8.0 CLEMENT TEST LOCALE

8.1 INTRODUCTION AND BACKGROUND

The Clement test locale is located on the floodplain of the Mississippi River in Sherburne County, a few miles downstream from St. Cloud, Minnesota (Figures 3.3.2-1 and 8.1-1). The test grid was located along the east bank of the river near the western edge of the floodplain and measured 40 m × 100 m (131 ft × 328 ft). Topographically, the study area lies 2 m to 3 m (6.6 ft to 9.8 ft) above the Mississippi River, is generally flat, and is composed mainly of alluvial sediments associated with a shallow ridge and swale landform. The uplands surrounding the valley consist of outwash (Meyer and Hobbs 1993) deposited in association with the advance and retreat of the Grantsburg sublobe. Two meltwater stream terraces and floodplain alluvium have been mapped in the Mississippi River valley near the test locale (Meyer and Hobbs 1993). The post-glacial channel belt in the valley has been incised into the T1 and T2 terraces (Figure 8.1-1) and is 10 m to 12 m (33 ft to 39 ft) below the lowest terrace surface. At present, the Mississippi River has an island braided channel pattern that is characteristic of sand-load dominated streams.

Geomorphologically, the Clement test locale occurs on the convex edge of a large bar/terrace that is attached to the east side of the post-glacial channel-belt valley wall (Figure 8.1-1). It forms a compound bar with an upper and lower surface. The upper surface lies north of the field road and consists of a flat ridge that is oriented differently than the ridges on the lower surface. The lower surface, where the sampling grid is located, has a ridge and swale topographic surface, and the outer-most ridge in the sampling grid (closest to the river) is best described as a levee. Based mainly on the expected geomorphological character of Mississippi River levee systems elsewhere in the upper valley, Mn/Model LfSAs indicate that this area has only a moderate suitability for preservation of buried archaeological deposits at a shallow depth (<2 m) and low suitability for preservation of deeper deposits. Such a rating is typical for other levee and floodplain settings along the upper Mississippi River between Minneapolis and St. Cloud.

Soils mapped on the terrace/bar of the Clement test locale are Elk River (cumlic hapludoll) fine sandy loam and the Elk River-Mosford (typic hapludoll) Complex (Jackson 2002). Both soils are formed in sandy outwash or alluvium and have A-AB-Bw horizon sequences in their solums. The Elk River series is somewhat poorly to moderately well-drained and the Mosford series is somewhat excessively drained. According to the soil survey (Jackson 2002), the terrace/bar is infrequently flooded. Soils on the high terrace immediately east of the locality are the Hubbard-Mosford, Arvilla, and Sandberg series (Jackson 2002). They are all formed in sandy parent material, are somewhat excessively to excessively drained, and characterized by A-Bw soil horizon sequences in the solum. Due to both the excessively-drained and poorly-drained nature of the soils at and around the test locale, their utility as a relative dating tool is limited.

During the survey, soils were moderately dry, although it had rained the day before the survey began, and the survey parcel recently had been mowed. The geophysical survey was conducted when surface conditions were satisfactory. Because of the nature of remote sensing, it was directed toward discovering soil or other anomalies that might be cultural features.

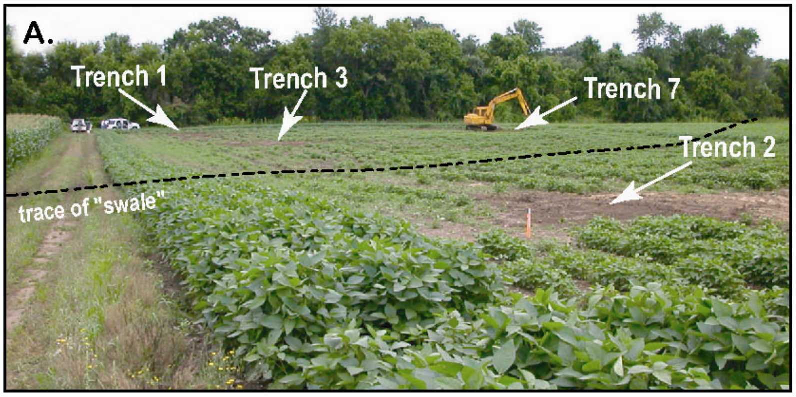

Figure 8.1-1. Clement Test Locale Overviews: (A) Testing Grid; (B) Mississippi River; (C) First Site

Nineteen cores, spaced on a 20 m grid pattern, were drilled, followed by the excavation of seven trenches up to 3 m (9.8 ft) deep. Trenching and coring focused first on determining the presence or absence of archaeological deposits and secondly on determining the sedimentology and stratigraphic relationships of the deposits forming two ridges located east and west of a swale or flood chute that bisects the test locale (Figure 8.1-1).

Archaeologically, no previously recorded sites occur near the Clement test locale. Interestingly, during the site selection process a small lithic scatter, the First site (21SH0048), was discovered by CCRG field crews about 350 m (1,148 ft) north of the Clement test locale during the initial phase of fieldwork at that locale (Figures 8.1-1 and 8.1-2). The fact that archaeological materials were found on the floodplain surface bode well for their discovery in the subsurface.

8.2 RESULTS OF GEOPHYSICS SURVEY

8.2.1 Magnetics

The magnetometer survey for the Clement test locale shows clear patterning in the data. However, most of the patterning is probably attributable to subsurface features and to general noise from survey effects (Figure 8.2.1-1). The survey detected a moderate amount of modern metal debris, which can mask subtle features. Modern iron objects typically create high-low dipole or spike anomalies, and these are apparent in the data (Weymouth 1986:344-5). The large anomaly in the southeast corner of the survey grid (Figure 8.2.1-1) likely is caused by a concentration of ferric material. Alternatively, highly-fired earthen material, such as brick or drain tile, can also create such anomalies. The random and sporadic distribution and lack of a regular pattern of the anomalies suggest that they likely are discarded or broken metal, clay tile, and/or other metal objects related to recent agricultural activities rather than occupational behavior around a farmstead, yard, or household.

The use of the survey area as an agricultural field is demonstrated not only by the pattern of modern plow furrows that were evident on the surface, but also by those apparent in the magnetic data. These occur as alternating bands of magnetic highs and lows, trending roughly north-northwest to south-southeast on Figure 8.2.1-1. These anomalies are probably the result of weathered, A horizon soils that form the ridges between the furrows. The ridges of organic-rich A horizon soils are relatively high in magnetic susceptibility and the furrows where the subsoil has been exposed are of lower susceptibility (see Scollar et al. 1990:397).

Large band-like magnetic lows, ca. 2-m (6.6-ft) wide and crossing at right angles to one another, are evident in the eastern two-thirds of the survey area. These are most likely the result of soil, geological, or depositional features. For example, they may represent erosional channels cut into the levee during flood events and subsequently infilled with lower magnetism sediments such as sand and gravel. Interspersed are magnetic highs, roughly ovoid and ca. 4 m to 6 m (13 ft to 20 ft) wide. The causes of these anomalies are not easy to attribute. Their origin may relate to sedimentary factors, odd soil structures, or other natural processes. They may also be related to cultural phenomena or to some sort of agricultural incident (such as a stuck tractor). Without exposing them through trenching or coring, their origin must remain unknown.

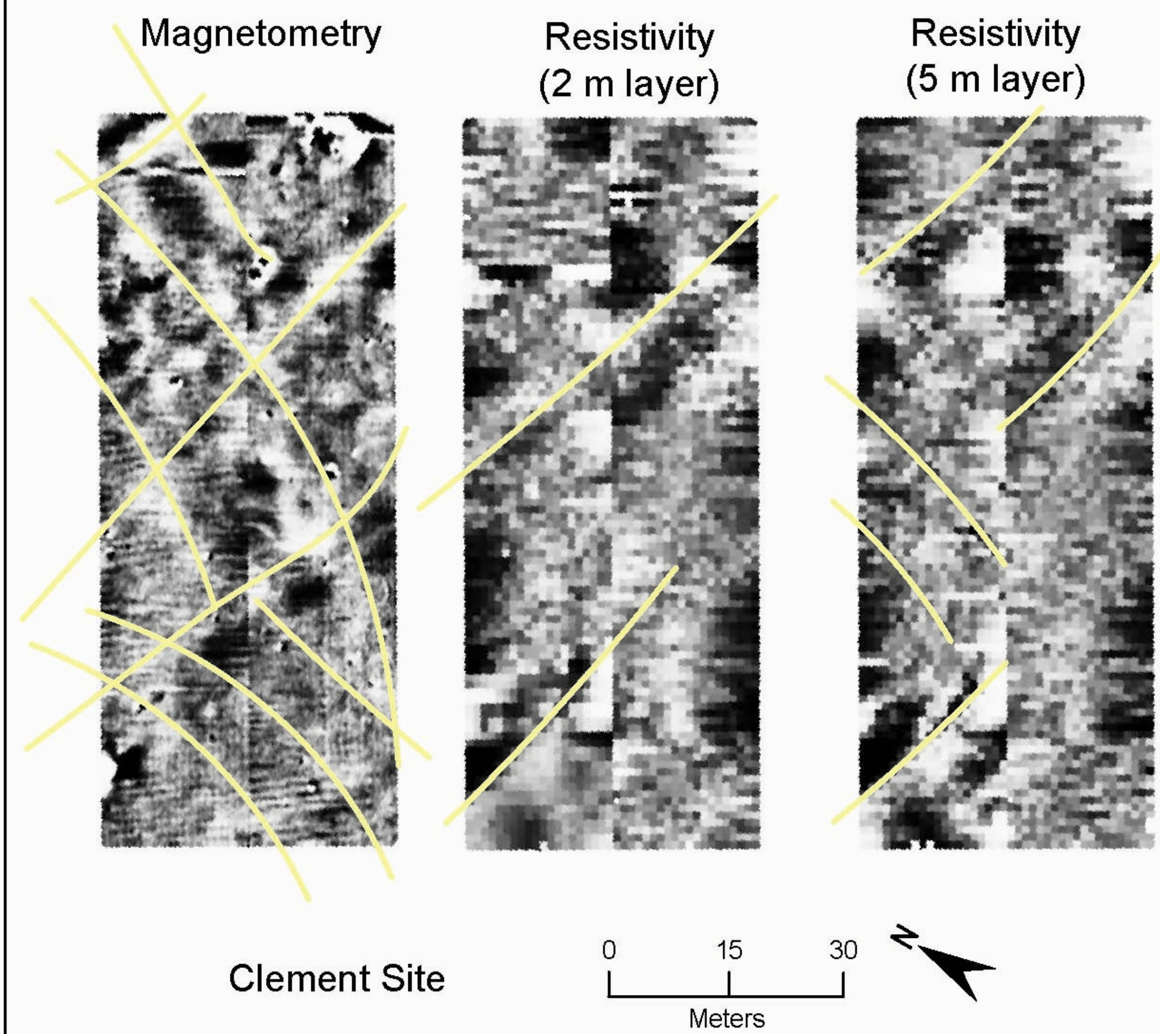

Figure 8.2.1-1. Magnetometry and Resistivity Data Plots, Clement Test Locale

8.2.2 Resistivity

The resistivity surveys at shallow depths (1 m to 3 m [3.3 ft to 9.8 ft] probe separation) are dominated by resistivity highs (dark areas) that correspond to the magnetic high anomalies (Figure 8.2.1-1). These areas are most likely superficial geophysical noise and are particularly evident at the margins of some of the grids. These features are still evident in the deeper 4 m to 5 m (13.1 ft to 16.4 ft) probe spacing surveys, though they are more subtle. This indicates that more resistive sediments are formed in the upper strata, which are underlain by more conductive moister or finer grained soils. Taken together, these data probably reflect the fact that groundwater saturated sediments begin below about 3 m (9.8 ft) in depth.

8.2.3 Ground Penetrating Radar

The GPR survey results show considerable variability at the Clement test locale (Figure 8.2.3-1). This is most apparent in the western portion of the survey area, which shows good reflection below 2 m (6.6 ft). These reflectors may be sedimentary beds and evince a non-horizontal structure. A strong reflector at about 0.8 m (2.6 ft) below surface is highly crenulated and often discontinuous. This reflector may indicate the presence of a paleosurface. Reflectors are generally seen deeper in the northwestern part of the test locale. Extreme disruptions of shallow (0.25 m to 1.0 m [0.8 ft to 3.3 ft]) beds occur throughout the western 50 m (164 ft) of the survey grid. Numerous tight, closely-spaced parabolas are seen between 27N/30E and 38N/30E (Figure 8.2.3-1).

Considerable disruptions in shallow reflectors also occur in this area and in the southwest one-third of the survey grid. Data dropouts indicated by vertical bars occur in several traces but do not seriously diminish resolution. A few skips shown by a stack of short, horizontal lines also occur. Occasionally, very tight chevrons that penetrate deeply indicate metal. It appears that archaeological activity has taken place in several parts of this test locale. Subtle features appear on the depth-slice (horizontal) maps, especially in the southwest part of this test locale (Figure 8.2.3-1). A diffuse large pattern between about 10N/70W and 30N/70W is probably geologic in origin.

8.2.4 Discussion of Geoarchaeological Significance from Geophysical Survey

The geophysical results are generally most informative concerning the geological and sedimentological environments of the Clement test locale. Even though variability was noted with all methods, the interpretation of what this variability represents remains unclear. Only limited and tentative suggestions about the presence of buried archaeological material could be proposed. Although the magnetic survey results show clear patterning in the data, much of this is probably related to agricultural and other general survey noise. Both the GPR and magnetic surveys detected a moderate amount of modern metallic debris.

GPR and resistivity results are most interesting for the western part of the Clement test locale, which also generally coincide with the buried archaeological material and related paleosol sequences. Here, the GPR survey shows a series of good reflectors that occur at a depth of 2 m (6.6 ft). These likely represent sedimentary beds. Additionally, a strong reflector that is

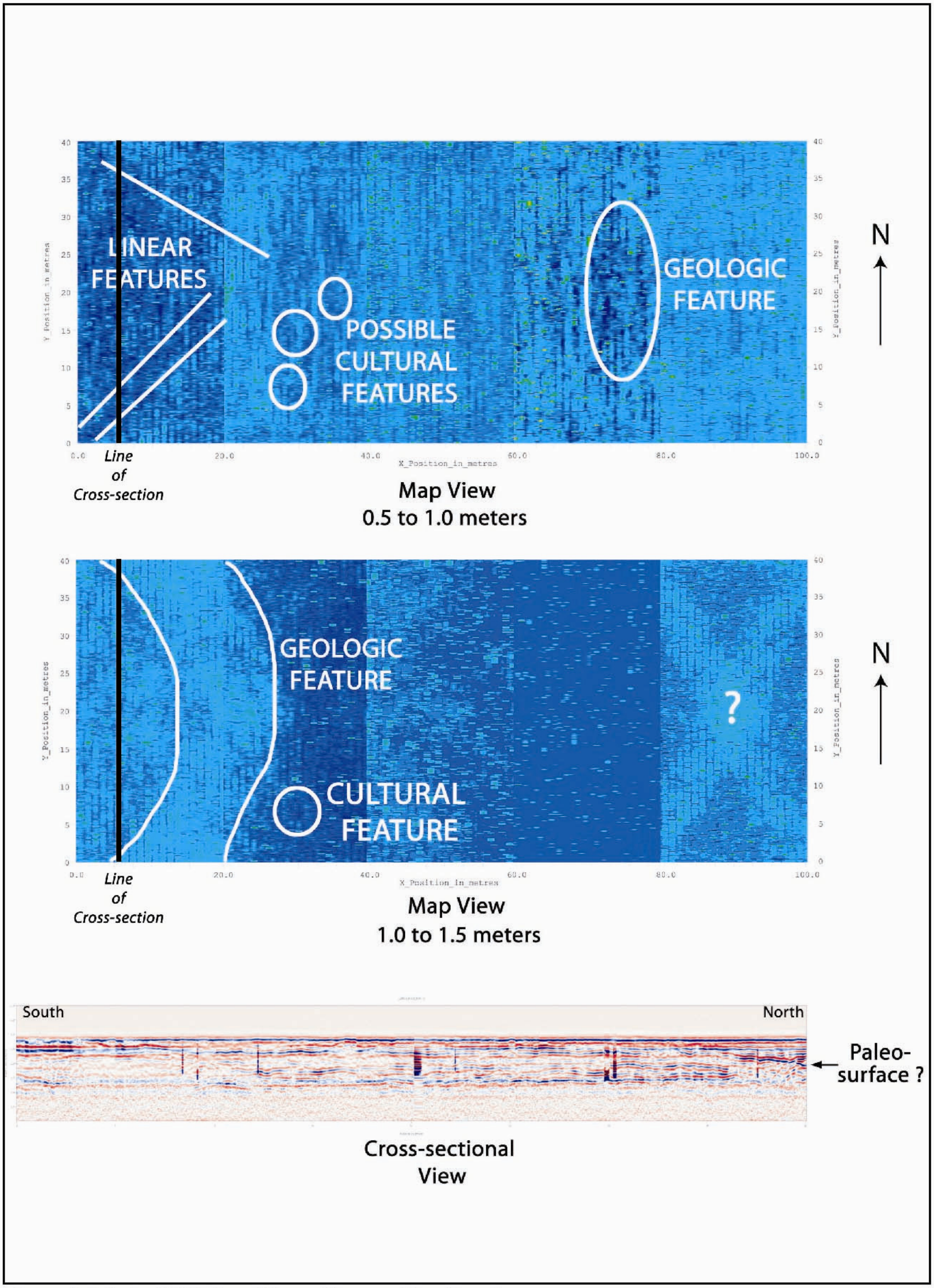

Figure 8.2.3-1. GPR Data Plots, Clement Test Locale

present at about 80 cm (2.6 ft) below surface may indicate a paleosol. The resistivity data complements both the magnetic and GPR survey and also indicates that groundwater-saturated sediments probably occur below 3 m (9.8 ft), although the data could also represent a dramatic change in sediment lithology. A pattern of generally parallel northeast-southwest and crosscutting parallel northwest-southeast ca. 2-m (6.6-ft) wide magnetic and resistivity highs and lows are clearly evident in the near-surface, as well as deeper in the subsurface. While interesting and provocative, the origin of these highs and lows is uncertain, but they are probably associated with some sort of natural sedimentary features, such as in-filled erosional channels. The fact that they are so well ordered, however, brings such a natural origin explanation into question. That these were absent in the GPR data is also troubling. Given the size and scale of these features, relating them to prehistoric cultural activity is doubtful. They may, however, reflect some sort of historic-age disruptions related to agriculture. If so, they should also be clear in the coring and trenching data.

8.3 RESULTS OF CORING SURVEY

8.3.1 Deposits and Soils

Deposits at the Clement test locale consist of silty and sandy top stratum sediments over sandy and gravelly bottom stratum sediments (Figures 8.3.1-1 and 8.3.1-2; Appendix B). The contact between the top stratum and the bottom stratum deposits is conformable but sometimes abrupt. Soils are weakly developed with either Ap-Bw or Ap-C horizon sequences with a few exceptions. Weak soil development may be due to a short soil forming interval on a young landscape, recent erosion, or a wet soil-forming environment. Soils with Ap-C profiles occur at the east and west ends of the test locale. The weaker morphological expression at these locations may be due to post-cultivation erosion, especially at the west end of the grid, and the shallow depth of the seasonal high water table at the east end of the grid. Soils with Ap-Bw horizon sequences have weakly structured Bw horizons, often with redox features. Sometimes, AB horizons are also present, marking the transition to the Bw horizon. Carbonates have been leached from most of the soil horizons, with the exception of some silty horizons that retain carbonate nodules.

Core 17, located on the levee, has a thick Bw horizon with weak lamella or lamellar blebs (Figure 8.3.1-1; Appendix B). The best drained soils are located on the levee portion of the test locale, perhaps allowing for slightly more intense pedogenic expression.

Buried archaeological deposits often occur in levee deposits. These contexts were sampled in Cores 18 and 19, which were placed along the levee shoulder and backslope. No buried soils were identified. Core 18 (10N/100W), located on the levee backslope, consists of three plow zones to a depth of 40 cm (16 in) over a Bw horizon. Beneath the Bw horizon are multiple C horizons formed in predominately sandy deposits. Core 19 is located on the levee shoulder and consists of an Ap horizon to 33 cm (13 in) over a Bw horizon to 40 cm (16 in). Below 40 cm (16 in) are multiple C horizons formed in sandy deposits. The very thin Bw horizon on the shoulder and the multiple Ap horizons on the backslope indicate erosion/deposition has occurred on the levee since the start of cultivation.

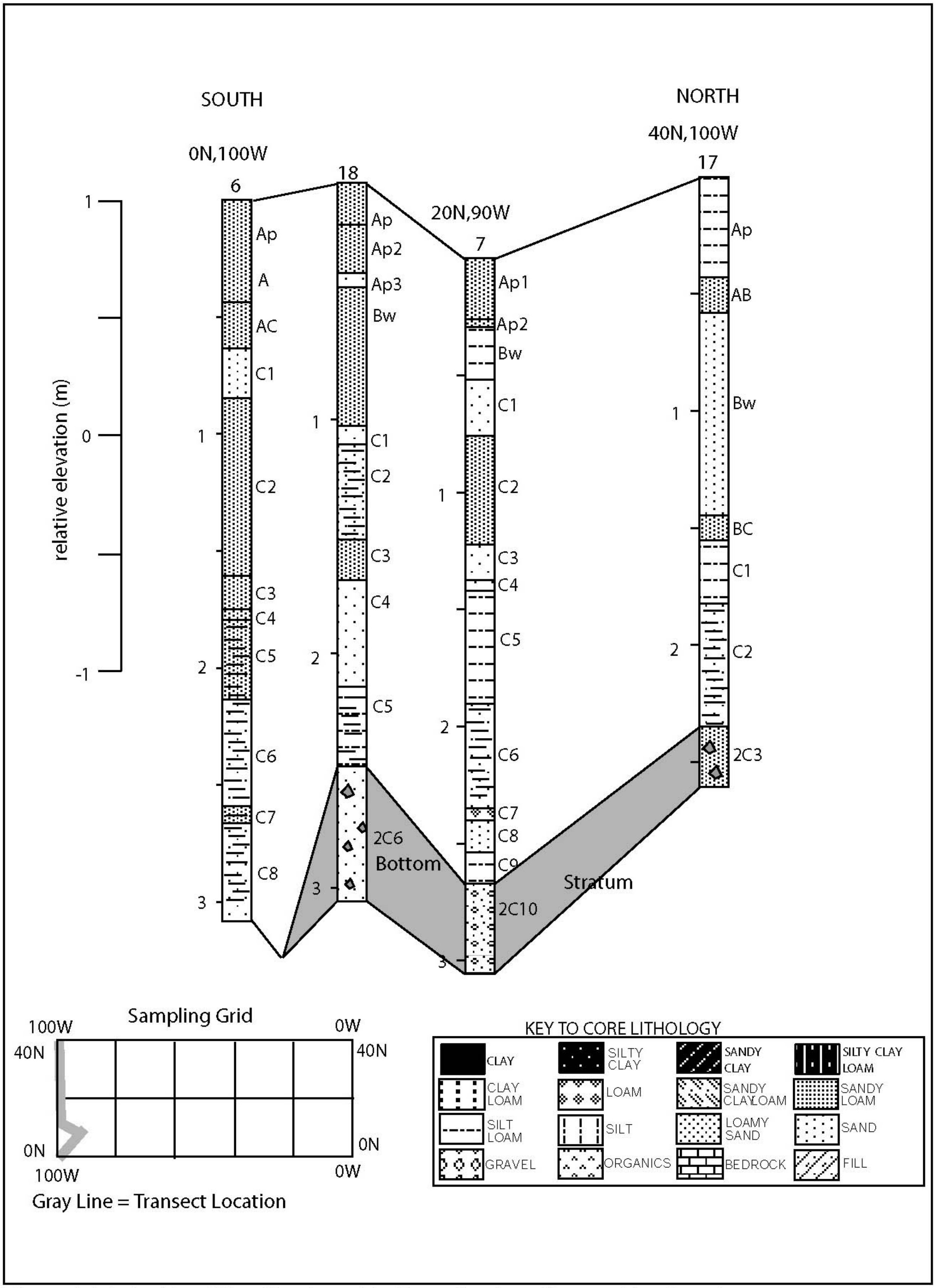

Figure 8.3.1-1. East-West Stratigraphic Cross-Section, Clement Test Locale

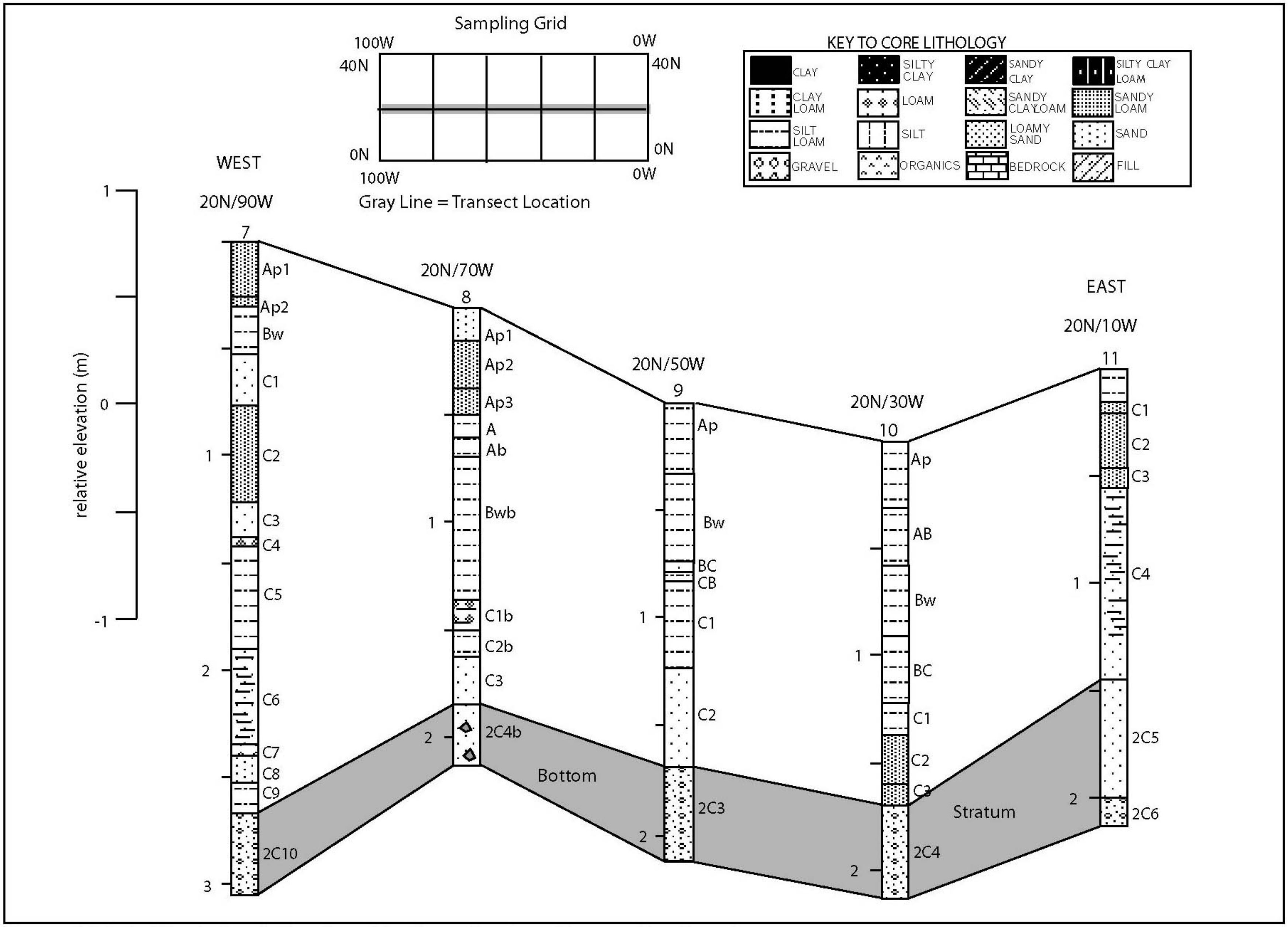

Figure 8.3.1-2. North-South Stratigraphic Cross-Section, Clement Test Locale

The only buried soil identified is in Core 8 at 20N/70W (Figure 8.3.1-2). It has an Ab horizon at a depth of 60 cm (24 in) beneath a series of Ap horizons and an A horizon. Its status as a buried soil is marginal due to the presence of 60 cm (24 in) of plowed or disturbed soil. The black color indicates it is well preserved and the presence of charcoal indicates that there may be some anthropogenic influence. It is either a buried surface (discrete soil) or the base of the surface cumlic epipedon.

8.3.2 Stratigraphy

Vertical stratigraphy is relatively simple, consisting of a coarse-grained bottom stratum deposit conformably overlain by the finer-grained top stratum deposits (Figures 8.3.1-1 and 8.3.1-2). Stratification on the scale of medium to coarse beds is present throughout the deposit, with the finer stratification in the levee and preserved at the base of the top stratum and upper bottom stratum deposits. Cores in the swale (Cores 9 and 10, Figure 8.3.1-2) have more silt and clay in the top stratum deposits.

8.3.3 Discussion of Geoarchaeological Significance from Coring

No buried landscape surface was identified at the Clement test locale. Only one buried soil was located and that was in Core 8. It was targeted for sampling and auguring but yielded no archaeological material. The lack of an extensive buried soil indicates: (1) the landform is infrequently flooded as suggested by the soil survey (Jackson 2002); (2) floods that reach the landform surface have low concentrations of suspended load, as may be the case in this sand-dominated reach of the river; and/or (3) the landform is young (late prehistoric or historic) and too few floods have occurred for a detectable fine-grained top stratum to accumulate. Regardless of the age of the landform, flooding and sedimentation may not have been significant until historic times, resulting in sedimentation on the backslope of the levee.

Preliminary analysis of USGS gauge data (1989 and 2004) from the Mississippi River in St. Cloud indicates that at the peak discharge (45,300 ft^3 [1282.8 $m^{3]}$/second) water elevation at the gage was at 969.75 ft (295.6 m) amsl. The Clement test locale is at an elevation of between 955 ft and 960 ft (291.1 m and 292.6 m) amsl, indicating that at times of peak discharge the site would be under 10 ft to 15 ft (3.1 m to 4.6 m) of water and that there would have been flow in the swales over the bar/terrace.

The landscape at the test locale consists of low ridges and shallow swales on the surface of a bar/terrace 4 m (13.1 ft) above the floodplain. Soils indicate that the seasonally high water table is very near the surface in the sandy swales, 50 cm to 60 cm (1.6 ft to 2.0 ft) below the surface in the silty part of the swales, and well below the surface beneath the sandy levee. The better-drained parts of the landscape would be most suitable for human occupation.

8.4 RESULTS OF TRENCHING SURVEY

8.4.1 Stratigraphy of Soils and Sediments

The results of excavations reveal that a relatively thin sequence of Holocene alluvium, which directly overlies fluvial channel or bar deposits, characterizes the floodplain along the Mississippi River at the Clement test locale (Figures 8.4.1-1 and 8.4.1-2). In general, the test locale can be divided into two areas based on surface morphology and separate depositional sequences: an eastern and western ridge, separated by a low swale or flood chute (Figures 8.4.1-1 and 8.1-2). These areas probably reflect relative age differences in separate sedimentary sequences formed within similar depositional environments and occur east (older) and west (younger) of the bisecting swale. The difference between the sequences relates mainly to the fact that the western portion of the test locale includes a sequence of buried, ephemeral paleosols within vertical accretionary alluvium. The western sequence, best characterized by Trench 1 (Appendix C; Figure 8.4.1-2 and Figure 8.4.1-3), also includes buried archaeological material within the paleosol sequence. On the other hand, the eastern area, characterized by deposits within Trenches 4 and 5 (Appendix C; Figure 8.4.1-2), includes relatively thin alluvium, with no evidence of paleosol development in the subsurface. In addition, no archaeological material was recovered from the eastern alluvial sequence. The absence of paleosols and archaeological material suggest that even short-term stabilization of the floodplain probably did not occur during deposition of the eastern sequence, while the presence of such stacked, ephemeral paleosols within the western sequence implies short-lived, episodic stabilizations of the floodplain during its deposition. The sedimentary deposit that underlies the swale separating the eastern from the western sequences is more similar to that of the eastern portion of the test locale. Based on this study, the swale probably formed as an erosional flood chute, rather than as an accretionary back swamp, during the deposition of the western alluvial sequence.

Deposits in Trench 5 typify the eastern sequence (Appendix C; Figures 8.4.1-2 and 8.4.1-4). Here, the base of the sequence is represented by the upper 80 cm (31.5 cm) of a tan and brown mottled reddish/orange, cross- to crudely bedded sand and sand/gravel unit. Large cobbles and pebbles are common throughout the unit although they are rare near the top of the unit, which also includes a few discontinuous inter-beds of clayey silt and silty clay. These grade downward into the more crudely bedded, coarse sand/gravel and cobble beds at the base. Several cross-bed dip measurements suggest a west and southwest direction of water flow during deposition, which is consistent with the general flow direction of the present Mississippi River. The sedimentary characteristics and depositional sequence for this unit in Trench 5, as well as elsewhere in the eastern part of the test locale, suggest that it is comprised of Mississippi River channel and/or bar deposits, which probably formed during westward migration of the channel. Elsewhere in the eastern part of the test locale these sand and gravel deposits include occasional soft-sediment deformations (Trench 2; flame-structure/injections) within the upper (sand/silt beds) part of the sequence. Pedogenically, these deposits represent minimally or unweathered subsurface (Bw and C) soil horizons.

The channel sand and gravels that mark the base of the eastern sedimentary sequence are overlain by about 1 m (3.3 ft) of brown to tan mottled reddish brown/orange, massive to bedded sand and silty sand with some clay in the matrix. The contact between this unit and the

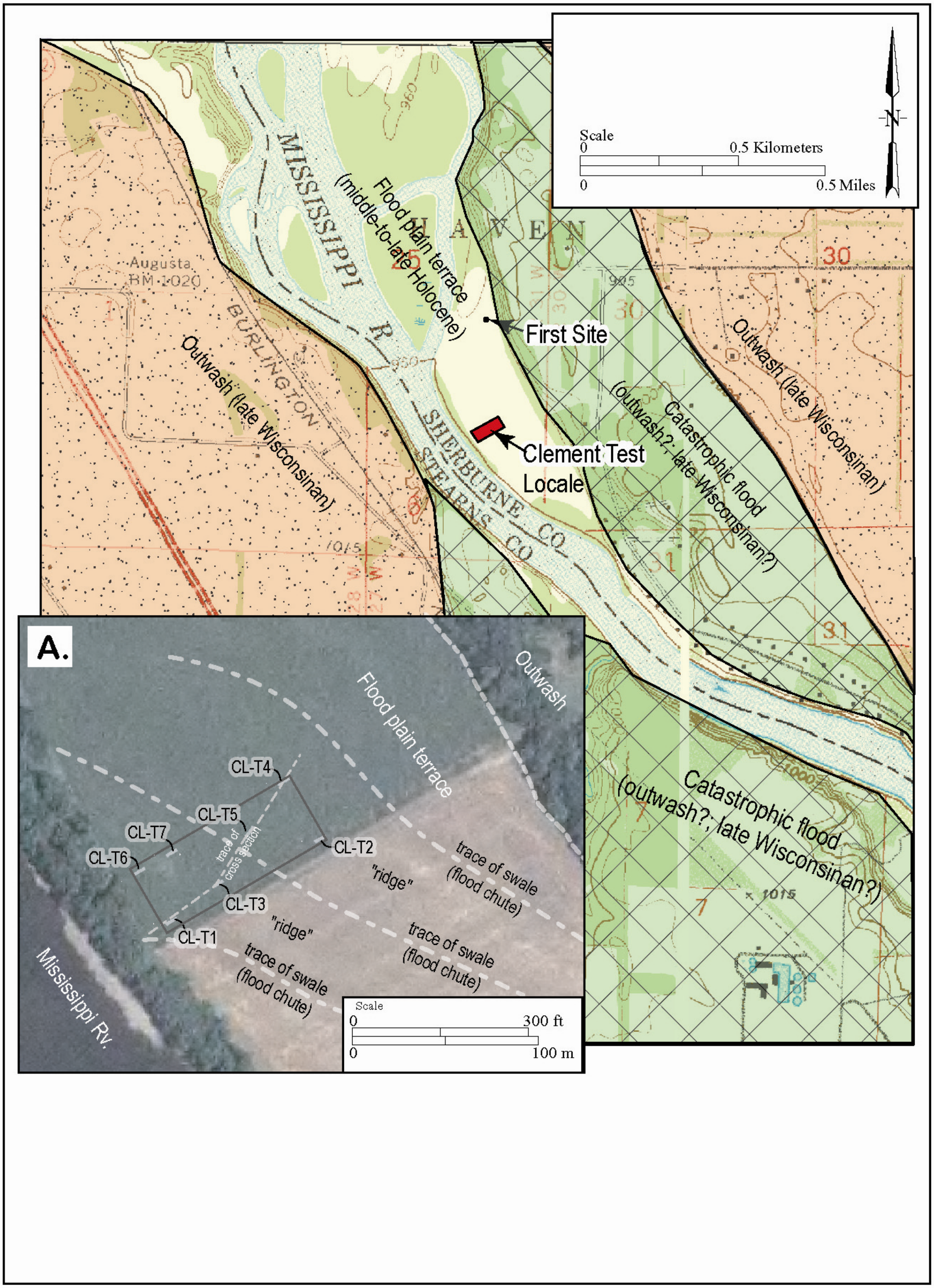

Figure 8.4.1-1. Trench Locations at the Clement Test Locale

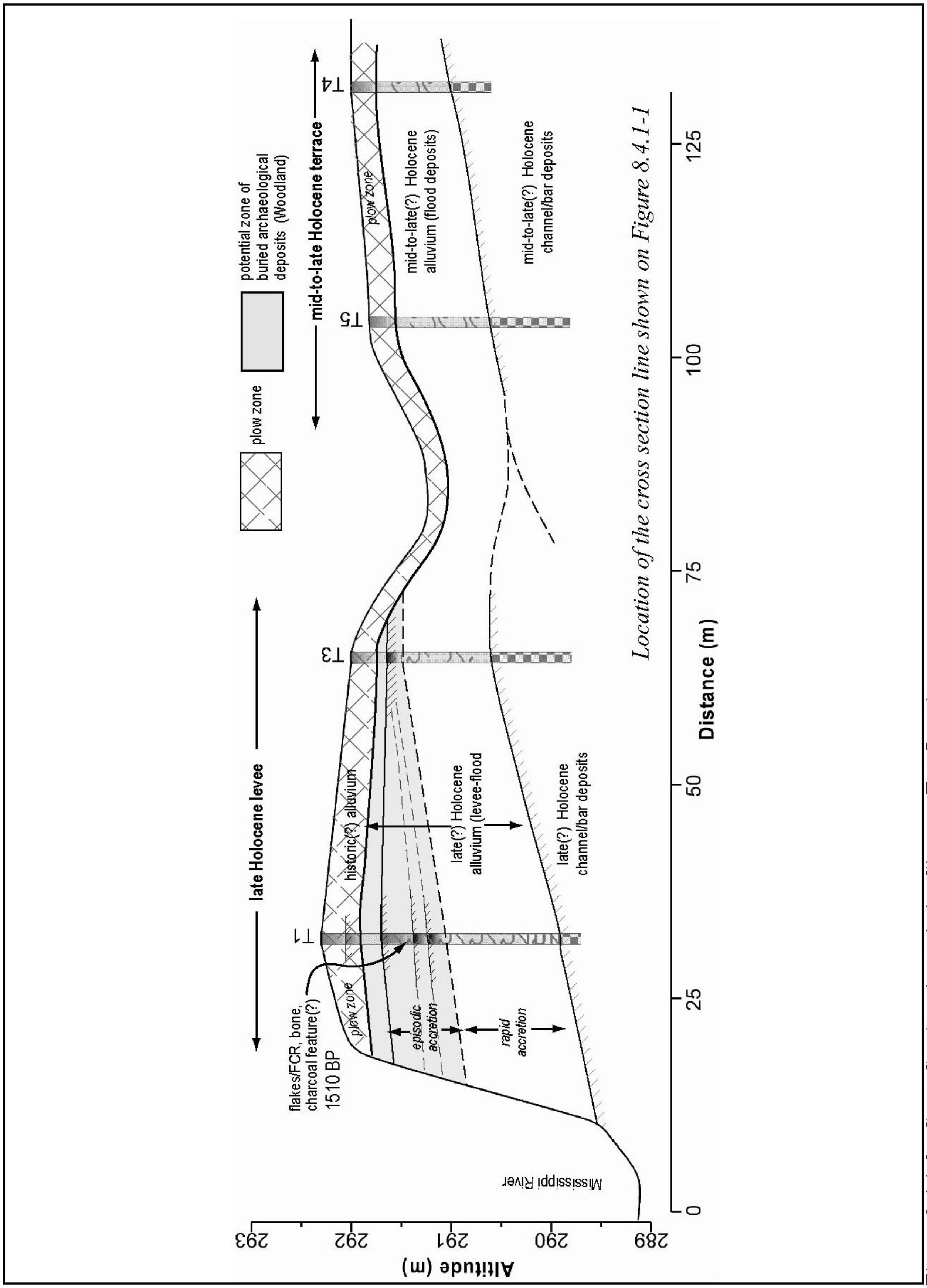

Figure 8.4.1-2. Cross Section through the Clement Test Locale

Figure 8.4.1-3. Clement Test Locale Trenches: (A) Trench 1; (B) Trench 5; (C) Trench 7

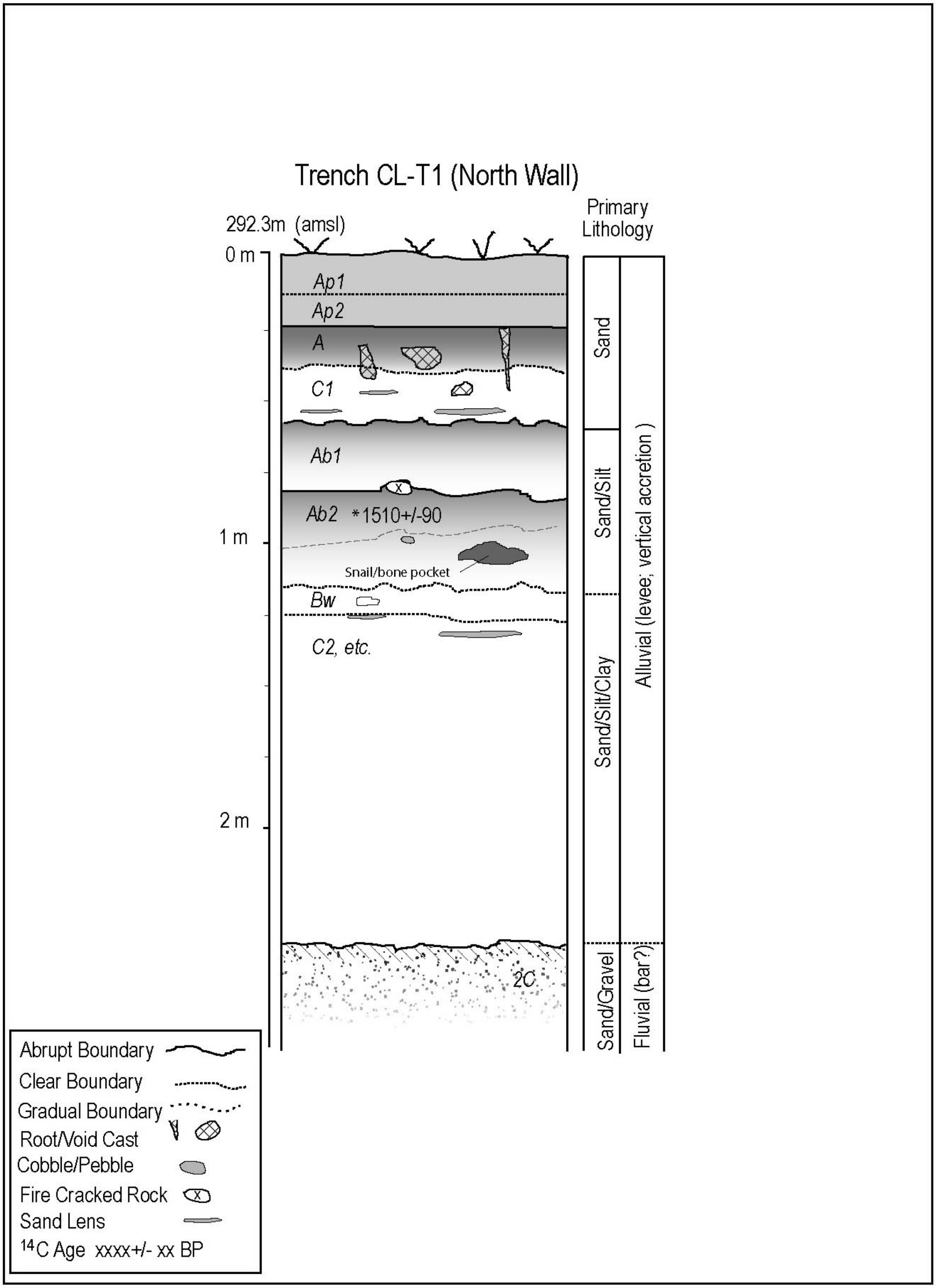

Figure 8.4.1-4. Soils and Sediments within the Upper Part of Trench 1, Clement Test Locale

underlying sand and gravels is abrupt in Trench 5, but elsewhere in the eastern portion of the test locale, it is more gradational, implying that these units are probably conformable. In general, these sand and silty sand deposits fine upward in texture, and the top of the sequence is marked by a 25-cm (9.8-in) thick plow zone (Ap) composed of brown to gray, massive sandy silt. The lower part of the unit in Trench 5 is composed of mainly thick, shallowly cross-bedded medium to coarse grained sand that includes discontinuous tabular inter-beds of silty sand. Sand partings are common in tabular siltier inter-beds and occasionally also include isolated pebbles. The tabular beds dip westward (towards the Mississippi River). The upper part of the unit (25 cm to 60 cm [9.8 in to 23.4 in]) grades to mainly massive to faintly bedded silty sand that also includes a few pebbles. The main difference between the upper and lower parts of the sequence is that the upper beds are generally thinner and include only a few, discontinuous and much thinner cross-bedded sand layers. No indications of paleosol development, a significant depositional hiatus, or charcoal or other organic debris were noted within the alluvial sequence anywhere in the eastern part of the test locale. This implies that sediment was deposited rapidly and probably during a relatively brief interval. The sequence represents Holocene over-bank alluvium, possibly part of an incipient levee, of the Mississippi River. These deposits form minimally weathered subsurface (Bw and BC) soil horizons.

The western sequence, although similar to the eastern part of the test locale, exhibits some important differences. For example, paleosols that include buried archaeological materials are clearly present within the upper part of the deposits. Although buried archaeological deposits were discovered only in Trench 1, each trench excavated west of the swale revealed a similar sedimentary and pedological sequence (Figures 8.4.1-1 and 8.4.1-2; Appendix C). Trench 1 typifies the sequence of sediments and soils found in the western part of the test locale (Appendix C; Figures 8.4.1-2 and 8.4.1-4). The base of the sequence is tan and brown-mottled, reddish/orange, cross-bedded to crudely bedded sand and gravel that commonly includes large cobbles and pebbles. Only the upper ca. 30 cm (11.8 in) of the unit was exposed within Trench 1 and, because it was so deep, details of its sedimentary characteristics were not observed. This is generally true throughout the western part of the test locale, except for Trench 3, which occurs along the swale margin where the overlying alluvium is thinner and the basal sand and gravel occurs closer to the ground surface. Here, as is true in the eastern area, the dip of the cross-beds suggest west and southwesterly flow direction during deposition and occasional soft sediment deformation (e.g., flame structures and loading/dewatering features) were noted in the upper part of the sequence. Moreover, as suggested for the basal deposits in the eastern sequence, the sand and gravel in the western part of the test locale also represent Holocene channel and/or bar deposits of the Mississippi River and unweathered subsurface (C) soil horizons (Figure 8.4.1-2).

In Trench 1, the basal sand and gravels are overlain by an approximately 1-m (3.3-ft) thick sequence of brown to tan mottled reddish brown/orange, massive to bedded sand, silt, and clayey silt. Although the contact between it and the underlying gravel is sharp, it is also probably generally conformable. The lower part of the unit is composed of relatively thick tabular beds of clayey silt and clayey sand that grade upwards (above 200 cm [78.7 in]) to thin, discontinuous tabular beds of sandy silt and silty fine sand at ca. 150 cm (59.1 in). Snail shell is common above 150 cm to 200 cm (59.1 in to 78.7 in), and a few pebbles occur in the sandy inter-beds above 200 cm (78.7 in). The upper part of the unit grades to mainly massive and faintly tabular bedded sand and silty sand. Taken as a whole, this unit is comprised of Holocene alluvial deposits of Mississippi River and probably relates to the initiation of vertical accretion and levee formation prior to about 1500 BP (Figure 8.4.1-2). Sediments within the unit represent unweathered subsurface (C) soil horizons.

A series of at least three poorly developed paleosols or buried soil horizons overlies the basal alluvial deposits (Figures 8.4.1-2, 8.4.1-3, and 8.4.1-4). These probably represent episodic flood events (deposition of sediments) followed by a brief interval of floodplain stability (no deposition and soil formation). The lowest of these sequences is about 15 cm (5.9 in) thick and formed in mainly brown (top) and light brown/mottled tan/light gray (lower part), massive, silty sand. A few pebbles and occasional snail shell (aquatic and terrestrial) occur chiefly in the lower part of the unit. The unit is composed of a fining-upwards alluvial sequence of silty sand. The base of the unit is quite sandy and includes discontinuous inter-beds of bedded medium to coarse sand that grade upwards into massive to very faintly bedded silty sand. These represent part of a Holocene flood sequence and are probably related to levee formation on the Mississippi River. The soil marks an interval of stability on the levee, and its poor pedogenic development suggests that this interval was brief.

Another ca. 20-cm (7.9-in) thick flood sequence occurs above the paleosol and is nearly identical in sedimentology and pedology. It consists of dark brown to dark gray silty sand (top of the unit; A horizon of paleosol) and light brown/mottled tan/light gray massive sand and silty sand that includes a few pebbles and occasional snail shells (lower part of unit). As suggested for the underlying paleosol, this probably represents part of a Holocene flood sequence, followed by a brief stable interval and is related to levee formation on the Mississippi River.

Significantly, a probable cultural feature, which contained burned bone and turtle carapace, possible fire-cracked rock, and a quartz flake, occurs within this sequence (Figures 8.4.1-2 and 8.4.1-4). The relatively dark color of the surface (A) horizon of the paleosol probably reflects an increase in organic material, particularly charcoal, related to the archaeological occupation. In fact, relatively large pieces of charcoal were associated with the cultural material, and one of these yielded a ^{14}C age estimate of 1510±90 BP (Beta-200793; calibrated cal yrs A.D. 380 to A.D. 680 (Appendix D). Although no diagnostic artifacts were identified, this age suggests a late Middle or early Late Woodland age for the archaeological materials. Except possibly for the occurrence of fine charcoal flecking within the alluvial sequence, no additional cultural material was observed at other trenches within the Clement test locale (21SH0047).

The paleosol and associated archaeological deposits in Trench 1 are overlain by another flood/paleosol sequence. Like the underlying sequences, it consists of brown (upper 10 cm [3.9 in]) and light brown/mottled tan/light gray (lower part of unit), massive, silty sand that also includes a few pebbles and occasional snail shells, mainly in the lower part. The top of the sequence represents surface (Ab) soil development and implies a depositional hiatus. This unit also likely represents part of a Holocene flood sequence, followed by a brief stable interval. It is related to levee formation on the Mississippi River. In the trenches excavated along the western edge of the test locale, similar sequences of stacked paleosols were noted (e.g., Trenches 1 and 6; Appendix C). Near the flood chute marking the edge of the western depositional area, however, relatively thick cumulative soils sequences were discovered. The thick A horizon of this paleosol found in Trenches 3 and 7 (Figures 8.4.1-1 and 8.4.1-3) probably reflects more gradual accretion on the back-side of the levee in the western part of the test locale.

The silty sand and paleosol sequence is overlain by about 60 cm (23.6 in) of generally massive sand, which probably reflects re-initiation of flooding after a brief hiatus. Evidence of bioturbation is common throughout this sandy unit. The base of the sand is tan/mottled light brown and gray and includes lenses of faintly bedded sand. The middle part (i.e., 20 cm to 40 cm [7.8 in to 15.7 in]) is black to dark gray and marks the sub-plow zone extent of the A horizon. The relatively thick nature of this sub-plow zone A horizon may indicate development of a mollic epipedon. The upper ca. 20 cm (7.8 in) of the A horizon has clearly been disturbed by plowing and the plow zone (top of the sequence) is massive and composed of a similar sandy texture, but lighter-brown color. This lighter color may reflect relative accretion of sediment once plowing commenced and, if so, may be formed, in part, from post-settlement alluvium.

8.4.2 Discussion of Geoarchaeological Significance of Trenching

Based on the trenches excavated, archaeological materials identified, and ^{14}C chronology, deposits near the Clement test locale are typical for late Holocene meandering channel systems (Figure 8.4.1-2). As the Mississippi River migrated westward across floodplain, older alluvium was probably eroded or reworked and replaced by a series of channel and/or bar deposits. Represented by the ubiquitous basal sand and gravels underlying the entire area, these mark episodes of lateral, coarse-grained accretion that have a very low potential for preserving in situ archeological deposits. These relatively high-energy sediments are overlain by a sequence of interstratified alluvial silts and sand that show evidence of increasing stability in its upper part. This alluvial sequence represents vertical accretion of sediment and is probably related to levee formation along the Mississippi River. Relative landform stabilization in the upper 1.0 m (3.3 ft) is suggested by the presence of ephemeral paleosols that indicate brief depositional hiatuses and short-lived surface weathering.

The timing for channel migration, levee formation, and human occupation at the Clement test locale is given by the 1510 BP ^{14}C age of charcoal associated with the archaeological material buried within the paleosol sequence (Figure 8.4.1-2, Appendix D). This age indicates that channel migration must have occurred some time prior to that date and that a levee had probably stabilized at nearly its present configuration just after 1500 BP. Although channel migration and levee formation can be idiosyncratic given individual basin hydraulic conditions, often they are episodic and relate to alterations in regional climate patterns (Bettis and Mandel 2002; Monaghan and Lovis 2005). Such climate variance can be continent-wide events, such as the Hypsithermal, that span several hundred or a few thousand years (Bettis and Hajic 1995) or cycles of small, regional events that each last only a few hundred years, such as suggested by Monaghan and Lovis (2005). Interestingly, an interval of increased alluviation along rivers and streams in the upper Great Lakes region just after 2000 BP has also been proposed by Monaghan and Lovis (2005) and may coincide with the episode of channel migration and levee formation that occurred along the Mississippi just prior to 1500 BP (Figure 8.4.1-2). Moreover, similar aged episodes of increased alluviation have been noted for the Northeast and Mid-Atlantic regions (Monaghan and Hayes 2001; Raber and Vento 1990), suggesting a more regionally scaled climate event may have been responsible for the accelerated depositional interval at the Clement test locale at ca. 1500 BP. If correct, this suggests that buried or stratified Early and Middle Woodland occupations may actually be more common along the upper Mississippi River than previously recognized.

8.5 RESULTS OF ARCHAEOLOGICAL TESTING

8.5.1 Previous Investigations

Prior to this research, no surface or subsurface testing had been done near the Clement test locale. A small lithic scatter, informally referred to as the First Site (21SH0048), was discovered about 350 m (1148 ft) north of the Clement test locale during the initial phase of fieldwork.. Other sites that typically lie on topographically higher terraces also occur up- and downstream from the Clement study area. The most significant of these are discussed in Chapter 2.0.

8.5.2 Current Investigations

Archaeological investigations at the Clement test locale consisted of augering and the excavation of four test units to establish the presence or absence of archaeological deposits and the nature of the occupation in buried soil horizons determined to have been stable surfaces. Test units were placed adjacent to Trenches 1, 3, 6, and 7. No cultural materials were identified during augering of the target horizon identified in Core 8, in Trenches 2-7, or as a result of test unit excavation. Buried prehistoric cultural deposits, however, were identified during the backhoe excavation of Trench 1. A ^{14}C age estimate from the trench containing the cultural deposits places the age of the occupation to about 1510 BP (Appendix D) or the transitional period between the Middle Woodland and Late Woodland periods.

The prehistoric archaeological material recovered from Trench 1, located at the western end of the test locale, consisted of a flake, fire-cracked rock, and a small concentration of charcoal and calcined animal bone (Figures 8.5.1-1a and 8.5.1-1b; Appendices E and F). The fire-cracked rock was recovered at the western end of Trench 1 and consisted of two pieces of fire-cracked rock, one of which disintegrated into 16 smaller fragments. These had an aggregate weight of 1.1 kg (2.4 lb) and were encountered during trenching at a depth of about 75 cm. A third piece of fire-cracked rock, which weighed 308 gm, was recovered from the south wall of Trench 1, approximately 2.5 m (8.2 ft) east of the specimens recovered on the north wall at a depth of 86 cm (33.9 in) below surface. Interestingly, this piece was refit to the larger of the first two pieces.

While excavating Trench 1 with the backhoe, an irregular ovate-shaped stain of mottled very dark gray and very dark grayish brown silt containing charcoal flecking and calcined animal bone, Feature 1, was identified in the north wall profile (Figures 8.4.1-1 and 8.4.1-4). The boundaries of the stain were diffuse and poorly defined and had maximum dimensions of 90 cm × 70 cm (35.4 in × 27.6 in). A slightly better defined inner core of the feature, consisting of very dark grayish brown silt with charcoal flecking and calcined bone, measured 65 cm × 45 cm (25.6 in × 17.7 in). The outer portion of the feature had little charcoal flecking in it and no

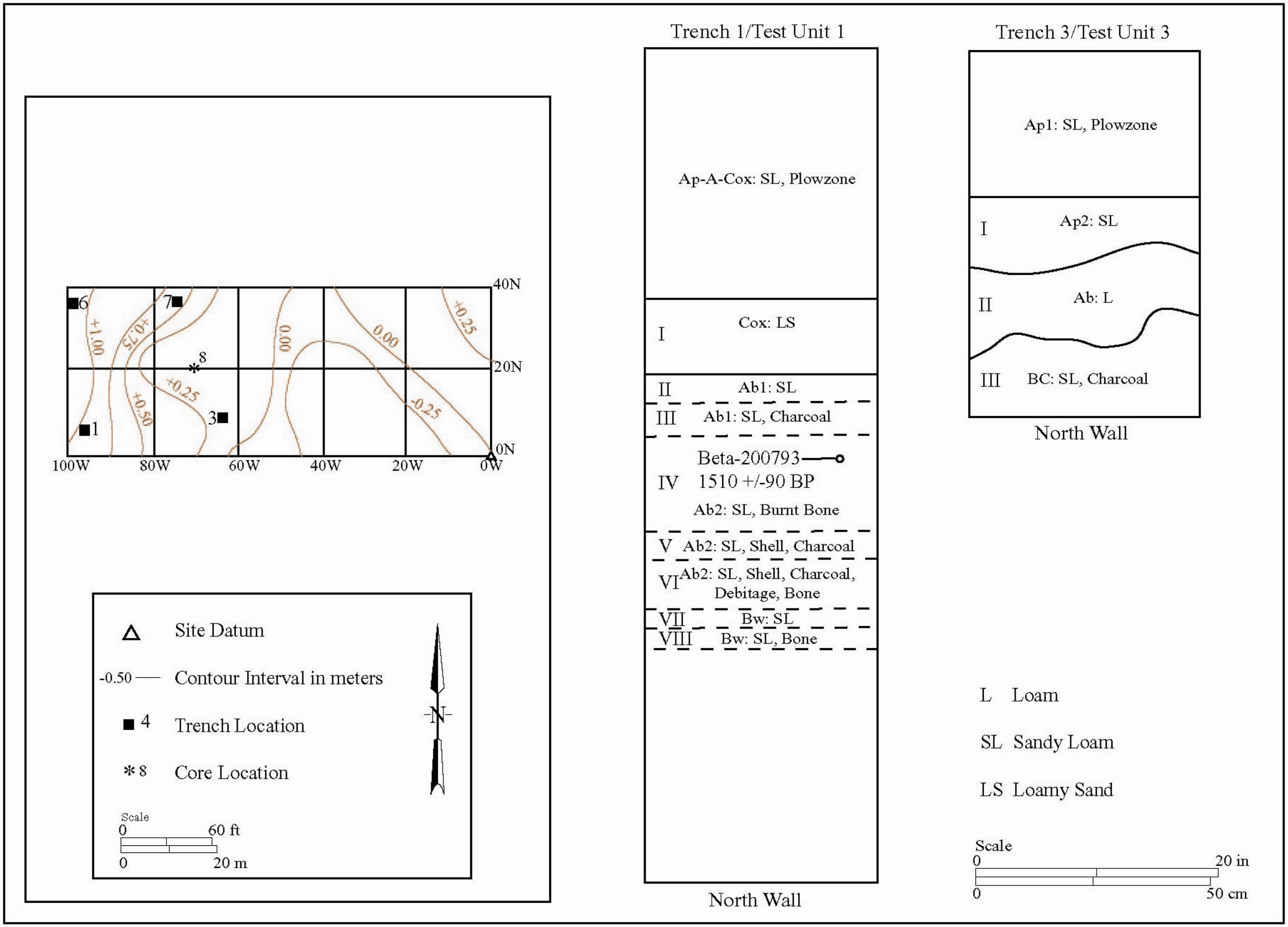

Figure 8.5.1-1a. Comparative Trench/Test Unit Profiles, Clement Test Locale

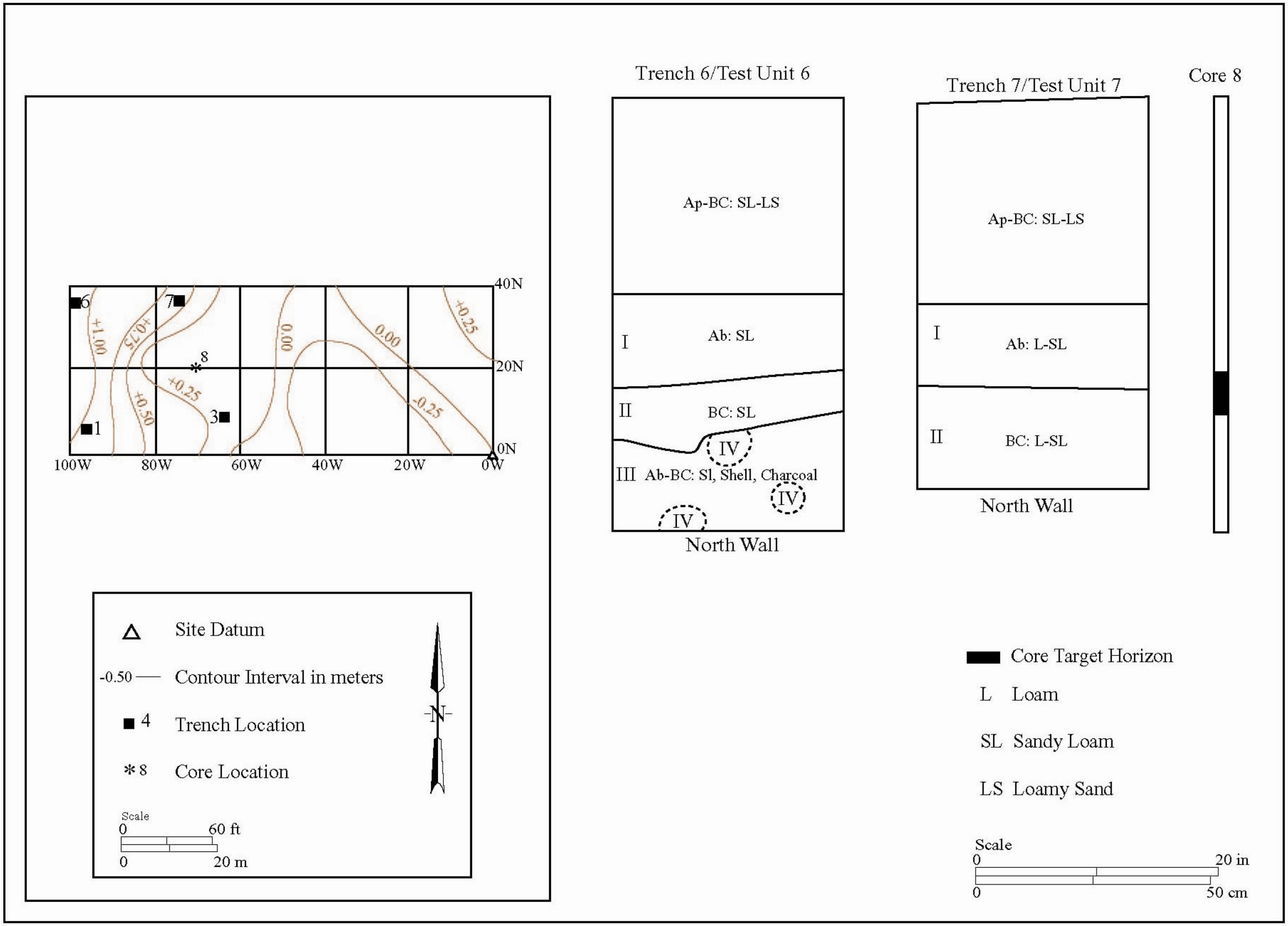

Figure 8.5.1-1b. Comparative Trench/Test Unit Profiles, Clement Test Locale

calcined animal bone. In cross-section, Feature 1 formed a shallow basin 1 cm to 2 cm (0.4 in to 0.8 in) deep. A small quartz blocky secondary flake was recovered at a depth of 110 cm to 120 cm (43 in to 47 in) proximate to Feature 1.

Test Unit 1 was placed along the north side of Trench 1 to intersect the area in which the feature was identified, although it could not be clearly defined in profile (Figure 8.5.1-1a). The surface sediment was removed to a depth of 60 cm (23.6 in) below ground surface before formal excavation began. Seven arbitrary 10-cm (3.9-in) thick levels were excavated and the test unit was terminated at a depth of 128 cm (50.4 in) below ground surface. The stratigraphy is illustrated in Figures 8.5.1-1a and 8.5.1-1b. No cultural materials were encountered in this test unit until Level 4 (88 cm-98 cm [34.6 in-38.6 in] below surface), which corresponds to the level at which Feature 1 was initially exposed. However, careful excavation of this level failed to identify any remnant of Feature 1 extending into the test unit. The archaeological material from Level 4 was limited to seven turtle carapace fragments and two indeterminate bone fragment. A small animal mandible fragment and one indeterminate bone fragment also were collected from the wall of Trench 1 at a depth slightly below that of Feature 1 (see Appendix F).

8.5.3 Artifact Assemblage

The artifact assemblage from the Clement site is limited to a single piece of debitage, three pieces of fire-cracked rock that had an aggregate weight of about 1.4 kg (3.1 lb), and 20 pieces of bone and shell (Appendices E and F). The sole piece of debitage from the site is a medium-size, blocky secondary flake fragment made of opaque white quartz (Appendix E). All of this material occurred in Trench 1, Strata IV, V, and VI and Test Unit 1, Levels 4-6.

As noted above, all of the fire-cracked rock occurred at the western end of Trench 1, and most of it consisted of a single disintegrating cobble. The only other piece of fire-cracked rock from Trench 1 was refit to the one intact fragment from the western end of the trench. The one piece of debitage was collected from the north wall of Trench 1 a short distance east of Feature 1 and at a depth of between 110 cm and 120 cm (43 in to 47 in) below ground surface.

Of the 20 pieces of bone and shell, 17 are from Trench 1 and Test Unit 1 and are assumed to be associated with the human occupation; however, the three pieces of shell from Levels 5 and 6 of Test Unit 1 may be natural inclusions and one piece of bone from a rodent burrow may be intrusive. The remaining three specimens include one piece of bone from the plow zone in Test Unit 2 and two pieces of shell regarded as incidental to any human occupation from sub-plow zone levels in Test Unit 6.

8.5.4 Discussion of Archaeological Significance

While augering of the target horizon identified in Core 8 failed to identify archaeological materials, backhoe trenching and test excavations at the Clement test locale identified the presence of a small prehistoric encampment. The excavation of a test unit in the only trench containing cultural materials produced small amounts of additional cultural material (bone). The low density of material, as well as the facts that it was restricted to a single backhoe trench and was not found in the augering stage of the investigations, suggest that the Clement site is a short-duration, special-function encampment. A ^{14}C date on charcoal collected from the horizon containing the cultural material produced a date of 1510 BP (Appendix D), which indicates that the occupation occurred during the Middle to early Late Woodland periods.

8.6 SYNTHESIS AND INTEGRATION

The ephemeral nature of the paleosol sequence and associated low-density occupation horizon highlight some of the problems and promises of the various methods tested. For example, comparisons of Figures 8.3.1-1 and 8.3.1-2 with Figure 8.4.1-2 and 8.4.1-3 show that many of the details of the subtle soil sequences were not apparent in cores. While the thicker, better developed sub-plow zone soils, which also have high potential for buried archaeological deposits, were apparent in both cores and trenches along the back of the levee (such as Trenches 3 and 7 [Figures 8.4-1-1, 8.4.1-2 and 8.4.1-3] and Core 8 [Figures 8.3.1-1 and 8.3.1-1]), the stacked sequence that actually included archaeological deposits was not discerned within the cores (Figure 8.3.1-3). Although the better developed soils in the upper part of this sequence were noted in Core 6, the more ephemeral lower part apparently was missed. Inspection of the Trench 1 profile wall photograph (Figure 8.4-1-3) explains why this is the case and shows that the visible expression (i.e., dark color) of horizons comes and goes even along the ca. 4-m (13.1-ft) long wall profile. If a small diameter core was placed in the less visible part of the horizon, no surface soil horizon (i.e., A/C or Ab) could be seen. As discussed below, the amount of development of these horizons may also directly relate to the intensity of human occupation, which for low-density occupations means the poorly expressed short-term surfaces may be dominant and the better expressed horizons relatively small and rare.

A retrospective comparison of the geophysical survey with the core and trench data offer several insights regarding the sensitivity of remote sensing at the Clement locale and similar depositional settings. Such comparisons also highlight the fact that geophysical data may be more useful to trace buried features and deposits whose characteristics are known rather than using it to discover buried deposits and horizons. While the geophysical data may not have been able to predict the nature of the subsurface as inferred from the core and trenching data, once the subsurface structure was generally known the remote sensing data could be used to trace the extent of some of the subsurface features and deposits. Clearly, the primary element of the geomorphological model developed from the trenches is the distinction in depositional histories for the eastern and western parts of the test locale. For example, the western levee and associated accretionary paleosol sequence contrasts with the apparently older, more coarse-grained eastern sequence (i.e., east of the swale; Figure 8.4.1-1). These data may account for the broad differences between the eastern and western areas noted in the magnetic survey data. Moreover, the initial suggestion that the large generally northwest-southeast and southwest-northeast sets of crossing linear features noted in eastern two-thirds of the survey area in both the magnetic and resistivity data (Figure 8.2.1-1) represent erosional channels cut through the levee, is supported by the trenching data (Figure 8.4-1.2) and reinforces the differences between the eastern and western parts of the testing grid. The linear features observed in the GPR data (Figure 8.2.1-2) probably represent similar erosional cuts, while the "geological" feature noted may reflect the fact that the stacked paleosol sequence apparently merges to form a thicker, near-surface accretionary paleosol along the back (eastern margin) of the western levee (i.e., just west of the swale; Figure 8.4.1-1 and 8.4.1-2). Similar trends in resistivity differences may trace this same phenomenon. The "blotchy" nature of these in both data sets the may indicate that small cut and fill erosional channels, related to overbank flood sequences, partly truncated the paleosol and/or buried it slightly deeper than in the surrounding areas.

Some general concepts applicable to the discovery of buried archaeological sites in similar levee environments can be examined from the perspective of the Clement test locale. For example, although prehistoric occupations could have occurred at any time during deposition of the Clement alluvial sequence, they most likely would be discovered associated with the upper, more stable part of the sequence when only minimal deposition occurred. This is suggested not because of specific geoarchaeological principles, but rather based on the developmental progression of the landform and the fact that human occupation is more commonly associated with relatively dryer and better-drained parts of a landscape. From this perspective, the occurrence of buried archaeological deposits within one of the paleosols marking relative landform stability at the Clement test locale is not surprising because such deposits are simply more likely to be present, preserved, and discovered by researchers in this part of the sedimentary sequence. Importantly, however, the association of the archaeological materials with the surface horizon of a paleosol, while typical, is neither required nor necessarily universal (Monaghan and Hayes 1998, 2001; Monaghan and Lovis 2005). The common relationship of human occupation with surface soil horizons may in part reflect the tendency of researchers to focus on the more visible Ab horizon within alluvial profiles rather than on more short-lived surfaces within accretionary flood deposits that now comprise buried subsoil horizons (Monaghan and Lovis 2005). Nevertheless, the association of human occupation with a specific soil horizon at Clement reveals the tendency of human habitation to enhance soil color by the additions of organic material, particularly charcoal. Indeed, the occupational debris associated with human occupation may be largely responsible for the relatively prominent color and apparently well-developed nature of the Ab horizon at archaeological sites.

From an archaeological perspective, the ephemeral nature of the Clement test locale archaeological deposits demonstrates the importance of employing site discovery methods that are sensitive enough to detect low-density occupations. Such single component occupations preserved in buried contexts have the potential to contain spatial information about the organization of space and subsistence data associated with a single occupation that are not preserved within repeatedly occupied short-duration, special function sites. Consequently, the site discovery techniques must also be able to detect and trace relatively young, short-lived, and poorly developed stratigraphic horizons that commonly form in the upper, more stable parts of levee systems. Although the buried archaeological deposits at the Clement test locale were discovered within the first trench excavated, no additional cultural material was found in any other trench. Similar buried and transitory soil horizons, however, were noted within the upper meter of alluvium elsewhere in the western part of the study area. Other spatially discrete, short-term occupations or processing areas may occur at other places on the levee but were not detected because the trenching interval was not close enough or the trenches were not long enough. This, of course, points out one of the drawbacks to backhoe trenching. Although they can detect ephemeral occupations and discern fine details of sedimentology and pedology, they are too invasive to effectively assess site limits without destroying much of the buried site, especially small sites such as that found at the Clement test locale.