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A Hidden Landscape: Interpreting Buried Archaeological Site Potential in the White River Valley, Indiana

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ABSTRACT

A model for buried site potential has been developed and presented here following extensive geoarchaeological investigations conducted along the White River valley in Indiana. Backhoe-trenching efforts identified 35 buried archaeological sites dating from the Late Archaic through postcontact periods. Buried archaeological sites were found primarily in soils classified as inceptisols, with fewer found in soils classified as mollisols and entisols. Geochronological dating and artifact analysis suggest that after 3000 BP the White River valley transitioned from lateral to vertical accretion, providing landforms suitable for precontact occupation.

KEYWORDS

geoarchaeology; buried site potential; inceptisols; mollisols; predictive model; soils; White River valley

The purpose of this article is to present a buried archaeological site model for the White River valley (WRV) in Indiana (Figure 1). The model I present uses data gathered during geoarchaeological investigations conducted for the I-69 Highway Corridor project in addition to integrating coring conducted by Herrmann (2013, 2016) and Herrmann and Monaghan (2019).

Geoarchaeological work examined a diverse range of Quaternary landscapes that spanned the main stem of the WRV as well as second-, third-, and fourth-order tributaries (see Figure 1; Trader 2021). Deep testing identified 35 buried archaeological sites.

Transportation departments and cultural resource management (CRM) firms, universities, and state agencies have developed and funded buried-site models (see Layzell and Mandel 2018; Layzell et al. 2018; Monaghan et al. 2006; Monaghan and Lovis 2005).

Previous studies conducted by Herrmann (2016) and Herrmann and Monaghan (2019) have modeled precontact settlement in the WRV. Herrmann (2016) proposed a settlement model for the location of PaleoIndigenous and Early Archaic sites in the WRV. Herrmann and Monaghan (2019) examined the results of previous work in the WRV, coupled with paleoclimatic data, to develop a model for floodplain development in the WRV.

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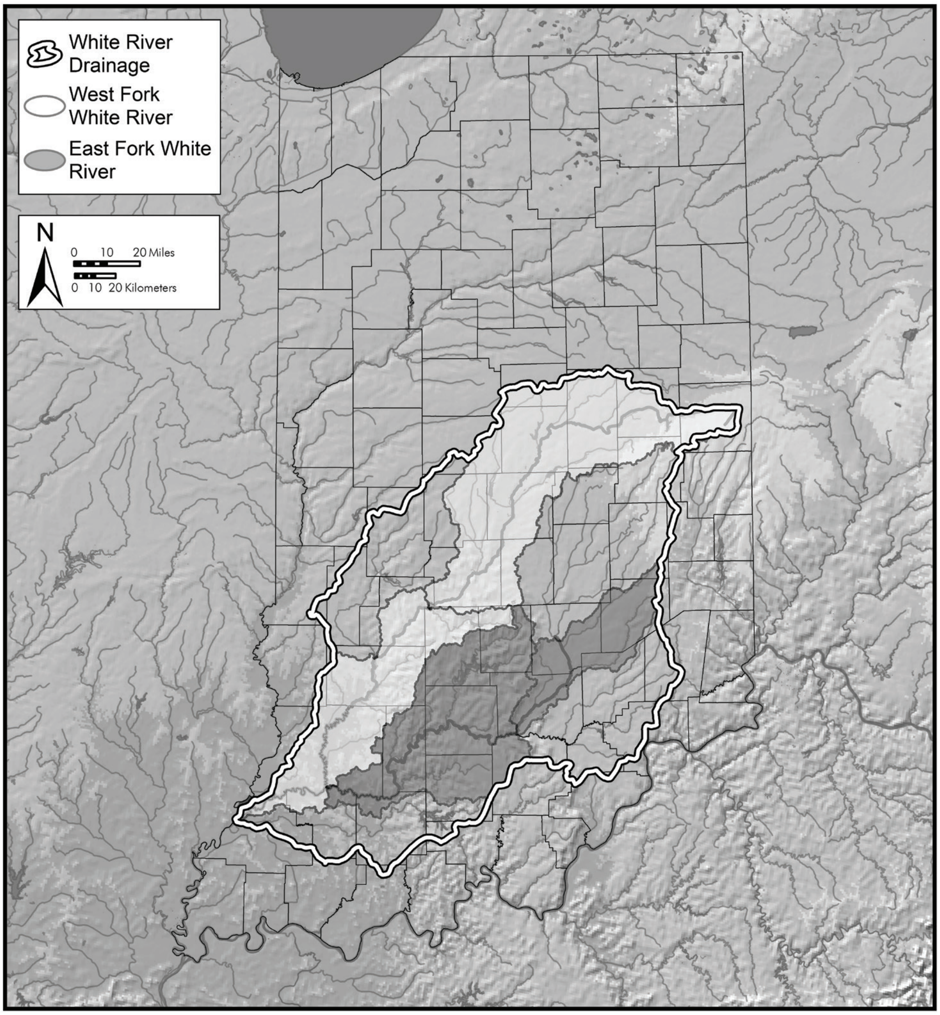

Figure 1. White River drainage, Indiana.

Herrmann found a greater potential for buried PaleoIndigenous and Early Archaic sites in bedrock-controlled sections of the river than in meandering sections, which hold little potential for extant older sites.

The work presented here shows there is a higher potential for Late Holocene-aged sites (i.e., Late Archaic, Woodland, and late precontact) in meandering sections of the river, particularly those sections where meandering occurred prior to the Late Archaic period.

Physical Setting

The White River drainage, part of the greater Mississippi River system, drains an area of 29,396 km^2 in central and southern Indiana consisting of the West and East Fork drainages (see Figure 1; Crawford et al. 1996:1).

The geology of the northern portion of the WRV was modified and transformed by glacial activity during the Last Glacial Maximum (LGM). Any geological structure that predates the LGM has been obscured (Wayne 1956:15). The central portion of the WRV is composed of Mississippian-aged limestone, shale, and sandstone, as well as Pennsylvanian-aged sandstone and shale (Schrader et al. 2002:13). Geology of the southern portion of the WRV is composed of a variety of sedimentary lithologies that have resulted from changes in the "angle of dip of strata associated with the . . . Cincinnati Arch; changes in upper Paleozoic sedimentation, the Mississippian/Pennsylvanian unconformity and post-Paleozoic Era erosion" (Schrader et al. 2002:13).

The East and West Forks acted as glacial sluiceways moving, burying, or mixing earlier deposits of Illinoian outwash (Thornbury 1950:5).

Herrmann (2013:101–102) has defined three major river styles for the WRV. The northernmost segment is found in glaciated terrain, which is characterized by low relief, a broad valley, till plains, and end moraines, resulting in a meandering stream. Herrmann (2013:101) notes that outwash terraces and till plains are still preserved along this portion of the river. The central portion is bedrock controlled, with bedrock outcrops and cliffs exposed along the narrow valley. The southernmost segment is defined by a broad floodplain, with a wide meander belt that provides evidence of multiple river meanders.

In the WRV, surface and near-surface deposits of fine-grained alluvium have been assigned to the Martinsville Formation (Table 1). The Martinsville Formation is the youngest of six formations originally defined by Wayne (1963).

Autin (1996) defined five new members (Prairie Creek, Black River, Conger Creek, Elnora, and Hyatt Island) of the Martinsville Formation along the Wabash River and WRV (Table 1). Autin (1996) notes that each of these members exhibits two lithofacies. The first is lower sandy facies composed of channel and bar deposits, while the second is silty facies and consists of overbank deposits that cover channel and bar deposits, concealing older members (Autin 1996:109). All members, except Hyatt Island, may contain paleosols.

The Prairie Creek member is the oldest and highest in the sequence in which younger members are inset (Autin 1996:109). Prairie Creek developed as an island-braid channel system and dates to the Late Pleistocene and may contain PaleoIndigenous artifacts in the plow zone (Autin 1996:122). The Black River member is the next youngest and is inset into the Prairie Creek and older deposits and often covered by sediments from the younger members (Autin 1996:113).

The Black River is the oldest meander belt system and may contain Late Archaic artifacts (Autin 1996:122). The next youngest is Conger Creek, which is inset into the Black Member and older deposits and may contain Terminal Archaic period artifacts (Autin 1996:113, 122). The Elnora member is the next youngest and is inset into Conger Creek and older deposits and may contain Early and Middle Woodland artifacts on top of the Elnora paleosol, and Late Woodland and younger

Table 1. Properties of the Martinsville Formation.*

	Hyatt Island Member	Elnora Member	Conger Creek Member	Black River Member	Prairie Creek Member
Facies	Fluvial overbank	Fluvial overbank	Fluvial overbank; fine sand and silty interbeds are common; locally gleyed	Fluvial overbank; fine-grained facies grades to interbedded loamy and sandy strata in lower portion; meander belt deposit	Fluvial-channel belt; increases in sand content with depth and reflects channel deposition in an island pattern
Color	Brown to dark yellowish brown	Yellowish brown to light yellowish brown	Yellowish brown to brownish yellow	Yellowish brown	Strong brown to brown; Brownish yellow to brown
Texture	Silt loam	Silt	Silt	Silt	Silty clay; sandy loam; silt loam
Thickness (m)	2	2.5	3.5	2 to 5	1.5 to 4
Surface soils	inceptisols, entisols	inceptisols, alfisols	alfisols	alfisols	alfisols
Horizonation	A-C; A-Bw-C	A-Bw-C; A-Bt-BC-C	Btg-BCg-Cg; Bt-BC-C	Bt-BC-C	Bt-BC-C; Bt-C
Buried Soils	Uncommon	Common	Common	Common	Common
Stratigraphic Relationship	Inset into Elnora and older members. Associated with present meander belt of White River	Inset into Conger Creek and older deposits	Inset into Black River and older deposits	Inset into Prairie Creek and older deposits	Cuts into Woodfordian valley train deposits of Atherton formation and older stratigraphic deposits
Age**	<1500 years BP	1500–3500 years BP	6500 to 3500 years BP	10,500 to 6500 years BP	14,000 to 10,500 years BP

*From Autin (1996); **Radiocarbon Years Before Present (RCYBP) artifacts may occur in the overlying deposits and on the surface (Autin 1996:119–122). The youngest member is Hyatt Island, which is inset into the Elnora member and older deposits and is weakly developed (see Table 1; Autin 1966:119). The Hyatt Island member contains the present meander belt of the WRV and may contain Late Woodland, late precontact, and postcontact period artifacts.

The previous summary is pertinent to understanding the alluvial systems in the WRV and their potential for sediments to bury archaeological sites during the Holocene. The Martinsville Formation consists of Late Pleistocene and Holocene-aged sediments that may contain the entire spectrum of human history in the region.

Methods

Geoarchaeological and geomorphological investigations consisted of a combination of geotechnical coring, backhoe trenching, and the hand excavating test units and archaeological features.

All soil and sediment properties were described per United States Department of Agriculture (USDA) standards (Soil Survey Staff 1993).

A Giddings and GeoProbe were used for coring. The Giddings hydraulic soil probe was 0.07 m in diameter and pulled a 1.22 m long solid core (Cantin and Stafford 2010:7), while the TR-54 series GeoProbe coring device dual tube system retrieved a 0.0319 m diameter solid earth core (Monaghan 2009).

Backhoe trenches were excavated with either a backhoe or trackhoe equipped with a smooth-edged bucket and measured between 0.9 m and 1.0 m in width. Trenches measured 3 m to 6 m in length and between 1 m and 3 m in width, depending on the final depth of the trench and Occupational Safety and Health Administration (OSHA) requirements.

Hand-excavated units measured 0.5 m by 0.5 m or 1.0 m by 1.0 m. Identified features were fully exposed, drawn in plan view, and excavated. We collected organic samples for radiocarbon or optically stimulated luminescence (OSL) dating from trench walls or feature contexts.

Botanical samples were processed by either Beta Analytic, Inc., or the University of Georgia's Center for Applied Isotope Studies (UG-CAIS). All ^{14}C dates were recalibrated using the CALIB 8.2 program using the IntCal14 calibration curve (Stuiver et al. 1993). Materials collected for radiocarbon dates included charred botanical remains, such as wood charcoal and nutshell.

We submitted sediment samples to the Indiana Geological and Water Survey Luminescence Laboratory at Indiana University in Bloomington for processing and analysis.

The buried site model was developed using the results of geoarchaeological work and the locations of buried sites within mapped soil data gathered from the Soil Survey Geographic Database (SSURGO; USDA 2023). The number of hectares covered with specific soil series was calculated for the West and East Forks. Additionally, site density per hectare was also calculated for each drainage. Total predicted sites were calculated by using the total number of hectares with sites determined to have a high potential divided by site density.

Results

During geoarchaeological work, we investigated 289 ha and excavated 142 cores and 659 backhoe trenches (Table 2). We found buried archaeological materials in 104 trenches (15.8%) and identified 35 buried archaeological sites, most (n = 33, 94.2) with no associated surface expression (Figure 2). Archaeological sites dated from the Late Archaic through postcontact periods (Supplemental Table 1).

We conducted most of the fieldwork within the meandering sections of the East and West Forks, rather than in bedrock-controlled sections, except for geoarchaeological work conducted along second-, third-, and fourth-order tributaries, such as Indian Creek, Black Ankle Creek, and Patoka River (see Herrmann 2013).

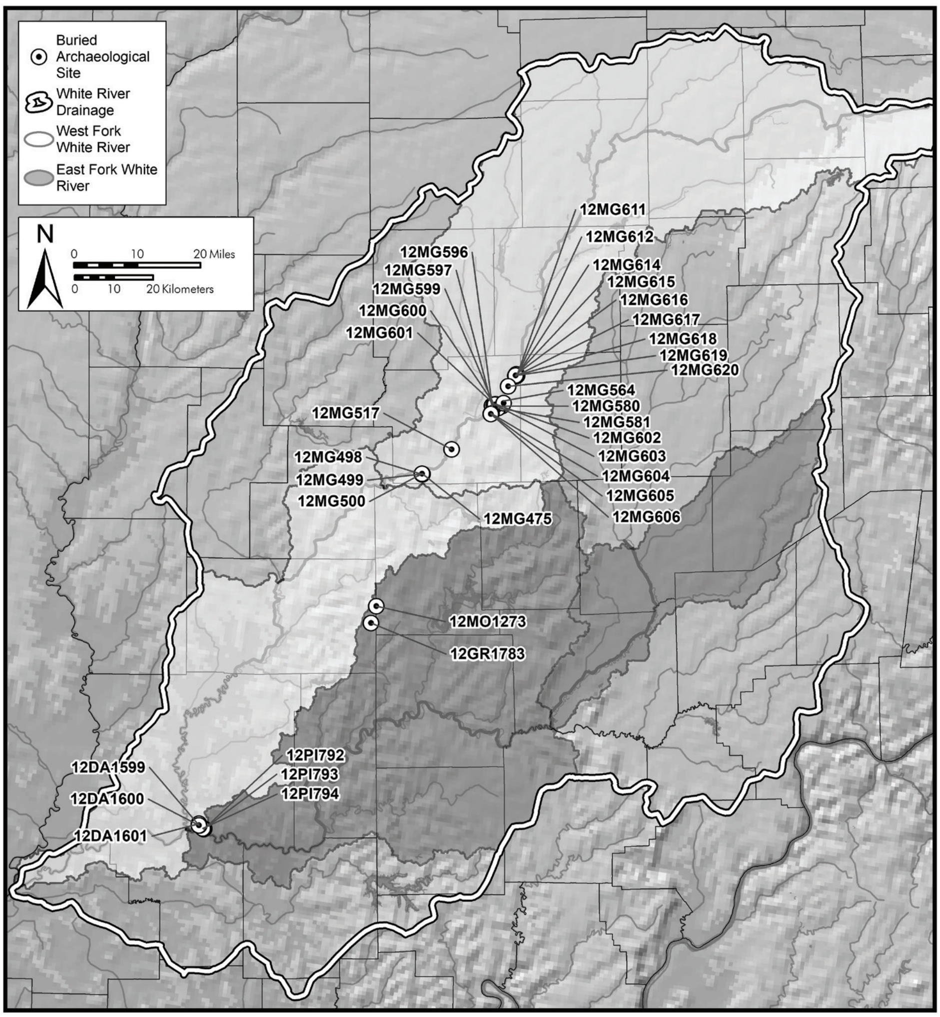

Figure 2. Location of buried archaeological sites in the White River drainage, Indiana.

Table 2. Trenches Excavated and Sites Found in WRV.

Drainage	Number Excavated	Number Sites Found
East Fork	149	8
West Fork	510	27
Total	659	35

Landform and Elevation

All the sites were found in floodplain settings of slightly variable microtopographic relief. For example, in some areas, little relief was present (Figure 3); however, ridge-and-swale topography dominated other areas (Figure 4). Buried archaeological sites were evenly distributed between featureless floodplains (*N* = 17) and levees and levee remnants (*N* = 17). One site was found on an erosional high.

We found buried archaeological sites between 125 m and 205 m above mean sea level (AMSL; see Supplemental Table 1). We documented 22 sites (62%) between 186 m and 195 m AMSL. Only one site was found above 196 m and was located on the floodplain of an intermittent tributary stream (see Supplemental Table 1).

Drainage

We found 77% of buried archaeological sites within the West Fork drainage. Most of these sites (70%) were found <200 m from the river (see Supplemental Table 1). Site density at the West Fork drainage was one site per 3.24 ha.

Figure 3. East Fork of White River floodplain, Pike County, Indiana, view to northwest. (Image courtesy of Gray & Pape, Inc.)

Figure 4. West Fork of the White River floodplain, ridge-and-swale topography, Morgan County, Indiana, view to northwest. (Image courtesy of Gray & Pape, Inc.)

We found 23% of buried sites in the East Fork drainage. Most (75%) were found >200 m from the river (see Supplemental Table 1). Site density at the East Fork drainage was one site per 9.3 ha.

Most buried archaeological sites in the East Fork drainage were found at a significant distance from the river, while buried archaeological sites in the West Fork drainage were found closer to the river. Discrepancies noted between the presence of buried archaeological sites in each of the drainages are related to the amount of prior fieldwork conducted between the two drainages and the fact that coring at the East Fork eliminated many areas as having no potential for buried archaeological sites. Finally, it is possible that less meandering occurred at the West Fork drainage, which resulted in preserving buried site locations.

Soils

We found that most buried sites were associated with inceptisols (n = 24; 68%), while fewer were associated with mollisols (n = 7; 20%) and entisols (n = 4; 11%; see Supplemental Table 1 and Table 3).

We found buried archaeological sites associated with a variety of soil horizons, including cambic (Bw; 51%), buried landforms (Ab, 2Ab, and Bwb; 42%), and argillic (Bt) and A2 horizons (7%; see Table 3; Figure 5). The association of buried sites

Table 3. Number of Sites Identified Per Soil Order.

Soil Order	Number of Sites
Entisols	4
Inceptisols	24
Mollisols	7
Total	35

with various soil horizons suggests episodes of overbank flooding and landform stability that preserved archaeological deposits.

Site Types

We defined five buried site types: artifact scatters, camps, fire-cracked rock (FCR) scatters, isolated finds, and lithic scatters (see Supplemental Table 1). Artifact scatters (n = 2; 5.7%) are postcontact period artifact scatters or mixed precontact/postcontact assemblages. Camps (n = 16; 45.7%) have a varied artifact assemblage, including lithics and/or ceramics, faunal and/or botanical remains, and features. FCR scatters (n = 5; 14.2%) include only scattered fragments of FCR. Isolated finds (n = 2; 5.7%) are a single artifact, while lithic scatters (n = 11; 31.4%) may include FCR, debitage, tools, and ground/pecked/battered stone without associated ceramics, faunal/botanical remains, or features.

Figure 5. Buried soil horizon in alluvial setting, West Fork of the White River floodplain, Morgan County, Indiana, view to north. (Image courtesy of Gray and Pape, Inc.)

Figure 6. FCR concentration, site 12MG601, view to south. (Image courtesy of Gray and Pape, Inc.)

Buried archaeological sites in the East Fork drainage consisted of stratified and multicomponent low-density temporary campsites with evidence of Late Archaic and Late Woodland occupations.

At the West Fork drainage, buried sites exhibited low archaeological signatures with few artifacts and features and consisted of short-term camps (Myers and Trader 2019; Trader 2014; Trader and Leone 2018; Trader and Vehling 2019; Trader et al. 2019). Occasionally, we found archaeological materials in concentrations, suggesting living-space floors or cultural features. Identified features consisted of FCR concentrations, representing the remnants of hearths or roasting pits, with no visible staining (Figure 6). The lack of staining may be attributed to either short-term encampments or the leaching of organic material, through erosion. We interpreted buried sites found in the West Fork as small temporary camps, some of which contained multiple occupations (see Supplemental Table 1).

Cultural Affiliation

We determined cultural affiliation using diagnostic artifacts, associated ^{14}C dates, and OSL dates. Forty-three percent ($n = 15$) of sites contained datable components. Buried deposits date as early as the Late Archaic ($n = 5$), with additional components of Early Woodland ($n = 4$), Middle Woodland ($n = 1$), Late Woodland ($n = 2$), late precontact ($n = 2$), and postcontact ($n = 1$) affiliations (see Supplemental Table 1).

Radiocarbon Dates

We obtained 15 ^{14}C dates from nine archaeological sites located along the East and West Forks (Supplemental Table 2). We obtained seven additional dates from trenches excavated at the East Fork floodplain or from cores excavated at the West Fork floodplain (see Supplemental Table 2; Kolb 2013; Trader et al. 2011). Radiocarbon dates were predominately Late Holocene in age and covered the Late Archaic through the modern period. However, Kolb (2013:Appendix B) obtained ^{14}C dates ranging from the Middle Holocene through the Late Holocene (see Supplemental Table 2).

Earlier dates obtained from wood charcoal between 2.3 m and 2.7 m suggest that by 3040 BP the East Fork floodplain transitioned from having been dominated by lateral accretion to being dominated by vertical accretion, which allowed Late Archaic groups to begin more long-term occupations.

More modern (<200 years) dates were obtained from wood charcoal collected from buried soil horizons between 0.3 m and 0.8 m below surface and ranged from 210 ± 40 BP to 60 ± 40 BP, indicating no potential for buried archaeological deposits.

Kolb (2013:13) reported ^{14}C dates ranging between 7000 BP and 4000 BP from abandoned channel-fill deposits at the West Fork and suggested that the river began migrating during the Middle Holocene through the early portion of the Late Holocene. At the West Fork drainage, ^{14}C dates are representative of Late Archaic, Early Woodland, Middle Woodland, and late precontact sites (see Supplemental Table 2).

Optically Stimulated Luminescence Dates

Table 4 provides a summary of OSL results. We obtained OSL dates from sediments recovered from backhoe trenches on the combined floodplain of Crooked Creek and the West Fork (Antinao et al. 2020; Trader et al. 2020a, 2020b). Samples provided chronological information on landform development.

An OSL date of 2,100 years ago combined with a ^{14}C date of 2440 ± 20 BP (UGAMS-46908) from site 12MG564 suggests that vertical aggradation began by 2,500 years ago, allowing Early Woodland groups to settle on the landform (Antinao et al. 2020; Trader et al. 2020a).

OSL dates obtained nearby from site 12MG580—a stratified, deeply buried site—ranged between 2,900 and 2,000 years ago (Table 4). The earlier date suggests this portion of the WRV transitioned from lateral accretion to vertical accretion around 400 years earlier than the landform at site 12MG564 did, allowing short-term occupations by Early Woodland groups by 2600 BP (see Supplemental Table 2 and Table 4). The later OSL date is associated with the Middle Woodland occupation of the site.

Table 4. OSL Dates from the White River Valley.

Site Number	Lab Number	Depth (m)	Context	Grain Size (μm)	Moisture (%)	Dose rate (Gy/ka)	De (Gy)	Over-dispersion (%)	OSL Age (ka)[1]	Reference
12MG564	IGWS-315	0.70	Trench 2	85-255	11.98	2.65 ± 0.15	5.5 ± 1.0	20	2.1 ± 0.4	Antinao et al. 2020; Trader et al. 2020a
12MG580	IGWS-316	0.90	Trench 30	85-255	13.11	3.96 ± 0.15	6.0 ± 0.3	20	2.0 ± 0.2	Antinao et al. 2020; Trader et al. 2020b
12MG580	IGWS-317	1.60	Trench 30	85-255	12.99	2.7 ± 0.15	7.8 ± 0.4	20	2.9 ± 0.3	Antinao et al. 2020; Trader et al. 2020b
12MG580	IGWS-318	1.85	Trench 25	85-255	16.78	3.05 ± 0.17	8.7 ± 0.3	20	2.9 ± 0.2	Antinao et al. 2020; Trader et al. 2020b

[1] Thousands of years.

Table 5. Macrobotanical Remains Collected from Sites at West Fork Drainage.

	Archaeological Sites					
Macrobotanical Remains	12MG517	12MG580	12MG597	12MG601	12MG602	Total
Elm/Hackberry charcoal	6	16	—	—	—	22
Sycamore charcoal	1	—	—	—	—	1
Maple charcoal	1	—	—	—	—	1
Elm charcoal	—	—	19	—	1	20
Ash charcoal	—	—	—	20	—	20
Honey locust charcoal	—	—	2	—	—	2
Black walnut nutshell	—	6	—	—	—	6
Hickory nutshell	—	—	2	—	3	5
Total	8	22	23	20	4	77

Archaeobotanical Remains

We did not conduct formal analysis of archaeobotanical remains collected from the East Fork drainage. However, we did conduct formal analysis of archaeobotanical remains collected from buried sites at the West Fork drainage. Table 5 provides an overview of macrobotanical remains recovered from buried sites in the West Fork drainage. We collected 77 macrobotanical remains from five archaeological sites. Identified macrobotanical remains included elm/hackberry (Ulmaceae), maple (*Acer* sp.), sycamore (*Platanus occidentalis*), honey locust (*Gleditsia triacanthos*), and ash (*Fraxinus*) wood-charcoal fragments in addition to black walnut (*Juglans nigra*) and hickory (*Carya*) nutshell fragments (see Table 5; Trader 2014:96; Trader and Leone 2018; Trader et al. 2019).

Sedimentation Rates

Archaeological sites buried by floodplain sediments from aggrading streams can be subject to variable sedimentation rates (Guccione 2008:379).

On average, when sites are considered together, the upper 1.0 m of alluvium in the WRV was deposited between 1000 BP and the present (0.001 m a year); while the lower 1–2 m of alluvium was deposited between 1000 BP and 3000 BP (0.00075 m a year). These results suggest a high rate of overbank sedimentation between 3000 BP and 1000 BP and a subsequent decrease in sedimentation and flooding after 1000 BP, likely increasing more over the past 250 years following deforestation by Euro-American settlers.

The WRV transitioned from lateral accretion approximately 3,000 years ago, which allowed the upward aggradation of alluvial sediments, resulting in landforms suitable for human occupation. Several landforms were left exposed for periods of time, allowing pedogenic development and modification by plants and animals.

According to Gladfelter (2001:105), floods occurred more frequently after 3300 BP, resulting in more sediment deposition. Therefore, it is unlikely that a standard archaeological survey employing systematic surface survey or shovel testing would identify buried sites unless they were found on higher ridges that represent older levees of the former river channel.

Summary

Geoarchaeological data have provided significant information regarding the occurrence of buried archaeological sites in the WRV. As noted previously, work conducted by Herrmann (2013, 2016) in the WRV focused on the identification of PaleoIndigenous and Early Archaic archaeological sites and Late Pleistocene and Early Holocene landforms with a potential for buried archaeological sites dating to these periods. Herrmann (2013, 2016) found a higher potential for earlier archaeological sites in bedrock-controlled sections of the WRV than in meandering sections, identifying buried soils beneath alluvial and colluvial fans. In bedrock-controlled sections of the WRV, river-channel migration is restricted due to bedrock that protects older landforms from destruction through erosion, resulting in protection of archaeological sites that are Late Pleistocene– and Early Holocene–aged. Conversely, in most meandering sections of the WRV, the migrating nature of the river has resulted in the destruction of older landforms containing older sites (Herrmann 2016).

Results presented here suggest that a high potential exists for the identification of buried archaeological sites dating to the Late Holocene and representative of the Late Archaic**,** Woodland, and late precontact periods in meandering sections of the WRV.

Buried Site Model

The style and fluvial architecture of a river have significant impacts on whether archaeological sites have been preserved in buried contexts or whether they have been destroyed. Basically, archaeological deposits are subject to a variety of processes that influence the identification and interpretation of the archaeological record. Guccione (2008) examined the impact that a river's style has on the preservation of archaeological sites and suggests that rivers with a high rate of lateral migration can be detrimental to site preservation.

In retrospect, these same processes can result in erosion and the subsequent exposure of buried archaeological sites along cutbanks and valley walls (Guccione 2008:379). Overbank floodplain sedimentation can also result in the burial of archaeological sites.

The processes that result in site burial are not uniform across a floodplain and can result in the differential burial and disturbance of archaeological deposits. This appears to be the case for several sites identified in the WRV, where archaeological deposits were found at variable depths and associated with a variety of soil horizons, including buried horizons (Ab), overthickened A (A2) horizons, cambic horizons (Bw), and argillic horizons (Bt).

According to Gooding (1971:396), the bottoms along the Ohio Valley first stabilized between 7000 BP and 1000 BP, covering much of the Middle to Late Holocene, which allowed repeated episodes of overbank flooding to deposit sediment. This, in turn, resulted in the upward aggradation of vertical accretional sediments and the development of landforms that provided potential surfaces for precontact occupation. Gooding (1971:397) notes that equilibrium would have been "attained first in the lower valley reaches, in this case the Ohio River valley to which the Whitewater, Miami, Wabash, and White rivers, and others are graded, and to have proceeded headward up these tributary drainage systems." That is, the WRV began aggrading vertically only after the main stem of the Ohio River did.

Recently, Herrmann and Monaghan (2019:69) examined the postglacial development of the WRV and noted that "[f]loodplain stability is implied by paleosol formation between terrace sequences." Based on their study, the WRV was dominated by lateral accretion processes between approximately 18 and 6 thousand years ago, which consisted of the incision and erosion of outwash terraces and the deposition of coarse-grained sediments. This channel incision and lateral accretion occurred throughout the early Holocene until 6 thousand years ago (Herrmann and Monaghan 2019:73).

After six thousand years ago, rapid vertical accretion, consisting of fine-grained sediments resulting from overbank flooding, occurred (Herrmann and Monaghan 2019:73). Herrmann and Monaghan (2019:73) report that three episodes of vertical accretion occurred: 5.5–4 thousand years ago, 3.5–2.5 thousand years ago, and after 500 years ago. These episodes were separated by periods of relative stability (Herrmann and Monaghan 2019:73).

These episodes of accretion and stability were likely the result of climate/environmental changes that modified the river style or upland vegetation patterns (Herrmann and Monaghan 2019:73). Erosion and lateral channel migration that occurred during the Early Holocene would have resulted in the destruction of archaeological sites that may have existed on lateral accretion deposits. Consequently, few if any PaleoIndigenous and Early Archaic sites have been preserved due to erosion, particularly on floodplains (Herrmann and Monaghan 2019:75). Preserved PaleoIndigenous or Early Archaic sites are likely to be found along valley margins, outwash terraces, or elevated bedrock landscapes (Herrmann and Monaghan 2019:75). More archaeological sites are likely to have been preserved in vertical accretional sediments deposited after six thousand years ago.

Late Archaic and Woodland archaeological sites are likely to be preserved in floodplains because these sites would have been deeply buried or stratified by vertical accretion, which was accelerated during the Middle and Late Holocene in the WRV (Herrmann and Monaghan 2019:75). Archaeological sites dating to the Middle and Late Archaic and Early Woodland periods are likely to be found in buried or stratified contexts because of vertical accretion that occurred between 6 and 2.5 thousand years ago (Herrmann and Monaghan 2019:76). Younger sites dating to later Woodland and Mississippian periods might be found in shallowly buried vertical accretional sediments deposited after 500 years ago (Herrmann and Monaghan 2019:76).

Our work at the West Fork suggests that vertical accretion occurred around 3,000 years ago, resulting in landform development suitable for human occupation.

Work conducted farther south (downstream) at the East Fork suggests vertical accretion occurred prior to 3000 BP, when deposition and aggradation occurred, burying and preserving archaeological sites.

Evidence from site 12MG580 suggests that, while the floodplain of the WRV had begun to aggrade, it was also in a state of flux between 3,000 and 1,880 years ago. Landforms were open and stable at different times (Trader et al. 2020b).

Evidence of buried landforms (e.g., Ab and Bwb) in the WRV suggests periods of floodplain stability. Forty-two percent of identified buried archaeological sites were associated with a buried landform, while 51% of sites were found floating in the Bw horizon, which suggests episodic flooding occurred and landforms were probably occupied seasonally during periods of low water. Most occupations identified were short-term encampments, with limited archaeological visibility.

The earliest sites one would expect to find in buried contexts in meandering valleys that are not bedrock controlled would date to the Late Archaic period, as suggested by Herrmann and Monaghan (2019). Early and Middle Woodland sites would be expected as well. Evidence suggests that Early Woodland sites may be found at depths between 0.5 m and 2.0 m below ground surface. The same is true for Middle Woodland period sites. Late precontact sites are likely to be found in near-surface contexts just below the plow zone.

Based on Autin (1996), all sediments identified in the WRV belong to the Martinsville Formation, which are Holocene-aged alluvial sediments that were deposited 5,000–7,000 years ago. This fits well with the model defined for the WRV by Herrmann and Monaghan (2019), which suggests that vertical overbank deposits developed after 6,000 years ago. Following Autin (1996), vertical accretional deposits containing buried archaeological sites belong to the Elnora Member, which has been dated between 3400 BP and 1500 BP, and the Hyatt Member, which has been dated between 1500 BP and the present. Archaeological sites dating to the Late Archaic and Early and Middle Woodland periods would be found in Elnora Member sediments, while Late Woodland and late precontact-aged sites would be found in Hyatt Member sediments.

Buried archaeological sites are more likely to be found associated with inceptisols; however, some sites have also been found with mollisols and fewer were found with entisols. Fifty-one percent of buried sites were found associated with cambic (Bw) soil horizons, while 42% were found associated with buried soil horizons; however, not all buried soil horizons were found associated with archaeological deposits. The remaining 7% of buried sites were found associated with an overthickened A horizon, identified as an A2 horizon. Buried archaeological sites were found primarily between 0.5 m and 2.0 m below ground surface.

Our findings indicate that the valley transition from lateral to vertical overbank sedimentation occurred around 3000 BP, although the exact timing of this transition remains unclear or perhaps was asynchronous. Following this transition, lower terraces stabilized and flooded less frequently. These Late Holocene deposits are punctuated with buried A horizons and overthickened B horizons, suggesting alternating periods of flooding and nonflooding. The presence of archaeological deposits in association with both Ab and Bwb horizons suggests precontact groups were visiting these landforms not only during periods of relative stability and soil development but also in settings where terraces were frequently inundated, perhaps on a seasonal basis. Based on geochronological dating and artifact analysis, post-3000 BP sediments range up to 2.5 m in thickness and contain archaeological deposits dating from the Late Archaic through postcontact periods. This range of site components suggests continued flooding of these settings, even after 3,000 years ago. This suggests that, although lateral aggradation may have ceased around this time, vertical aggradation in the form of overbank sedimentation continued throughout the precontact period and likely accelerated during Euro-American land clearance.

Buried A horizons represent former stable surfaces, while other buried horizons indicate that there was a surface at some point, but it may have been eroded away before it was buried; however, lithological discontinuities may represent temporary surfaces that were ephemeral and "suitable for human habitation, but they are not physically detectable by geological means" (Stafford 1995:80). Herrmann (2013, 2016) suggests that buried soils may be associated with the locations of buried archaeological materials. However, the research presented here has shown that over half the identified buried archaeological sites were found floating in the Bw horizon. The Bw horizon represents a surficial soil, where the river deposited sediments faster than the rate of pedogenesis, then stabilized later long enough for pedogenesis to horizonate the sediments into a soil.

Stafford and Creasman (2002:134) in their work near the confluence of the Great Miami and Ohio Rivers found buried archaeological sites in the upper 2–3 m of alluvial sediments and none associated with buried soil horizons. Buried sites dated to the Terminal Archaic, Early Woodland, Middle Woodland, and Late Woodland periods and were identified within Late Holocene sediments in meander belts. Fort Ancient sites were found in surface or near-surface contexts (Stafford and Creasman 2002:136). They considered these sites to be part of a hidden record within Late Holocene landscapes. As part of the hidden record, burial of these sites was extensive enough "to mask them from typical archaeological near-surface investigations" (Scholl 2014:150). While "stratified remains were common, most of site components had relatively low archaeological visibility. Occupation levels in trench exposures were characterized by low densities of diffuse charcoal, burnt soil, and fire altered rock" (Stafford and Creasman 2002:134). Artifact densities were generally low and consisted of lithic debitage and tools, dominated by retouched utilized flakes. Features consisted of pit features and/or shallow roasting pits (Stafford and Creasman 2002:134).

Findings in the WRV mirror those noted by Stafford and Creasman (2002) and Scholl (2014). While some buried sites are associated with buried horizons (Ab), most of the sites were found in cambic (Bw) or argillic (Bt) horizons. For the most part, identified sites in the WRV were low-density sites with low archaeological visibility that consisted of scattered pieces of FCR, charcoal, and lithic debris. Identified features consisted of FCR concentrations, with some botanical and faunal remains. Features were identified by artifact concentrations rather than by organic staining. Buried sites are short-term camps found at elevations ranging from 186 m to 195 m AMSL, within 200 m of stream channels. Buried sites can be found on levee remnants between old stream channels or on featureless floodplains.

Buried sites were found associated primarily with inceptisols (68%). Other buried sites were minimally associated with mollisols and entisols. No sites were found in association with alfisols. Most alfisols investigated consisted of shallow vertical alluvial deposits situated on lateral fluvial deposits composed of unconsolidated deposits of sand and gravel.

Figure 7 illustrates the locations of Armiesburg, Cuba, Genesee, Haymond, Nolin, and Wakeland soils, which have the potential for containing buried archaeological site locations. Buried archaeological site potential is highest along the main stem of the East and West Forks; however, equally high potential is noted along second-, third-, and fourth-order streams (see Figure 7).

In total, 87,635 ha of the White River valley have been determined to have high potential for buried archaeological sites (see Figure 7). Of that, 55,276 ha are found in the West Fork drainage and 32,360 ha are found in the East Fork drainage (see Figure 7).

Site density in the West Fork River consisted of one site per 3.2 ha. Using the current model, over 17,000 buried archaeological sites are predicted within the West Fork drainage. Conversely, one site per 9.3 ha was found in the East Fork River. With the current model, over 3,400 buried archaeological sites are predicted within the East Fork drainage.

In this model, the river style has a significant influence on the potential for buried archaeological sites. The investigations presented here were conducted primarily in the meandering section of the WRV, rather than in the bedrock-controlled sections. Herrmann (2013, 2016) found a higher incidence of PaleoIndigenous and Early Archaic sites in bedrock-controlled sections and limited potential in meandering sections. However, current results found a high potential for buried archaeological sites in meandering sections of the WRV dating to the Late Holocene (i.e., Late Archaic, Woodland, and late precontact periods). Differences in site density between the East and West Forks are largely the result of limited availability of landforms and soils that are prone to site burial. Landforms and soils in the West Fork drainage are more likely to preserve than those found in the East Fork drainage.

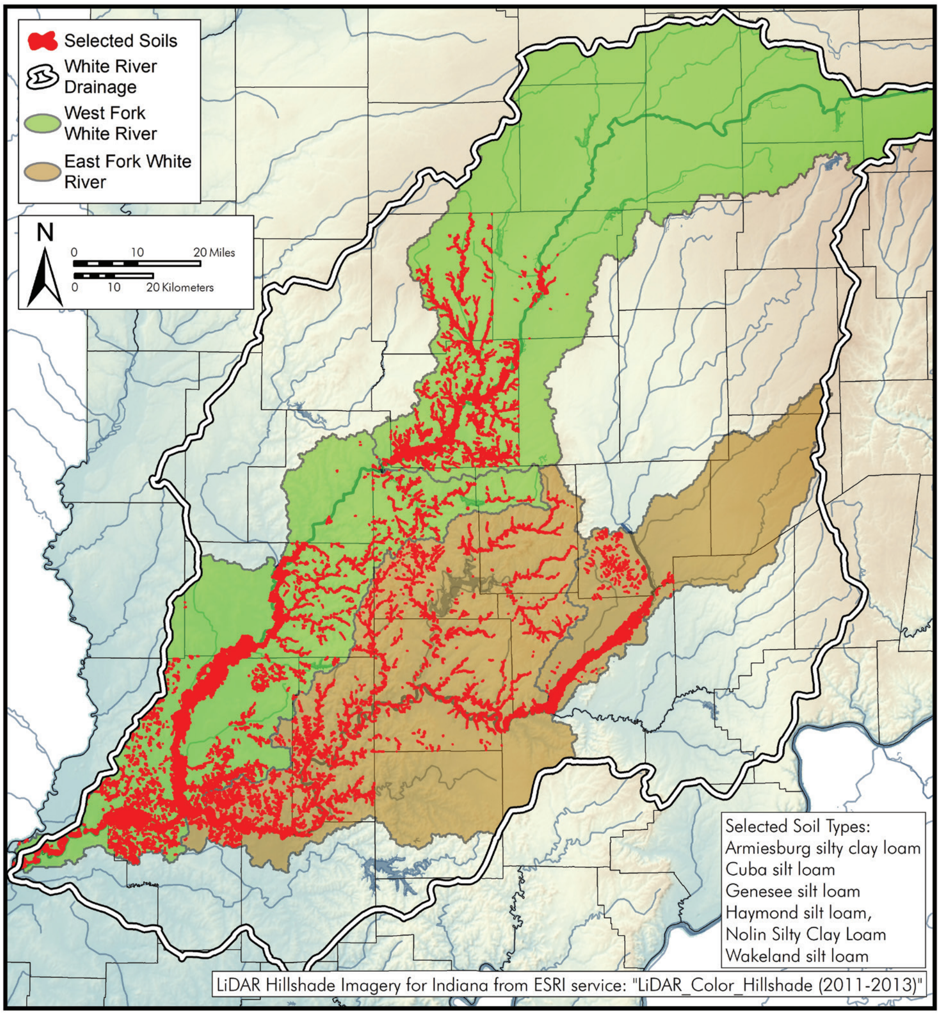

Figure 7. Distribution of soils with potential for buried archaeological deposits in the East and West Forks of the White River drainage.

Conclusions

The buried site model presented here is based on the results of geoarchaeological investigations conducted for the I-69 project in the White River valley. These investigations identified 35 buried archaeological sites dating between the Late Archaic and postcontact periods. Identified sites consisted primarily of short-term camps composed of isolated features, FCR scatters, lithic scatters, and artifact scatters. Investigations found a higher buried site density on the West Fork than on the East Fork. Buried archaeological sites dating to the Late Holocene are more likely to be found in meandering sections of the WRV.

Finally, mechanical coring is important in defining areas with a potential for buried sites and developing geomorphic histories of a river system. For this project, coring has provided significant data regarding the geomorphology and development of the WRV and possible locations for buried archaeological deposits. However, a combined coring and trenching strategy is essential for complete buried-site identification and characterization (Monaghan and Lovis 2005).

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Supplementary Material

Supplementary material for this article can be found at https://www.midwestarchaeology.org/mcja/supplemental-materials.

Supplemental Table 1. Summary of Buried Sites

Supplemental Table 2. Radiocarbon Dates from the White River Valley

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Patrick D. Trader received an MA in anthropology from the University of Missouri–Columbia with an emphasis in precontact cultures of the Midwest. Trader is a senior principal investigator at Gray & Pape, Inc., where he has been employed for the past 17 years. Trader has worked across the midwestern and southeastern United States and in the Northern Plains. Trader's interests include geoarchaeology, lithic raw-material conveyance, and the development of late precontact societies.

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