11.809	0	0	0	0.0189	9.3945	59.215
13.903	14.299	10.504	7.8957	6.0971	23.939	0	0	0	0.036	0.1439	2.554
4.3097	4.6218	3.1212	2.593	2.569	9.952	0	0	0	0.048	8.2833	48.187
15.718	20.806	12.666	7.6204	5.461	19.684	0	0	0	0	0.1661	2.2425
13.821	13.571	8.9863	6.0353	4.8349	20.207	0	0	0	0	0.4668	5.1684
1.4988	1.3952	0.9946	0.7045	0.6009	3.8265	0	0	0	2.5142	54.828	82.76
10.33	7.4594	5.0865	4.2606	3.1463	13.962	0	0	0	0.0524	1.5207	13.844
9.7266	8.0527	5.7151	4.3284	3.6153	14.788	0	0	0	0.1189	5.7448	20.008
10.784	8.7249	5.9662	4.5803	3.4187	14.902	0	0	0	0	0.1584	12.012
8.0719	6.8107	4.5843	3.356	2.8954	12.634	0	0	0	0	1.2503	25.356
14.701	13.536	9.5124	6.4617	5.1285	19.265	0	0	0	0	0.1441	4.2517
12.259	11.069	7.8515	5.1587	4.2659	17.021	0	0	0	0	0.1701	7.2846
15.143	17.846	11.034	7.7738	5.6562	20.368	0	0	0	0	0.0557	2.2012
12.012	14.508	8.8693	8.6637	4.9339	17.68	5.3744	9.397944	10.543	11.659	13.686	16.446
11.553	14.317	12.308	11.054	6.562	29.34	0	0	0.3165	1.3392	1.8262	2.9218
10.246	16.591	14.535	12.706	7.4781	26.611	0	0.258983	0.777	1.1331	1.4568	2.1366
9.9974	15.772	13.79	13.738	6.8822	26.069	0	0.078206	0.9906	1.9291	2.7372	4.6142
14.442	13.807	10.038	7.4304	5.3904	23.061	0	0	0	0.054	0.1621	1.7293
5.1242	4.0467	2.7965	2.3359	1.7026	9.2285	0	0	0	0	5.7246	47.129
20.426	15.79	9.7831	6.8973	4.3082	19.842	0	0	0	0	0.0614	0.6959
1.9299	1.765	1.0566	1.1909	0.7634	2.4185	0	0.085501	0.5741	9.0265	58.825	81.068
6.8738	6.1589	4.3855	2.9695	2.4883	11.74	0	0	0	0	2.887	29.585
14.477	12.331	8.4656	6.2169	4.3504	17.813	0	0	0	0	0.0294	4.5561
12.286	11.469	7.84	5.9698	4.1739	19.396	0	0.421105	0.4211	0.4211	0.5202	6.9111
9.8035	8.5781	5.6414	4.2835	3.1243	13.149	0	0	0	0	0.2208	15.875
16.478	16.26	12.14	8.5269	5.6184	21.392	0	0	0	0	0.0199	1.0721
6.4016	6.6936	5.0614	3.6313	1.0557	11.822	0	0	0	0.0299	2.8302	47.26
13.814	15.582	11.044	7.8078	4.7714	21.655	0	0	0	0	0.2336	8.3083
14.299	14.314	11.312	8.1146	4.902	22.775	0	0	0	0	0.0603	2.7753

63.436	71.331	76.997	82.538	86.365	89.413	91.726	100	7.8953	6.6968	1.2
53.209	66.332	70.63	79.226	83.524	87.822	89.255	100	13.123	7.1633	6.0
37.398	51.515	62.62	72.395	77.901	84.054	87.232	100	14.117	12.14	2.0
30.183	45.206	57.852	68.246	75.111	81.448	84.311	100	15.022	13.744	1.3
21.61	37.523	52.223	63.249	72.437	77.949	81.624	100	15.913	11.025	4.9
35.721	51.169	60.047	68.926	74.845	82.243	86.682	100	15.448	11.838	3.6
9.1892	24.71	38.224	55.598	67.181	74.903	78.764	100	15.521	13.514	2.0
91.958	93.375	93.884	93.884	93.884	94.904	94.904	100	1.4168	1.0193	0.4
91.166	93.238	94.678	95.876	96.826	97.718	98.298	100	2.0714	1.8993	0.2
29.438	45.506	57.823	67.683	73.947	79.537	82.978	100	16.067	14.382	1.7
33.412	47.995	59.919	68.475	74.541	79.534	82.744	100	14.583	15.749	-1.2
36.889	49.829	61.114	70.967	77.772	82.922	86.39	100	12.94	12.296	0.6
12.432	26.449	40.977	55.487	65.567	73.186	78.126	100	14.017	12.432	1.6
37.436	52.768	61.934	71.254	77.073	81.784	84.9	100	15.332	13.8	1.5
31.444	45.926	57.352	66.352	72.407	74.333	81.037	100	14.481	15.519	-1.0
40.604	55.521	65.908	74.054	79.473	83.979	86.762	100	14.917	13.801	1.1
31.042	47.202	59.499	69.198	75.366	80.655	84.173	100	16.16	15.268	0.9
46.341	64.945	70.93	77.77	82.045	88.03	87.175	100	18.605	14.535	4.1
48.543	64.016	70.313	78.409	82.908	87.406	91.004	100	15.473	9.8956	5.6
21.939	35.254	49.317	61.665	70.315	76.85	80.884	100	13.315	12.555	0.8
41.91	55.616	65.503	73.555	78.957	83.518	86.482	100	13.706	10.779	2.9
19.655	35.242	47.999	61.373	71.608	79.239	84.136	100	15.587	11.861	3.7
94.917	96.604	97.736	97.736	98.868	98.868	98.868	100	1.6867	1.132	0.6
54.691	65.895	72.829	78.042	81.698	84.893	87.884	100	11.204	8.8693	2.3
39.059	52.271	60.964	68.757	74.925	79.917	83.825	100	13.212	10.998	2.2
14.686	28.026	41.679	55.554	65.627	73.266	79.52	100	13.339	13.469	-0.1
16.551	27.312	38.5	51.218	61.32	70.023	76.538	100	10.76	9.5591	1.2
68.421	72.392	76.146	79.909	82.965	85.757	88.191	100	3.9709	4.386	-0.4
11.187	23.363	37.266	51.565	62.068	69.964	76.061	100	12.176	12.482	-0.3
65.018	72.833	77.143	81.765	84.886	87.479	90.048	100	7.8151	7.0948	0.7
7.4336	18.044	33.762	54.568	67.234	74.855	80.316	100	10.61	9.0532	1.6
17.873	32.544	46.365	59.937	68.923	74.958	79.793	100	14.672	14.421	0.3
88.424	90.979	92.478	93.873	94.868	95.573	96.174	100	2.5556	2.0652	0.5
40.456	55.755	66.085	73.545	78.631	82.892	86.038	100	15.299	14.919	0.4
40.293	53.774	63.5	71.553	77.268	81.597	85.212	100	13.481	13.56	-0.1
35.876	51.624	62.408	71.133	77.099	81.679	85.098	100	15.747	13.873	1.9
50.647	61.647	69.719	76.53	81.114	84.47	87.366	100	11	10.298	0.7
15.734	31.396	46.097	59.632	69.145	75.607	80.735	100	15.662	12.587	3.1
27.551	42.375	54.634	65.703	73.554	78.713	82.979	100	14.824	10.856	4.0
10.309	22.179	37.322	55.169	66.202	73.976	79.632	100	11.87	9.2644	2.6
21.41	33.333	45.345	59.853	68.722	77.386	82.32	100	11.924	9.8678	2.1
6.7202	14.865	26.418	40.735	53.044	64.098	70.66	100	8.1446	5.5758	2.6
5.0826	11.832	22.078	38.669	53.205	65.911	73.389	100	6.7498	6.4098	0.3
7.6642	13.751	23.749	39.52	53.311	67.049	73.931	100	6.0871	4.8488	1.2
12.51	25.831	40.273	54.08	64.118	71.548	76.939	100	13.321	11.781	1.5
66.639	74.766	79.89	83.937	86.733	89.069	90.772	100	8.1263	7.2134	0.9
6.4675	22.953	43.379	59.169	68.952	75.849	80.158	100	16.486	14.245	2.2
87.847	90.876	92.806	94.571	95.627	96.818	97.582	100	3.0292	2.907	0.1
52.846	65.384	72.257	78.416	82.802	85.771	88.26	100	12.538	8.9634	3.6
20.517	36.346	50.823	63.154	71.62	77.837	82.187	100	15.829	13.154	2.7
23.235	38.865	51.152	62.621	70.461	76.431	80.604	100	15.63	16.423	-0.8
42.393	55.421	65.224	73.802	79.444	83.727	86.851	100	13.027	12.31	0.7
8.239	19.585	36.063	52.323	64.463	72.99	78.608	100	11.346	10.165	1.2
59.09	65.334	71.736	78.429	83.491	87.122	88.178	100	6.2444	5.3534	0.9
13.514	25.325	39.139	54.721	65.766	73.574	78.345	100	11.812	5.8559	6.0
12.398	24.284	38.582	52.896	64.208	72.323	77.225	100	11.885	5.9729	5.9

0 60.859 27.754 11.387	0 63.436 25.978 10.587 63.4357 25.978 10.587
0 50.28 36.413 13.306	0 53.209 34.613 12.178 53.2092 34.613 12.178
0 32.673 49.765 17.562	0 37.398 46.656 15.946 37.3984 46.656 15.946
0 26.43 53.354 20.216	0 30.183 51.265 18.552 30.1834 51.265 18.552
0 18.35 58.151 23.498	0 21.61 56.34 22.051 21.6097 56.34 22.051
0 32.165 48.135 19.7	0 35.721 46.523 17.757 35.7206 46.523 17.757
0 7.747 65.128 27.125	0 9.1892 65.714 25.097 9.18919 65.714 25.097
0 91.579 3.0568 5.364 0.04077	91.917 2.9457 5.0963 91.9547 2.9469 5.0984
0 90.083 7.4012 2.516	0 91.166 6.5519 2.2817 91.1663 6.5519 2.2817
0 25.743 52.326 21.932	0 29.438 50.098 20.463 29.4382 50.098 20.463
0 29.154 49.068 21.778	0 33.412 46.122 20.466 33.4119 46.122 20.466
0 32.408 49.162 18.431	0 36.889 46.033 17.078 36.8891 46.033 17.078
0 10.989 60.196 28.815	0 12.432 60.755 26.814 12.4316 60.755 26.814
0 33.167 47.38 19.453	0 37.436 44.349 18.216 37.4356 44.349 18.216
0 28.098 45.729 26.172	0 31.444 42.889 25.667 31.4444 42.889 25.667
0 36.093 46.703 17.204	0 40.604 43.375 16.021 40.6039 43.375 16.021
0 26.875 52.392 20.734	0 31.042 49.614 19.345 31.0418 49.614 19.345
0 41.451 45.007 13.542	0 46.341 41.689 11.97 46.3406 41.689 11.97
0 43.342 42.882 13.776	0 48.543 38.863 12.594 48.5426 38.863 12.594
0 19.05 56.084 24.867	0 21.939 54.911 23.15 21.9386 54.911 23.15
0 37.467 44.853 17.68	0 41.91 41.608 16.482 41.9095 41.608 16.482
0 17.47 59.765 22.766	0 19.655 59.583 20.761 19.6551 59.583 20.761
0 94.495 4.3735 1.132 0.12452	94.793 3.9506 1.132 94.911 3.9556 1.1334
0 50.462 33.592 15.946	0 54.691 30.203 15.107 54.6907 30.203 15.107
0 34.961 43.645 21.394	0 39.059 40.858 20.083 39.0593 40.858 20.083
0 12.717 58.542 28.74	0 14.686 58.579 26.734 14.6863 58.579 26.734
0 14.699 53.038 32.263	0 16.551 53.472 29.977 16.5515 53.472 29.977
0 66.727 18.297 14.976	0 68.421 17.336 14.243 68.4211 17.336 14.243
0 9.5986 58.292 32.11	0 11.187 58.777 30.036 11.1871 58.777 30.036
0 61.921 24.877 13.202	0 65.018 22.461 12.521 65.018 22.461 12.521
0 6.4784 66.375 27.147	0 7.4336 67.421 25.145 7.43355 67.421 25.145
0 15.535 57.838 26.627	0 17.873 57.086 25.042 17.8726 57.086 25.042
0 87.382 8.0059 4.6124	0 88.424 7.1488 4.4274 88.4238 7.1488 4.4274
0 35.56 46.214 18.227	0 40.456 42.436 17.108 40.4562 42.436 17.108
0 36.561 43.899 19.54	0 40.293 41.303 18.403 40.2932 41.303 18.403
0 31.485 48.991 19.524	0 35.876 45.803 18.321 35.8765 45.803 18.321
0 45.994 37.595 16.411	0 50.647 33.823 15.53 50.6471 33.823 15.53
0 13.621 60.288 26.09	0 15.734 59.873 24.393 15.7338 59.873 24.393
0 23.822 53.536 22.642	0 27.551 51.162 21.287 27.551 51.162 21.287
0 8.8174 63.117 28.066	0 10.309 63.667 26.024 10.3093 63.667 26.024
5.37445 15.122 54.614 24.889 9.39794	12.012 55.977 22.614 13.2577 61.783 24.959
0 6.0213 55.173 38.805	0 6.7202 57.378 35.902 6.72023 57.378 35.902
0 4.5405 58.034 37.426 0.25898	4.8236 60.829 34.089 4.83609 60.987 34.177
0 7.103 56.338 36.559 0.07821	7.586 59.385 32.951 7.59196 59.431 32.977
0 10.526 59.07 30.403	0 12.51 59.038 28.452 12.5101 59.038 28.452
0 63.049 25.406 11.545	0 66.639 22.43 10.931 66.6392 22.43 10.931
0 5.4055 68.632 25.962	0 6.4675 69.382 24.151 6.46746 69.382 24.151
0 86.599 9.9061 3.4946 0.0855	87.761 8.9715 3.1819 87.8362 8.9792 3.1846
0 48.566 36.426 15.009	0 52.846 32.925 14.229 52.8458 32.925 14.229
0 17.58 58.623 23.796	0 20.517 57.319 22.163 20.5173 57.319 22.163
0 20.231 54.631 25.137 0.4211	22.814 53.195 23.569 22.9104 53.42 23.669
0 37.514 45.088 17.398	0 42.393 41.334 16.273 42.3935 41.334 16.273
0 6.9203 63.83 29.25	0 8.239 64.751 27.01 8.23903 64.751 27.01
0 56.913 29.255 13.832	0 59.09 28.032 12.878 59.0895 28.032 12.878
0 12.556 58.967 28.477	0 13.514 60.06 26.426 13.5135 60.06 26.426
0 10.628 59.564 29.808	0 12.398 59.925 27.677 12.3982 59.925 27.677

66.4919	25.234	8.2738	SANDY LOAM	7	8.47	2.582
58.2891	30.966	10.745	SANDY LOAM	7	10.25	3.124
42.8629	44.369	12.768	LOAM	7	12.60	3.84
35.9985	48.312	15.689	LOAM	7	19.33	5.892
27.7697	53.855	18.376	SILT LOAM	7	21.12	6.437
41.7006	44.982	13.318	LOAM	7	22.84	6.962
15.1974	63.567	21.236	SILT LOAM	7	24.35	7.422
92.5034	2.3982	5.0984	SAND	7	27.55	8.397
91.9682	6.3301	1.7017	SAND	8	2.82	0.86
35.6578	47.32	17.022	LOAM	8	6.80	2.073
39.0571	43.687	17.256	LOAM	8	11.10	3.383
41.8982	44.492	13.61	LOAM	8	15.07	4.593
17.8578	60.268	21.874	SILT LOAM	8	21.10	6.431
43.3707	41.529	15.1	LOAM	8	23.60	7.193
37.0502	43.987	18.963	LOAM	9	1.50	0.457
46.3781	40.384	13.238	LOAM	9	3.20	0.975
37.2975	46.875	15.827	LOAM	9	5.90	1.798
53.5424	33.633	12.825	SANDY LOAM	9	9.38	2.859
54.5323	36.472	8.996	SANDY LOAM	9	12.90	3.932
27.0929	53.791	19.116	SILT LOAM	9	13.10	3.993
47.2151	39.267	13.518	LOAM	9	23.20	7.071
25.6889	58.447	15.864	SILT LOAM	9	27.08	8.254
95.5647	3.3019	1.1334	SAND	9	31.20	9.51
59.0279	28.856	12.116	SANDY LOAM	10	1.30	0.396
44.1735	39.652	16.175	LOAM	10	6.40	1.951
19.85	59.67	20.48	SILT LOAM	10	13.15	4.008
20.7167	55.822	23.462	SILT LOAM	10	16.38	4.993
69.9582	18.233	11.809	SANDY LOAM	10	17.25	5.258
15.9004	60.161	23.939	SILT LOAM	10	18.80	5.73
68.0432	22.005	9.952	SANDY LOAM	10	19.70	6.005
11.5408	68.775	19.684	SILT LOAM	10	20.80	6.34
23.5519	56.241	20.207	SILT LOAM	10	24.10	7.346
89.4131	6.7604	3.8265	SAND	11	3.90	1.189
46.3784	39.66	13.962	LOAM	11	7.30	2.225
45.5115	39.7	14.788	LOAM	11	8.85	2.697
41.9721	43.126	14.902	LOAM	11	10.60	3.231
54.9052	32.46	12.634	SANDY LOAM	11	16.50	5.029
21.7965	58.939	19.265	SILT LOAM	11	20.80	6.34
33.2894	49.69	17.021	LOAM	11	25.35	7.727
14.904	64.728	20.368	SILT LOAM	11	27.55	8.397
18.3521	62.134	19.514	SILT LOAM	12	0.60	0.183
9.87299	60.787	29.34	SILTY CLAY LOAM	12	3.40	1.036
7.45569	65.865	26.68	SILT LOAM	12	9.55	2.911
9.95009	63.961	26.089	SILT LOAM	12	11.45	3.49
17.6665	59.272	23.061	SILT LOAM	12	15.30	4.663
69.7849	20.987	9.2285	SANDY LOAM	12	21.40	6.523
12.8491	67.309	19.842	SILT LOAM	12	24.55	7.483
89.0098	8.5697	2.4205	SAND	12	25.80	7.864
57.6991	30.56	11.74	SANDY LOAM	13	4.65	1.417
26.6447	55.542	17.813	SILT LOAM	13	8.60	2.621
28.9865	51.536	19.478	SILT LOAM	13	13.40	4.084
47.4362	39.415	13.149	LOAM	13	15.80	4.816
12.631	65.977	21.392	SILT LOAM	13	19.15	5.837
61.5067	26.671	11.822	SANDY LOAM	13	21.55	6.568
18.0858	60.259	21.655	SILT LOAM	13	21.80	6.645
16.999	60.226	22.775	SILT LOAM	13	24.80	7.559

EAST-WEST CROSS-SECTION OF THE ST. ALBANS ARCHEOLOGICAL SITE TERRACE (PLATE A)

WEST

SCALE: $\text{---} = 14.1 \text{ m}$