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Archaeological and Geophysical Investigations During 2018 at Molander Indian Village State Historic Site, Oliver County, North Dakota

Edited by Mark D. Mitchell

Research Contribution 116

PCRG
PaleoCultural Research Group

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Dedicated to W. Raymond Wood

Abstract

The Molander site (32OL7) consists of two Plains Village settlements and an American Settlement-era homestead located on the right bank of the Missouri River in northeastern Oliver County, North Dakota. The larger of Molander's two Plains Village settlements is a fortified earthlodge community covering about 2.1 ha (5.2 acres). The recent historic homestead is superimposed on the eastern third of the fortified village. Both the fortified community and the homestead, which together are the focus of this report, were purchased by the state of North Dakota in 1935 and are managed by the State Historical Society of North Dakota (SHSND) as Molander Indian Village State Historic Site. The property is listed on the North Dakota State Historical Site Registry and is eligible for inclusion on the National Register of Historic Places. The smaller of the two Plains Village settlements comprising the site is an apparently unfortified community located on an adjacent terrace and is privately owned.

Over the course of 12 days in August 2018, Paleocultural Research Group (PCRG) in cooperation with Oklahoma State University and the SHSND conducted an archaeological and geophysical field investigation at the site. The work built directly on the results of geophysical surveys, photogrammetric mapping, and hand coring undertaken in 2017 by the University of Arkansas's Archeo-Imaging Lab, PCRG, and the SHSND. The primary goals of the project were to achieve a better understanding of Molander's place in the regional cultural landscape and to answer specific questions about the settlement's age and occupation history, its architectural features and overall layout, and its current condition.

The 2018 project's 31 participants opened 16 1x1-m excavation squares grouped into five blocks, in the process screening 6.2 m^2 of sediment and exposing 15 cultural features. The crew also extracted 78 soil cores and conducted geophysical surveys covering 0.56 ha (1.4 acres). The project investigated the site's encircling fortification ditch, sampled storage pits and other features inside two earthlodge depressions, and exposed two sets of superimposed hearths and pits located between earthlodges. The resulting collection, which consists of 89 provenience lots, includes roughly 2,700 flakes, 150 stone tools, 7,300 pottery sherds, and 30 kg of vertebrate faunal remains, along with a wide variety of other materials.

Molander's Plains Village component is well remarkably well preserved, notwithstanding the effects of the construction and occupation of the homestead. The most extensive post-occupation impacts are due to plowing and to animal burrowing. Preservation of the site's complex fortification system is especially good.

At least three periods of occupation are represented at the site. The most recent is the homestead, which was established in 1882 and occupied until 1935. The oldest comprise one or more camps dated to between about 6300 and 1500 cal B.P. The most extensive is the fortified earthlodge community. Based on historical documents and maps, metal and glass trade goods density data, and stratigraphic data, the occupation for the earthlodge community is estimated to have spanned a 30-year period between 1735 and 1765.

Multiple lines of evidence, including historical documents, traditional histories, and archaeological data, indicate that the earthlodge community was established by the Awaxawi Hidatsa, one of three Hidatsas tribal divisions. The Awaxawis likely arrived on the Missouri River from the Northeastern Plains about 1600. By 1787 they had joined the two other Hidatsa divisions at the confluence of the Knife and Missouri rivers, where they established Amahami Village. After their departure from Molander, but before they moved to the mouth of the Knife, they likely established a settlement at the Mahhaha site.

Analyses Molander's material culture provide new data bearing on the archaeological history of the Awaxawis. Molander's residents cultivated different kinds of relationships with their neighbors to the north and south. Their ties to the Mandan communities of the Heart River region appear to have been primarily economic. By contrast, Molander's ties to Hidatsa communities of the Knife River region appear to have been primarily cultural.

The 2018 project also provides important new data on earthlodge construction practices and on extramural features. Analysis of the site's well-preserved defensive system provides a more comprehensive understanding of eighteenth-century community leadership and mobility.

The survey and testing project at Molander Indian Village State Historic Site, which is the subject of this report, has been financed in part with Federal funds from the National Park Service, United States Department of Interior, and administered by the State Historical Society of North Dakota. However, the contents and opinions do not necessarily reflect the views or policies of the Department of Interior or the State Historical Society of North Dakota, nor does the mention of trade names or commercial products constitute endorsement or recommendation by the Department of Interior or the State Historical Society of North Dakota.

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Acknowledgements

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The success of PCRG field projects depends on the dedication of the organization's citizen-science volunteers. The 2018 volunteer crew—made up of professional archaeologists, students, and avocationals—included Don Andrews, Courtney Crawford, Chloe Dougan, Frank Delaney, Bob Gardner, Amy Gillaspie, Stephanie Grossart, Jessica Harrington, Craig Johnson, Paul Sanders, Barry Splawn, Amy Woodruff, and Lisa Yeager. Their dedication and hard work are gratefully acknowledged.

The results of the 2018 project lean heavily on the archaeological and historical scholarship of W. Raymond Wood. It is no exaggeration to say the Ray wrote the book(s) on Hidatsa ethnohistory, regional historical cartography, and fur trade-era history. His early archaeological work at Molander and other sites in the northern Middle Missouri was also critical to the success of the 2018 project. We are deeply saddened by Ray's passing and the void it has left in the community of Plains archaeologists.

PCRG thanks Ken Kvamme for his many contributions to numerous PCRG projects, including the Molander project. Ken's generosity with students and colleagues is well-known, as is the breadth of his scientific scholarship. PCRG looks forward to many more collaborative projects with Ken in the future.

Participation by Paul Picha, who at the time of the fieldwork was North Dakota's Chief Archaeologist, and Tim Reed, SHSND Research Archaeologist, was crucial to the success of the field investigation. Paul also provided critical comparative data on artifacts and other materials recovered from sites located in the Knife River Indian Villages National Historic Site. In addition to his contributions to the excavation effort, Tim collected valuable aerial video footage during the project. SHSND Research Archaeologist Amy Bleier provided GIS data for the project.

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Carl Falk, formerly with the National Park Service's Midwest Archeological Center and the Department of Anthropology, University of Nebraska-Lincoln, is a co-founder of the Paleocultural Research Group. He has worked in coastal California, northwestern Mexico, the Missouri Ozarks, and throughout the Midwest and Great Plains. Carl's principal interests center on the archaeology and zooarchaeology of village horticulturalists within the Middle Missouri and Central Plains subareas. He has authored and co-authored numerous articles, technical reports, and presentations at regional, national, and international conferences.

Ken Kvamme is Professor emeritus of Anthropology at the University of Arkansas. Most of his career has focused on the topic of archaeological prospecting, beginning with pioneering work in GIS-based "predictive" models of archaeological location in the 1980s. In more recent years he has pursued archaeological detection through geophysical prospecting and remote sensing. He is author of over 100 publications and 150 technical reports on GIS approaches, archaeological modeling, spatial analysis, geophysical applications, and remote sensing. He directed the Archeo-Imaging Lab at the University of Arkansas, devoted to these methods. Formerly he was the W. M. Keck Associate Professor of Archaeology and Remote Sensing at Boston University, Associate Curator of Archaeology at the Arizona State Museum, and Research Associate Professor of Anthropology at the University of Arizona. Although his geophysical fieldwork takes him to projects worldwide, he specializes in the archaeology of the American Great Plains and Rocky Mountain West. He has edited or has sat on the editorial boards of numerous journals including *Archaeological Prospection*, *Journal of Archaeological Method and Theory*, *Plains Anthropologist*, *Heritage*, *Journal of Computer Applications in Archaeology*, *Geoarchaeology*, *American Antiquity*, and *Remote Sensing*.

Mark Mitchell is Research Director for Paleocultural Research Group. His research explores the archaeology of two different regions: the Northern Plains in western North Dakota, and the Southern Rocky Mountains in Colorado and New Mexico. Mitchell's Southern Rockies research focuses on American Indian mobility and land use in the San Luis Valley and adjacent mountains. He is particularly interested in how technological and environmental change affected native peoples' economic decisions. Mitchell's Northern Plains research focuses on the political and economic development of post-A.D. 1200 farming villages of the Missouri River valley. He also studies historic American Indian rock art and the history of archaeology. Mitchell's research has appeared in *Plains Anthropologist*, *Antiquity*, *American Antiquity*, *Southwestern Lore*, *Colorado Archaeology*, *Quaternary International*, *Reviews in Colorado Archaeology*, and in a dozen book chapters. He is the author of *Crafting History in the Northern Plains: A Political Economy of the Heart River Region, 1400-1750* (University of Arizona Press, 2013) and co-editor of *Across A Great Divide: Continuity and Change in Native North American Societies, 1400-1900* (University of Arizona Press, 2010).

Robert Nickel worked for thirty years as an archeologist at the Midwest Archeological Center doing surveys, excavations, geophysical surveys and botanical studies. Since leaving the Midwest Archeological Center in 2000 he has continued to do geophysical studies of archeological sites and historic cemeteries in the Plains and a dozen other states. He also has conducted magnetic and radar surveys in half a dozen cold case investigations for law enforcement agencies. His MA thesis analyzed botanical remains recovered from two Native American village sites in South Dakota and he continues to study archeologically recovered botanical collections from the Dakotas with a focus on village sites near and north of Bismarck, North Dakota.

Paul Picha is retired from the State Historical Society of North Dakota where he served as research archaeologist and chief archaeologist. He has been involved with archaeology of the Middle Missouri subarea since 1978. His research interests include molluscan analysis and history of the fur trade. Picha resides in Bismarck.

Meagan Schoenfelder is the Archaeology Collections Assistant at the State Historical Society of North Dakota. It is her great joy to work with the artifacts and their records in the state collections. Her interests include ground stone, perishable materials, and small metal artifacts. She first came to plains archaeology as a field technician with Metcalf Archaeological Associates, Inc. She has an MA in Medieval Archaeology from the University of York.

1 Introduction

Mark D. Mitchell

Archaeologists partition the valley of the Missouri River in North Dakota into four regions (figure 1.1). The Cannonball region, which runs from just below the state line upstream to the mouth of the Cannonball River, and the Heart region, which runs from the mouth of the Cannonball to Square Buttes, constitute the traditional homeland of the Mandan people, bison-hunting farmers whose ancestors first built villages in the region about 1200 or 1250.

The Knife region from Square Buttes to just above the mouth of the Knife River and, to a lesser extent, the Garrison region from the Knife upstream to the mouth of the Yellowstone River, is the traditional homeland of the Hidatsa people, who like the Mandans spoke a Siouan language and practiced a multi-focal hunting and harvesting economy.

Tracing the cultural relationships between these two groups, along with their social and economic interactions, have long been central themes of regional archaeological and anthropological research. Anthropologists and ethnohistorians have had success in doing so, largely owing to the region's abundant documentary and oral historical record. By contrast, archaeologists have been impeded until recently by the limited extent of high-resolution data from post-1500 Mandan sites. However, a series of important projects carried out by the State Historical Society of North Dakota (SHSND) over the past two decades now permit more robust evaluations of the differences and similarities between the archaeological records of the Mandans and Hidatsas.

The 2018 archaeological and geophysical fieldwork at Molander Indian Village State Historic Site (32OL7) was carried out with that overall goal in mind.

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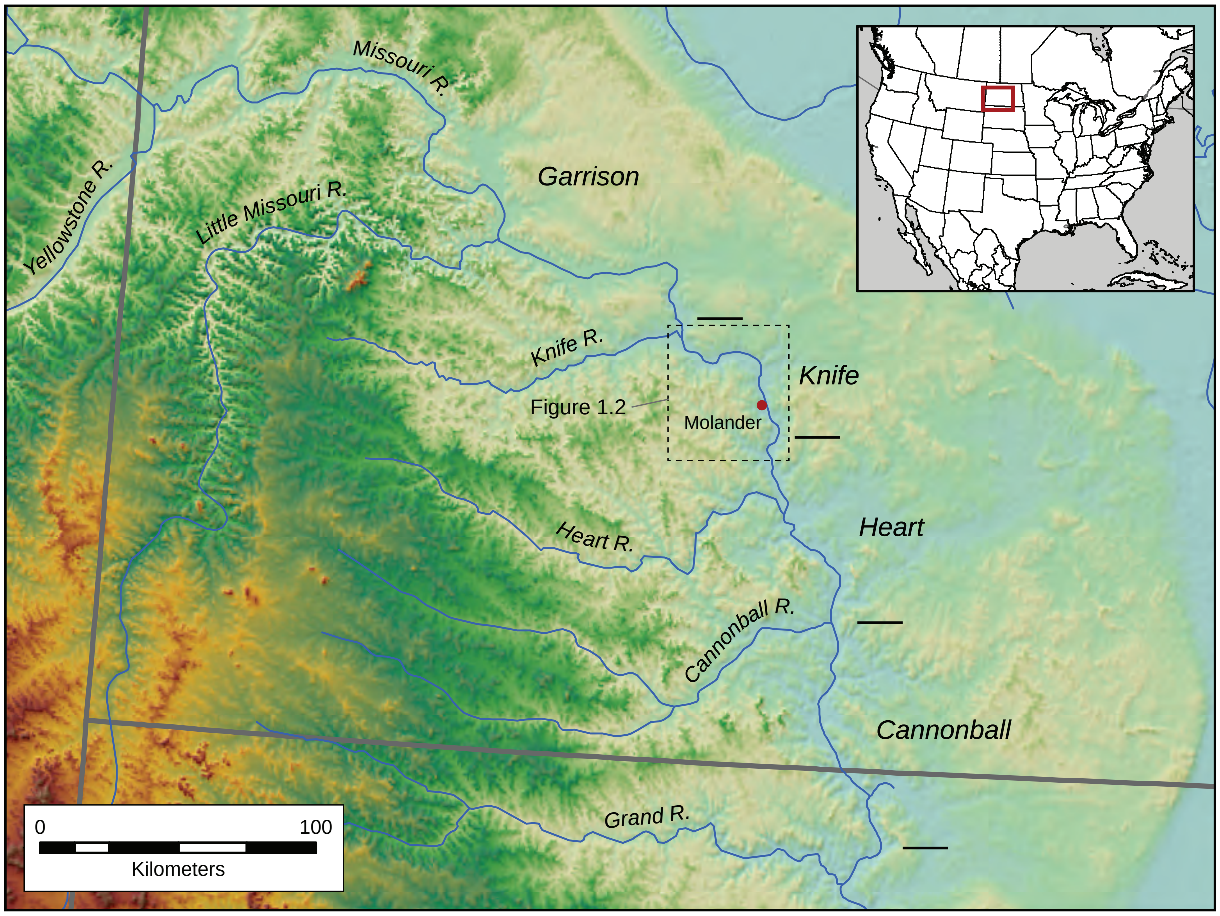


Figure 1.1. Map of the northern Middle Missouri showing the locations of four archaeological regions.

Molander, an Hidatsa site that dates to the eighteenth century, is located in a conspicuous gap between contemporaneous Mandan communities in the Heart region and the core area of Hidatsa settlement in the Knife region. The site's archaeology is therefore an ideal context to begin using the newly acquired Heart region data to trace regional relationships.

The project was a collaborative effort among Paleocultural Research Group (PCRG), a nonprofit research and education organization, the Oklahoma State University Department of Sociology, and the SHSND. Although the site has been owned by the state of North Dakota for 85 years and is remarkably well-preserved, it is among the least studied of the Plains Village settlements managed by the SHSND. For that reason, in addition to an overall goal of advancing regional research, the project also sought to gather basic data on the site, including its age and occupation history, its overall layout, and its current condition. Data obtained during the project can be used to develop public interpretive products and to prepare a National Register of Historic Places nomination for the site.

Major funding for the project was provided by the SHSND through a cooperative agreement with PCRG. Funding was also provided by the Northern Plains Heritage Foundation, which manages the Northern Plains National Heritage Area to educate the public about the region's history and culture through heritage tourism and in cooperation with private and public partners.

Site Setting and Description

Molander is located on the southern end of the Knife River region, on the right bank of the Missouri River, approximately 18 km south of the town of Washburn, North Dakota (figure 1.2). The Knife region comprises roughly 60 km of the Missouri River valley. The region's boundaries in part reflect the history of archaeological research and in part reflect the indigenous cultural landscape. The upstream limit corresponds to the location of the Garrison Dam, behind which is Lake Sakakawea, the largest of the Missouri River reservoirs. The downstream limit of the Knife region is marked by Square Buttes, a prominent cluster of mesas and pinnacles standing some 120 m above the floodplain of the Missouri, which the Hidatsa regard as a traditional territorial boundary (Bowers 1965). Other named landscape features in the Knife region include oxbow lakes (Mandan Lake and Painted Woods Lake) and several small streams (including Turtle Creek, Painted Woods Creek, Alderin Creek, Chardon Creek, and others).

Present in the Knife River region are archaeological sites representing every phase of the Plains Village period in North Dakota, which statewide began about 1200 or 1250 and ended in the late 1880s or early 1890s. Late Woodland occupancy of the Knife region is also well documented.

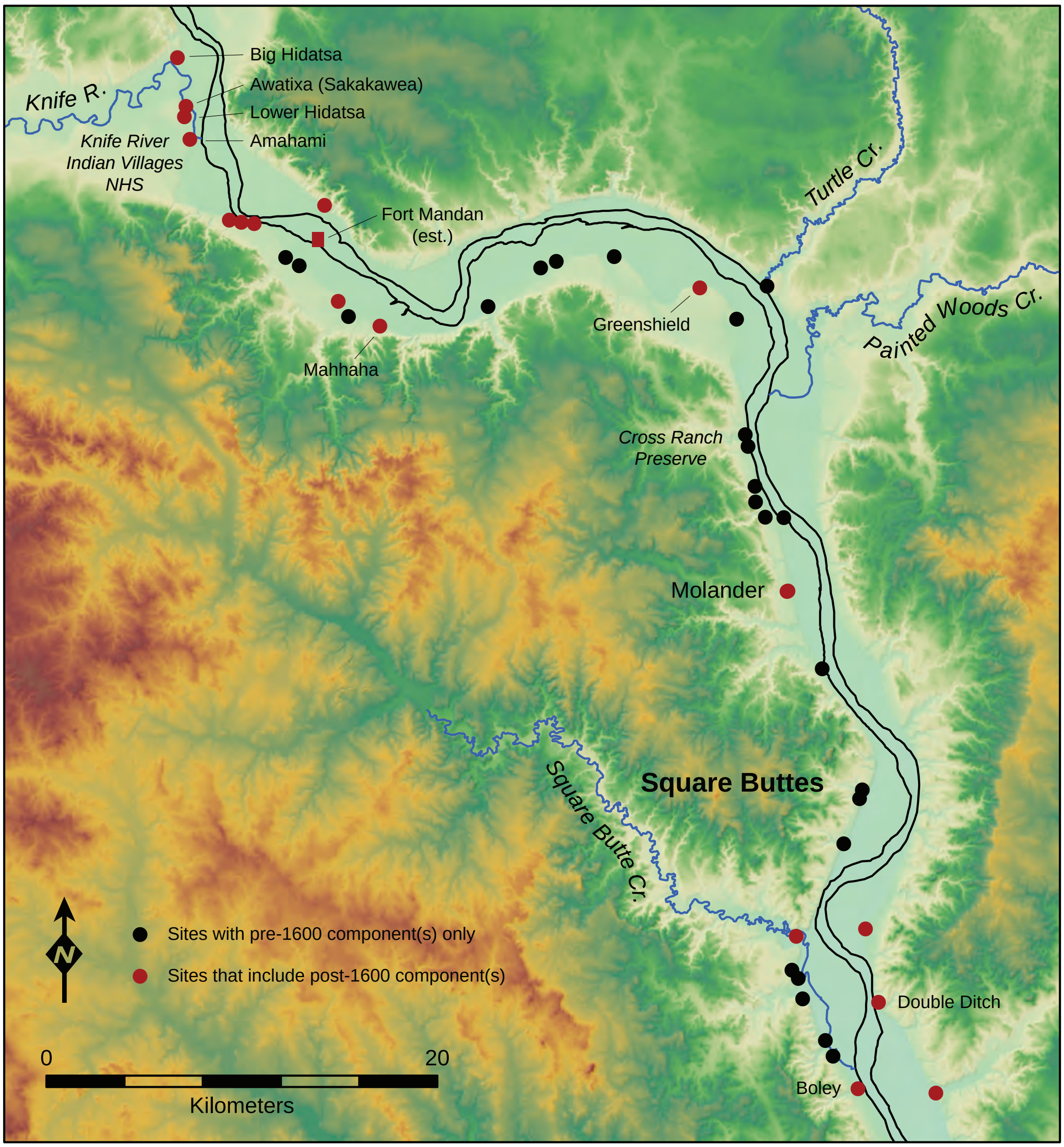


Figure 1.2 Map of the Knife River region showing the locations of selected archaeological sites and other features.

The best-documented indigenous settlements in the Knife region were occupied between about 1600 and 1845. Especially prominent are sites, including Molander, that date to the eighteenth and early nineteenth centuries. Molander's location is notable among that group of late communities. Most of the Knife region's fur trade-era towns and villages are clustered at and immediately below the confluence of the Knife and Missouri rivers, more than 20 river-miles above Molander. Seventeenth- and eighteenth-century communities are present in the Heart region, beginning about 13 river-miles below Molander. Thus, Molander is located in the middle of a conspicuous gap in the distribution of post-1600 sites.

The Molander site consists of two Plains Village settlements and an historic homestead (figure 1.3). The upper or western settlement is a fortified earthlodge community covering about 2.1 ha (5.2 acres). The northern side of the fortified village is bounded by a deep unnamed coulee. The River Road, a continuation of North Dakota State Highway 1806 north of Mandan, loops around the site about 200 m to the west. A segment of the Burlington Northern-Santa Fe Railway runs along the edge of the terrace immediately east of the fortified settlement. The historic homestead is superimposed on the eastern third of the village.

The lower or eastern settlement is an apparently unfortified settlement located on a low terrace east of the railroad right-of-way. Apart from its approximate extent, nothing is known about the age or layout of the lower settlement, which is privately owned.

The fortified community, which is the focus of this report, was purchased by the State Historical Society of North Dakota (SHSND) in 1935. The site is listed on the North Dakota State Historical Site Registry and is eligible for inclusion on the National Register of Historic Places, although it is not currently listed. The state parcel encompassing the upper settlement is surrounded by private land and access to the site is limited.

Geological Context

Molander's geological and hydrological setting had important consequences for the site's construction and occupation. This section summarizes geological and other data for a portion of the Missouri River valley running downstream from Mandan Lake, an oxbow lake located roughly 15 km below the mouth of the Knife River, to Square Buttes.

The western wall of the Missouri River valley in this section is formed by the Cannonball, Slope, Bullion Creek, and Sentinel Butte formations. All four at Tertiary (Paleocene) in age (Fort Union Group [Clayton *et al*. 1977]). The Cannonball Formation comprises marine deposits and consists of poorly consolidated sandstone and mudstone (Groenewold *et al*. 1979). The other three formations comprise terrestrial fluvial (river, lake, and swamp) deposits that mostly consist of alternating beds of silt, clay, sand, and lignite. Contacts between these formations can be difficult to identify.

Marine fossils occur in the Cannonball Formation (Cvancara 1976). Silicified wood occurs within the terrestrial formations (Clayton *et al*. 1977), although is more commonly found in the Sentinel Butte Formation (Bluemle 1980). However, the suitability of locally obtained silicified wood for tool production is not known. Bedrock outcrops of smooth gray Tongue River Silicified Sediment (TRSS) could occur at the contact between the Slope Formation and the overlying Bullion Creek Formation (Ahler 1977). Near Molander, that contact occurs in the middle to upper portion of the western valley wall. However, to date no quarry localities of that material have been identified in Oliver County.

Johnson and Kunkel (1959:24-26) identify five fill terraces bordering the Missouri River between Mandan Lake and Square Buttes, in addition to the modern channel alluvium (T0). The lowest terrace (Qtm1) occurs 5 to 15 ft above the river level. Adjacent to Molander, the elevation of the Missouri River channel is about 500 m and the tread of the T1 terrace is between 504 and 505 m. The T1 terrace consists of recent silt and fine sand and in places merges with the T0. Meander scars are preserved on the upper surface of the T1.

The second terrace (Qtm2) occurs between 20 and 55 ft above the river. Near Molander, the upper surface of the T2 is at an elevation of 507 to 508 m, or about 3 m above the T1. The T2 terrace is generally narrow between Mandan Lake and Square Buttes; adjacent to Molander the T2 tread is just 175 m wide. The upper surface does not appear to preserve meander scars. The fill of the T2 terrace consists of silt and fine sand overlying sorted sand and gravel channel deposits.

T2 deposits primarily mantle the Cannonball Formation. The surfaces of both the T1 and T2 terraces are mapped at 1:500,000 scale as the Oahe Formation. Bickley (1972) and Clayton and others (1976) define the Oahe Formation as primarily

Figure 1.3. Aerial photo mosaic and digital terrain model of the Molander site showing the locations of two Plains Village settlements and a historic homestead.

loess deposited during the latest Wisconsinin and Holocene; however, the geologic map units likely reflect Groenewold and others's (1979:16) definition of the Oahe Formation as all "Holocene age stream, pond, and windblown sediment." The lower Plains Village settlement at Molander is located on the T2 terrace.

The T3 terrace (Qtm3), on which the upper settlement is located, is the most extensive the five Missouri River terraces between Mandan Lake and Square Buttes. At Molander, the T3 lies at an elevation of 518 to 524 m, or about 11 to 16 m above the T2. Johnson and Kunkel (1959:25) put the height of the T3 terrace at 30 to 80 ft above the river. In many places, the tread of the T3 slopes toward the river and the riser is eroded and intermittently dissected (see chapter 2 and figure 2.5). Spring channels likely supplied by groundwater emanating from the Bullion Creek Formation are deeply incised into the surface of the T3. Numerous ponds occur within these channels as well as on the tread of the T3 between Square Buttes and Cross Ranch State Park, providing a potentially productive microenvironment that occurs only intermittently on the left bank of the Missouri between the Knife and Heart rivers as well as south of Square Buttes on the right bank.

At 1:500,000 scale, the T3 terrace is mapped as the Coleharbor Formation, which comprises all "unconsolidated Pleistocene age sediment resulting from deposition during glacial or interglacial periods" (Groenewold *et al.* 1979). However, Johnson and Kunkel (1959) note that within the T3 the poorly sorted till deposits of the Coleharbor are capped by a 3 to 7 ft-thick silt layer representing the Oahe Formation. At Molander the Oahe Formation consists primarily of reworked loess. A radiocarbon age obtained on a buried soil formed in the lower portion of the silt at Molander (see chapter 2 and figure 2.30) suggests that only the Pick City member of the Oahe (Clayton *et al.* 1976) is represented on the T3 terrace in eastern Oliver County.

The fourth and fifth Missouri River terraces are poorly represented between Mandan Lake and Square Buttes. The surface of the T4 (Qtm4, 60 to 135 ft above the river) is irregular and in places forms low hills rather than a continuous tread. The highest terrace (Qtm5, 120 to 180 ft above the river) is only preserved in a few places in Oliver County.

Today, the main channel of the Missouri adjacent to Molander is located on the eastern edge of the floodplain (figure 1.4). In addition to the location of the modern channel, figure 1.4 also shows Plamondon's (2000:172) interpretation the maps that William Clark made of the river's course in 1804 as well as the course mapped in 1894 by the Missouri River Commission (USGS 2020). Although significant changes are evident in the position of the main channel in the vicinity of Mandan Lake, the location of the river between Painted Woods Lake (a Missouri River meander that was cut off in 1797 [Clark 2005a; Plamondon 2000:173]) and Square Buttes appears to have been relatively stable over the past 200 years.

The geological factor that most affected the construction and occupation of Molander was the relatively shallow depth of the Coleharbor Formation beneath the site. Virtually every excavation project undertaken by the settlement's residents exposed till deposits. The presence of till undoubtedly increased the time and effort required to excavate the fortification ditch. Near-surface till may also have limited the depths of subterranean cache pits, possibly increasing the number of pits needed to store surplus produce.

Access to the main channel of the Missouri may have been limited if the river was in its present location during the occupation of the site, a circumstance that seems probable given the stability of the channel between 1804 and the present. However, that limitation was partially or perhaps wholly offset by the presence of numerous springs and ponds located on the T3 terrace near the site. Will (1924:317), for example, notes that the coulee immediately north of Molander was at the time of his visit "full of waterholes." Those water sources may also have attracted wildlife and supported stands of wild plants that were important to the residents' subsistence. Spring channels and pond margins may also have been important locations for agricultural fields.

Existing Data and Interpretations

Although Molander has never previously been a primary focus of study, numerous sources contain data on the possible age and cultural affiliation of the site, including historical documents and maps, oral historical accounts, and reports that describe the results of archaeological field and laboratory investigations. Data bearing on the site are presented and discussed by Ahler (1993), Ahler and Swenson (1993), Bowers (1948, 1965), Chomko (1986), Lehmer and others (1978), Thiessen and others (1979), Weston and others (1978), Will (1924), Will

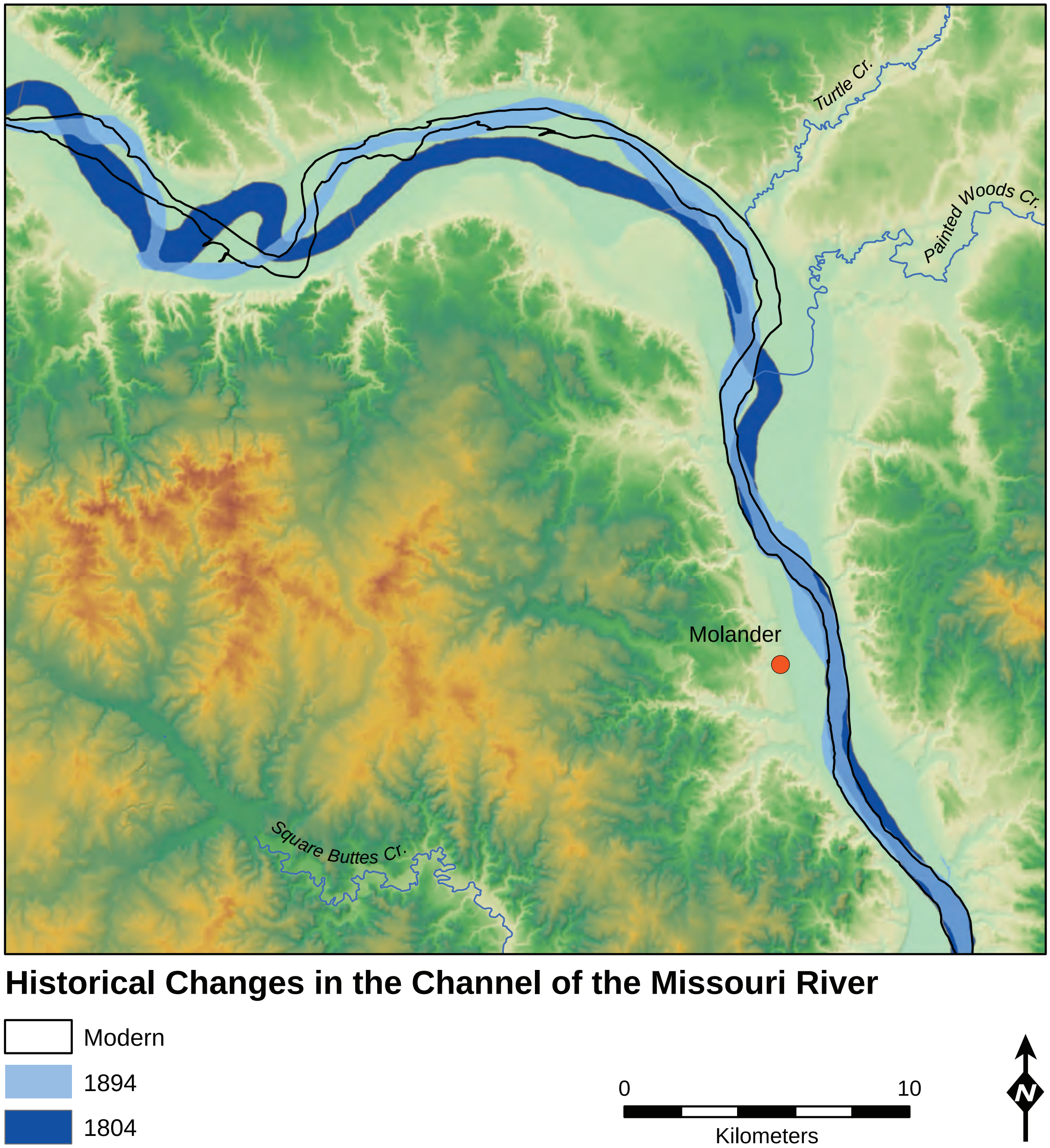


Figure 1.4. Map illustrating changes in the location of the Missouri River main channel between 1804 and today.

and Hecker (1944), and Wood (1986a, 1986b, 1993). The following sections review and critically evaluate the existing data.

Historical Documentary and Cartographic Data

The field notes and journals of William Clark, co-leader with Meriwether Lewis of the Corps of Discovery, offer the most explicit—as well as the earliest—evidence for Molander's age and cultural affiliation.[1] In his field notes, Clark reported that on October 23, 1804, the expedition "passed an old [village] of a Band of Me ne tarres Called Mah har ha where they lived 40 year ago (*i.e. 1764)* on the L. S. (*larboard or left side of the boat)*" (Clark 2005a; italicized text added).[2] The site is also shown on the right bank of the Missouri on Sheet 18 of Maximilian's copy of Clark's route map, in the bend immediately below the expedition's October 23 camp (Moulton 1983:Map 29) (figure 1.5). Apart from Molander, no settlement dated to the late seventeenth or eighteenth centuries has been documented in the section of the valley that the expedition traversed on October 23.

Clark uses two terms, one in his field notes and one on his map, to identify the settlement's former residents. Both clearly refer to the Awaxawi Hidatsas, one of three Hidatsa subgroups or divisions recognized today. The field notes attribute the site to the "Me ne tarres Called Mah har ha," an English interpretation of the Mandan term *wą̨xá·xa*, which is a village name meaning "spread out place" (Stewart 2001). Clark's map identifies the site as an "Old Village or (*of*) Ah na ha was band" (Moulton 1983:Map 29; italicized text added). Ahnahawas, Ahwahharways, Ahahaways, and a variety of similar terms are English interpretations of the Hidatsa word *awaxáˀwi*. Stewart (2001:347) notes that this division name is separate from but related to the word for "mountain," *awaxá·wi,* and that Lewis and Clark translated it as "people whose village in on a hill."

Contemporary Canadian traders knew the Awaxawis as "Gens de Soulier" or "Soulier Noir." Using an English translation of the trader's French term, Clark sometimes referred to them as the Shoe Nation, Shoe Men, or Shoe Indians. English interpretations of a Sahnish (Arikara) term, *wi·tatshá·nuˀ*, rendered variously as Wattason, Weter soon, Wattasoons, and so forth, also were used at the turn of the nineteenth century to designate the Awaxawis (Stewart 2001).

In contrast to the understanding of indigenous groups that developed later in the nineteenth century, Clark and his contemporaries recognized three rather than two different tribal groups living in the northern Middle Missouri. In addition to the Awaxawis, Clark's "Estimate of the Eastern Indians," which he prepared at Fort Mandan during the winter of 1804-1805, identifies the Mandans and the "Big bellies" or "Minetares" as residents of the region (Clark 2005d). (The "Estimate of the Eastern Indians" is also known as the "Ethnological Table" [Stewart 1976]. A version of Clark's data published in 1806, which differs in some respects from the "Estimate," is commonly known as the "Statistical View" [Jefferson 1806].) The various terms Clark used for the latter group, including "Manitarres," "Me-ne-tar-re," and so forth (from the Mandan *wrįtari*), made no distinction, except at the village level, between the Hidatsas proper and the Awatixas, two Hidatsa divisions that are today recognized as separate (Stewart 2001). Clark further observed that although the Awaxawis spoke the Hidatsa language, and "are of the Big Belley nation," "[t]hey differ but very little, in any particular, from the Mandans, their neighbors" (Clark 2005d).

Clark's understanding of regional cultural relationships is echoed by Alexander Henry, who writes that the Awaxawis then living at the mouth of the Knife

> are an entirely different tribe from the Big Bellies and Mandanes; their language resembles that of the latter more than that of the former, but is not the same (*Henry's comparison is in error*). Their long intercourse with those people has tended to this similarity of language, and from proximity they have acquired the manners and customs of the other nations, though they continue to live by themselves [Coues 1897:343-344; italicized text added].

The source of Clark's information about the age and cultural affiliation of Molander almost certainly was Too Né, a Sahnish community leader and diplomat who accompanied the expedition as far as the Mandan and Hidatsa settlements at the mouth of the Knife River (Steinke 2014). Also known as Arketarnashar (Sahnish *Akitaaneešaáanuˀ*), Too Né had traveled widely and was an accomplished linguist and so there is every reason to regard his information as accurate. Given his status and likely age in 1804, it is certainly plausible and perhaps probable that he was acquainted with people who had lived at Molander. Molander's founding leaders may have been born about the same time as Too Né's father. Although Too Ne himself may never have visited the site, it is likely that he learned about it from someone who had.

Clark's journals include a second apparent reference to the Molander site, which if perhaps less direct is nevertheless compelling. On March 10, 1805, just under a month before the expedition's departure from Fort Mandan, Clark reported that

> we are visited by the Black mockersons, Chief of the 2d Manetarre Village *(Awatixa [Sakakawea] Village, 32ME11)* and the Chief of the Shoeman [NB: Shoe or Mocassin Tr :] Village or Mah hâ ha V. [NB: Wattassoans] those Chiefs Stayed all day and the latter all night and gave us man[y] Strang accounts of his nation &c this Little tribe or band of Menitaraies

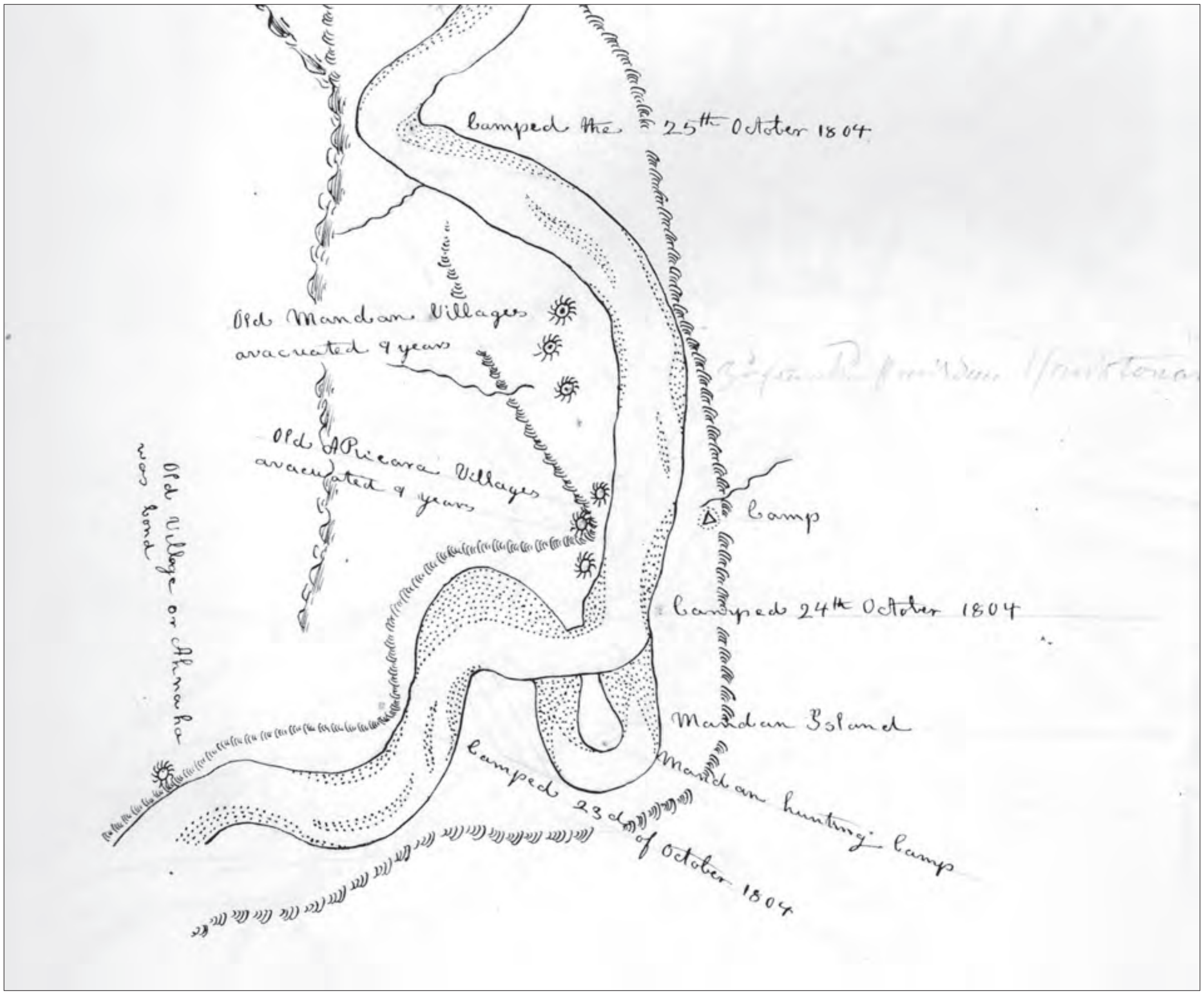


Figure 1.5. A portion of Sheet 18 of Maximilian's copy of William Clark's route map showing the location of the native settlements and the expedition's daily camps (Moulton 1983:Map 29). The "Old Village or (of) Ah na ha was band" is located in the lower left.

> Call themselves Ah-nah-hâ-way or people whose village is on the hill. [NB: Insert this Ahnahaway is the nation Mahhaha the village] nation formerleyed lived about 30 miles below this but beeing oppressed by the Asinniboins & Sous were Compelled to move ⟨near⟩ 5 miles the Minitaries, where, the Assinniboins Killed the most of them those remaining built a village verry near to the Minitarries at the mouth of Knife R *(Amahami Village, 32ME8)* where they now live [1] and Can raise about 50 men, they are intermixed with the Mandans & Minatariers— [Clark 2005c; italicized text added; "NB" indicates Nicholas Biddle's emendations].

Molander is located almost precisely "30 miles below" the probable location of Fort Mandan; the current distance along the modern channel of the Missouri is 28 miles. The source of Clark's March 10 information was "Ta-tuck-co pin re has, white Buffalow Skin unfolded," a man the expedition designated as "first chief" of Amahami (32ME8), the community where the Awaxawi were living in 1804 (Clark 2005e). Clark does not report his age, although he does note that older Awaxawi chiefs were present at the assemblies the expedition held. Nevertheless, Tetuckopinreha, as Biddle renders his name (Coues 1893:183), was no doubt knowledgeable about Awaxawi history. As is the case for the information provided by Too Né, there is every reason to regard Tetuckopinreha's statements as accurate.

The Awaxawi leader also provided information on the division's movements after the abandonment of Molander, as well as on the circumstances that led to their relocations. Two moves are described. More is known about the destination of the second move, which brought them to the mouth of the Knife River. The Awaxawi presence there was first noted by James Mackay in 1786 or 1787 (Wood 2003). Of his visit to the settlements on the Missouri, Mackay wrote "The Mandaines, jointly with the Manitouris [Minitarees] and Wattasoons [Amahamis] live in five Villages, *which are almost in sight of one another*, three of those Villages are on the South of the Missouri and two are on the North Side" (Wood 2003:39; emphasis added). Mackay did not provide a map and so the precise relationships among the five settlements he observed, as well as their associations with known archaeological sites, are not clear.[3]

However, further confirmation of the Awaxawis presence at the mouth of the Knife is provided by John Evans, who produced a map and narrative describing his 1796-1797 visit to the region (Wood 2003). Evans's map shows five settlements at the mouth of the Knife, in locations that correspond closely to the locations of known archaeological sites (figure 1.6). Although he does not explicitly identify the residents of each, he notes that on September 23, 1796 "I arrived at the Mandaine Village which is situated about 10 leagues above the Rikara (*at the Greenshield site [32OL17]*) on the Same Side (south) of the Missouri, there I was visited by the Munitarees and Wattassoons whose villages are only a league above those of the Mandaines" (Wood 2003:180; italicized text added).[4] The village symbol on the right bank of the Missouri immediately below the mouth of the Knife may represent the Awaxawis' Amahami Village.

A minor complication is presented by the fact that another of Evans's maps, which illustrates his understanding of the cultural and natural landscapes above the Knife, shows just four settlements at the mouth of the Knife (Wood 2003:Figure 27). The settlement missing from that map may be Amahami. Four settlements, along with René Jusseaume's trading post, are also shown on Antoine Soulard's 1795 map, which may have been prepared specifically for Evans and Mackay's 1796-1797 expedition (Wood 1996, 2001). However, one of the four settlements illustrated on the Soulard map is shown in the approximate location of Amahami.

David Thompson visited the Mandan and Hidatsa

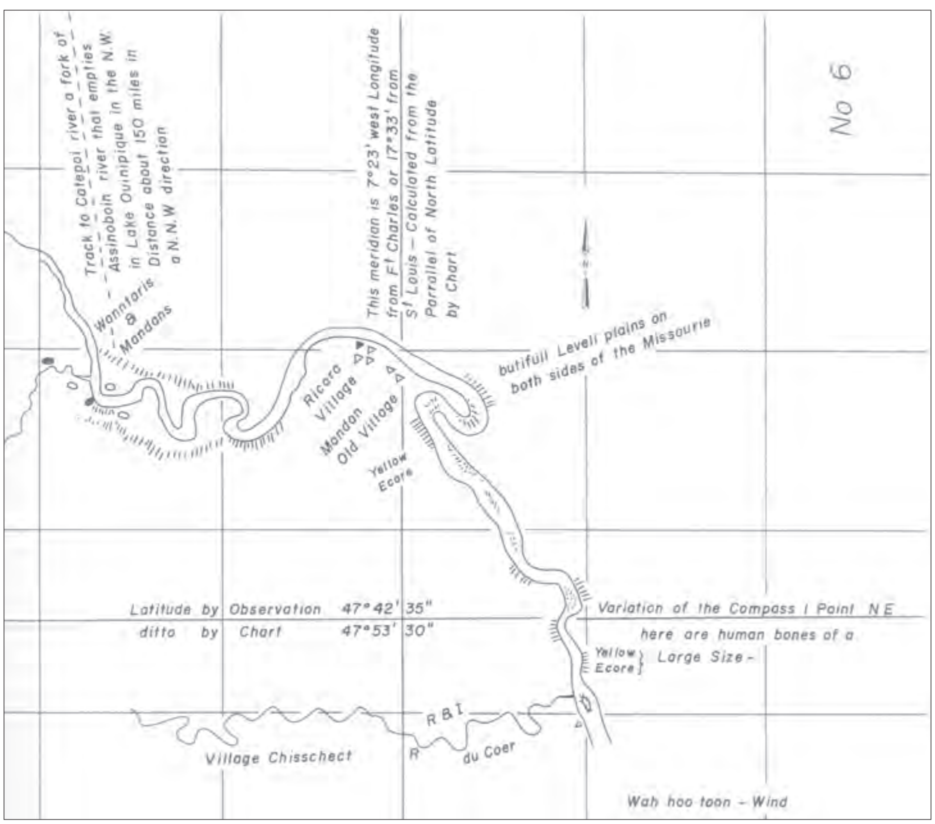


Figure 1.6. Sheet 6 of John Evans's 1796-1797 map (Wood 1986b:Figure 9).

settlements during the winter following Evans's departure. His map illustrates five settlements, but they are not the same locations as the five shown on Evans's map (Wood 1977). In his field notes and journal Thompson provides a rough census of each village. Together the map and narrative describe three Hidatsa settlements and two Mandan settlements. One of the Hidatsa settlements is located on the left bank of the Missouri above and opposite the mouth of the Knife in a location that does not correspond to that of a known archaeological site. The other two Hidatsa sites can be associated with Big Hidatsa Village (32ME12) and Sakakawea (Awatixa) Village (32ME11). Both of the Mandan sites shown on the map and listed in the census are associated with known archaeological sites (Deapolis [32ME5] and Black Cat, neither of which is extant). Missing from Thompson's map and narrative is any mention of the Awaxawis.

The reason for Thompson's omission is unknown. However, Toussaint Charbonneau, who accompanied Lewis and Clark to the Pacific, told Maximilian that when he first came to the Knife River confluence "three (*Hidatsa*) villages existed then, exactly as now" (Witte and Gallagher 2012:121-122; italicized text added). Maximilian's visit occurred during the winter of 1833-1834 and Charbonneau told him that he had lived with the Hidatsas for 37 years. Thus, Charbonneau's first winter on the Knife likely occurred at the same time as Thompson's visit.[5] Charbonneau was an abrasive individual, but certainly the longest-tenured trader in the area and was according to Maximilian "fully acquainted with their (*Hidatsa*) language, traditions and customs" (Witte and Gallagher 2012:116; italicized text added).

These data indicate that the Awaxawis' second move after the abandonment of Molander occurred at least by 1787. They likely were living at Amahami Village in 1796 and certainly were there in the winter of 1797-1798, Thompson's map and narrative notwithstanding. The archaeological record provides no obvious alternative place of residence near the mouth of the Knife for the period between 1787 and 1796, unless the Awaxawis co-located with another Hidatsa division when they first arrived.

Returning to the account of Awaxawi settlement history that Tetuckopinreha gave to William Clark, questions remain about the destination of the first post-Molander move. Clark's journal entry appears to indicate that the Awaxawis first moved to a settlement within five miles of the "Minitaries," which in Clark's understanding could refer either to the Hidatsas proper or the Awatixas. (Clark wrote and then crossed out the word "near" in his journal entry, leaving some doubt as to his meaning [Moulton 2005].)

However, Biddle's (Allen 1814:130; emphasis added) paraphrase of Clark's journal reports that the Awaxawis "formerly resided on the Missouri, about thirty miles below where they now live. The Assiniboins and Sioux forced them to a spot *five miles higher*, where the greatest part of them were put to death, and the rest emigrated to their present situation, in order to obtain an assylum near the Minnetarees." Thus, the Awaxawi settlement occupied between the abandonment of Molander the establishment of Amahami could have been either about five miles below the mouth of the Knife (from Clark's original journal) or about five miles above Molander (from Biddle's paraphrase).

Wood (1993:17) notes that an archaeological site likely dating to the eighteenth-century has not been identified in the location Biddle described. A candidate site also is not present in the location Clark reported. However, the multicomponent Mahhaha site (32OL22), which includes an ephemeral late eighteenth- or early nineteenth-century component (Wood 1986a), is located about 9 miles below the Awatixa settlement (following the modern channels of the Knife and Missouri rivers).

Apart from this archaeological evidence, analysis of the contexts of Clark's and Biddle's statements offer reasons to double Biddle's. Clark's statement was recorded contemporaneously. By contrast, Biddle's understanding emerged from reading the journal and conversing with Clark some six years later. Biddle's emendations are by no means error-free; one need only look as far as his interlineation of Clark's October 23 field note, which misstates the location of the "Maharha" settlement (see notes at the end of the chapter). Perhaps most significant is the fact that Biddle's account is given under the entry for November 21, 1804. Clark's (2005f) journal entry for that day is just 54 words long and reports nothing about the Awaxawis or any other group, apart from the fact that "maney Indians visit us to day." Biddle's account, which runs to three pages and editorializes about the "tottering fortunes of the American nations" (Allen 1814:129), clearly compiles information from several different journal entries as well as from Clark's "Estimate of Eastern Indians."

Tetuckopinreha does not indicate when the Awaxawis left Mahhaha, or possibly another nearby site that is no longer extant. As noted previously, James Mackay's account puts them at the mouth of the Knife at least by 1787 but does not specify the date of their arrival. However, one clue is provided by a map produced in 1791 by Edward Jarvis and Donald Mackay illustrating the situation Mackay observed during his 1781 visit to the region (figure 1.7) (Wood 2001, 2010). (John and Donald Mackay were not related.) Jarvis and Mackay illustrate the locations of four tribal groups on the Missouri, including the "Flying big belly Inds," the "Shoe Indians," the "Mandane Inds," and farthest downstream the "Shevitoon Inds." (The map states that all four groups "live on islands;" however, Wood [2010:259] rightly regards the existence of island settlements, at least in the northern Middle Missouri, as improbable at best.) The identities of the upper three groups are clear: the Hidatsas (presumably including both the Hidatsas proper and the Awatixas), the Awaxawis, and the Mandans. Wood argues that Mackay's Shevitoon Indians may have been the Sutaios, a Cheyenne subgroup.

Pertinent to Awaxawi settlement history is Mackay's location of the "Shoe Indian" settlement, roughly equidistant between the Mandans and Hidatsas. Molander is approximately mid-way

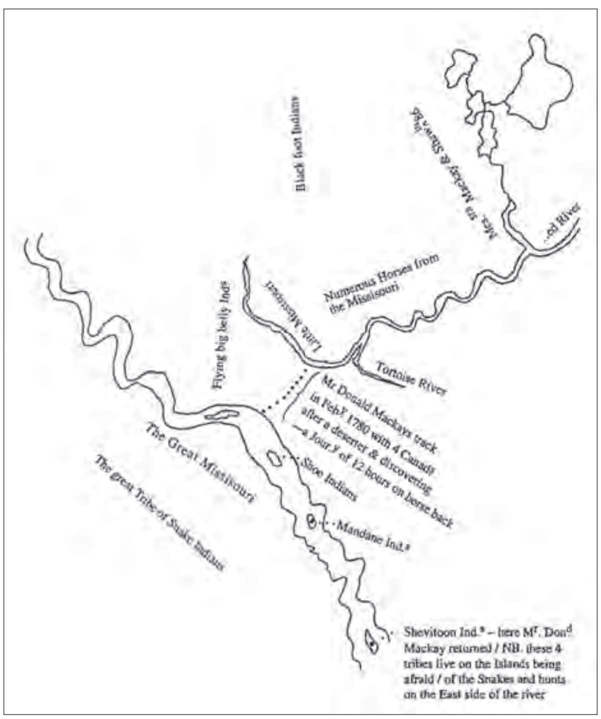


Figure 1.7. Jarvis and Mackay's 1791 map (Wood 2010:Figure 1).

between the mouth of the Heart and the mouth of the Knife and so Jarvis and Mackay's map could indicate that Molander was still occupied as late as 1781. However, scale is clearly variable across the Jarvis and Mackay map and although the Shoe Indians' settlement is shown below a sharp bend in the Missouri, a situation similar to the location of Molander, the course of the Missouri shown on the map appears to be a graphic convention rather than a realistic representation. The precise placement of settlements relative to specific bends in the river, or to distances along the river's course, may therefore not be meaningful.

Nevertheless, the map does suggest that the Awaxawis were living some distance away from both the Mandans and Hidatsas in 1781, an interpretation which suggests that the Awaxawis had not yet moved to the mouth of the Knife. If so, it is likely that they did so shortly after Mackay's visit: the continental smallpox epidemic of the late 1770s and early 1780s arrived in the region during the summer or fall following his departure (Fenn 2001; Wood 2010). In addition to horrific casualties, that epidemic triggered a wave of settlement relocations, the most dramatic and wrenching of which was the Mandans' decision to leave the Heart River region.

Chomko (1986:69) suggests that a third entry in Clark's journal, written on August 18, 1806 during the expedition's return to St Louis, also refers to the Molander site. Lewis and Clark were accompanied downriver by Šehékšot (White Coyote or Sheheke), a Mandan leader who later would travel to Washington to meet with President Jefferson (Potter 2003). Biddle's emendation of Clark's journal entry for the date states that

> he (*Šehékšot*) Said that the Meni-tarras Came out of the water to the East and came to this country and built a village near the mandans from whome they got corn beens &c. they were very noumerous and resided in one village a little above this place on the opposit side. They quarreled about a buffalow, and two bands left the village and went into the plains, (those two bands are now known bye the title Pounch, and Crow Indians. the ballance of the Mene- taras moved their village to where it now Stands where they have lived ever Since [Clark 2005b; italicized text added].

The expedition passed a large number of abandoned settlements on August 18 and so Šehékšot's description of the community in question as "a little above" their camp at the mouth of the Heart River is insufficiently precise for positive identification. However, regardless of which site he was naming, the content of Šehékšot's statement indicates that he was not referring to the Awaxawi. Although Awaxawi oral tradition claims a deep time connection with the Crow (discussed in the next section), that connection was severed long before their arrival on the Missouri. Ahler (1993) argues that the River Crow separated from the Hidatsas proper about 1700, while the Mountain Crow separated from the Awatixa about 1400. Bowers (1948) reports that the Crow themselves do not regard the Awaxawi (or the Awatixa) as a related band but do so regard the Hidatsas proper.

Two additional points indicate that Šehékšot was not referring to the Awaxawi. Clark recorded the tribal name as "Meni-tarras," which as described previously was a term understood at the time to denote the Hidatsas proper and the Awatixas rather than the Awaxawis. If Šehékšot, who—like Too Né and Tetuckopinreha—was a knowledgeable and reliable informant, had told Clark that the story involved the Awaxawis, Clark certainly would have recognized the distinction. Biddle, too, understood Clark's interpretation of tribal identities. Finally, the context of Šehékšot's statement indicates that he was recounting oral tradition, rather than historical information as had Too Né and Tetuckopinreha two years earlier (Vansina 1985). Together, these data and interpretations indicate that Clark's August 18 journal entry does not refer to Molander.

Traditional Data

Wood (1993) summarizes the abundant and complex narratives comprising Hidatsa oral tradition. Many of the narratives were recorded by Alfred Bowers (1965), who was the first to recognize that each of the three Hidatsa divisions—the Hidatsas proper, the Awatixas, and the Awaxawis—had distinct origin traditions and separate histories, which have been preserved by elders sanctioned to do so (Bowers 1948).

In brief, the Awaxawi origin tradition brings them to the earth's surface on a vine, a path that parallels that of the Mandans in several of their origin traditions. Accompanied by the Hidatsas proper and the Crows, the Awaxawis moved to Devil's Lake in present eastern North Dakota. From there the Awaxawis separated from the Crows and Hidatsas proper, who moved north. After a period of residence at Devil's Lake, the Awaxawis moved to the Missouri where they found the Awatixas already in residence. They were joined there by the Hidatsas proper and the Crows, who later separated as described by Šehékšot.

Bowers (1948) notes that the among the three Hidatsa divisions, the cultural practices of the Awatixas were the most similar to those of the Mandans, while those of the Hidatsas proper were least similar, reflecting their relative lengths of residence on the Missouri. However, the dialects of the Awatixas and Hidatsas proper—despite their distinct origins and differing archaeological histories—were closer to one another than they were to the dialect of the Awaxawis. This seems the likely source of Clark's perception that the Awaxawis were culturally distinct from the combined Awatixas and Hidatsas proper.

Square Buttes and the Painted Woods area figure prominently in Awaxawi tradition. Two of the elders that Bowers interviewed stated that the Awaxawis first arrived on the Missouri at a place called Many Snake Hill above the mouth of the Knife but their first settlement was located near Square Buttes, close to a Mandan village and an Awatixa village. They further stated that the Awaxawis claimed the reach of the Missouri from Square Buttes to the mouth of the Knife, but also had lived for a time in the Cannonball region due they said to overcrowding in the Knife region. Another tradition has the Awaxawis arriving on the Missouri at Square Buttes where they lived amicably with the Mandans and Awatixas (Bowers 1965:20-21). Later the Awaxawis moved to a settlement above the Knife. That move provoked the enmity of the Hidatsas proper and the two groups engaged in a three-year war. The Awaxawis were defeated and moved downstream to the Cannonball region. However, they had returned to the Painted Woods area prior to the smallpox epidemic of 1781.

An indigenous map draws in 1906 by a Mandan named Sitting Rabbit shows three settlements on the Missouri between Mandan Lake and Square Buttes (Thiessen *et al*. 1979). The map was commissioned by Orrin Libby, who at the time was Secretary of the SHSND, and was modeled on maps of the river produced in the early 1890s by the Missouri River Commission. One of the three illustrated settlements, "Arrow People Village," is located on the left bank, while the other two are located on the right. Both of the right bank villages are labeled "Mandan." Thiessen and others (1979:158) suggest that the upper Mandan settlement, located close of Mandan Lake, corresponds to one of the village in that area observed by Clark and drawn on Evans's 1796 map. The lower settlement, located immediately above Square Buttes ("High Hills"), is labeled "High Hill Village" and, in Hidatsa transcribed by Thiessen and others (1979:152), "awahackiš." They observe that no historic Mandan settlements are known in the reach immediately above Square Buttes and suggest that the symbol represents the "Old Village or Ah na ha was band" shown on Clark's map (Thiessen *et al.* 1979:157).

Wood (1986b:54, Figure 23) describes four indigenous maps that show Hidatsa and Crow settlements at the mouth of the Knife, including one that shows the Awaxawi community at Amahami. All four maps were obtained in the early twentieth century by Gilbert Wilson, a Presbyterian minister and ethnographer.

Two other native maps, one contemporaneous and one modern, illustrate the locations of the Mandan and Hidatsa settlements at the confluence at the turn of the nineteenth century. Too Né, the Sahnish diplomat, produced a map of the Missouri River and adjacent regions in 1805 or 1806 that shows five settlements (Steinke 2014). The locations of all five correspond to the locations of known archaeological sites. A settlement identified as the home of "Les Siffleurs" (the Whisperers) is shown at the location of Amahami. The second map was drawn by Sitting Rabbit (Thiessen *et al.* 1979). Like other maps of the confluence, Sitting Rabbit's map also shows five villages at the mouth of the Knife, but the settlements illustrated are not the same as the five on Evans's, Thompson's, Clark's, or Too Né's maps. One of Sitting Rabbit's five, identified as "Hilltop Village," corresponds the Mandan settlement at Fort Clark (Mitu'tahakto's or Mih-Tutta-Hangkusch), which was not established until 1822 (Mitchell 2014b). In addition, Sitting Rabbit appears to have reversed the known locations of the Awatixa settlement (labeled "awati-has Scattered Village") and the Awaxawi settlement (labeled "awahawi Mountain Village").

Early Survey Data

Molander was first mapped by the surveyor Theodore H. Lewis on October 23, 1883, 79 years to the day after William Clark had first seen the site. Lewis's map of the upper settlement shows 42 lodge depressions entirely encircled by a deep fortification ditch (figure 1.8). The map also shows the location of a "modern house" and stable. In a letter to Alfred J. Hill, Lewis's partner in a privately funded venture known as the Northwestern Archaeological Survey (Haury 1990), Lewis (1883) noted that the fortification ditch was 20 feet wide and 4 ½ to 5 feet deep. Lewis's (n.d) field notes also indicate that the lower settlement was "within a stonethrow (*sic*) of the first," covered an area that measured 542 ft north-south by 143 ft east-west (approximately 0.6 ha or 1.4 acres), and contained lodge depressions that were 30 to 55 ft in diameter and 1 to 2½ ft deep.

George Will, a North Dakota native, tireless researcher, prolific author, and President of the SHSND from 1947 to 1955, briefly mentions the upper settlement in his 1924 compendium of Missouri River sites, noting that it was in "excellent condition" and contained "a large number of very plainly marked house rings" (Will 1924:317). He also describes the lower settlement as "considerably obliterated by cultivation" and suggests that it may have been occupied "in conjunction with" the upper settlement but does not suggest a cultural affiliation for either. Will (1924:Fig. 4) provides a map of the site that shows the fortification ditch and earthlodge depressions in the upper village, along with the locations of four historic structures, an access road, fences, and the extent of plowed ground inside the fortification ditch (figure 1.9). Will's map also illustrates the locations of two lodge depressions on the southeast edge of the settlement, outside the fortification. The general location of the lower settlement, which he describes as "supplementary," is also shown. Will (1924:Fig. 3) also reproduces Lewis's 1883 map of the site.

The SHSND mapped the site in the late 1930s in conjunction with their acquisition of the property. Their map accurately depicts the locations of the fortification system's most prominent bastions but distorts the shape of the intervening ditch segments and only provides as approximate location for the recent historic structures (figure 1.10).

George Will and Thad Hecker provided a slightly more detailed discussion of the site in their 1944 synthesis of Missouri Valley archaeology (figure 1.11). They describe Molander as a "double site," with the upper settlement covering about 4 acres and the lower covering about 6 (Will and Hecker 1944:107-108). By 1944, the lodge depressions in the lower settlement were only "faintly" visible. Lodge depressions were more prominent at the upper settlement, although Will and Hecker confirm that a portion of that settlement also had been plowed. They argue that Molander was occupied by the Arikara, based on their assessment

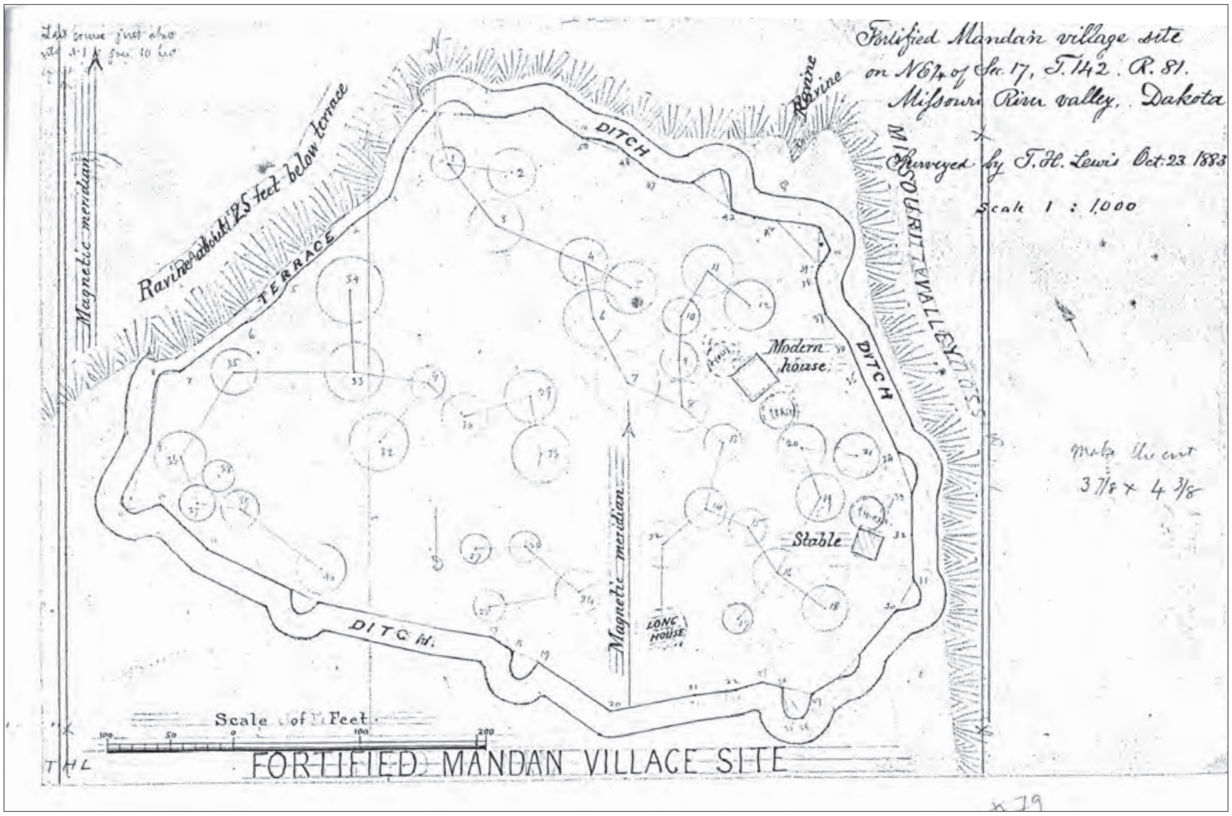
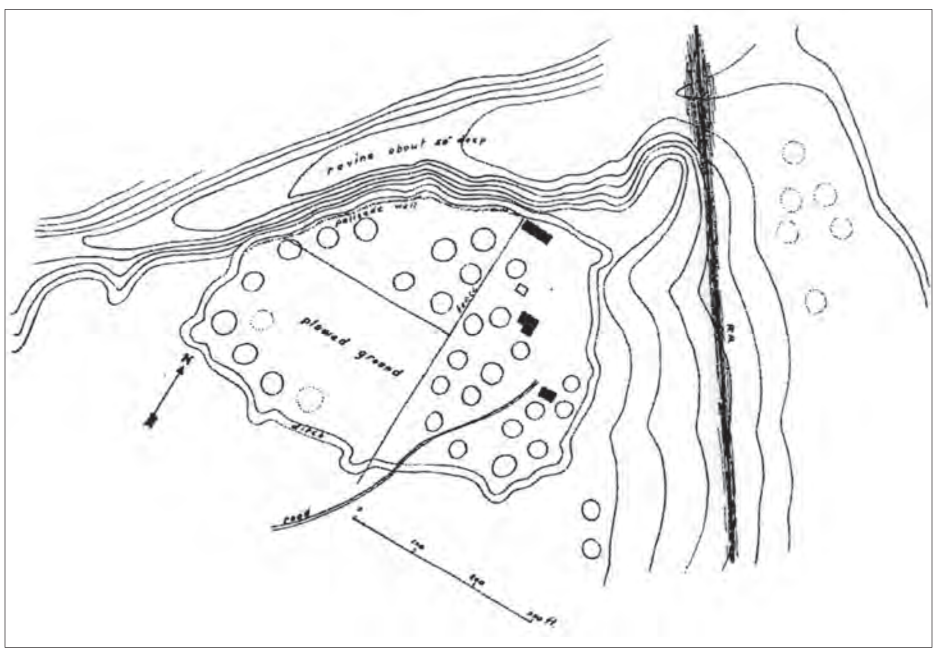


Figure 1.8. Theodore H. Lewis's 1883 map of the Molander site (image courtesy SHSND).

Figure 1.9. George Will's 1924 map of the Molander site (Will 1924:Figure 4).



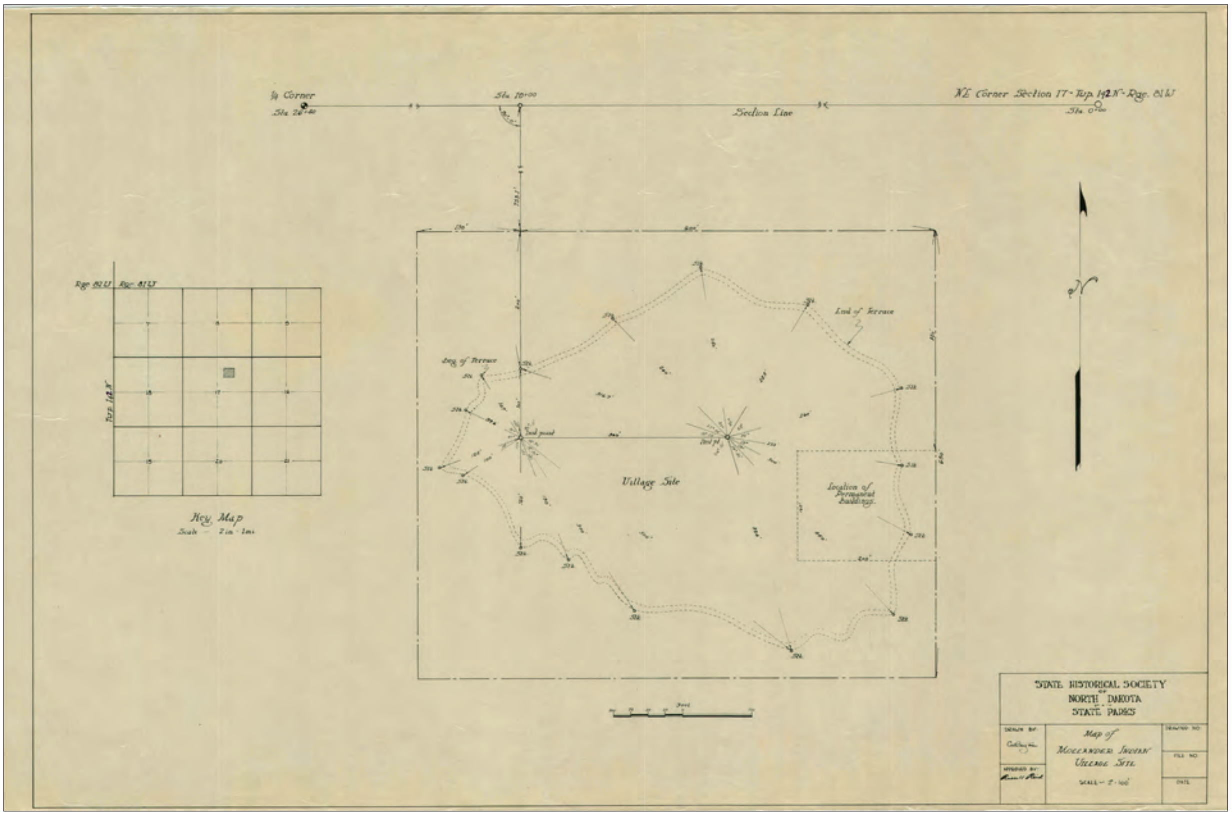


Figure 1.10. A map of the Molander site produced in the late 1930s by the State Historical Society of North Dakota (image courtesy SHSND).

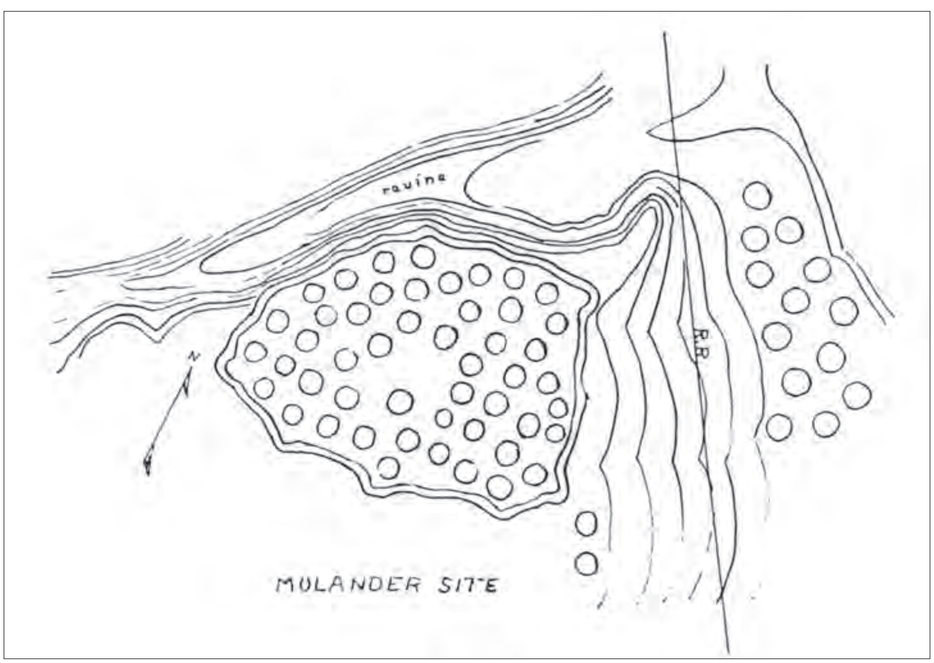


Figure 1.11. George Will and Thad. C. Hecker's 1944 map of the Molander site (Will and Hecker 1944:Plate 3).

of the site's pottery and their understanding of the historical documents available at the time and of the then-known distribution of archaeological. The judge the site's pottery to be "decadent but still of fair quality," and report a scarcity of flaking debris and stone tools. Their site map appears to be a simplified reproduction of Will's 1924 map, although a larger number of earthlodge depressions is illustrated both for the upper and lower villages (Will and Hecker 1944:Plate 3).

Archaeological Data

Four small testing projects have occurred within or near Molander. In 1966, the SHSND excavated an approximately 5 x 5-ft block in the upper settlement that exposed two cultural features, the larger of which was an undercut storage pit approximately 2 ft deep (figure 1.12). The smaller feature exposed by the SHSND crew may have been a straight-sided pit and was 1 ft deep. No notes are available for this work and the location of the test unit is unknown.

In June 1968, Raymond W. Wood and Donald Lehmer excavated a single 5 x 5-ft test unit adjacent to the upper settlement as a part of their Upper Knife-Heart Project. The unit's precise location is unknown; however, the location is described on the excavation form as "outside the ditch on the northeast edge of the site" (Wood and Falk 1968). Given the location of the adjacent rail grade and the property boundary, Wood and Lehmer's excavation likely was located within an area of roughly 1,000 m^2. Their unit exposed a midden composed of alternating cultural and sterile strata (figure 1.13). Intact subsoil was encountered at an unspecified depth below 8 in. Excavation stopped in sterile sediment at a maximum depth of 26 in. Numerous charred seeds were observed in one prominent cultural stratum observed at about 8 in below the surface.

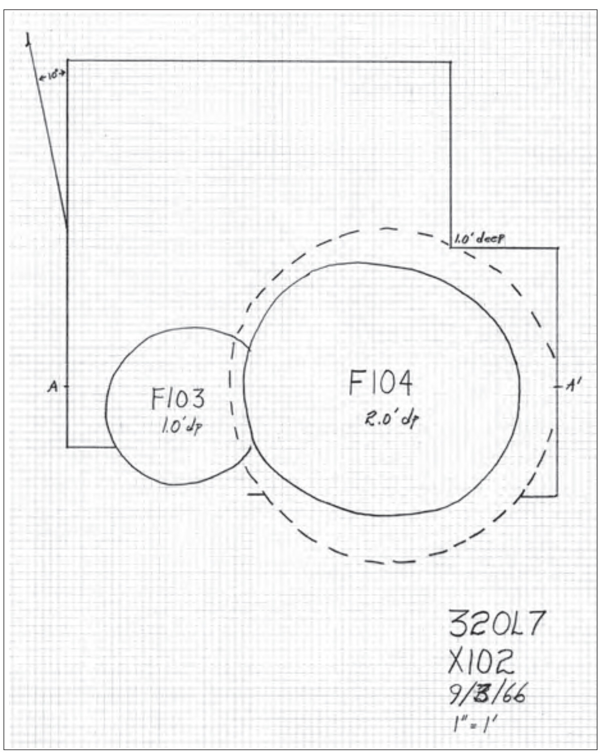


Figure 1.12. Sketch map of the 1966 State Historical Society of North Dakota excavation block (image courtesy SHSND).

Lehmer and others (1978; see also Wood 1986a) assign the Molander pottery assemblage, which is dominated by Knife River ware, to their Knife River phase (1780-1845). (Lehmer and others [1978] allocate Molander to their "Components Unassigned to Subphase" group; however, Wood (1986a) allocates the site to his "Documented Hidatsa" subphase.) No trade goods were identified during the Wood and Lehmer excavation, but they do comment on the presence of bone tools manufactured with metal implements (Lehmer *et al.* 1978:434). Lehmer and others (1978) also call attention to the seemingly unusual form of the fortification, in which they counted six bastions. In the 1960s and 1970s, bastions were primarily regarded as features of so-called Huff focus sites, which date to the fifteenth century and are found farther downstream on the Missouri. No bastioned fortifications were then known from eighteenth-century sites. Lehmer and others (1978:435; see also Wood and Falk 1968), citing information received from adjacent landowners, suggests that the ditch may have been "cleaned out" by the workers who fenced the site when it was purchased by the SHSND in 1935.

In 1978, Timothy Weston, John Kjos, and Stan Ahler excavated 36 shovel probes on the east side of the upper settlement, adjacent to and outside the fortification ditch (figure 1.14) (Weston *et al.* 1978). The project was prompted by a proposal to upgrade and widen North Dakota Highway 1806. Their shovel tests revealed sparse village-age cultural materials near the surface in an area extending approximately 30 ft east of the fortification ditch (Weston *et al.* 1978:Table 1). The testing also demonstrated that fill removed from the ditch had been thrown outward. Undisturbed terrace sediment was encountered at

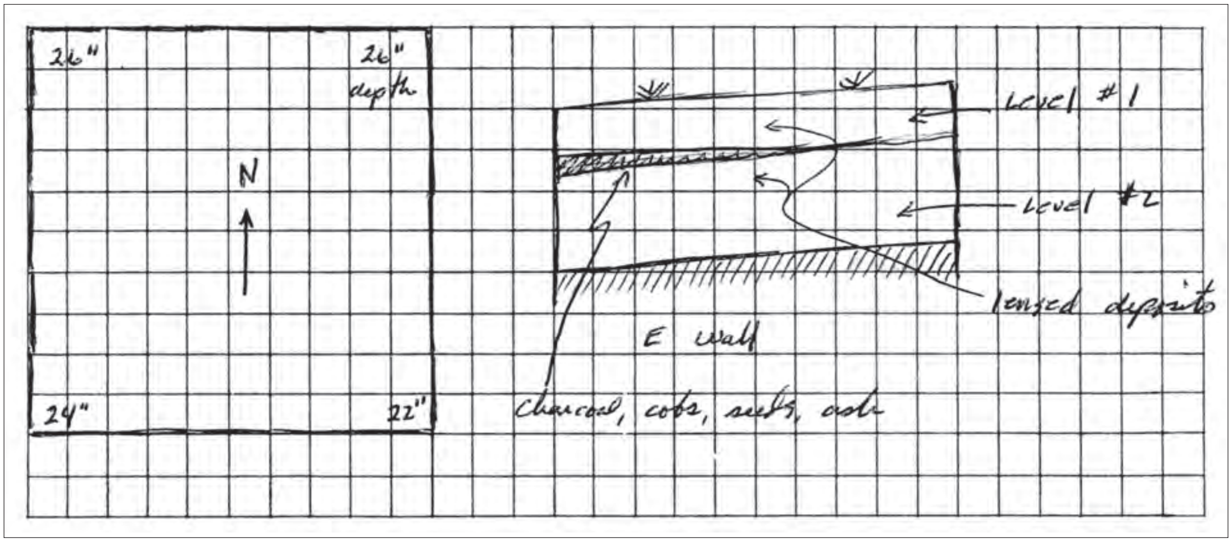


Figure 1.13. Sketch map of the 1968 Lehmer and Wood excavation at Molander (Wood and Falk 1968) (image courtesy SHSND).

depths ranging from the modern surface to more than 12 in. The project also revealed the presence of an older, preceramic component at the site, along with artifacts associated with the site's recent historic component (Weston *et al*. 1978:34).

Metcalf Archaeological Consultants, Inc. (MAC) re-mapped the fortified settlement in 2004, in the process identifying a cairn and an earthlodge depression possibly associated with the site but located just outside the SHSND property boundary (Stine *et al*. 2004). The MAC crew also excavated five shovel probes on the bluff across the coulee north of the site, two of which produced cultural materials possibly related to the occupation of Molander.

In 2017, the Archeo-Imaging Lab at the University of Arkansas, in cooperation with the SHSND, conducted extensive geophysical surveys at the site (Kvamme 2018). The fieldwork included a complete magnetic gradiometry survey of the fortified settlement, along with resistivity and ground-penetrating radar surveys of selected blocks. Concurrently, PCRG staff and volunteers conducted a focused hand coring program and a team from the University of Texas – Dallas captured aerial imagery to create a digital elevation model of the site's surface. Results of the 2017 field investigation are summarized in chapter 2. The 2018 testing project described in this report built directly on the results of the 2017 field investigation.

Collections Data

Several studies of museum collections from Molander have also been carried out. Alfred Bowers (1948) examined collections from the site during his dissertation research, although quantitative data on the Molander assemblage are not reported in the tables of ceramic attribute he compiled. This omission likely reflects the fact that Bowers (1948:87) knew that the SHSND collection he studied incorporated samples from both the upper and lower settlements. Bowers assigns Molander to the Huff focus based on the morphology of the fortification, his pottery data, and topographic or other data that led him to infer the presence of long-rectangular lodges and deep midden deposits at the site. Bowers regarded Huff focus sites as ancestral Mandan and dated them to the late fifteenth or sixteenth centuries.

Stan Ahler and Anthony Swenson (1993) included the 1966 SHSND and 1968 Lehmer and Wood collections from Molander in their regional pottery study, which they conducted in conjunction with analyses of collections from Hidatsa sites at the Knife River Indian Villages National Historic Site (KNRI). Ahler and Swenson's (1993:13) preliminary analysis indicated that both Molander samples represented a "single post-contact period component." The combined sample, which they designated "Batch 4," included 106 vessels and 677 body sherds (Ahler and Swenson 1993:Table 17.1). Their initial cluster analysis groups the Molander sample with thirteen

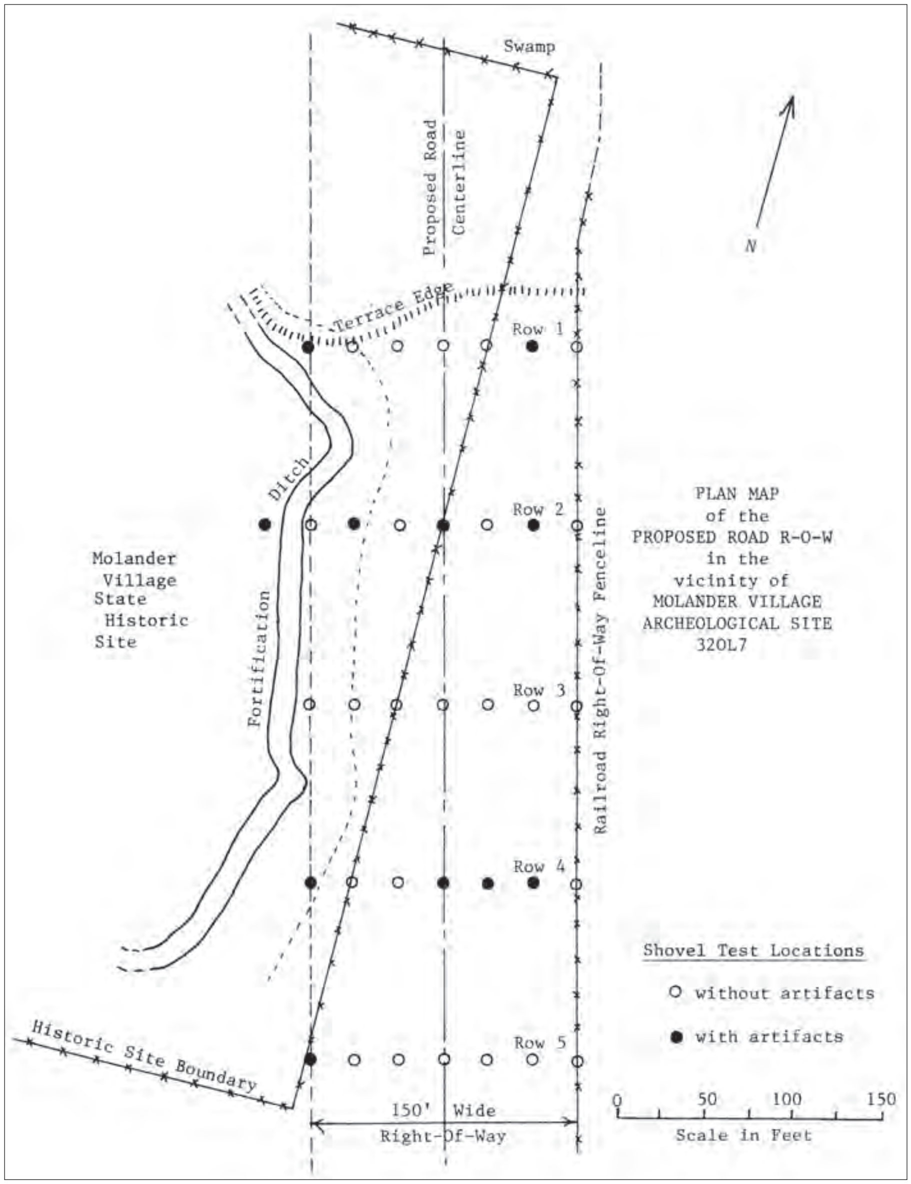


Figure 1.14. Map showing shovel test locations on the east side of the Molander site (Weston et al. *1978:Figure 21).*

others in a cluster they assign to the Early Knife River phase. That cluster, which is relatively heterogeneous, includes batches dated to the 1600s through the early 1800s (Ahler and Swenson 1993:56, Figure 17.3).

A second stratified cluster analysis grouped Molander with five other batches, including two from Mahhaha (Batches 29 and 30), two from Lower Hidatsa Village (32ME10, Batches 44 and 54), and one from Big Hidatsa Village (32ME12, Batch 68) (Ahler and Swenson 1993:Figure 17.6). This second grouping, also assigned to the Early Knife River phase, includes batches thought to date from the late 1600s through the 1700s. Because the cluster includes samples from both Molander and Mahhaha, Ahler and Swenson suggest that it may in part represent an Awaxawi potting tradition. However, they note that the inclusion of samples from Lower Hidatsa and Big Hidatsa "is not entirely compatible with this interpretation" (Ahler and Swenson 1993:65).

Based on the pottery analysis and other site data, Ahler (1993:Table 25.1) allocates both Molander and Mahhaha (TP1, Batch 29) to the Minnetaree phase (1700-1785). Mahhaha TP2 (Batch 30) is allocated to the preceding Willows phase (1600-1700), while the later component at Amahami (Batch 41) is allocated to the succeeding Roadmaker phase (1785-1830).

Recent Ownership Data

The land on which the Molander site is located was part of nearly 40 million acres granted by Congress to the Northern Pacific Railroad in 1864. Revenue generated by land grants were an important principal means by which companies financed the construction of the transcontinental rail network. Northern Pacific mortgaged the parcel containing the site to the Farmers Loan and Trust Company in 1879.

In 1888, a 160-acre parcel consisting of the northeast quarter of Section 17, Township 142 North, Range 81 West, which included the site, was purchased by Albert J. Hanson for $480 dollars. The deed indicates that Hanson first settled the property prior to December 7, 1882. Theodore H. Lewis's October 1883 map shows the location of a "modern house," which was Hanson's residence.

Hanson sold the entire 160-acre parcel to Gustav W. Molander in 1898 for $600. (The deed was recorded in 1907). Molander (1862-1953) was born in Sweden and emigrated to the United States in 1881. He arrived in Oliver County in 1883.

Gustav Molander sold an 11.65-acre portion of the parcel he bought from Hanson that encompasses the upper settlement to the State of North Dakota in 1935 for $582.50. That parcel has been managed by the State Historical Society of North Dakota for the past 85 years.

Summary

Contemporaneous indigenous accounts recorded by William Clark in October 1804 and March 1805 provide the clearest evidence for Molander's age and cultural affiliation. Both of the men who provided the information were community leaders who were knowledgeable about regional geography, history, and politics. Too Né had traveled widely and it is certainly possible that Tetuckopinreha had as well. Their statements can be described as news, eyewitness statements, or historical accounts, rather than as oral tradition (Vansina 1985). To the extent that they can be compared, their statements are in agreement. Their statements appear to have been supplied without obvious cause to deceive. For these reasons there is no reason to doubt the reliability or accuracy of their statements.

Archaeological data, although limited, support the statements that Clark recorded. To date, no other archaeological site dating to the eighteenth century has been documented in the vicinity of the Molander site. Sites dating to the 1700s occur below Square Buttes and above Painted Woods Lake, but not near the location described by Tetuckopinreha or shown on Clark's map. Although many sites, including relatively recent sites, have been destroyed by the shifting channel of the Missouri and by construction and development in the twentieth century, none of those factors appears to have been significant in the section of the valley immediately above Square Buttes.

The most comprehensive analysis of Molander's material culture to date is Ahler and Swenson's (1993) pottery study. Their analysis indicates that the fortified settlement at Molander likely dates to the eighteenth century. Wood (1986a) and Lehmer and others (1978) similarly conclude that the Molander's pottery indicates an eighteenth-century occupation. The absence of metal and glass trade goods in the 1968 Wood and Lehmer test unit is almost certainly due to their relatively coarse field recovery methods as well as the small size of their sample.

Both Bowers (1948) and Will and Hecker (1944) offer alternative interpretations. However, their conclusions are based on very limited data and, at least for Will and Hecker, a misreading of the documentary evidence. Sitting Rabbit also offers an alternative interpretation; however, his sources are poorly understood and the basis for his attribution of the settlement near Square Buttes to the Mandans is unknown. Certainly, Hidatsa oral tradition makes a clear connection between the Awaxawis and the Square Buttes-Painted Woods region.

Historical documentary and cartographic data suggest that the Awaxawis arrived at the mouth of the Knife from a site other than Molander after 1781 but before 1787. The best candidate for that first post-Molander site is Mahhaha, although too little is known about its archaeology at present to fully evaluate that possibility. However, if the Awaxawis did move to Mahhaha following their departure from Molander, they likely would have lived there for less than 20 years. Whether they built Amahami when they first arrived at the Knife is not known but seems likely.

Research Orientation and Project Goals

Archaeological research on historic-era settlements—whether occupied by Native Americans, European colonists, or both—inevitably invites comparisons or contrasts between interpretations drawn from historical documents and interpretations drawn from the archaeological record. But the view that archaeological data can either corroborate or refute historical data often is not warranted, not because one or the other of those sources is more likely to be correct, complete, or reliable but because documentary and archaeological data are differently structured (Mitchell 2013a:43). Given the specificity of the historical data on Molander's age and occupation history—and the clear credibility of the sources of those data—it is hard to imagine how they could be convincingly challenged, let alone refuted, by archaeological data. For the most part, material culture data lack the precision necessary to accomplish that task. About the best one can hope for is that archaeological data will provide context for Too Né's chronological statement.

But the imprecision of material culture data does not relegate archaeological research to second-class status. To the contrary, archaeology's role in research on historical American Indian societies is crucial (e.g. Rubertone 2000). For Molander, archaeology offers an opportunity to better understand the Awaxawis' cultural, social, and economic connections to their neighbors during a transformative period. By comparing data on trade relationships, subsistence practices, lithic territories, architectural features, and other topics, analysis of Molander's material culture can add to the growing body of historical processual data for the region. Such comparisons are now possible, owing to the robust datasets produced by recent SHSND projects in the Heart river region, which complement similar datasets previously produced by National Park Service projects at the Knife River Indian Villages National Historic Site.

Research Questions and Objectives

In addition to the primary goal of achieving a better understanding of Molander's place in the contemporaneous cultural landscape, the 2018 project also sought to answer several specific questions about the site. Those questions relate to three overall research themes, including the settlement's history of occupation, its overall layout and architectural features, and its current condition.

Occupation History

Apart from obtaining chronological data needed to evaluate Too Né's historical statement, the 2018 field investigation sought to generate data on the number of archaeological components present at the site and on their duration. Reconstruction of the site's occupation history requires data on the frequency of structure remodeling or reconstruction and on the mode of abandonment. Multiple superimposed lodge floors or evidence for structural timber replacement may indicate a relatively long occupation span. Evidence of catastrophic structure fires may suggest that the site was abandoned rapidly, whereas the absence of catastrophic burning may suggest a protracted or planned abandonment. Ceramic or stratigraphic evidence may indicate the presence of a Plains Village component that pre-dates the eighteenth-century settlement described by Too Né. The project also sought to define the age and extent of the preceramic component or components identified by Weston and others (1978).

A fundamental aspect of the site's occupation history is the relative age of the fortification ditch. Determining whether the defensive system was built before or during the occupation has critical implications for understanding Awaxawi settlement history, processes of community leadership and organization, and the nature of warfare during the period of occupation.

Settlement Layout and Architectural Features

Geophysical data collected in 2017 revealed aspects of the site's structure. However, questions remain about whether a central plaza was present and, if so, where it was located. Questions also remain about the number, layout, and size of earthlodges present, both inside and outside the fortification ditch. Historic plowing inside the ditch complicates the interpretation of the magnetic data, and soil moisture conditions during the 2017 fieldwork limited the effectiveness of other methods. Additional geophysical data, combined with targeted excavation data, are needed to better define the attributes of the settlement's residential structures as well as details of its overall layout.

Current Condition

Historic maps and descriptions along with the microtopographic and geophysical data collected in 2017 indicate that a variety of post-occupation processes have affected Molander's archaeological deposits. The most extensive disturbance process certainly has been plowing. Construction of the homestead and outbuildings, along with trash disposal during the period of occupation, has also significantly affected a portion of the site. Moreover, examination of the site surface indicates that animal burrowing, although currently limited, was at one time extensive. However, despite clear surface evidence for these processes, understanding their specific effects on subsurface archaeological deposits requires data on the depths of lodge floors, storage pits, and other features.

Notes

1. This section takes advantage of the comprehensive presentation of William Clark's field notes and journal entries made available in *The Journals of the Lewis and Clark Expedition Online* by the Center of Digital Research in the Humanities (University of Nebraska – Lincoln) and the University of Nebraska Press (University of Nebraska Press/University of Nebraska-Lincoln Libraries Electronic Text Center 2005). Previous analyses of data reported by Clark related to Molander have relied on older, and in some cases partial, presentations of the original documents.

2. In Clark's field notes, the quoted material is dated October 24, 1804. However, Maximilian's copy of Clark's route map clearly shows that the October 23 camp was located above the location indicated for the settlement to which Clark refers (Moulton 1983; Wood and Moulton 1981). Nicholas Biddle's emendation of Clark's October 23 journal entry states that the expedition "saw at 12 miles passed old village on S. S. of Maharha* Indns, a band of Minnetarrés who now live ⟨with⟩ between Mands & Minnetarres *Ah na ha wa's see note 10 May, 1805." Biddle clearly recognized that the expedition passed the settlement in question on the 23rd (see also Coues 1893:176), although he incorrectly states that it was located on the "S. S.," or river left, when in fact it is located on the "L. S.," or river right as Clark indicates in his incorrectly dated field note. (Biddle's reference date is also incorrect; it should be March 10, 1805 rather than May 10.) In addition to the map evidence, this interpretation is supported by the fact that Clark's journal entry for October 24, which may have been written after the field note entry, does not mention the abandoned village, nor do the journal entries for that day penned by John Ordway, Patrick Gass, or Joseph Whitehouse.

3. James Mackay likely authored the map that Wood (1986b:32) designates the "Indian office 1797 map." The map includes three village symbols near the mouth of the Knife, but the accompanying legends imply that four or perhaps five settlements were present.

4. Don Lehmer (Wood 2003:149) argued that the filled symbols on Evans's map represent Hidatsa sites and the open symbols represent Mandan sites.

5. Bowers (1948:107) gives 1796 as Charbonneau's first year on the Knife; however, this is likely an arithmetic error.

2 Field Investigation

Mark D. Mitchell, Kenneth L. Kvamme, and Rory Becker

The archaeological and geophysical fieldwork reported in this chapter was carried out over the course of two field sessions. The first session, which took place in August 2017, primarily consisted of a site-wide magnetic gradiometer survey. Hand coring of selected magnetic anomalies and limited electrical resistance and ground-penetrating radar (GPR) surveys were also undertaken during the first session. The second field session in August 2018 involved archaeological testing as well as hand coring and limited geophysical surveys. Detailed results of the 2017 geophysical surveys are presented in Kvamme (2018) and are briefly summarized in this chapter, the primary focus of which is the 2018 testing effort. Previously unreported coring and surface inventory data collected in 2017 also are discussed.

The 2018 investigation began on August 4 and continued through August 15. The first day of the project was devoted to re-establishing the existing site grid, to setting up the waterscreen station, and to hand coring of magnetic anomalies. Excavation began on the afternoon of August 5 and continued through August 14. Anomaly coring continued through August 9. Unit profiling began on August 13 and continued through August 15. During the final day of fieldwork, the waterscreen station was dismantled and excavation units were backfilled with coarse sand.

The 2018 geophysical surveys began on August 5 and continued through August 11. Electrical resistance, electromagnetic (EM; conductivity and magnetic susceptibility), and GPR surveys were carried out to better define the perimeters and interior features of selected earthlodges. On August 9,

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electrical resistance tomography (ERT) data were collected along a 20-m transect across a single earthlodge depression. On August 11 and 12, a Nokia OZO camera was used to capture virtual reality (VR) video and audio segments.

Mark Mitchell, Paleocultural Research Group (PCRG) Research Director, supervised the field investigation. He was assisted by Oklahoma State University (OSU) Associate Professor of Anthropology Stephen Perkins, OSU Teaching Assistant Tanner Wiseman, PCRG Project Archaeologist Chris Johnston, and PCRG Crew Chief Britni Rockwell. Mandan, Hidatsa, Arikara Nation (MHA) interns included Amber Gwin and Mary Baker. University of Arkansas (UA) Professor of Anthropology Ken Kvamme supervised the geophysical data collection. Kvamme was assisted by Jo Ann Kvamme and UA graduate student Jeremy Menzer. Rory Becker (Eastern Oregon University) collected the ERT and VR data. State Historical Society of North Dakota (SHSND) staff participants included Chief Archaeologist Paul Picha and Research Archaeologist Tim Reed.

OSU archaeology field school students included Olivia Benton, Garrett Bulger, Torrey Butler, Erin Francis, Dylan Lambert, Alannah Templeton, and Seyvon Vick. PCRG volunteers included Don Andrews, Courtney Crawford, Chloe Dougan, Frank Delaney, Bob Gardner, Amy Gillaspie, Stephanie Grossart, Jessica Harrington, Craig Johnson, Paul Sanders, Barry Splawn, Amy Woodruff, and Lisa Yeager.

Project participants devoted a total of 2,832 person-hours (354 person-days) to the 2018 fieldwork. Of that total, 2,144 person-hours (76 percent) were donated to the project. Major funding was provided by the SHSND. Supplementary funding for public outreach and community involvement was provided by the Northern Plains Heritage Foundation. OSU provided additional funding for field operations.

MHA Tribal Historian Calvin Grinnell and MHA Tribal Councilman (Twin Buttes Segment) Cory Spotted Bear visited the site during the field investigation. Additional visitors included National Park Service archaeologists and park staff, North Dakota Department of Transportation staff, SHSND staff, and members of the North Dakota Archaeological Association.

The research design and work plan for the 2018 field investigation were based in part on the results of Kvamme's 2017 magnetic gradiometer survey. He was assisted in that work by Menzer and Jo Ann Kvamme. A PCRG volunteer crew led by Mitchell set up the site grid and carried out a program of hand coring. 2017 volunteers included James Kovats, Craig Johnson, Karen Jordan, Paul Sanders, Denise Stuckle, and Rebecca Wallace. Jordan also conducted archival research on nineteenth- and twentieth-century ownership of the site.

The UA and PCRG field crews were assisted by Amber Gwin, Knife River Indian Villages National Historic Site (KNRI) intern, KNRI Interpretation and Cultural Resources Program Manager Alisha Deegan, and National Park Service Archaeologist Jay Sturdevant. Arlo McKee and Brent Dell, both graduate students in the Department of Geospatial Information Sciences at the University of Texas at Dallas, provided an unmanned aerial vehicle (UAV) for the project and collected aerial imagery of the site. Funding for the 2017 fieldwork was provided by the SHSND, the University of Texas at Dallas, and several anonymous PCRG donors.

Field Methods

Horizontal and vertical controls for the geophysical surveys, hand coring, and excavation were provided by a local northing-and-easting grid system oriented to true north. Figure 2.1 illustrates this grid along with the site's principal features and elements of the surrounding built and natural environments. Three permanent datums were established at the site (table 2.1). Each consists of a 2-ft steel reinforcing rod capped with a 1.5-in aluminum marker. The master datum is located near the site access gate, approximately 5 m east and 3 m north of the property's southwest boundary marker. The back sight is located about approximately 111 m due east of the master datum, about 3 m north of the southern boundary fence. Both the master datum and the primary back sight were established in 2016. A third permanent datum was established during the 2017 fieldwork. That datum is located in the northwest corner of the site about 30 m northeast of the western end of the fortification ditch.

A CST/Berger 205 total station was used to locate grid positions within the site. In 2017, a 20-m array of grid corners was established across the entire site to guide the gradiometer survey. The staked geophysical survey corners also were used to triangulate the positions of monopole anomalies selected for further investigation by hand coring. During 2018, only a few corners were staked to guide the geophysical surveys and the positions of monopole anomalies selected

Figure 2.1. Map of the Molander site showing the local grid, permanent datums, and elements of the built and natural environments.

for hand coring were located directly with the total station.

The corners of individual excavation units were set by a combination of total station measurements and local triangulation. Prior to backfilling at the end of the project, total station shots were taken on each unit's southwest corner. Vertical control for each multi-square excavation block was provided by one or more local datums that consisted of a wooden stake located just outside the block. The elevation of the top of the stake was measured with the total station and a datum string was tied to the stake on a decimeter grid elevation. Excavation depths were measured below the datum strings and so represent grid "datum depths" (DD) rather than local surface depths. Both datum depths and corresponding grid elevations are reported in this chapter.

Following initial excavation unit layout, the sod layer, which ranged in thickness from 2 to 5 cm, was removed without screening. This material was stockpiled on plastic sheeting nearby to be used later for backfilling. Each square was then excavated separately in arbitrary levels with complete waterscreen recovery until individual cultural features were identified. Each identified feature was excavated separately in arbitrary levels. Thus, excavation levels can be described either as "general levels" (GL), if they included material from the entire excavation unit, or as "feature levels" (FL), if they included only material from a defined cultural feature.

Table 2.1. Site datum coordinates.

	Local Grid Coordinates				UTM Coordinates (NAD83)	
Datum	Northing	Easting	Vertical	Grid HzA from D1	Northing	Easting
D1 (Main)	200.000	300.000	100.000	-	5220750.2	350692.4
D2 (Back Sight)	200.000	411.055	99.031	90° 0' 0"	5220748.1	350803.4
D3 (Subdatum)	330.951	351.019	100.134	201° 17' 13"	5220880.2	350745.8

Excavation was carried out primarily with trowels, brushes, and other small hand tools. Skim shovels were used in a few instances, particularly for removal of the first one or two general levels. Excavated sediment was transferred to 5-gallon plastic buckets that in turn were loaded onto a trailer pulled by an ATV for transport to the waterscreening station (figure 2.2).

Waterscreening procedures were identical to those used for other recent projects in the Heart River region (e.g. Ahler, *ed*. 2006; Mitchell, *ed*. 2007). Washed samples were dried on canvas cots near the waterscreening station and bagged by catalog number. No artifact sorting or identification was undertaken in the field. At the end of the field session, approximately 55 1.5-ft^3 boxes containing waterscreen samples were transported to PCRG's Broomfield, Colorado lab for sorting and analysis.

Data on each excavated level were recorded in the field on level forms designed for the project. The collected data included each unit's coordinates, excavation depths, and associated catalog numbers, along with short narratives describing the observed sediment packages and artifacts as well as problems encountered during the course of excavation. Plan maps were drawn at the end of each level; the end of most levels was also photographed. Catalog numbers were assigned in the field to each excavation level, and all of the objects recovered during waterscreening were grouped under that number. Thirteen fragile or unusual specimens were piece-plotted or assigned individual catalog numbers. One bulk feature fill sample was taken for subsequent flotation in the lab and a sample of natural terrace sediment was taken for radiocarbon dating.

No human remains were observed during the field investigations. Two human teeth fragments (CN1084 and CN1036) were recognized in the collection during laboratory analysis and were returned separately to the SHSND for repatriation.

Mitchell drew at least one profile of each numbered excavation square. Digital photographs were taken of each drawn profile. Digital photographs also were taken of the work in progress. A photograph log was maintained that included the shot number assigned by the camera as well as the subject of the image. After excavation, pit features were lined with perforated plastic sheeting and the excavation units were backfilled first with imported sand and then with stockpiled sod.

A one-inch Oakfield soil probe was used to collect data on the fill and depth of each of the targeted magnetic anomalies. The depths of stratigraphic boundaries observed in the sediment cores were recorded on standardized data sheets and notes were made about the numbers and kinds of artifacts encountered. During 2017, sediment from the cores was dryscreened through 1/16-in mesh screen. Core sediment was not screened during the 2018 field investigation. Two slightly different numbering systems were used to record coring data. During 2017, cores were numbered sequentially as they were taken. The letter "T" was subsequently added to numbered cores taken from an east-west transect. During 2018, fractional designations were assigned to multiple cores taken from a single geophysical anomaly. Thus,

Figure 2.2. Photograph of the waterscreen station.

the first core taken from the fifth anomaly investigated was designated Core 5, the second was designated 5.1, the third was designated 5.2, and so forth.

During both field seasons, the coordinates of anomalies selected for coring were calculated by hand from small-scale printed maps. Each map depicted an approximately 30 by 45-m section of the magnetic data, along with the local site grid. In seven cases, cores were taken from locations outside magnetic anomalies due to measurement or calculation errors.

Geophysical Survey Methods and Instrumentation

The focus of the geophysical surveys at Molander during 2017 was magnetic gradiometry, which covered the entire village area. This survey employed a Bartington 601 dual fluxgate gradiometer, with 1 m sensor tube length, 1 m horizontal separation between the two sensor tubes, and 0.03 nT resolution. Sampling density was one measurement for every 12.5 cm (8 per m) along transects with transects separated by 0.5 m, for 16 measurements per m^2. Bottom sensor height was approximately 30 cm above the ground.

Limited investigations were also conducted using electrical resistance and GPR. These surveys primarily were undertaken to evaluate their potential for locating subsurface features during future projects at the site. The electrical resistance surveys utilized two instruments, both in the form of twin-probe arrays with half-meter electrode separation (for a prospecting depth targeted at about one-half meter below surface). Sampling occurred every 50 cm along transects separated by 1 m (for two measurements per m^2). A Geoscan Research RM-15 with an MPX-15 multiplexer was utilized with four twin-probe arrays in parallel for more rapid survey. A TR Systems CIA resistance meter was also used for a small portion of the survey.

GPR survey utilized a Geophysical Survey Systems, Inc. (GSSI), SIR 2000 with a 400 MHz antenna and survey wheel, which enabled precise location of GPR traces. GPR transects were separated by 50 cm with traces recorded every 2.5 cm, for 80 traces per m^2. The time window was set at 50 ns, which permitted a depth penetration of approximately 2.2 m. Each trace was recorded in 512 samples.

The SHSND mowed the site prior to the geophysical survey. The survey crew also used a brush hog to remove woody vegetation from the fortification ditch and from a portion of the fortification terrace (figure 2.3). For all surveys, transect locations were marked on the ground by meter tapes. Each tape was marked at regular intervals, which guided instrument operators as they collected data.

Figure 2.3. UA graduate student Jeremy Menzer clearing brush from the fortification ditch (Kvamme 2018:Figure 3[a]).

GIS Methods

The geophysical data were pre-processed utilizing special purpose geophysical software in the form of Geoplot 3.0 by Geoscan Research and RADAN, by GSSI. All data were then imported to a GIS to facilitate data registration, overlay, analysis, and digitizing. For example, a standard linear affine transformation permitted historic maps and air photos to be registered to the local coordinate grid.

Shapefiles depicting the locations of earthlodge depressions shown on historic maps were then created. Obvious depressions visible in the digital surface model (DSM) derived from the aerial imagery were also digitized. The resulting polygons could then be compared against each other as well as the geophysical data as aids to interpretation. Historic aerial photos also registered to the DSM, permitting digitization and comparison of some of the features seen in those images.

The TerrSet GIS, by Clark University, was employed for most of these purposes, which permitted simple export to ArcGIS by Environmental Systems Research Institute (ESRI). ArcGIS was also employed for certain functions and for collaborative sharing.

Earth Resistance Tomography

Earth Resistance Tomography (ERT) is a geophysical prospection technique that has the capacity to model subsurface sediment depths and identify archaeological features (Aspinall and Gaffney 2001; Clark 1997; Dahlin 1996; Noel and Xu 1991; Papadopoulos *et al*. 2006; Samouëlian *et al*. 2005). The investigation at Molander provided an opportunity to employ this technique in association with an earthlodge feature. The goal of the 2018 ERT survey was to test the capacities of a high data density ERT profile in estimating living surfaces and buried archaeological features within the earthlodge.

A single ERT profile was obtained. The profile bisected an earthlodge (H6) while also intersecting two geophysical anomalies (26 and 29). These anomalies were first identified through the gradiometer surveys and confirmed by coring. A GeoScan RM85 instrument arranged in a pole-pole array (Becker *et al*. 2019; Bevan 2000) was used for data collection. The total length of the profile was 20 m running generally east to west across the selected earthlodge and extending beyond the raised perimeter mound on both ends. Along this single line, the exterior berms and interior floor of the lodge were completely contained within the 20 m length. The constant electrode spacing on the 2018 profile was 0.1 m with a maximum electrode spacing of 2 m resulting in a dataset of 3,810 readings across the 20 m profile (Dahlin and Zhou 2004; Wilkinson *et al*. 2006).

Data download from the RM85 and export to spreadsheet format was accomplished with TerraSurveyor. Microsoft Excel was used for conversion of readings in ohms to apparent resistivity (ohm-m) and to create a file format compatible with Res2DInv software which includes elevation data at 0.5 m intervals along the profile line. Res2DInv software carries out the inversion modeling with the L1 Norm regularization for the least squares optimization at a 0.05 data constraint factor. A robust model inversion constraint at a 0.005 cutoff factor improves the effect of high surface resistivity, although these effects are still apparent in the results. A convergence of 1 percent Root Mean Square Error (RMS) across two iterations was the optimization limit with the resulting number of iterations and Mean Absolute Error (Abs.) displayed in the Res2DInv output. Additionally, the "reduce effect of side blocks" function in the Res2DInv software improved the modeling near the ends of the profile line (Loke 2017; Loke *et al*. 2003).

Aerial Photogrammetry

Drone photogrammetry surveys were conducted in 2016 and 2017. The preliminary survey in 2016 was carried out by Kvamme, Menzer, and McKee using a commercial quadcopter UAV. Unfortunately, the results were not particularly informative owing to the extent of vegetative cover. The fortification ditch was clearly visible, primarily because it had been colonized by woody vegetation, as were the ruins of the homestead and associated outbuildings. However, earthlodge depressions and other village-age topographic features mostly were obscured by the thick grass cover.

McKee and Dell returned to the site in 2017 to collect additional imagery. The 2017 survey used a single-rotor Pulse Aerospace Vapor 55 unmanned helicopter equipped with two cameras: a near-infrared PhaseOne 50 MP and a visible light Sony aRII 35 MP (figure 2.4). A total of 1,257 images were used in the photogrammetric analysis. The resulting orthophoto covers approximately 37.2 ha (92 acres). The resolution of the digital elevation model is 8 cm/pixel or 156 points/m^2.

The site was mowed prior to the survey and woody vegetation was removed from the fortification ditch, revealing many subtle surface features. Spatial data on 14 photogrammetric control points are provided in appendix A.

Geologic and Geomorphic Setting

Molander is located on the T3 terrace (Qtm_3) of the Missouri River, the most extensive of the five terraces identified between Mandan Lake and Square Buttes

Figure 2.4. The UAV platform used to capture aerial imagery in 2017.

(Johnson and Kunkel 1959). At Molander the T3 tread is level parallel to the valley axis (approximately north-south in the Molander reach) but the riser is eroded and intermittently dissected and the tread slopes toward the river (figure 2.5). The tread of the T2 terrace is roughly 15 m below the eroded edge of the T3 tread. The site's northern boundary is marked by a spring channel or coulee emanating from the Cannonball Formation, which forms the lower portion of the western valley wall between the Little Heart River and the former Sanger townsite.

The T3 terrace fill consists of poorly bedded silt, sand, and gravel capped by silt (the Oahe Formation). The terrace is primarily cut into till (the Coleharbor Formation), although some sections of the T3 south of the town of Hensler directly overlie the Cannonball formation. At Molander, the Oahe Formation is approximately 1 m thick.

Geophysical Survey Results

During 2017 the entire site was surveyed by magnetic gradiometry in 86 complete or partial 20 x 20-m blocks. In all, 32,323 m² was surveyed (3.2 ha or 7.9 acres),

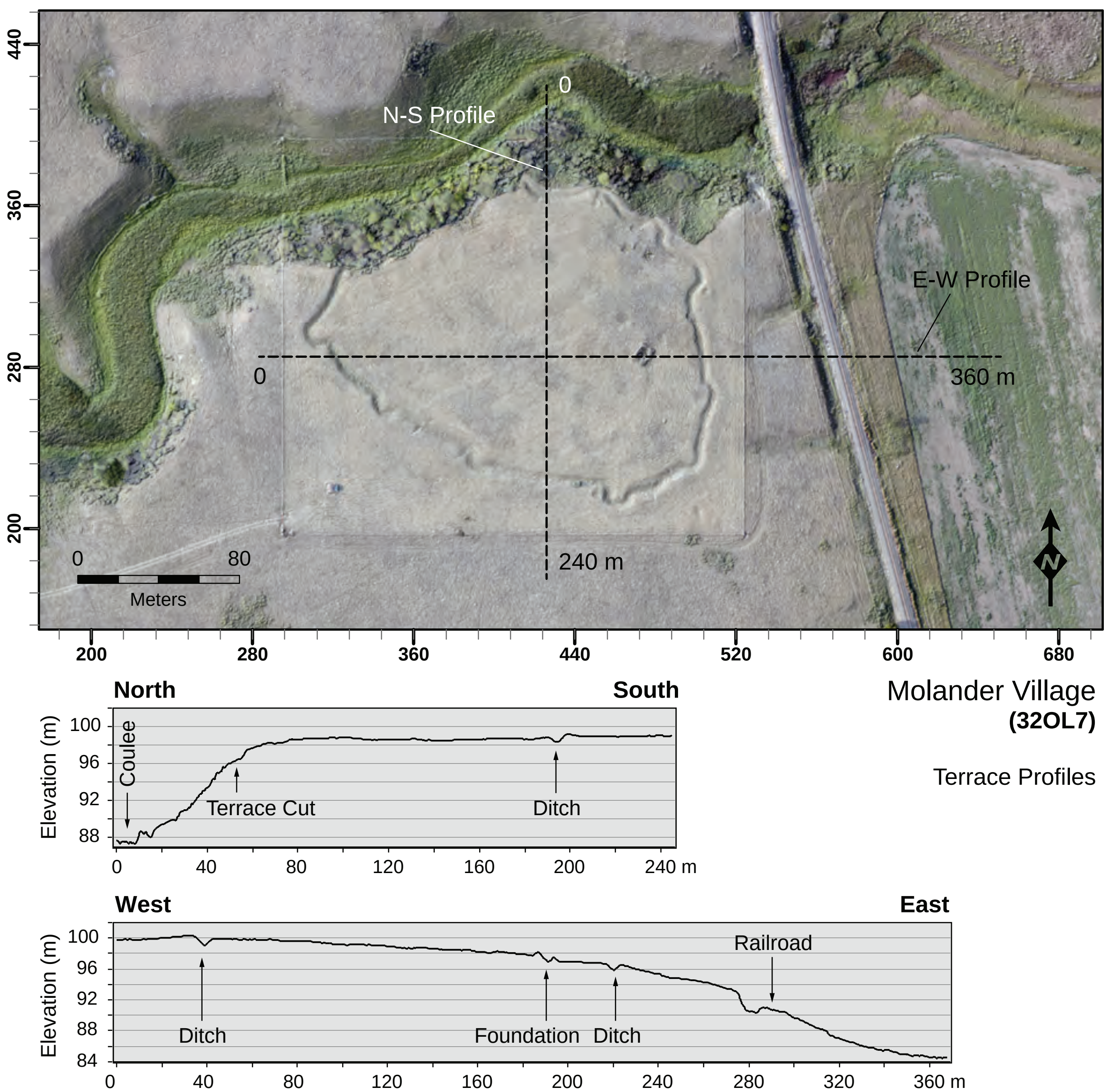

Figure 2.5. Orthogonal surface profiles of the T3 terrace derived from DSM data.

yielding 517,168 magnetic measurements (figure 2.6). Electrical resistance surveys were conducted in two areas where the magnetic data suggested possible village-age anomalies, one of 1,600 m² and the other of 400 m² for a total of 2,000 m² (0.2 ha) and 4,000 measurements. GPR survey was conducted over a single area of 1,040 m². A larger area originally was planned, but a fault in a cable prevented additional data collection. A total of 83,200 GPR traces were recorded, each to a depth of approximately 2 m, far greater than the likely depth of cultural deposits.

The GPR and electrical resistance surveys were designed primarily to test the local efficacy of those methods and in fact the 2017 work produced only limited results, owing primarily to adverse soil moisture conditions at the time of the fieldwork. By contrast, the magnetic survey was highly informative, despite the challenges to data interpretation posed

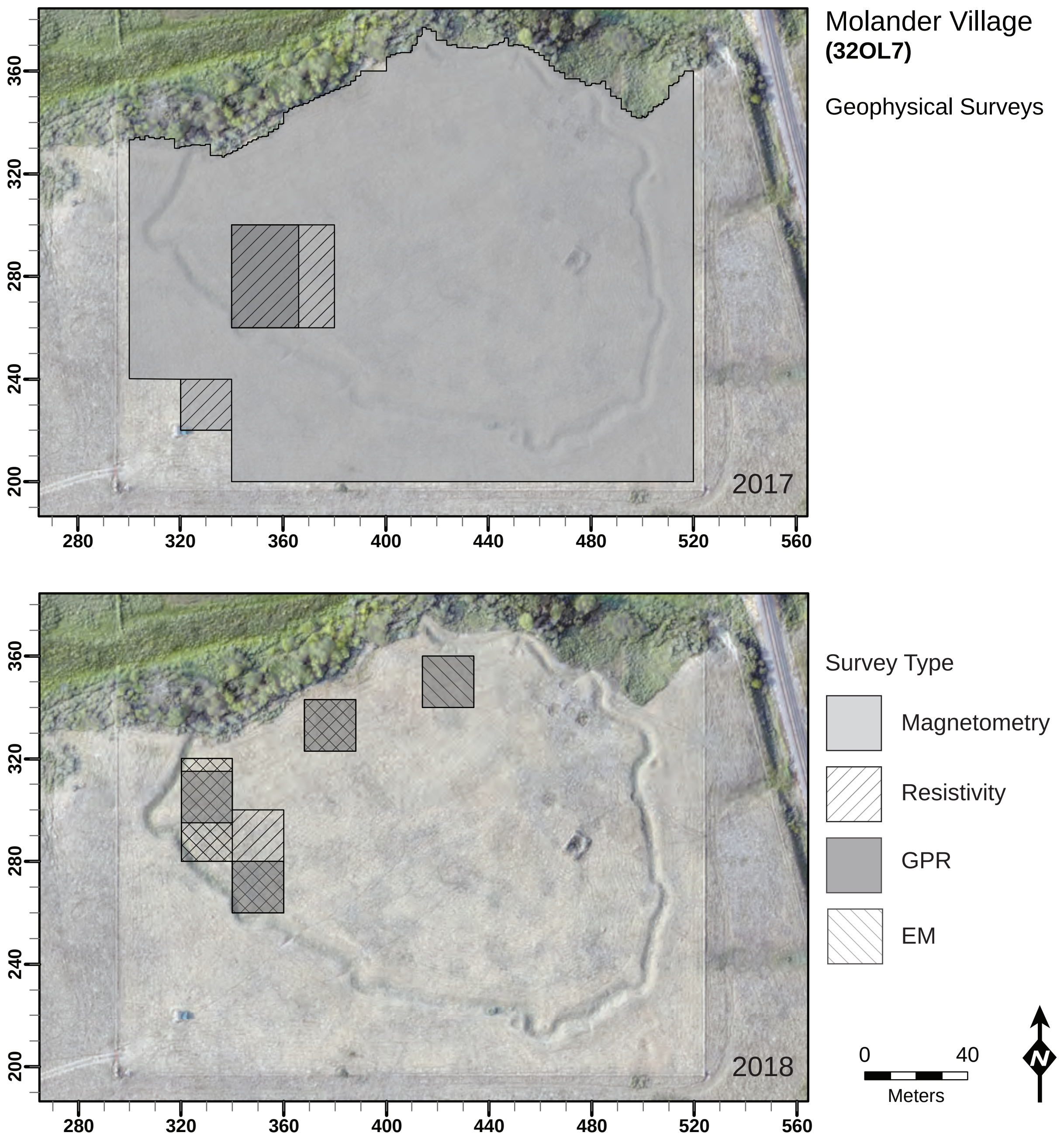

Figure 2.6. Maps showing the extent and type of 2017 (upper panel) and 2018 (lower panel) geophysical surveys.

by the presence of the recent historic occupation and other factors.

Limited geophysical surveys also were conducted in 2018 (figure 2.6). An electrical resistance survey was carried out on five 20 x 20-m blocks, or 0.2 hectares (0.49 ac). Unfortunately, the resistance data lack significant geophysical contrasts, likely owing to a lack of soil moisture and perhaps to the effects of plowing. A similar area (five 20 x 20-m blocks) was surveyed using electromagnetic methods. The conductivity results were about as insightful as the resistance results, although one block in the north-central part of the site yielded some new insights. The magnetic susceptibility data contains fewer anomalies than the magnetic gradiometry data, probably due to the shallower penetration of the former. Both datasets reveal the presence of numerous ferrous metal objects.

GPR survey was carried out during 2018 on four 20 x 20-m blocks (0.16 hectares or 0.40 acres). The GPR survey was conducted with a spacing of 4 transects/m, yielding relatively high-resolution data. The data are not especially informative for blocks on the western end of the site, agreeing with the results of the resistance and EM surveys. However, the GPR survey of one block (H11) produced what may be the best GPR data of a Northern Plains house that Kvamme has ever obtained, showing remarkable interior details and house outlines. The data quality may be related to the local geological context, soil or moisture conditions, or perhaps to the limited impacts of plowing in that part of the site.

2017 Gradiometry Results

Kvamme (2018) presents the results of the 2017 geophysical surveys in detail. This section summarizes those aspects of Kvamme's findings most relevant to interpretation of the 2018 excavation data; additional selected geophysical data also are presented elsewhere in the chapter. Figure 2.7 illustrates the magnetic data. A larger version of the magnetic map is presented in appendix B.

Interpretation of the magnetic survey results was complicated by several factors. The primary factor is the presence of features and artifacts associated with the 1880s to 1920s occupation of the site, including a substantial scatter of ferrous artifacts and other materials across the eastern quarter of the site. In

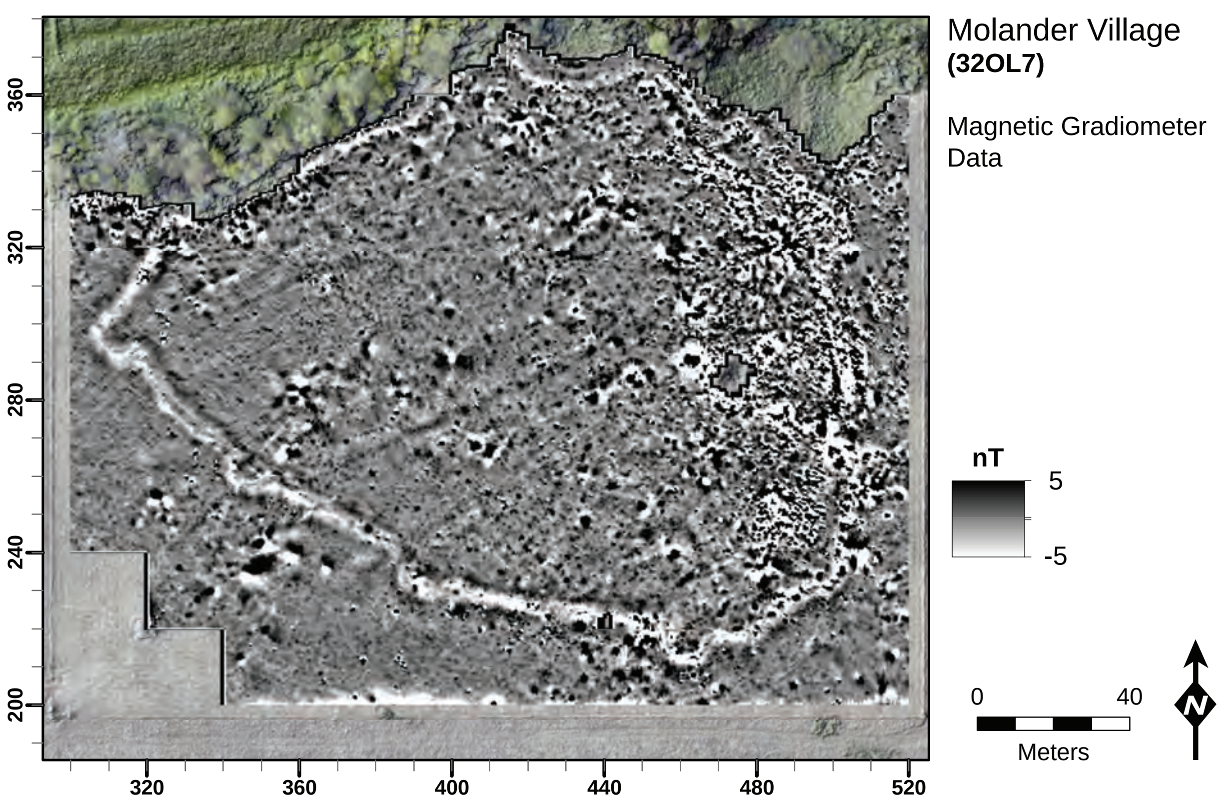

Figure 2.7. Map showing the complete magnetic gradiometry dataset.

addition, the historic occupants apparently plowed much of the remainder of the native settlement, a practice that has had profound effects on the geophysical expression of village-age features. In addition, glacial cobbles and boulders were observed throughout the site. Composed of igneous rock, they too introduce robust magnetic noise into the data that lends additional uncertainty to interpretations.

The historic debris field in the vicinity of the homestead includes many ferrous artifacts that are indicated by paired black and white features referred to as *dipolar anomalies* because they each represent the twin positive (black) and negative (white) poles of a magnet. Anomalies caused by iron artifacts are extreme in magnitude, frequently exceeding hundreds or thousands of nanoteslas (nT) in intensity, although the gradiometer settings employed at the site limited the measurements between ±100 nT. These extreme measurements can have a profound effect on the ability to prospect for subtler anomalies produced by hearths and storage pits, which typically vary in intensity between 3 and 12 nT. This is apparent in figure 2.8[a], where relative magnetic intensities are illustrated in a pseudo-three-dimensional trace plot that shows the enormous magnitude of measurements associated with iron artifacts, as well as their concentration on the east side of the site. (Additional data on the site's late occupation is presented in the "Recent Historic Component Inventory" section.)

It is also apparent from figure 2.8[a] that many extreme magnetic measurements occur elsewhere in the village. They may represent other iron artifacts associated with the recent historic occupation, including plow, wagon, or farm machinery parts. Several large magnetic anomalies may also represent igneous glacial boulders that tend to be highly magnetic and randomly located. Several such boulders were observed throughout the site.

Plowing is a well-known disrupter of shallow archaeological deposits. At many nearby Plains Village sites, the former locations of houses often are indicated by depressions in the modern surface. At Molander, such depressions are not greatly obvious to an observer standing on the surface, although advanced computer imaging methods help to make some visible in the DSM (Kvamme 2018:Figure 4d). Even so, there are areas at Molander devoid of any topographic indications of houses. Plowing is the likely cause, because maps produced by Lewis in 1883 and by Will in 1924 show the presence of house depressions. It would be impossible to create such a map standing on the surface today.

The patterning of the magnetic results similarly reveals broad areas in the western half of the village largely devoid of magnetic anomalies. Yet, in more than a dozen villages that have been subjected to magnetic prospecting in North Dakota (Kvamme 2007) numerous anomalies (indicative of storage pits, hearths, or other features) are commonly indicated in settled spaces owing to the extent of the activity that

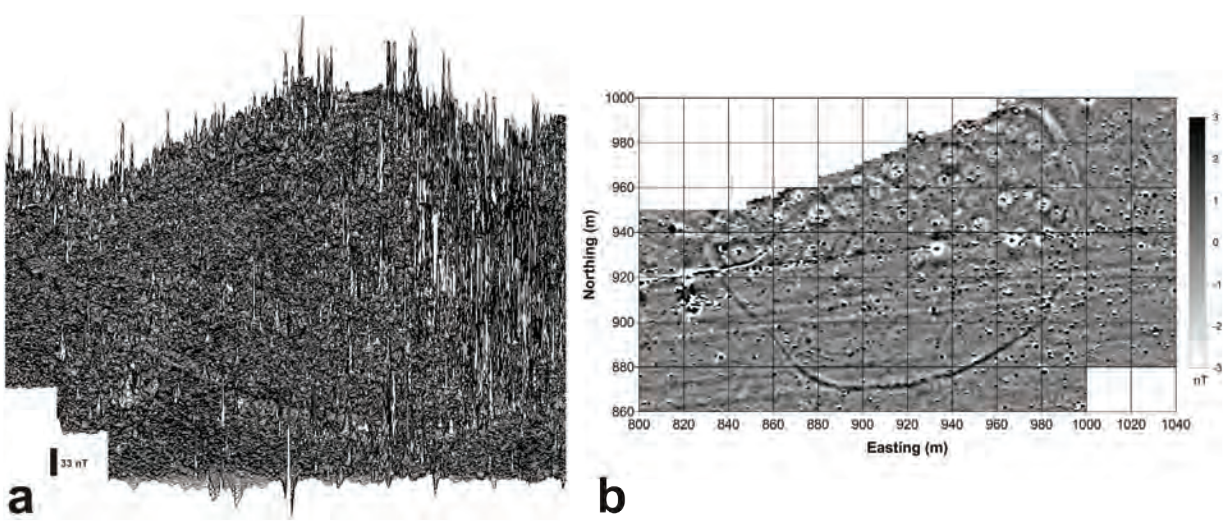

Figure 2.8. Maps showing a) extreme magnetic magnitudes at Molander caused by dipolar anomalies generated by ferrous artifacts, seen particularly on east side of village; and b) the effects of plowing on magnetic signatures of houses at the Biesterfeldt site (32RM1), North Dakota (image courtesy of Steven DeVore, Midwest Archeological Center, Lincoln) (reproduced from Kvamme 2018:Figure 9).

occurred within them. Moreover, in those villages, evidence of houses frequently exists in the form of increased magnetism along their perimeters due to mounding of soil. Very little of such evidence exists at Molander and no apparent "house rings" of raised magnetism are discernable.

An example of plowing's effects on magnetic gradiometry mapping of shallow Plains villages can be seen at the Biesterfeldt site (32RM1) of eastern North Dakota (figure 2.8[b]). That village, like Molander, has a surrounding defensive ditch. The northern half of the village is protected on public land and magnetic house rings are readily visible, while the southern half lies on a private farm and has been subjected to plowing for many decades. It is clear in the magnetic data that in the plowed half little evidence of former house locations remains, while in the unplowed half strong evidence of them exists. A similar contrast occurs at Molander, indicating that plowing has affected the magnetic results.

Non-residential Features

The outer fortification ditch that is so visible on the site surface is also the most obvious feature of the magnetic data. As is commonly seen in magnetic datasets from nearby settlements with unfilled ditches, the ditch at Molander is represented by a strip of "negative" magnetism. This occurs because subsoil, into which the ditches are excavated, is typically far less magnetic than topsoil (Kvamme 2007). With the more magnetic topsoil removed, they appear as negative anomalies. During excavation, the topsoil and sod was typically mounded along the inside edge of the ditch, probably along the line of the palisade. This circumstance is apparent adjacent to some sections of the ditch at Molander.

In addition, slightly elevated magnetism can be seen in places along the axis or centerline of the Molander ditch. This points to greater magnetism may be due to the dumping of village debris or to local in-filling of more magnetic topsoil into the ditch. Pedogenesis arising from the lush plant growth that occurs in the ditch may also be partly responsible.

Another pattern seen at other villages in the northern Middle Missouri, such as at Huff and Double Ditch, is the placement of subterranean storage pits in a line along the interior side of fortification ditches (Kvamme 2007). This pattern is likely seen in the magnetic data at Molander as well, with a series of 37 anomalies of the approximately correct magnitudes in this position (figure 2.9).

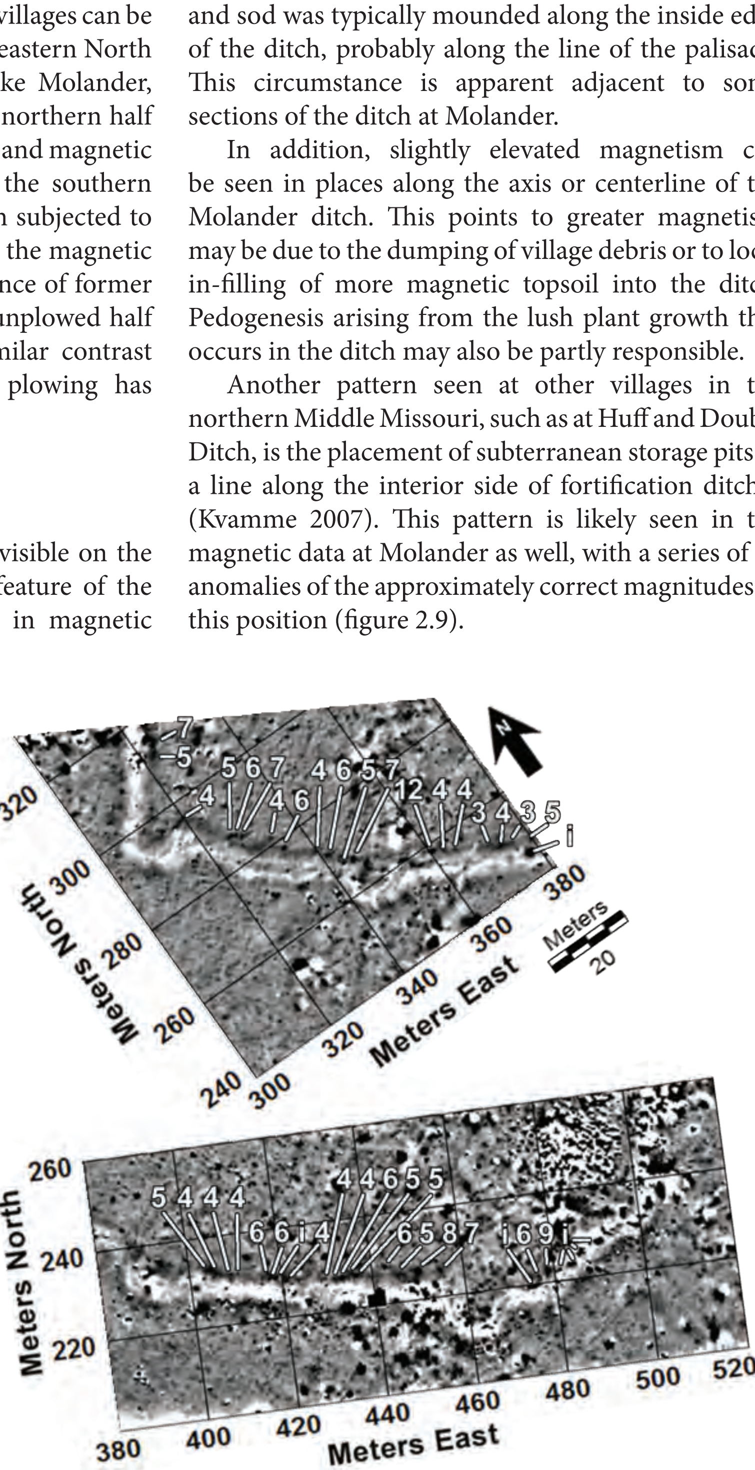

Figure 2.9. Maximum magnetic measurements in nT of anomalies thought to represent storage pits located along the inside of the fortification ditch; the letter "i" indicates an anomaly likely due to an iron artifact (reproduced from Kvamme 2018:Figure 19).

Residential Features

The primary goal of the magnetic data analysis was the identification of earthlodge locations. The main challenge to doing so was the absence of clear magnetic indications of earthlodge perimeters or "house rings." The analysis therefore incorporated topographic data from the DSM with magnetic and hand coring data. All circular-to-oval surface depressions observed in the DSM that were approximately the size of a house were digitized and assigned to three categories of "house likelihood"—high, medium, and low—depending on their robustness, size, and circularity. Many assigned to the low likelihood category seem obviously to be associated only with agricultural scarring that postdates 1880.

In addition, houses indicated in the GIS-registered 1883 and 1924 maps of Molander were digitized to provide additional clues from times when houses were presumably more visible on the surface than they are today. Although location errors are apparent in these maps, the relative positions of indicated houses might yield further insights. Limited use of subtle vegetation changes in aerial imagery that suggest possible houses were also employed.

While together these data might point to potential house locations, sometimes strongly, it was the magnetic data that provided ultimate validation: (1) all houses must possess a centrally located hearth, and (2) in many instances subterranean storage pits should be apparent around house perimeters. Both types of features are highly visible magnetically, and a number were validated through coring.

Figure 2.10 illustrates the interpreted locations of 32 houses, organized by likelihood. Data on the magnetic field strengths of anomalies interpreted as hearth features are presented in table 2.2. Eleven of the 32 houses are assigned to the high likelihood category, 13 are assigned to the moderate or medium likelihood category, and 8 are assigned to the low likelihood category. One of the highly probable houses was validated by electrical resistance and GPR data.

2018 GPR Results

Three of the four GPR blocks surveyed in 2018 failed to produce new insights, likely because of very dry conditions that limited the ground moisture necessary for reflection contrasts. However, the fourth block, which contained a single house (H11) indicated by

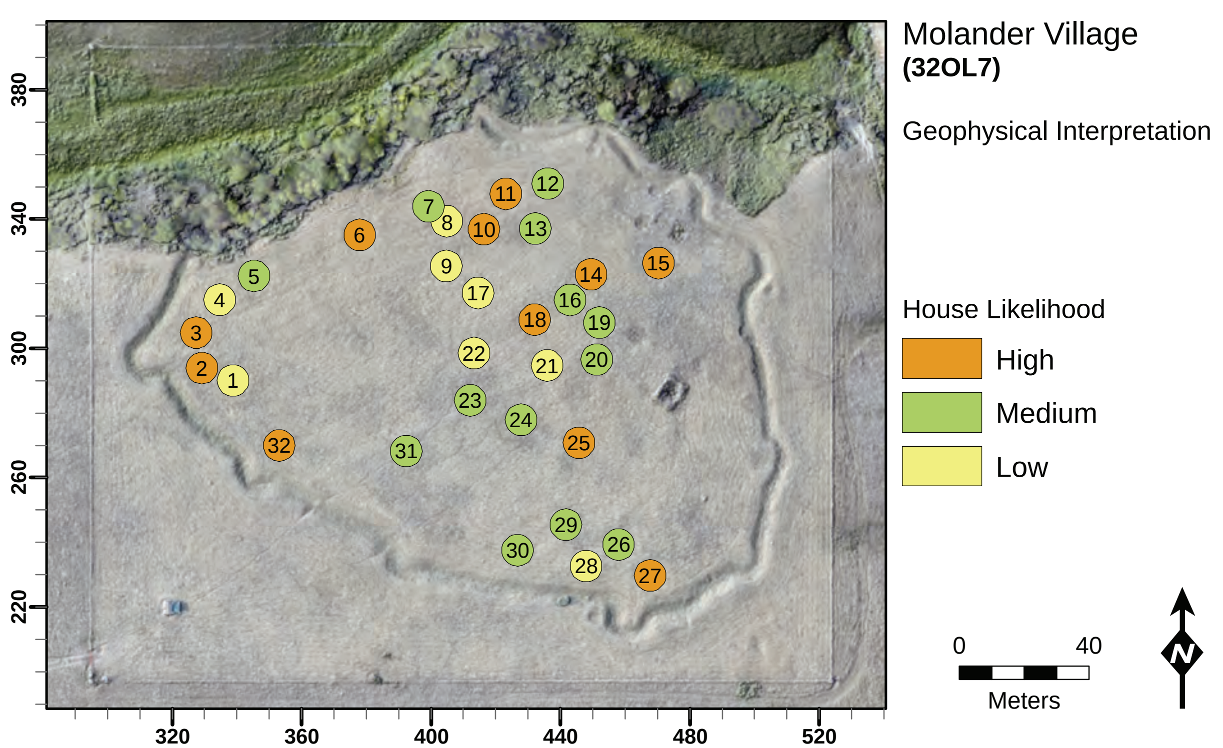

Figure 2.10. Map showing the locations of potential earthlodges identified in the analyses of geophyical, aerial, topographic, and historical map datasets (adapted from Kvamme 2018:Figure 18.)

Table 2.2. Maximum magnetic field strengths and spatial data on anomalies possibly representing hearths associated with houses (Kvamme 2018:Table 1).

			Primary Hearth Local Grid Coordinates		Alternate Hearth Local Grid Coordinates		
House	Hearth (nT)	Alternate Hearth (nT)	Easting	Northing	Easting	Northing	House Likelihood[a]
1	4.82		339.40	286.36			1
2	5.91		329.25	293.15			3
3	7.31	6.33	327.67	304.20	326.89	307.23	3
4	4.66		334.13	316.10			1
5	10.66	12.31	346.82	320.48	346.77	323.68	2
6	9.86		378.53	344.17			3
7	10.09		398.74	344.60			2
8	12.56		404.36	337.15			1
9	3.90	7.48	403.75	322.85	404.63	326.93	1
10	6.21	5.45	416.40	336.39	414.68	337.56	3
11	9.40	5.91	425.16	347.37	426.23	345.81	3
12	15.29[b]	8.35	437.13	350.37	435.45	351.14	2
13	5.01	4.41	432.19	336.17	430.40	337.39	2
14	14.75[b]	4.30	450.68	322.69	448.97	322.05	3
15	14.66[b]	6.73	470.80	326.35	469.66	324.87	3
16	8.16	5.10	443.91	314.12	442.86	314.94	2
17	5.82	6.58	414.44	317.17	414.35	316.12	1
18	13.65	4.04	431.63	308.37	429.44	309.10	3
19	5.86		454.14	308.83			2
20	8.60	8.48	450.17	295.65	449.82	294.94	2
21	9.03		426.79	293.72			1
22	11.97		409.26	296.54			1
23	6.43	7.24	415.69	284.39	417.88	284.23	2
24	9.54		428.24	278.94			2
25	6.63		444.88	271.12			3
26	2.44		461.48	238.37			2
27	6.17		469.376	229.66			3
28	7.48		446.89	232.68			1
29	18.25[b,c]	6.22	443.61	244.54	444.64	247.16	2
30	9.56	12.98	428.54	236.47	430.58	238.89	2
31	11.00[c]	8.44	390.86	266.07	394.12	265.89	2
32	6.00	5.04	358.64	276.39	352.64	271.14	3

[a] 1=low; 2=medium; 3=high.
[b] May include an iron artifact.
[c] Validated through coring.

a modest surface depression about a dozen meters in diameter, yielded startlingly clear GPR findings. The house is located on moderately sloping ground in the north-central portion of the village close to the outer fortification ditch, as is indicated by the DSM generated from aerial imagery (figure 2.11[a]). A diagonal scar across its surface suggests historic plowing in this area. Apparently, geological, moisture, or soil conditions were somewhat different at this location, and favorable to forming strong GPR reflections. The slope is somewhat lower in elevation and less than 40 m from a wetland and small creek to the north. Moreover, a soil conductivity survey of this 20 x 20 m block (indicated by the red polygon in figure 2.11[a]) reveals the presence of a likely paleochannel beneath it (figure 2.11[b]). The sediment below likely held greater moisture because soil conductivity was more than twice as great within the house as outside

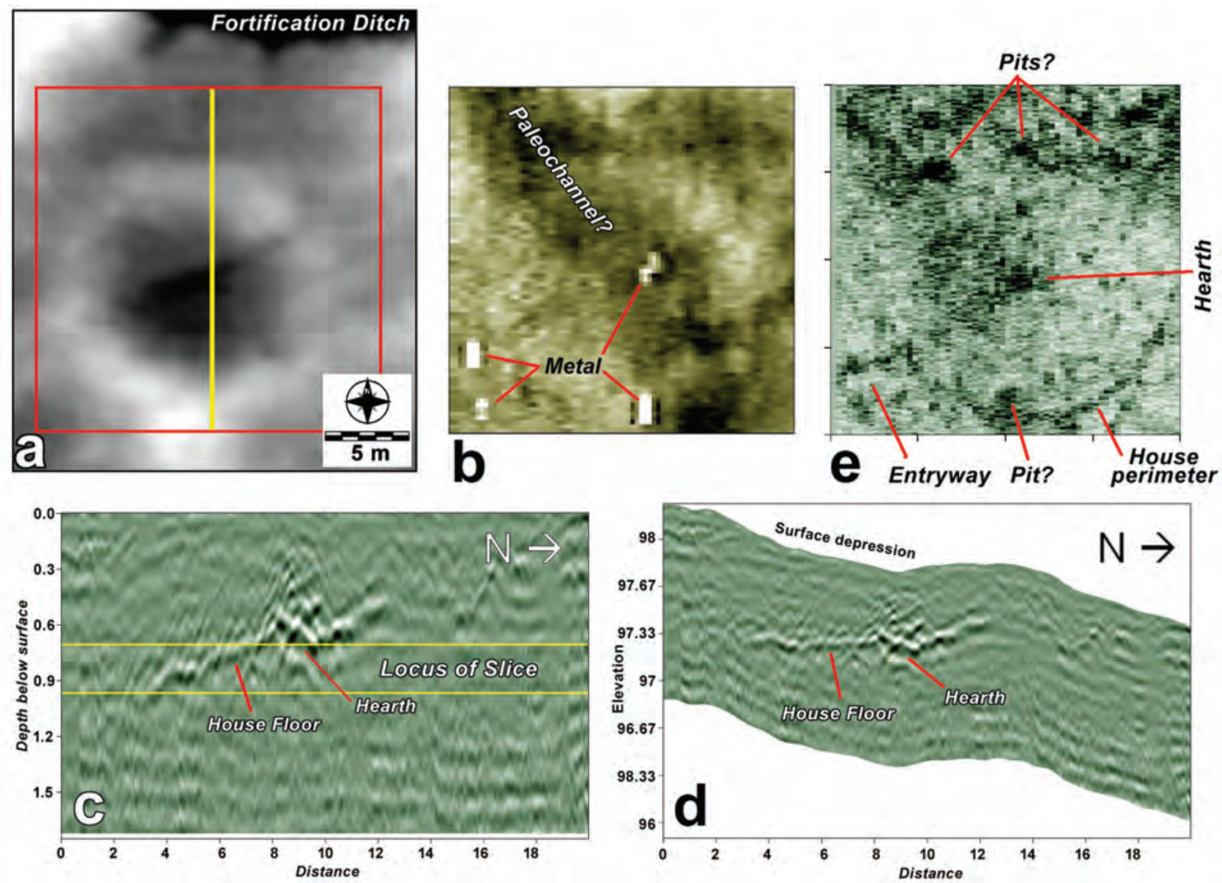

Figure 2.11. Surface, soil conductivity, and GPR findings for H11: a) surface depression indicated by a DSM with survey area in red, b) soil conductivity survey showing likely paleochannel (black high), c) initial GPR profile, d) terrain-corrected GPR profile, e) plan-view slice map across all uncorrected GPR profiles showing significant house features.

it, which likely contributed to the improved GPR response. A GPR profile (figure 2.11[c]), acquired at the position of the yellow line in figure 2.11[a], shows clear indications of a central hearth and house floor, tilted because of the sloping ground; the earthlodge is more deeply buried on its southern end. The elevations corresponding to this transect were extracted from the DSM to "terrain-correct" this profile (figure 2.11[d]). The shallow depression on the surface is visible and, more significantly, the house floor appears in its correct horizontal position.

Figure 2.11[e] illustrates a tantalizing composite which gives a partial plan-view map created by a thick "slice" across all 80 profiles in their original state—not terrain corrected—that cuts through the southern half of the house up to the central hearth, but which then "dives" below the floor, perhaps picking up deeper features, such as pits, to the north (the approximate locus of this slice is indicated in figure 2.11[c]. In the partial plan, the central hearth, perhaps a compacted work area near the hearth, part of the house perimeter, the southwest-facing entryway, and several possible storage pits may be visible. One thing can be immediately concluded from these data: the actual diameter of this house—close to 18 m—is much greater than its associated surface depression (about 12 m), a cautionary tale for future interpretations of house sizes from surface evidence.

2018 ERT Results

The results of the high data density ERT survey are promising. The topography of the profile line is displayed in figures 2.12 and the peaks of the house perimeter berms are at approximately 4 and 17 m. Between these two points is the interior of the earthlodge with the berm sloping down to the exterior away from each peak.

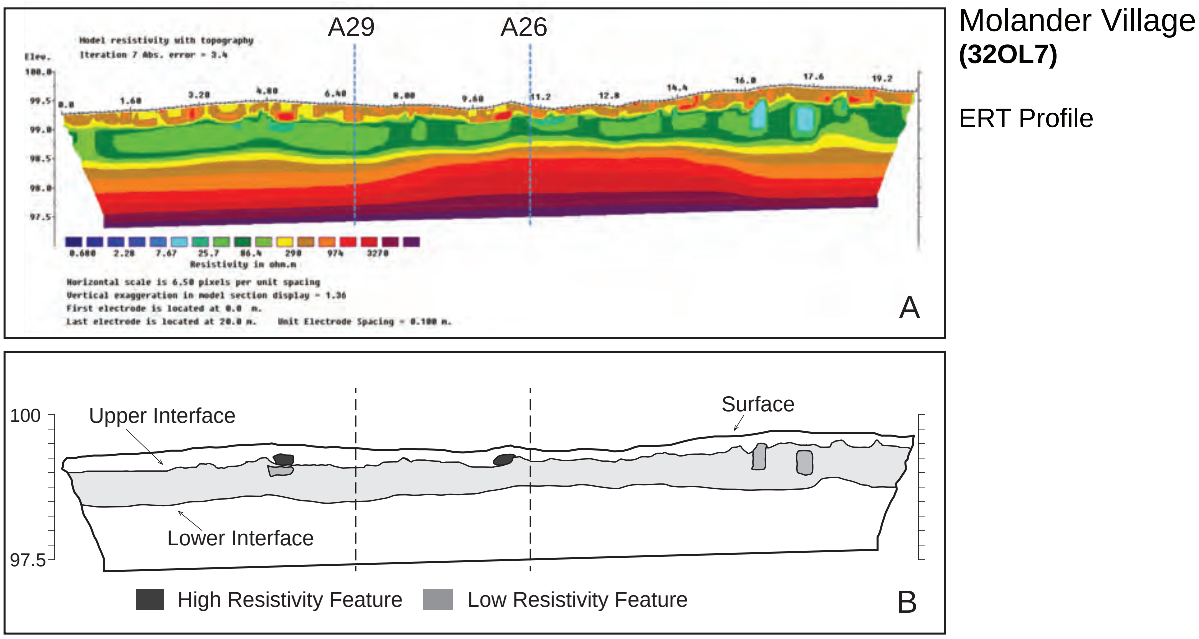

Figure 2.12. ERT transect resistivity data (a) and interpretation (b).

A strong interface is noted in the tomography model at approximately 0.5 m below surface across the entire profile line (the "upper interface" noted in figure 2.12[b]). This upper interface may be due to the high surface resistance experienced across the profile. Within this zone between the surface and the upper interface there are many zones of relatively higher resistivity. The majority of these are interpreted as recent rodent burrow activity which is noted in the data collection notes. On many occasions during data collection, the probe encountered little to no compaction when inserted indicating a near-surface void or rodent burrow. Such voids will produce an area of high resistivity in the modeling. However, it is interesting to note that the majority of these high resistivity features, which are abundant above the upper interface, do not extend below the interface, except for the areas near 5.0 m and 11.4 m. These two locations do have a relative low resistivity zone below the upper interface with the feature at approximately 5 m having an interesting high/low arrangement. In other surveys, these feature types have indicated a high resistance zone, such as a large stone or foundation, sitting immediately above a low resistance zone, such as a storage pit or construction trench.

A "lower interface" is identified at approximately 1 m below surface, with a zone of lower resistivity occurring between the upper and lower interfaces (generally displayed in green in figure 2.12[a]).

Perhaps the most interesting aspect of these results is the two low resistivity features located approximately 0.5 m below the surface near 16.2 m and 17.4 m along the profile line. These are shown in blue in figure 2.12[a] and outlined in figure 2.12[b]. Each is roughly rectangular in shape, oriented vertically, and spans approximately 1.0 m in depth (from 0.5m below surface to about 1.0 m below surface). This, combined with their location on the interior perimeter of the house, suggests that they may represent storage pits filled with loosely compacted sediment that retains moisture. This interpretation is supported by the absence of features immediately above them in the upper interface, indicating that they may be intact archaeological features rather than the result of intense rodent activity.

Recent Historic Component Inventory

Pedestrian survey undertaken in 2017 identified six features associated with the recent historic occupation (figure 2.13). The age of a seventh identified feature is unknown, although it may have been constructed after the site was acquired by the SHSND.

Feature 1 is the foundation of the original homestead (figure 2.14). It consists of stacked fieldstone (till) cobbles and boulders. Cement mortar was not observed on or between the stones. The foundation's long axis is oriented to the northeast. The

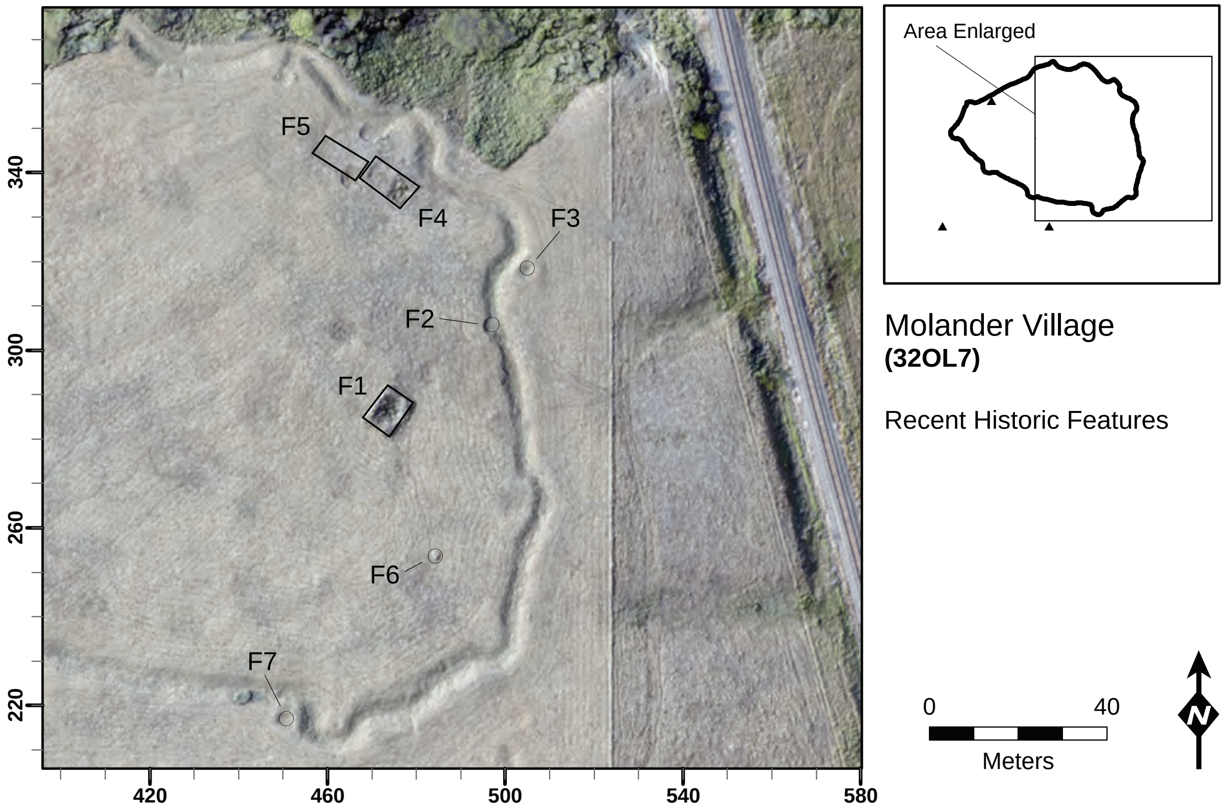

Figure 2.13. Map showing the locations of recent historic features documented in 2017.

door likely was positioned on the southeast-facing elevation. The upper courses of the foundation have fallen; however, the building's original dimensions were approximately 8.5 m southwest-northeast by 7 m southeast-northwest. Inside the foundation is a pit approximately 1.5 to 2 m deep, suggesting that the structure originally incorporated a low cellar for storage. Interior partitions are absent, likely indicating that the structure consisted of a single room.

Only fragments of the building's superstructure remain; however, several wall logs exhibiting dovetailed corner joins are preserved. Both wire and cut nails are present, which suggests that at least portions of the building were repaired or modified after its original construction.

Feature 2 is a dense surface scatter of late nineteenth- and early twentieth-century artifacts measuring approximately 6 m north-south by 4.5 m east-west. Feature 2 primarily occurs within the Plains Village-age fortification ditch. Artifacts present within Feature 2 consist primarily of domestic items.

Feature 3 is a well-defined circular pit roughly 3 m in diameter and 60 cm deep located roughly 40 m northeast of Feature 1 and immediately outside the village fortification. Magnetic data indicate that numerous iron artifacts occur within and around the pit and hand coring demonstrated that it is filled with recent historic artifacts.

Feature 4 is the foundation of an outbuilding located about 40 m north of Feature 1. (figure 2.15.) The long axis is oriented to the west-northwest. The building's overall original dimensions were about 6.5 m on the short axis and 11.5 m on the long axis. The foundation's western half consists primarily of a graded or cut surface measuring about 6 m on each side. A continuous line of large stones occurs on the western side and a smaller number occur on the northern side; these likely represent an informal foundation. The eastern half consists of a shallow pit surrounded by foundation stones that measures roughly 4.5 m by 6 m. A raised berm roughly 1 m wide between the two halves of Feature 4 may represent a breezeway. Alternatively, the western half may have been a corral or fenced area attached to a more substantial structure represented by the stone-lined pit. No traces of the building's superstructure remain. Artifacts associated with Feature 4 include window glass and fragments of one or more cast-iron vessels.

Figure 2.14. Photograph of Feature 1; view to the northeast.

Figure 2.15. Photograph of Feature 4 (foreground) and Feature 5; view to the northwest.

Feature 5 is a graded area or slope cut that measures approximately 5 m southwest-northeast by 11.3 m southeast-northwest and is located immediately west of Feature 4. No foundation stones were observed; Feature 5 may represent a corral. A possible borrow pit occurs in the southeast corner of Feature 5. Another broad, shallow pit occurs about 4 m northeast of the northern wall.

Feature 7 is a well-defined circular pit similar in size and morphology to Feature 3. It is located about 70 m south-southwest of Feature 1. Magnetic data indicate that numerous iron artifacts occur within and around Feature 7. Coring revealed the presence of decomposing wood in the fill, along with recent historic artifacts. Feature 7 may represent the location of a privy.

Feature 6 is a metal fire grate set on an oval arrangement of 13 fieldstone cobbles. Two additional large cobbles have been placed over the grate. The overall dimensions of Feature 6 are 1.7 m north-south by 1.4 m east-west; the grate itself measures 75 by 40 cm. No recent historic artifacts were observed in association with Feature 6, which is located 30 m south-southeast of Feature 1. Feature 6 may have been built for recreational use after the site was acquired by the SHSND.

Figure 2.16 summarizes data on the recent historic component and illustrates relationships between the features recorded in 2017 and data from maps of the site prepared in by Lewis in 1883 and Will in 1924. The extent of the late nineteenth- and early twentieth-century occupation is clearly visible in the magnetic data (figures 2.7 and 2.8). Dipolar anomalies produced by surface and near-surface iron artifacts occur primarily in the eastern quarter of the site. Virtually all the iron artifacts on site were deposited after the homestead was constructed in 1882. The concentration of metal artifacts shown in figure 2.16 is approximately conterminous with a zone of higher reflectivity likely indicative of surface erosion that is visible in an air photo of the site likely taken in 1938 (Johnson 2007:Figure 31[e]).

Magnetic data in combination with the DSM provide additional information about the site's recent historic occupation. A portion of an access road is visible in the magnetic data, beginning just outside the southwest arc of the fortification ditch and extending east-northeast for approximately 50 m. A different access road was mapped by Will in 1924; both are visible in the 1938 air photo. The approximate extent of plowing within the fortification ditch is indicated in the magnetic data by lines of low-intensity monopole anomalies oriented toward the northeast was well as shallow linear surface features. The area outside the fortification does not appear to have been plowed.

Resistivity data collected in 2017 revealed a rectangular anomaly measuring roughly 6 m long and 4 m wide located northeast of the interpretive panel kiosk and well outside the village fortification ditch. Its size and shape suggest some sort of historic construction adjacent to a cattle trail visible in the DSM and in a 1960s aerial image. The magnetic data gives hints of two sides of this feature and reveals the presence of a large monopolar anomaly in excess of 20 nT. This intensity value is large for village-age pits.

Figure 2.16 also illustrates the locations of structures that were not recognized during the 2017 inventory. Will's 1924 map shows the locations of two structures not mapped in 2017, one north of the homestead and one south. Lewis also mapped the structure south of the homestead in 1883.

Hand Coring Results

A total of 148 Oakfield core samples were taken in 2017 and 2018 (figure 2.17). In 2017, 53 cores were taken from 38 magnetic anomalies and two small surface depressions. An additional 17 cores were

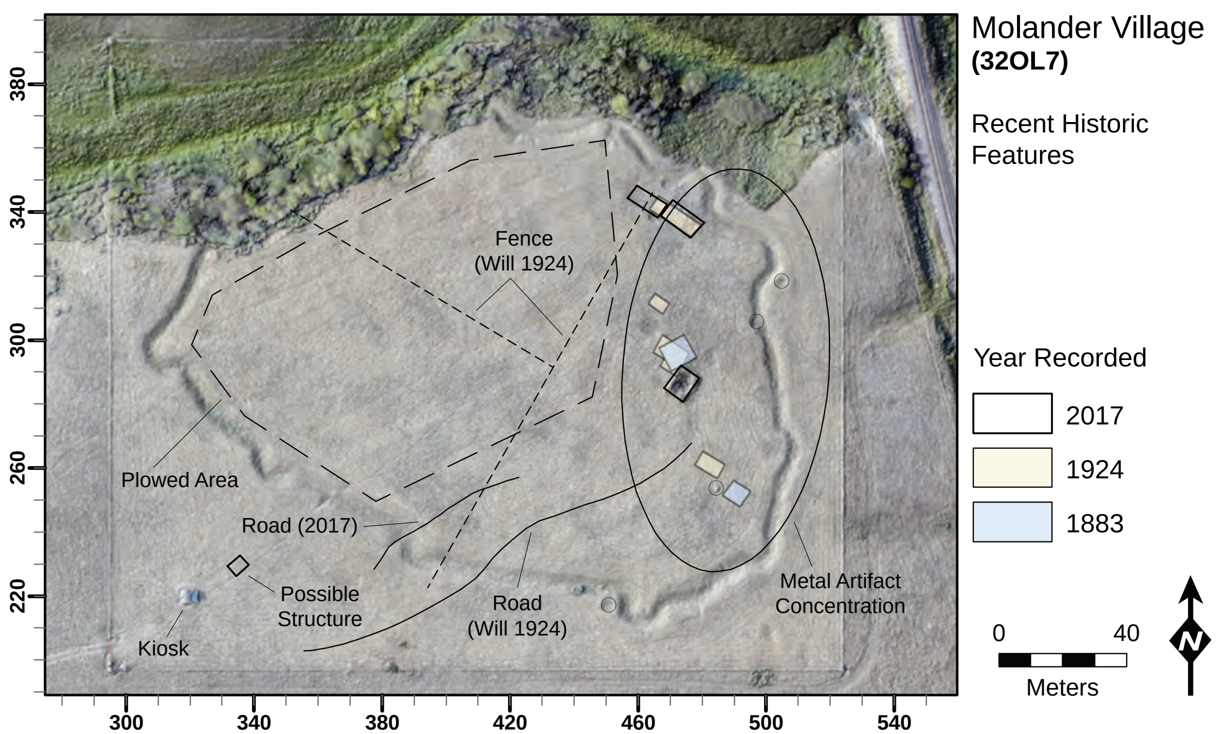

Figure 2.16. Map summarizing the distribution of recent historic features.

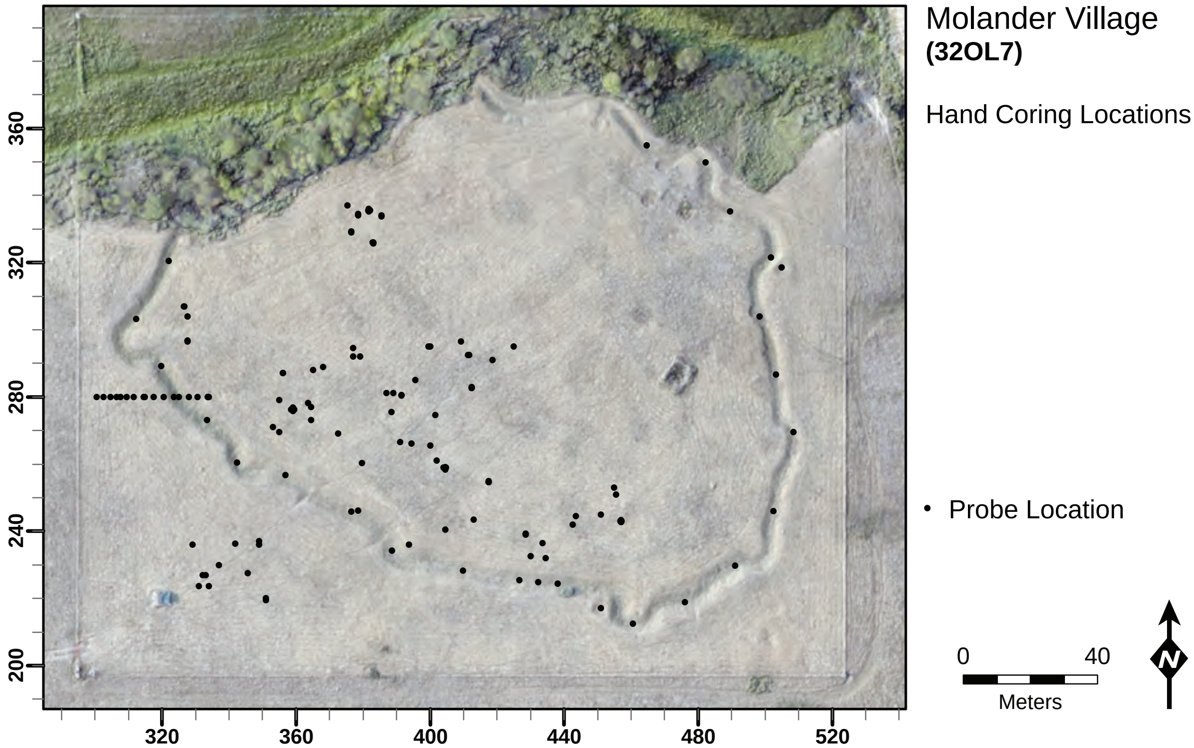

Figure 2.17. Map of 2017 and 2018 hand coring locations.

taken from an east-west transect that spanned the fortification ditch. In 2018, 55 cores were taken from 21 magnetic and 2 GPR anomalies. Two of the 21 magnetic anomalies investigated in 2018 were also sampled in 2017. In addition, 23 cores also were taken from the fortification ditch at approximately 20-m intervals. Appendix C provides spatial and other data on the core samples.

Among the 61 different point locations sampled, two were pits associated with the recent historic occupation, six were hearth features or probable hearth features, 14 were pits, 11 were possible or probable pits, and two were large boulders (table 2.3). The source of the local magnetic anomaly could not be determined in 26 locations, although four of these may have been glacial cobbles or boulders.

The primary goal of the coring program was to identify suitable locations for archaeological testing. Table 2.4 provides coring data on the four anomalies selected for testing.

Coring data on the six certain or probable hearths also provide information about the depths of earthlodge floors or outdoor work areas as well as the effects of plowing on the site's archaeological deposits. Compact white ash deposits were observed in four of the six hearth or probable hearth cores; the upper surface of the ash may represent the top of the hearth fill and therefore the likely depth of the associated earthlodge floor or exterior work surface. The mean depth of the top of the ash in the four cores was 24 cm below surface, with a range of 18 to 30 cm. Oxidized sediment, representing the base of the feature, was observed in all six cores. The mean depth of the top of the oxidized layer was 41 cm, with a range of 36 to 45 cm. Moldboard plows commonly used in the late nineteenth and early twentieth centuries produced a plowzone up to about 30 cm thick (e.g. O'Neal and Lowery 2017). Aeolian erosion may have removed sediment from the site surface while the site was under cultivation. The coring data therefore suggest that on average at least 24 cm of sediment accumulated on earthlodge floors or exterior work areas following the occupation. The absence of intact ash deposits may indicate that plowing has impacted those floors or work areas in some portions of the site.

Coring Transect

A transect consisting of 17 probes was placed across the fortification ditch along the 280N line, from E300.50 outside the ditch to E334 inside the ditch (figure 2.18; table 2.5). Probe spacing varied from

Table 2.3. Summary data on magnetic anomalies and other features investigated by hand coring.

Anomaly No.	Interpretation	Magnetic Intensity (nT)	Anomaly Description[a] and Other Data
2017-1	No feature; boulder?	28.8	V. large outside ditch; possibly large boulder(s)
2017-10	Hearth	6.0	Very amorphous
2017-11	No feature	20.6	Amorphous, large
2017-12	No feature	15.8	
2017-13	Probable pit	14.4	Amorphous
2017-14	No feature	5.0	Small, amorphous; core off center
2017-15	No feature	8.9	Slightly amorphous; core off center
2017-16	No feature	10.0	Broad anomaly
2017-17	No feature	11.7	Broad anomaly
2017-18	Possible pit; boulder?	23.4	Large symmetrical; core off center
2017-19	No feature	7.1	Compact; good definition
2017-2	No feature	13.8	Slightly amorphous; core off-center
2017-20	Historic pit	84.9	Dipoles
2017-21	Historic pit	101.3	Dipoles
2017-22	Pit or ditch fill	17.7	Very well-defined anomaly
2017-23	Hearth; possibly over pit	18.2	
2017-24	Possible pit	8.0	Rodent disturbance
2017-25	Pit	15.3	Many artifacts
2017-26	Pit	17.7	Slightly amorphous
2017-27	Possible pit	16.8	Slightly amorphous
2017-28	Hearth	15.9	Compact; good definition
2017-29	Pit	18.2	Few artifacts
2017-3	No feature	17.3	Core off-center
2017-30	Hearth?	24.3	Small, compact
2017-31	Possible pit	8.4	Slightly amorphous
2017-32	Hearth	10.7	Compact; good definition
2017-33	No feature	5.6	Small; core off center
2017-34	No feature	19.7	Amorphous, possible dipole
2017-35	No feature	6.8	
2017-36	No feature	10.3	Amorphous
2017-37	No feature	14.2	Very compact
2017-38	No feature	12.1	Slightly amorphous
2017-39	Rock	6.3	Very amorphous
2017-4	No feature; boulder?	24.5	Large anomaly outside ditch; possibly boulder
2017-40	Pit	13.0	Many artifacts
2017-5	No feature	6.0	Slightly amorphous
2017-6	Probable pit	9.2	Slightly amorphous
2017-7	No feature	15.3	Amorphous; core off center
2017-8	Possible pit	20.9	Compact; good definition
2017-9	No feature	22.5	Slightly amorphous; core off-center
2018-1	No feature	7.3	Slightly amorphous
2018-10	Pit	15.3	Same as 2017-25
2018-11	No feature; boulder?	21.4	Small, compact
2018-12	Possible pit	22.1	Compact
2018-13	No feature	11.5	
2018-14	Pit	18.2	Compact; pit probably sediment filled
2018-16	Possible pit	15.7	Very compact; shallow pit
2018-18	Pit	21.1	
2018-19	Pit	7.7	Compact

Table 2.3. Summary data on magnetic anomalies and other features (*continued*).

Anomaly No.	Interpretation	Magnetic Intensity (nT)	Anomaly Description[a] and Other Data
2018-20	Pit	8.5	Amorphous; sediment filled
2018-21	Possible pit	7.9	Compact; outside fortification
2018-22	No feature; boulder?	9.9	Amorphous
2018-26	Hearth	9.9	
2018-29	Pit	7.0	Small; shallow rock filled
2018-30	Pit	5.7	Sediment filled
2018-31	Pit	7.2	Sediment filled
2018-33	Pit	n/a (GPR)	Amorphous in magnetic data
2018-34	Possible pit	n/a (GPR)	Amorphous in magnetic data
2018-4	Pit	6.3	Small; pit is probably sediment filled
2018-6	Pit	13.0	Same as 2017-40
2018-7	Boulder?	9.8	Small
2018-8	No feature	14.2	Compact
2018-9	No feature	9.1	Small, compact

[a] All anomalies are monopoles unless otherwise indicated.

Table 2.4. Hand coring data for excavated magnetic anomalies.

				Local Grid Coordinates			
Block	Year	Anomaly No.	Core No.	Northing	Easting	Maximum Depth (cm)	Reason for Termination
2	2017	2017-25	56	243.00	457.00	50	Rock?
	2017	2017-25	57	243.20	457.00	101	End of probe
	2018	2018-10	10	243.00	457.00	111	Rock
	2018	2018-10	10.1	243.00	457.25	29	Compact
	2018	2018-10	10.2	243.00	456.75	46	Compact
	2018	2018-10	10.3	242.75	457.00	30	Compact
3	2018	2018-18	18	259.00	404.50	20	Rock
	2018	2018-18	18.1	258.75	404.50	25	Rock
	2018	2018-18	18.2	258.75	404.25	7	Rock
	2018	2018-18	18.3	259.25	404.50	7	Rock
	2018	2018-18	18.4	259.00	404.75	52	Rock
	2018	2018-18	18.5	258.50	404.50	33	Rock
	2018	2018-18	18.6	259.00	404.00	127	Sterile
4	2017	2017-40	74	282.50	412.50	113	Rock
	2018	2018-6	6	282.50	412.50	107	Compact
	2018	2018-6	6.2	283.00	412.50	77	Compact
5	2018	2018-29	29	335.50	381.75	38	Rock
	2018	2018-29	29.1	336.00	381.75	102	Sterile
	2018	2018-29	29.2	335.25	381.75	44	Rock
	2018	2018-29	29.3	335.50	381.50	72	Sterile
	2018	2018-29	29.4	335.50	382.00	44	Rock

two to three meters. Outside the ditch, the depth of cultural deposits varied significantly, from a few centimeters to as much as 63 cm. A large trash-filled pit was also encountered outside the ditch, which extended to a depth of approximately 130 cm (Core 3 at E304.5). The depth of fill within the ditch was at least 58 cm (Core 13 at E325.0).

A buried soil was recognized in five cores. The depths suggest that a single prominent paleosol occurs in this part of the site.

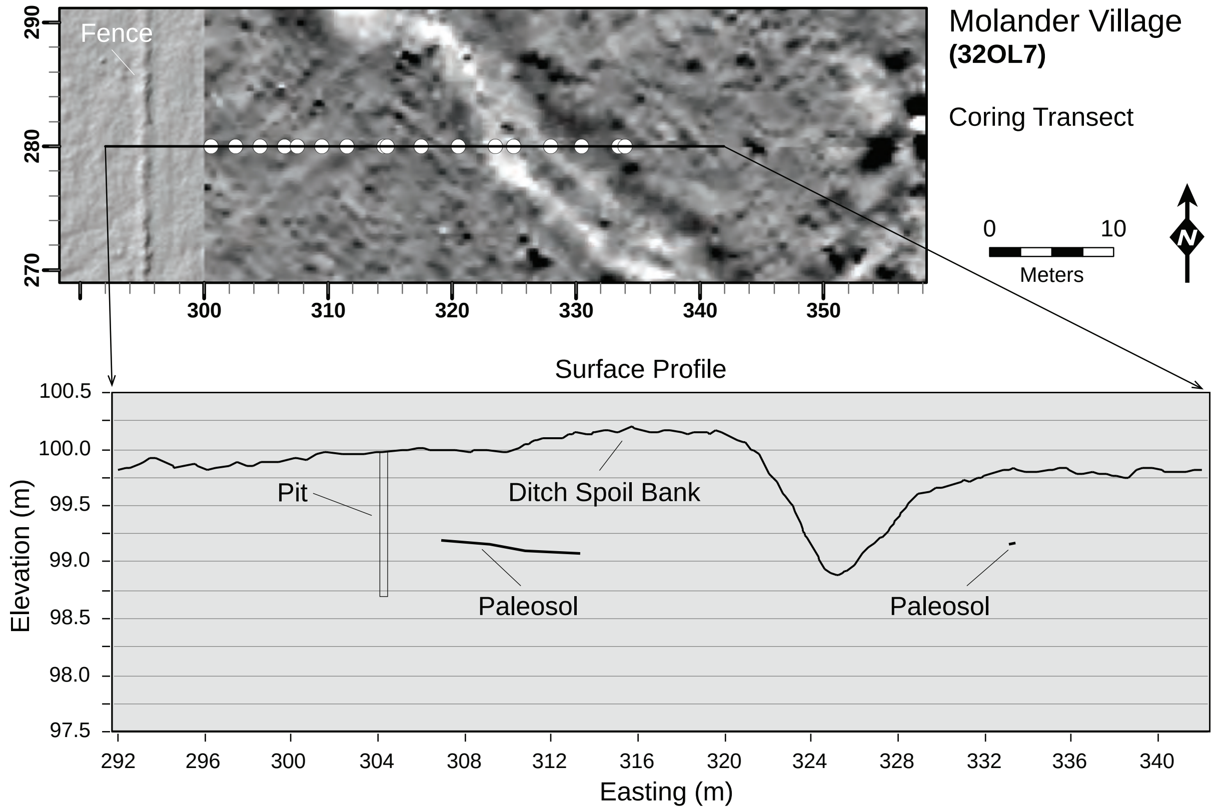

Figure 2.18. Map and profile of the coring transect along the 280N grid line. Upper panel shows probe locations (white circles) superimposed on the magnetic gradiometer data; lower panel shows surface (with vertical exaggeration) and subsurface data.

Table 2.5. Subsurface data from the 280N probe transect.

Core No.	Easting	Depth of Cultural Deposits (cm)	Maximum Depth (cm)	Reason for Termination	Depth of Paleosol (cm)
1	300.50	12	50	Complete	
2	302.50	2	57	Complete	
3	304.50	130	130	Base of pit or obstruction	
4	306.50	22	22	Rock or compact sediment	
5	307.50	44	90	Complete	77-83
6	309.50	36	87	Complete	75-87
7	311.50	63	95	Complete	84-95
8	314.50	13	13	Rock or compact sediment	
9	314.75	59	92	Complete	86-92
10	317.50	40	40	Rock or compact sediment	
11	320.50	21	21	Rock or compact sediment	
12	323.50	55	92	Complete	
13	325.00	58	58	Rock (ditch floor?)	
14	328.00	55	65	Complete	
15	330.50	25	33	Complete	
16	333.50	10	10	Rock	
17	334.00	36	67	Complete	61-67

Fortification Ditch

Cores were taken from 23 points along the centerline of the ditch at approximately 20-m intervals along its length. The goal was to estimate the current depth of cultural deposits within the ditch and to identify variations in the depth of those deposits that might point to differential formation processes, including recent disturbance. The maximum depth of the ditch cores ranged from 47 to 119 cm, with a mean depth of 75.1 cm. Unfortunately, in most cases the reason that the core was terminated was not recorded. The maximum core depth could therefore reflect either the extent of cultural materials or the depth of an obstruction, such as an artifact or an especially compact stratum, that prevented further penetration of the probe. However, based on three cases where the fill depth was explicitly recorded, the mean maximum depth of cultural deposits within the ditch is 100.5 cm. The DSM further suggests that the depth of fill within the ditch is relatively uniform.

Excavation Results

The research team opened a total of 16 1 x 1-m excavation squares, partitioned into five blocks distributed across the site (figure 2.19). A total of 15 cultural features were identified and sampled, including eight pits, two post molds, three hearths or surface burns, a rock pile, and the surface-visible

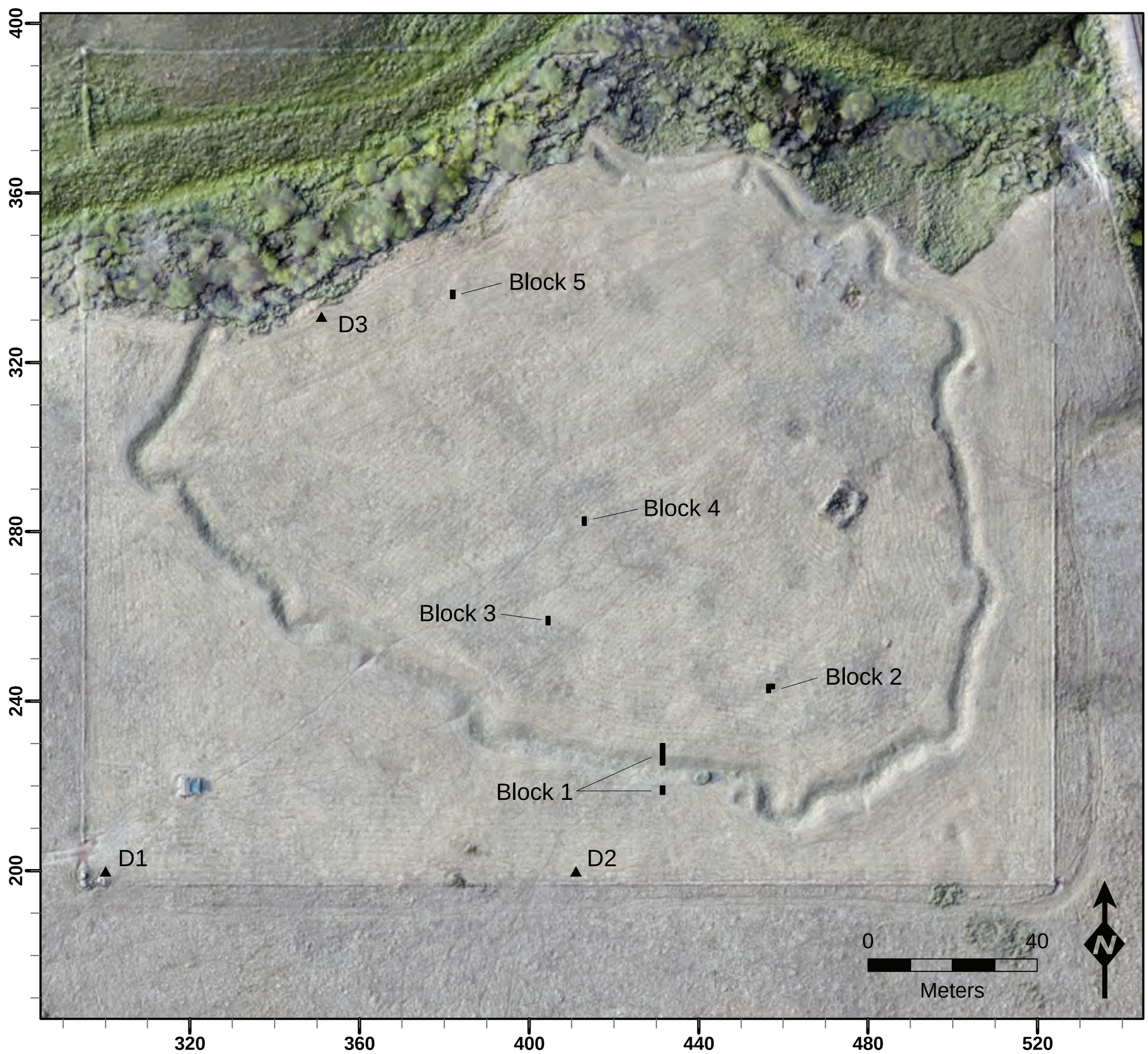

Figure 2.19. Map showing the locations of the 2018 excavation blocks.

fortification ditch. A total of approximately 6,160 liters of sediment was excavated and processed. Table 2.6 provides spatial and other data on each of the excavation units. Artifacts were collected under a total of 89 field-assigned catalog numbers, including 74 waterscreen lots, 13 piece-plotted specimens, and two bulk sediment samples.

Block 1 (Units 1, 4, 7, 11, 14, 15, and 16)

Block 1, located on the southern edge of the site, was opened to investigate the size, morphology, and construction history of the settlement's fortification ditch. At this location the ditch is relatively straight and is approximately aligned with the site grid. The exterior spoil bank is also prominent and well-defined. In addition to gathering basic data on the ditch's size and shape, the primary question of interest was whether the fortification was constructed when the village was founded or was added later, after the village had been occupied for some time. The team also wanted to know whether the ditch fill had been disturbed during the twentieth century and to gather data on the position and construction method of the log palisade.

The block comprised seven excavation squares, including two on the village-side of the ditch, three within the ditch itself, and two on the spoil bank outside the ditch (figure 2.20). Five contiguous squares forming a 1 x 5-m trench extended from the approximate centerline of the ditch northward into the village. The remaining two units were located outside the ditch and were separated from the southern end of the 1 x 5-m trench by a 5-m gap. Each of the seven squares was excavated separately, primarily in 10-cm-thick arbitrary levels aligned to common site-grid elevations.

Excavation in Block 1 began in Units 1 and 4 outside the ditch (figure 2.21). The first few centimeters below the sod contained pottery sherds, stone tools, and animal bones. A small number of unidentifiable recent metal fragments occurred within this apparently intact village-age deposit. Beneath that veneer of silt was a thick deposit of glacial till consisting of sand, gravel, cobbles, and boulders that had been displaced from the bottom of the ditch. The base of the displaced till contained fewer large stones, suggesting that it represented loess that had capped the intact till deposit prior to the excavation of the ditch. However, the limited thickness of this displaced loess suggests that the upper portion of the ditch fill is mostly not present in the exterior spoil bank. Only a small number of artifacts were present within the till deposit; none were of recent manufacture.

Table 2.6. Excavation unit data.

Block Number	Unit Number	SW Corner Coordinate	Local Datum Elevation (m)	Number of General Levels	Identified Features	Excavation Volume (Liters)
1	1	219NE431	99.30 (A)	6	-	584
	4	218NE431	99.30 (A)	6	-	588
	7	229NE431	98.90 (D)	5	F2	449
	11	228NE431	98.90 (D)	4	-	350
	14	225NE431	98.70 (F)	2	F12 (Ditch)	575
	15	226NE431	98.70 (F)	-	F12 (Ditch)	43
	16	227NE431	98.70 (F)	3	F12 (Ditch)	298
2	5	243NE456	98.30 (C)	3	F7	427
	6	243NE457	98.30 (C)	3	-	248
	8	242NE456	98.30 (C)	3	F7	383
3	9	258NE404	99.10 (E)	2	F5, F9, F13[a], F15[b]	392
	10	259NE404	99.10 (E)	2	-	114
4	2	281.5NE412.5	98.90 (B)	2	F1, F3, F4, F6	456
	3	282.5NE412.5	98.90 (B)	3	F3, F4, F6	473
5	12	335NE381.5	99.60 (G)	3	F10, F14[a]	327
	13	336NE381.5	99.60 (G)	3	F11, F16[a]	452
Totals	16	-	-	50	15	6,160

[a] Not excavated separately.
[b] Not excavated.

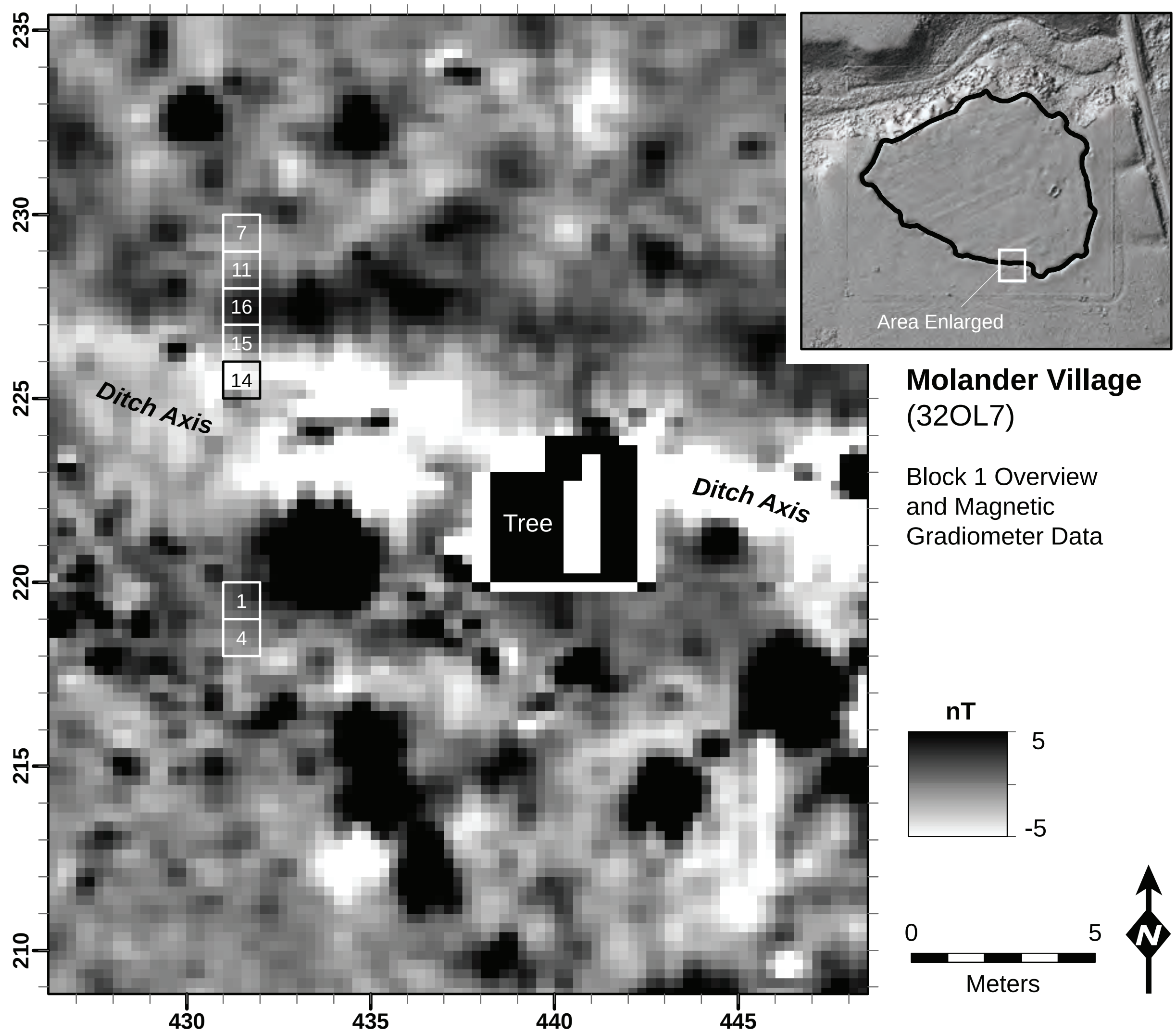

Figure 2.20. Map showing the location of Block 1.

An intact, pre-village A horizon was preserved below the displaced loess and till (figure 2.22). Excavation of GL4 ceased at the contact between displaced sediment and the intact A horizon, at an elevation of about 98.73 m. Knife River flint (KRF) flaking debris recovered from GL4 mostly is not patinated, suggesting that a few Plains Village-age artifacts were deposited on the pre-village surface prior to the excavation of the ditch. Plains Village pottery also occurred in GL4 (50-55 cm DD) and GL5 (55-70 cm DD). A single size grade 5 fragment of probable Plains Village-age metal also occurred in GL4.

Flaking debris occurred in GL5 (55-70 cm DD) and GL6 (70-80 cm DD); however, all but one of the KRF flakes recovered from these levels is patinated, suggesting that they represent a Woodland or Archaic occupation. A small number of Plains Village sherds were recovered from GL5, but none were recovered from GL6.

Krotovina were present but not especially abundant in the pre-village soil horizons, suggesting only limited animal burrowing occurred before the displaced loess and till was deposited. Excavation in Units 1 and 4 stopped at the base of GL6 (98.50 m).

Figure 2.23 illustrates a modern surface profile along the E432 grid line (the east side of the Block 1 excavation units), from 205N (outside the ditch) to 235N (inside the village). For clarity, the vertical dimension is exaggerated by about 600 percent. The dark dashed line on the left side of the illustration shows the elevation of the pre-village soil surface

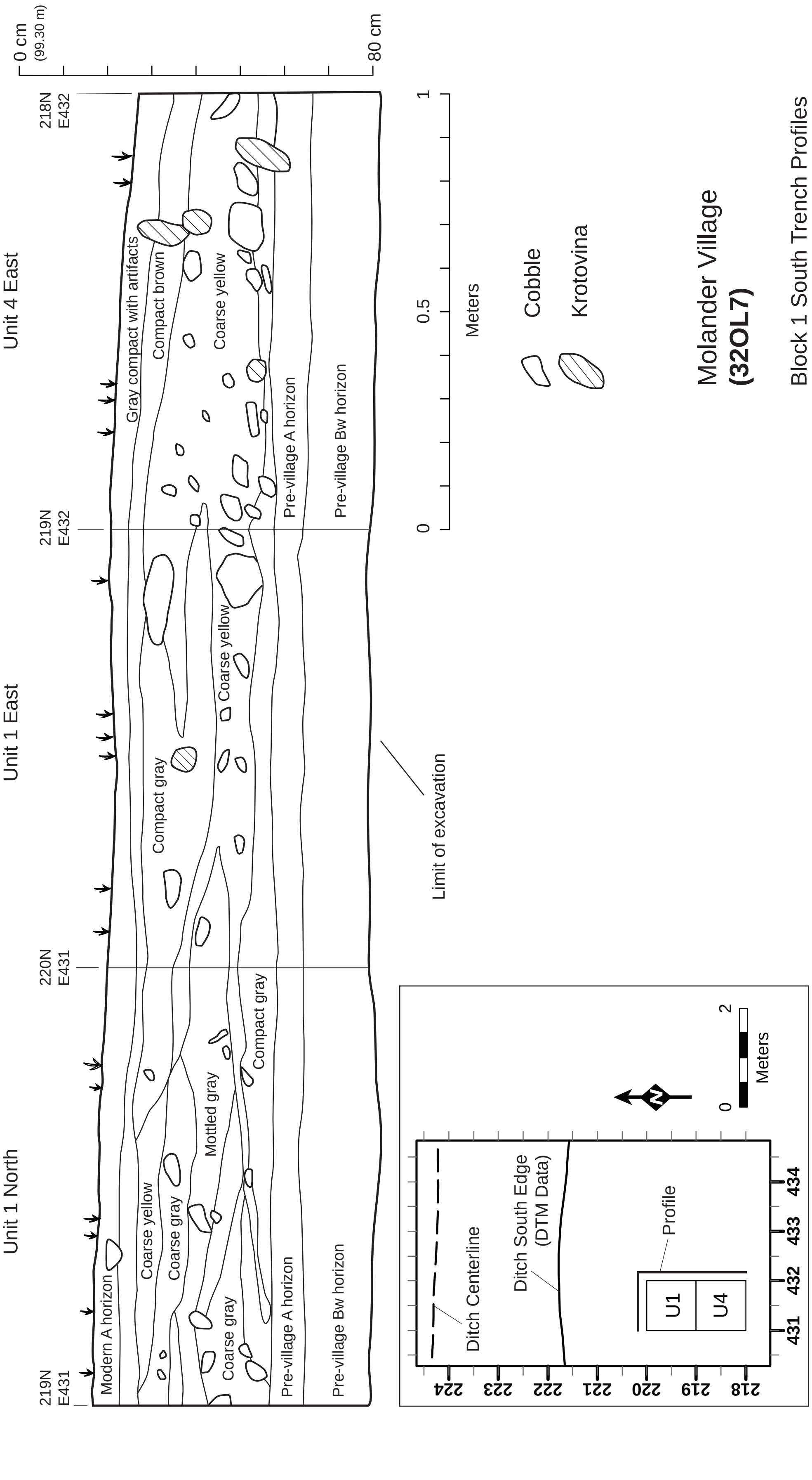

Figure 2.21. Profiles of Units 1 and 4 in Block 1.

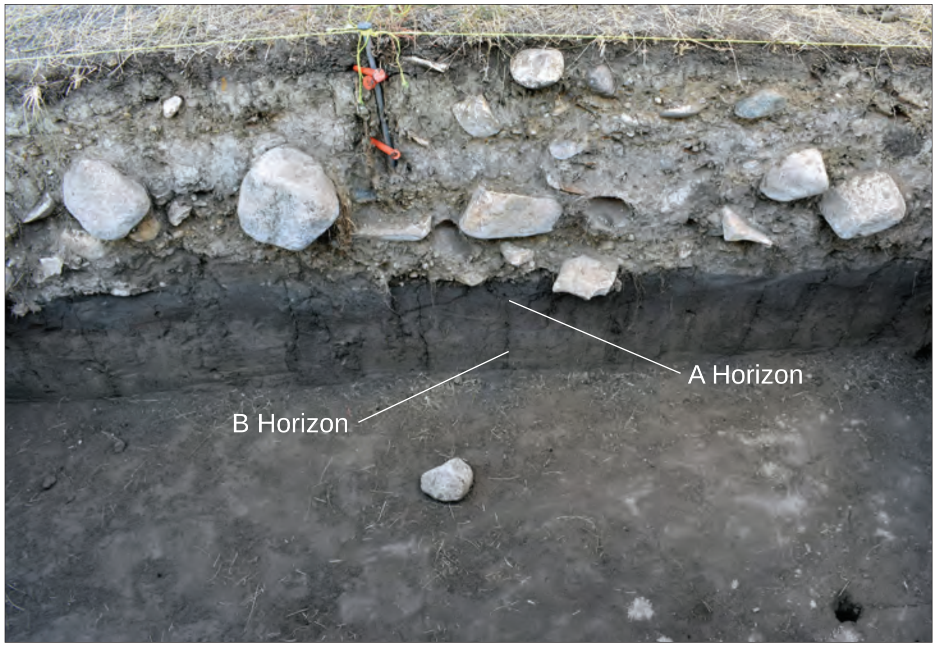

Figure 2.22. Photograph of the west elevation of Units 1 and 4 showing displaced till overlying the pre-settlement soil.

(98.73 m) preserved beneath the ditch spoil bank. (The surface buried by the ditch spoil merges with the modern surface south of the spoil bank.) The light dashed line on the right projects the pre-village ground surface northward into the settlement. (As noted in the "Site Setting" section, the upper surface of the T3 terrace dips to the east but is level to the north.) These elevation data, combined with the digital model of the site surface, demonstrate that the pre-village soil surface has been stripped away across much of site.

Coring below the limit of hand excavation (98.50 m) in Units 1 and 4 revealed the presence of a buried soil some 66 cm below the pre-village surface. Coring also demonstrated that the loess deposit overlying the till extends to a depth of at least 145 cm (the length of the available coring tool) below the pre-village surface. By contrast, the estimated original depth of the upper surface of intact till deposits exposed in the north wall of the fortification ditch was roughly 75 or 80 cm. This difference suggests that the upper surface of the till was uneven or hummocky.

Excavation in Block 1 also occurred in a 1 x 5-m trench within and north of the surface-visible ditch, which was designated Feature 12 (figure 2.24). The southern end of the trench exposed a portion of the ditch wall and fill, while the northern end exposed midden deposits and soil horizons located within the village. As noted above, the original pre-village ground surface is not preserved on the village side of the ditch. However, intact B horizon sediment was observed at the upper edge of the ditch in Unit 15 at about 226.35N and an elevation of 98.42 m; this sediment represents the original inside edge of the ditch. The interior wall of the ditch varied in slope from about 20 to 50 degrees; the lower of those two angles occurs above the contact between the loess deposit and the underlying till deposit, the latter of which was more difficult for the ditch-diggers to excavate. The bottom of the ditch was approximately flat, although only a small portion was exposed in Unit 14.

Multiple lines of evidence are needed to estimate the original width and depth of the fortification ditch, including elevation data from the DSM, excavation profile data, and coring data. Two width estimates can be made. The distance from the point at which the pre-village soil surface intersects the south wall of the ditch (estimated from the GIS) to the north wall of the ditch visible in the Unit 15 profile is 4.05 m (222.3N to 226.35N). Alternatively, the distance from the estimated centerline of the ditch at 224.75N (about 25 cm outside the south wall of Unit 14) to the north wall of the ditch is about 1.6 m (224.75N to 226.35), which yields an estimated overall width of 3.2 m. The mean of these two values is 3.63 m.

The bottom of the ditch in Unit 14 occurred at an elevation of 97.48 m or 125 cm DD. As discussed previously, the observed elevation of the pre-village soil was 98.73. Thus, approximately 1.25 m of

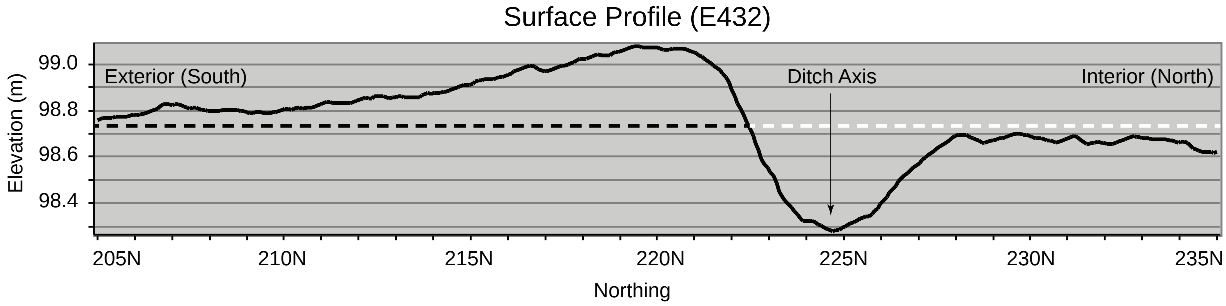

Figure 2.23. Surface profile along the E432 grid line showing the elevation of the pre-settlement surface.

sediment was removed to build the ditch. However, the final effective depth of the ditch was greater than that on the south (outside), owing to the emplacement of lower ditch fill in the spoil bank, and smaller on the north (inside), owing to surface stripping. The effective depth of the ditch on the outside was about 1.57 m (99.05 to 97.48 m). The effective depth on the inside was about 0.94 m (98.42 to 97.48 m).

Numerous discrete strata, which ranged in thickness from 6 to 14 cm, occurred within the ditch. The uppermost, which occurred only in the lowest portion of the ditch swale, consisted of platy gray sediment indicative of periodic ponding. Beneath that was a thick brown compact silt layer containing numerous recent metal and glass artifacts (post-1882) along with village-age artifacts; this stratum may represent a recent deposit or may simply reflect intense near-surface bioturbation. The next stratum, the lowest recent historic artifacts, likely represents a village-age deposit into which recent artifacts have been introduced by burrowing animals. The lowest 50 or 55 cm of ditch fill consisted of silt strata 2 to 10 cm thick containing bison bones, stone tools, pottery, and other village-age items and lacking recent historic artifacts.

The thickness and lateral extent of the village-age fill deposits in the ditch suggests periodic dumping of sediment and domestic trash by community residents, rather than incremental infilling by natural processes. It can be inferred, based on the character of the fill deposits and the distribution of recent historic artifacts, that the ditch was filled approximately to its current depth during the settlement's period of occupation.

Thin cultural deposits immediately north of the ditch in Unit 15 consisted of mottled gray-brown sediment containing rip-up clasts that likely represent sediment excavated from the ditch during construction. These deposits lay directly on intact but truncated B horizon sediment. Somewhat thicker midden deposits occurred in Units 7, 11, and 16. These deposits consisted primarily of mottled to gray compact silt containing rip-up clasts and relatively few artifacts. Recent historic artifacts including glass bottle fragments, chunks of concrete, scraps of rubber or rubberized fabric, coal, and recent iron artifacts occur throughout these units. The stratigraphic integrity of the deposits—including intact B horizon sediment—along with abundant evidence for bioturbation suggests that these specimens originally were deposited on the surface and were subsequently incorporated into subsurface strata by burrowing animals.

Coarse-fraction KRF flaking debris exhibiting moderate to pronounced ventral surface patination occurs in each of the seven units comprising Block 1. The proportion of G1-G3 flakes exhibiting patination in Block 1 (57 percent) is more than twice as high as the proportion in any other block. These specimens likely derive from pre-Plains Village deposits exposed during the excavation of the ditch; the occurrence of out-of-context patinated flakes in the excavation squares immediately north of the ditch support the inference that the lowest stratigraphic units there represent ditch fill.

A shallow basin or swale roughly 1 m across and 15 cm deep was present immediately north of the ditch, beneath the probable ditch spoil deposits. This pit was only observed in the east walls of Units 11 and 16 during profiling and was not excavated separately or assigned a feature number. This feature may represent a borrow basin. **Feature 2**, a post mold, was identified in the southwest quadrant of Unit 7 (figure 2.25). The feature was first defined at an elevation of 98.50 m, about 16 cm below the base of the sod and within the mottled gray-brown cultural deposit containing rip-up clasts. Given the number and extent of observed krotovina, it is possible that the feature's origin was

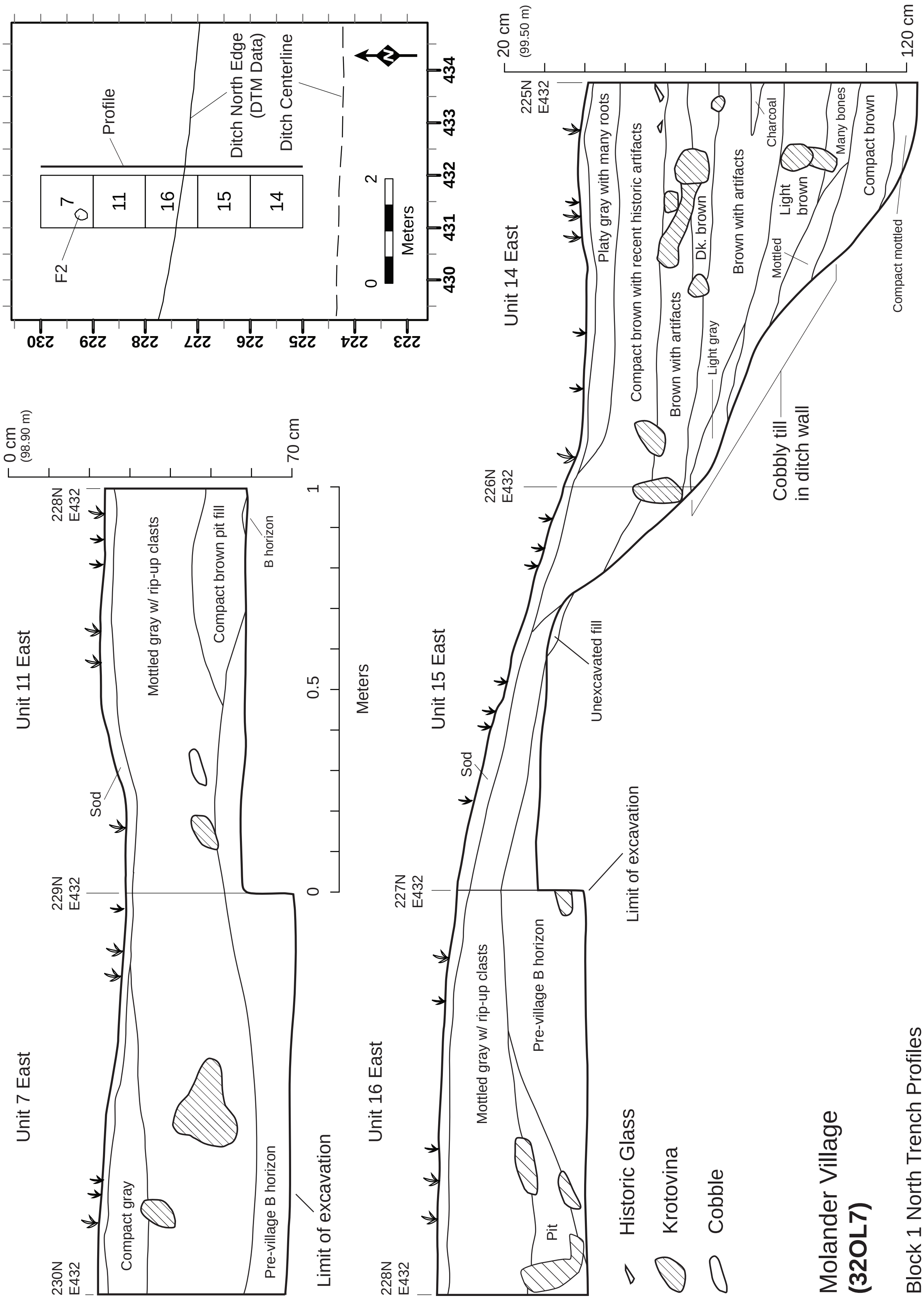

Figure 2.24. Profiles of Units 7, 11, 16, 15, and 16 in Block 1.

Figure 2.25. Photograph of the Feature 2 post mold.

somewhat higher. In any case, the Feature 2 post was installed after the ditch had been excavated. Wood was not present within the feature, which was 20 to 23 cm in diameter and 23 cm deep. Three small cobbles that may have served as stabilizing wedges were present in the bottom of the feature. The center of the post mold was approximately 294 cm north of the northern (village-side) edge of the ditch. No other features were observed in Block 1.

Only a limited inventory of metal and glass trade goods was recovered from Block 1: apart from the probable G5 piece of ferrous trade metal recovered from beneath the displaced till deposit in Unit 4, the only other trade goods consist of a small-diameter copper or brass tube from undisturbed ditch fill, one glass bead from the base of the ditch, and one glass bead from the unnumbered swale or borrow basin in Units 11 and 16.

Block 2 (Units 5, 6, and 8)

Block 2 was an L-shaped arrangement of three excavation squares that was opened to sample a cache pit inside an earthlodge depression located in the settlement's southeastern quadrant (figures 2.19 and 2.26). (This depression is designated H26 in the geophysical analysis; see figure 2.10.) Little or no plowing occurred in this portion of the site; small-scale surface swales evident in the DSM indicate that the site surface may have been plowed immediately west of, but not inside, the H26 depression. The depression is shallow but nevertheless distinct. The exterior diameter is approximately 14 m. The depression's northern perimeter is slightly higher than its southern perimeter, a difference that may reflect earth moving within the settlement during the occupation or possibly post-occupation disturbance. The depression varies in depth from 20 to 30 cm.

The earthlodge's perimeter and several interior features are visible in the magnetic data,. The estimated diameter of the floor inside the perimeter posts is 13 m; it is not clear whether an *atuti* is present. The central hearth is partly obscured by a large dipole anomaly with a maximum magnetic intensity of about 47 nT. Monopole anomalies along the earthlodge's perimeter exhibit intensities of 5 to 14 nT.

The maximum magnetic intensity of the anomaly targeted in Block 2 is 15.3 nT. Coring in 2017 indicated that the anomaly, which is approximately 1.3 m in diameter, represents a pit feature with a maximum depth below surface of more than 1 m. Additional coring in 2018 indicated that the pit's fill contained abundant ash, burned rock, bone, and other artifacts.

Excavation in Block 2 began in Units 5 and 6. After the targeted feature (described later in this section) was exposed at the base of GL3 (98.80 m), a third square (Unit 8) was added to the block south of Unit 5. That third unit simplified excavation of the pit by exposing more of its orifice.

Two primary strata were observed beneath the modern A horizon in Block 2 (figure 2.27). The upper stratum consisted of mottled grey silt containing scattered artifacts and abundant krotovina. Pockets of lighter sediment representing rip-up clasts of C horizon loess also occurred throughout this layer. The rip-up clasts may represent sediment excavated from nearby pits or other features after the Block 2 earthlodge was no longer occupied. It is also possible that the earthlodge depression was partly filled by the residents of homestead: bottle and window glass, concrete, and fragments of recent metal are present in each of the block's general level lots. However, the preservation of portions of the earthlodge's floor and the distinctness of the depression argue against this possibility. It is more likely that recent artifacts were incorporated into primarily village-age deposits by burrowing animals.

The upper fill layer capped a prepared floor surface. Only small portions of the floor were preserved owing to the number and size of post-occupation burrows. The best-preserved section occurred on the west side of Unit 8 and was visible in the west profile of that square (figure 2.28). The upper surface of the floor may have been coated a layer of light-colored sediment roughly 1-2 mm thick. It is possible that the floor had been resurfaced on several occasions. The thin coating had been applied to a compact gray

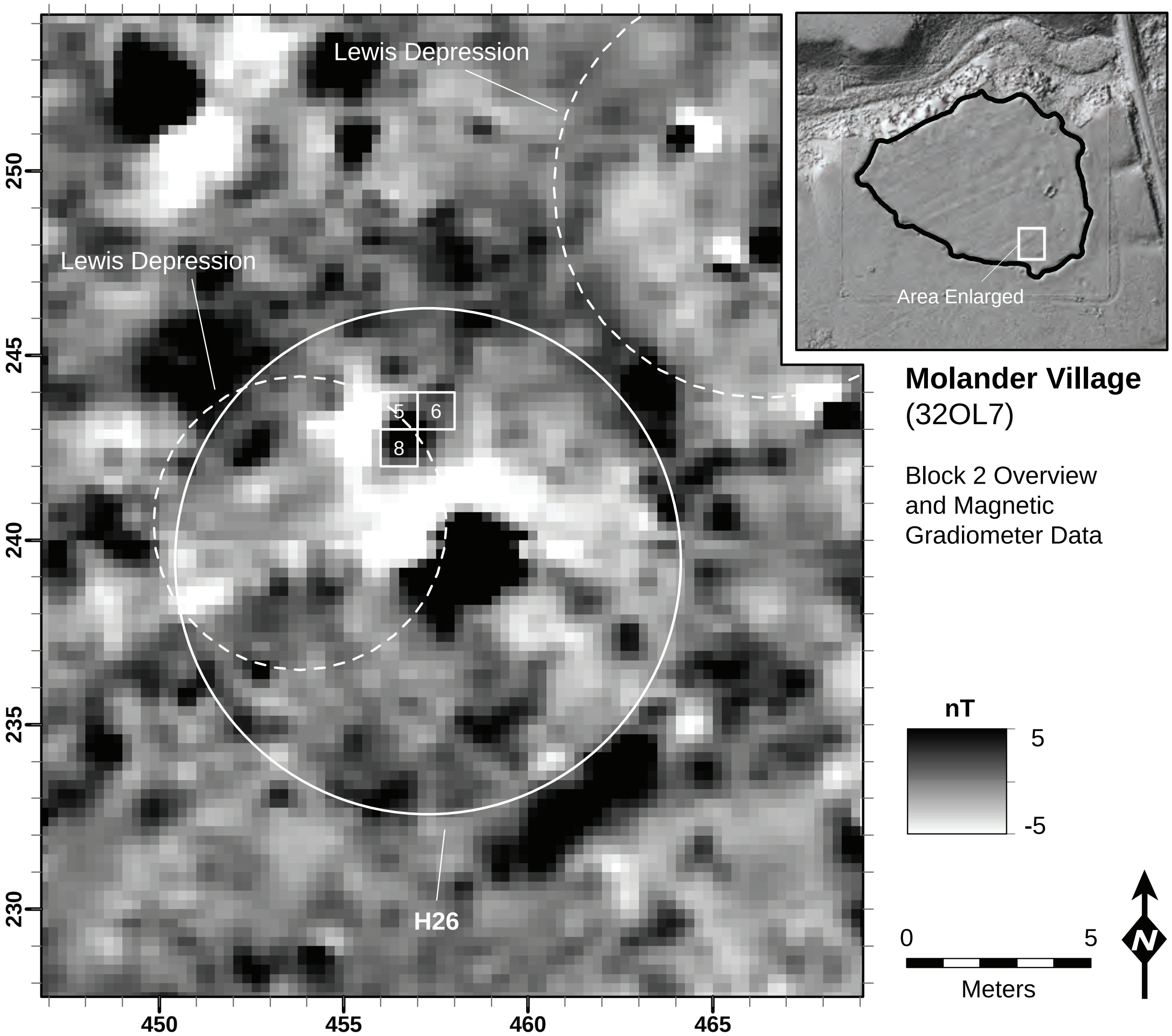

Figure 2.26. Map showing the location of Block 2.

cultural stratum that contained scattered bones, pottery sherds, charcoal, and burned rock. That 8-cm thick compact stratum in turn capped an earlier lodge floor. Unlike the upper floor, the lower lodge floor consisted of platy gray clay lacking a light-colored top coat. The top coat may never have been applied or may have be removed by foot traffic before the floor fill stratum was laid down. The platy character of the lower floor material may indicate that it was applied in a saturated or puddled state. No evidence of burning was observed on the surface of either floor.

A single feature was identified in Block 2. **Feature 7** was a bell-shaped storage pit associated with the lower house floor; the upper floor containing thin, white layers capped Feature 7 (figure 2.29). The pit was ovoid, with an orifice 80 by 56 cm across and a maximum interior dimension of 96 by 73 cm. The pit's depth below the lower floor was 66 cm. This unusually shallow original depth was no doubt due to the presence a glacial boulder more than 75 cm in diameter that covered about one third of the pit's floor. This boulder would have prevented the earthlodge's residents from increasing the pit's depth without significant lateral excavation.

The excavated volume of Feature 7 was 318 liters (0.318 m^3); the feature's fill was entirely removed, apart from a small section south of Unit 6 and east of Unit 8. Fill strata consisted of dumps of primary domestic refuse containing abundant unmodified animal bones, bone tools, pottery sherds, cottonwood bark, burned rock, and stone tools. Large chunks of cottonwood bark in the fill likely represent a portion

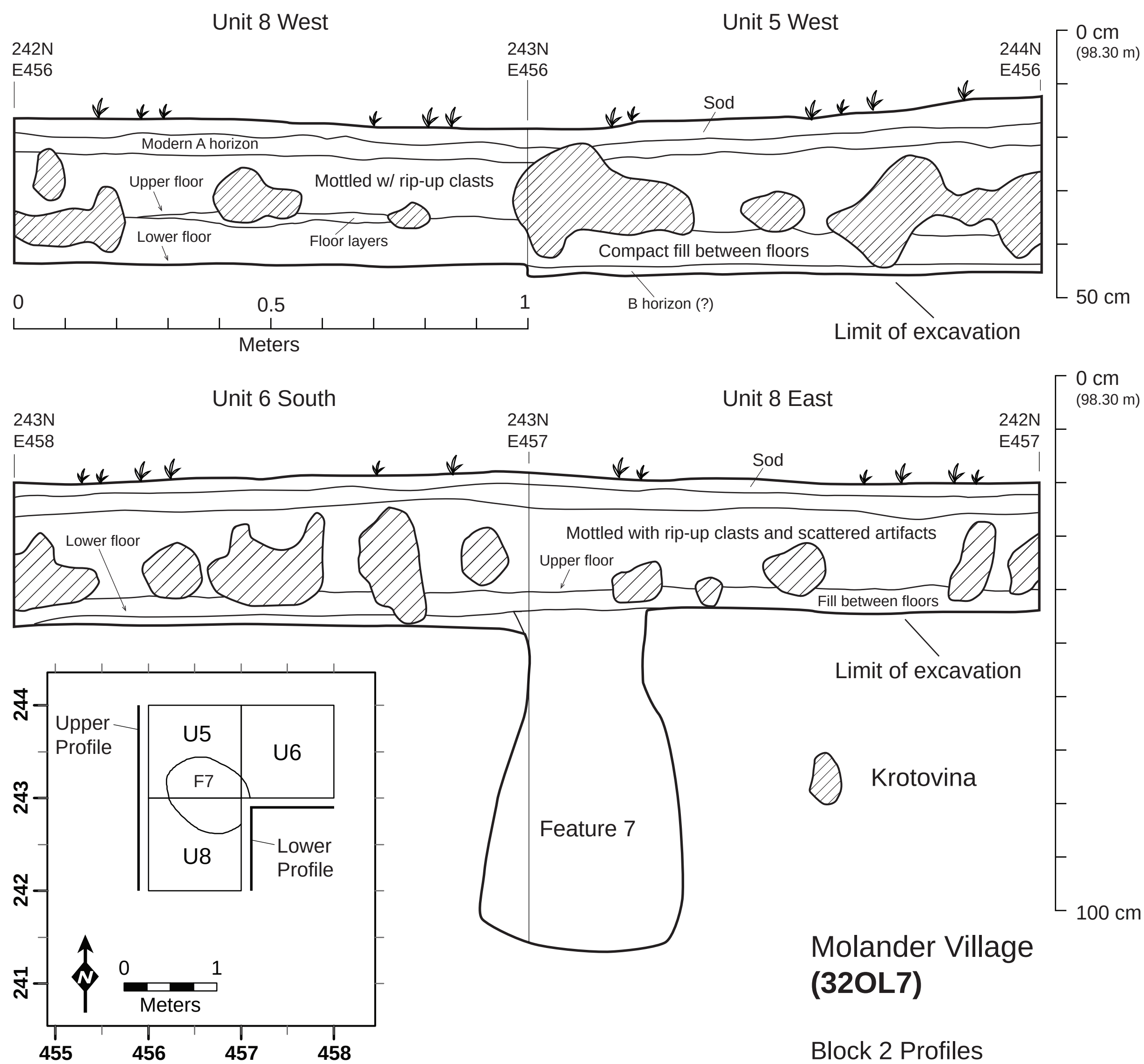

Figure 2.27. Profiles of Units 5, 6, and 8 in Block 2.

of the pit lining; however, none of the original lining remained in place. No other features were identified in Block 2.

Following excavation of Feature 7, a profile was cut into the pit's north side to further investigate the soil horizons present in the intact terrace deposits below the site (figure 2.30). Six horizons were observed (table 2.7). The uppermost intact horizon was a B horizon that likely is equivalent to the B horizon observed in Block 1, Units 7, 11, and 16. The lower floor of the Block 2 earthlodge was built on this truncated B horizon. As noted previously, the B horizon of the pre-village soil was about 30 cm thick. The thickness of the remaining B horizon preserved in Block 2 suggests that the A horizon and about 20 cm of the B horizon were removed prior to the construction of the earthlodge.

Two buried soils were observed in the profile. The upper soil was about 24 cm thick (9 to 33 cm below the base of GL3) and less well-developed than the lower soil. The top of the lower soil was approximately coincident with the top of the glacial boulder exposed in the bottom of Feature 7. A bulk sample of sediment from the A horizon of the lower soil yielded an age of 5362±27 ^{14}C yr B.P. (D-AMS 036156). The AB horizon of the lower soil, the lowest exposed horizon, contained numerous insect krotovina. The relative shallowness of the loess deposit overlying till in Block

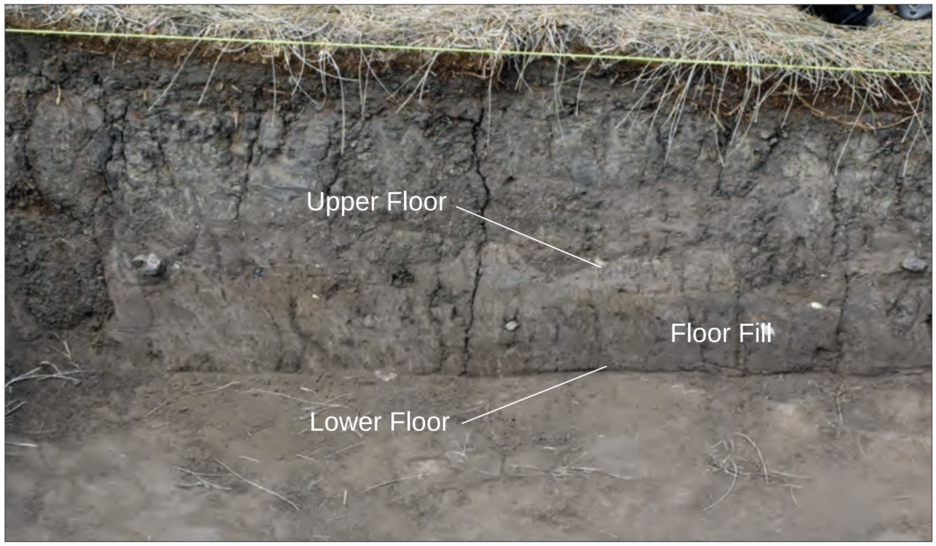

Figure 2.28. Photograph of the west profile of Unit 8 showing disturbed earthlodge floor strata.

Figure 2.29. Photograph of the Feature 7 cache pit; note glacial boulder in the base of the pit; view to the southwest.

2 compared to Block 1 supports the inference that the upper surface of the till is irregular or hummocky.

In addition to recent historic artifacts (post-1882), Plains Village-age trade metal also occurred in all three general levels of Block 2. Glass beads occurred in GL2 and GL3. Numerous pieces of Village-age cut metal scrap occurred in Feature 7, along with four glass beads. No recent historic artifacts were recovered from the fill of Feature 7.

Block 3 (Units 9 and 10)

Block 3 was a 1 x 2-m excavation located outside an earthlodge depression (figures 2.19 and 2.31). Lewis's 1883 map shows a cluster of three small depressions and one large depression adjacent to Block 3. H31, a "medium probability" house identified in the geophysical data, is located about 10 m to the northwest. Topographic and magnetic data suggest that only limited plowing occurred adjacent to Block 3. The primary access road to the historic homestead is located just 9 m to the south; however, no recent historic artifacts were recovered from Block 3.

Numerous small- to medium-sized magnetic anomalies occur in the area around Block 3. A compact monopole anomaly with a magnetic intensity of 15.9 nT is located about 3.5 m to the northwest. That anomaly was cored in 2017 and was interpreted

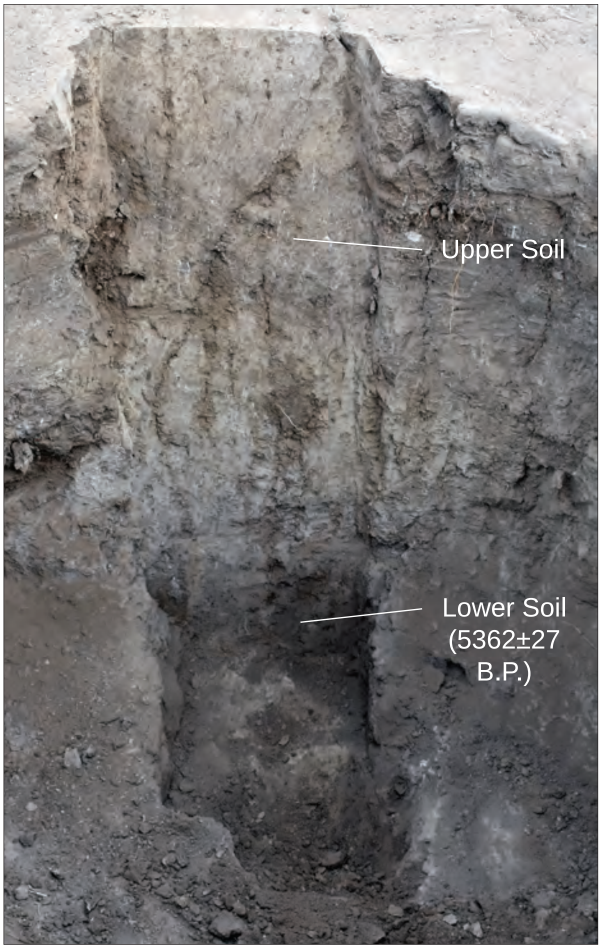

Figure 2.30. Terrace sediment profile; view to the northwest.

Table 2.7. Soil horizons observed in the north wall of Feature 7. Surface depths estimated from the west elevation of Unit 5.

Surface Depth (cm)	Horizon	Color
30-39	Bw	10YR 4/2
39-54	Ab1	10YR 3/2
54-63	Bwb1	10YR 4/2
63-84	C	10YR 5/2
84-95	Ab2	10YR 4/1
95+	ABb2	10YR 5/2

as a hearth, although it may also be a pit containing abundant ash. A second nearby anomaly, located about 8.25 m to the north-northwest, has a magnetic intensity of 18.2 nT and was cored and interpreted as a pit containing few artifacts. Several large dipoles occur to the north-northeast; given their size, these may represent glacial boulders near the surface.

Block 3 was positioned over a compact monopole anomaly with a magnetic intensity of 21.2 nT. Coring in 2018 indicated the presence of numerous rocks within the feature. Six of the seven cores were stopped by rocks at depths ranging from 7 to 52 cm. The seventh core penetrated beyond the base of the cultural deposits, which ended at a depth of about 66 cm. A possible buried A horizon was observed in the core between about 100 and 114 cm below the surface.

At the base of GL1 (20 cm DD or 98.90 m) the top of a pit feature was visible but not fully defined. The surface stratum exposed in GL1 consisted of compact gray silt containing pebbles and scattered artifacts (figure 2.32). Beneath that compact layer was mottled gray-brown silt containing artifacts that may represent a mixture of cultural fill and pre-village A horizon sediment. Definitive evidence for the presence or absence of a plow zone was not observed; however, the fact that the compact gray silt was just 8 to 12 cm thick suggests that little or no plowing occurred in this part of the site.

A second, 5-cm thick general level was removed from Units 9 and 10 and excavation of **Feature 5** began at the base of GL2 (25 cm DD or 98.85 m). However, it quickly became apparent that the target magnetic anomaly represented multiple intersecting features, including **Feature 9**, **Feature 13**, and **Feature 15** in addition to Feature 5**,** rather than a single discrete feature (figures 2.33 and 2.34). In addition, cultural material was observed in the bottom and lower walls of Feature 9, the deepest of the excavated pits. This material may represent a large, primarily sediment-filled storage pit that predated all of the numbered features, or it may represent a pre-Plains Village occupation layer or layers. No diagnostic artifacts were associated with this deposit, although only a small volume was sampled.

The next oldest feature exposed in Block 3 was either Feature 5 or Feature 15. Because these two features did not intersect it was not possible to determine which was older. Only a small portion of Feature 15 was visible in the north wall of Feature 9 between 55 and 80 cm DD (98.55 and 98.30 m), suggesting that it may have been a large undercut pit. Feature 15 was not sampled. A remnant of the orifice of Feature 5 was visible at the base of GL2 and a portion of what remained of the feature was excavated separately. The orifice of Feature 15 was not visible at the same level, suggesting that it could have been older than Feature 5.

The youngest feature exposed in Block 3 was either

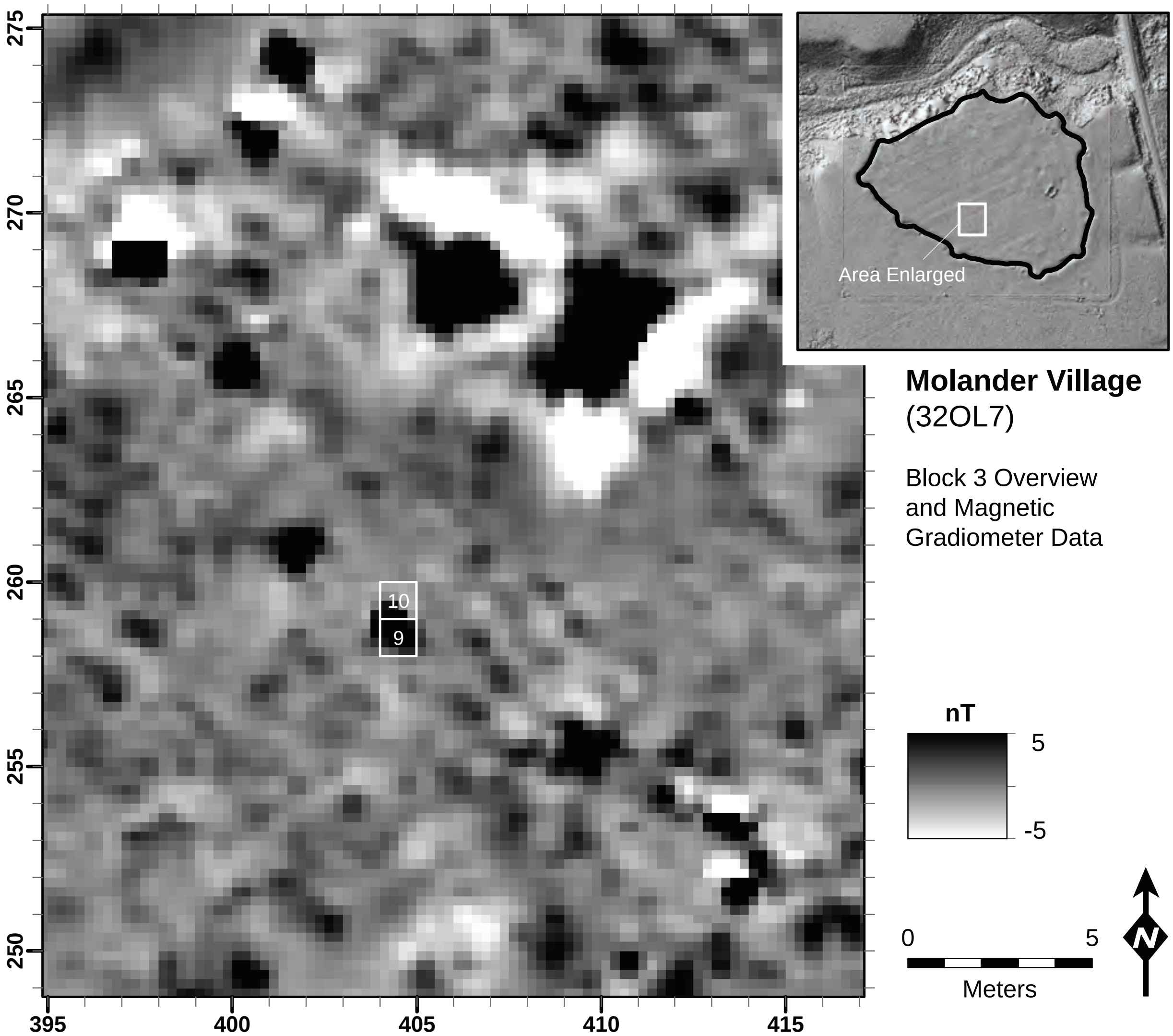

Figure 2.31. Map showing the location of Block 3.

Feature 13 or Feature 9. As was the case for Features 5 and 15, these two features did not intersect and so it was not possible to determine which was older. The orifices of both were exposed at the base of GL2. Thus, the orifices of Features 5, 9, and 13 all occurred within or at the base of GL2. However, the orifice of Feature 9 appears to have been slightly higher than that of Feature 13, likely making it the most recent. Feature 13 was not recognized until after feature excavation had begun; the fill of Feature 13 was partially removed but not separately from the upper fills of Features 5 and 9. The lower fill of Feature 9 was excavated separately from Features 5 and 13. Table 2.8 summarizes data on feature level samples from Block 3.

Metal and glass trade goods occur throughout Block 3, including in general level samples, in Feature 9, and in mixed samples from Features 5, 9, and 13. Thus, the entire sequence exposed in Block 3—with the possible exception of the stratum or feature exposed in the bottom and lower walls of Feature 9 (CN1076)—dates to Molander's primary period of occupation.

In sum, four village-age pit features and one feature or stratum of unknown age were identified in Block 3. Little is known about Feature 15, which only was visible in the lower wall of Feature 9 and was not sampled. However, it appeared to have been a large undercut pit filled with domestic refuse. Feature 5 was a small, slightly undercut pit. It was approximately 40 cm deep and 70 or 75 cm in maximum diameter. The fill consisted of loose brown silt with sparse bone, pottery, and charcoal. Feature 13 was a shallow

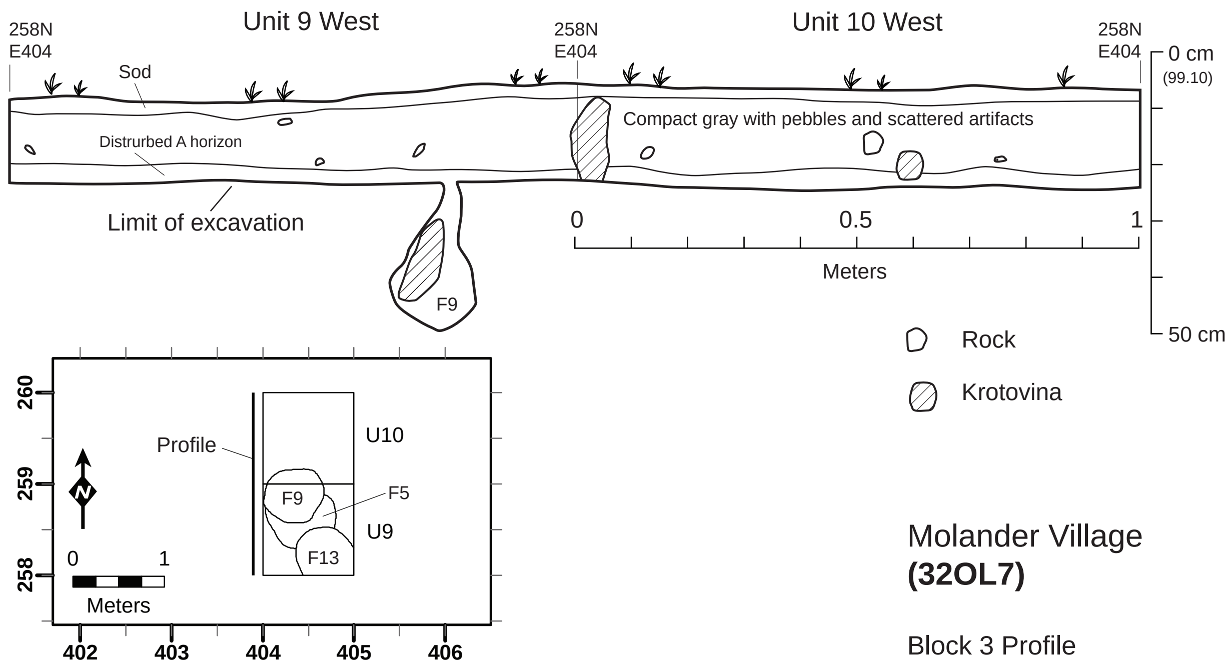

Figure 2.32. Profiles of Units 9 and 10 in Block 3.

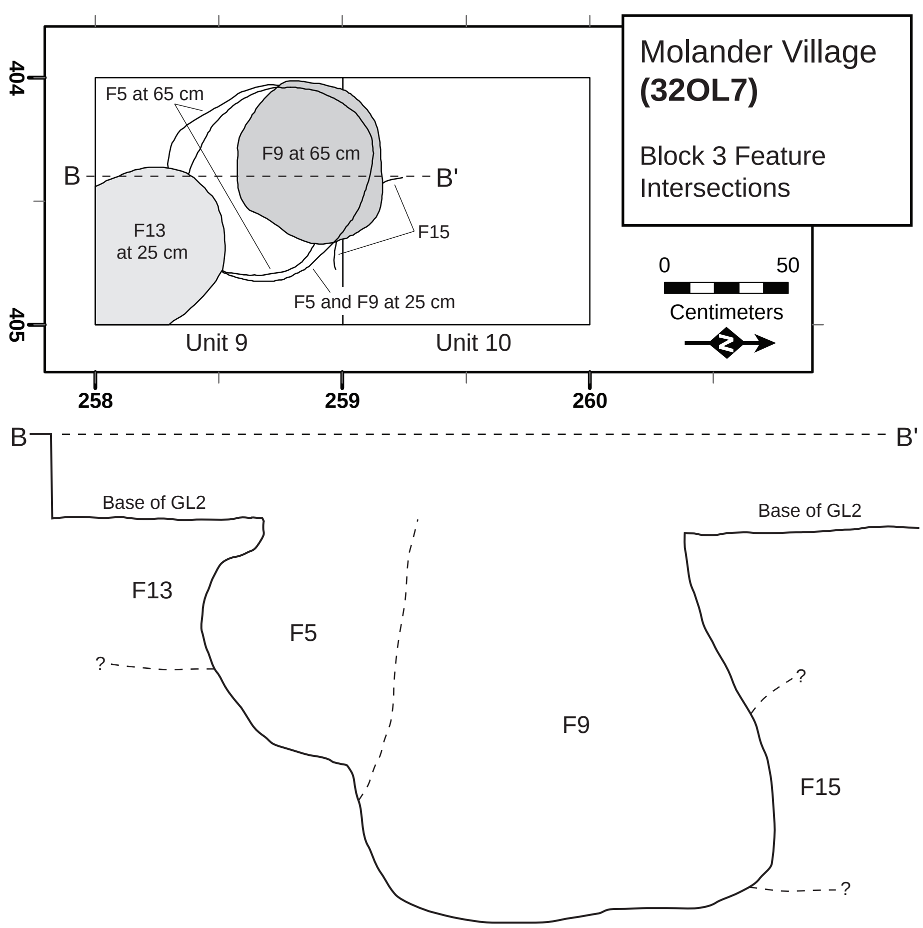

Figure 2.33. Plan and section of intersecting features in Block 3. Section view to the west.

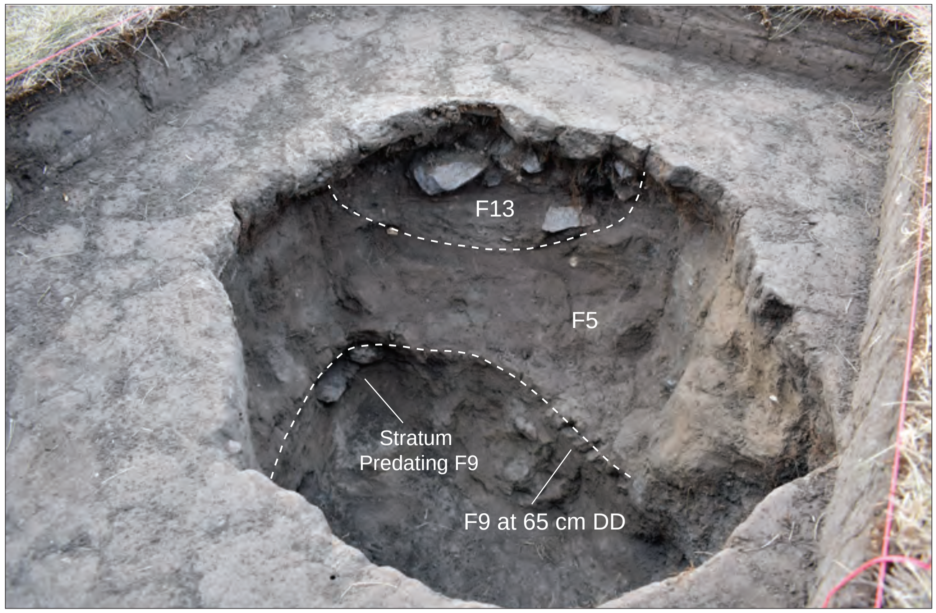

Figure 2.34. Photograph of intersecting features in Block 3.

Table 2.8. Data on feature level samples from Block 3. Feature 15 was identified but not excavated; see text.

Catalog Number	Context	Depth (cm DD)	Volume (L)	Relative Age
1047	F5, F9, and F13 mixed	25-35	43.4	Mixed
1055	F5, F9, and F13 mixed	35-55	86.7	Mixed
1059	F9 only	55-88	102.8	Youngest
1069 (Bulk)	F9 only	55-65	10.0	Youngest
1064	F5 only	55-65	22.4	Intermediate
1076	Unnumbered feature or strata pre-dating F5	65-89	13.1	Oldest

oblong basin primarily filled with burned rock, ash, and charcoal. It was approximately 25 cm deep and at least 55 cm wide. Feature 13 extended outside Block 3 to the southeast and so its length could not be determined. Feature 9 was a deep, slightly undercut pit filled primarily with ash, burned rock, and domestic refuse. A large proportion of the fill consisted of the dismantled remains of an earthlodge central hearth, including abundant ash and charcoal and tabular hearth-perimeter rocks exhibiting smoothing on their upper surfaces. The orifice of Feature 9 was about 50 cm in diameter and its maximum diameter was about 60 cm. The depth was about 70 cm.

Block 4 (Units 2 and 3)

Block 4 was a 1 x 2-m excavation located near the center of the site (figures 2.19 and 2.35). The block was located within geophysical house H23 and numerous magnetic anomalies occur in this portion of the site. The Block was also located on the perimeter of one of Lewis's mapped depressions; however, a depression is not preserved in the modern surface topography.

Both topographic and magnetic data indicate that this portion of the site has been plowed. Three broad ridges, each roughly 10 to 15 cm high and 4 or 5 m wide run from the inside edge of the fortification ditch northeast toward the homestead. The ridges are represented in the magnetic data as linear zones of modestly elevated magnetic intensity (2-4 nT). Block 4 was located close to the crest of the southern ridge.

Block 4 was positioned over a monopole anomaly with a magnetic intensity of 13.0 nT. Hand coring in 2017 indicated that cultural deposits containing abundant ash and artifacts extended to a depth of more than 113 cm below the modern surface. Additional coring in 2018 produced similar results. Based on these data, the Block 4 anomaly was interpreted as a trash-filled storage pit, possibly located inside an earthlodge.

Excavation began with the removal of two general levels in Unit 2 and three in Unit 3, ending at depths

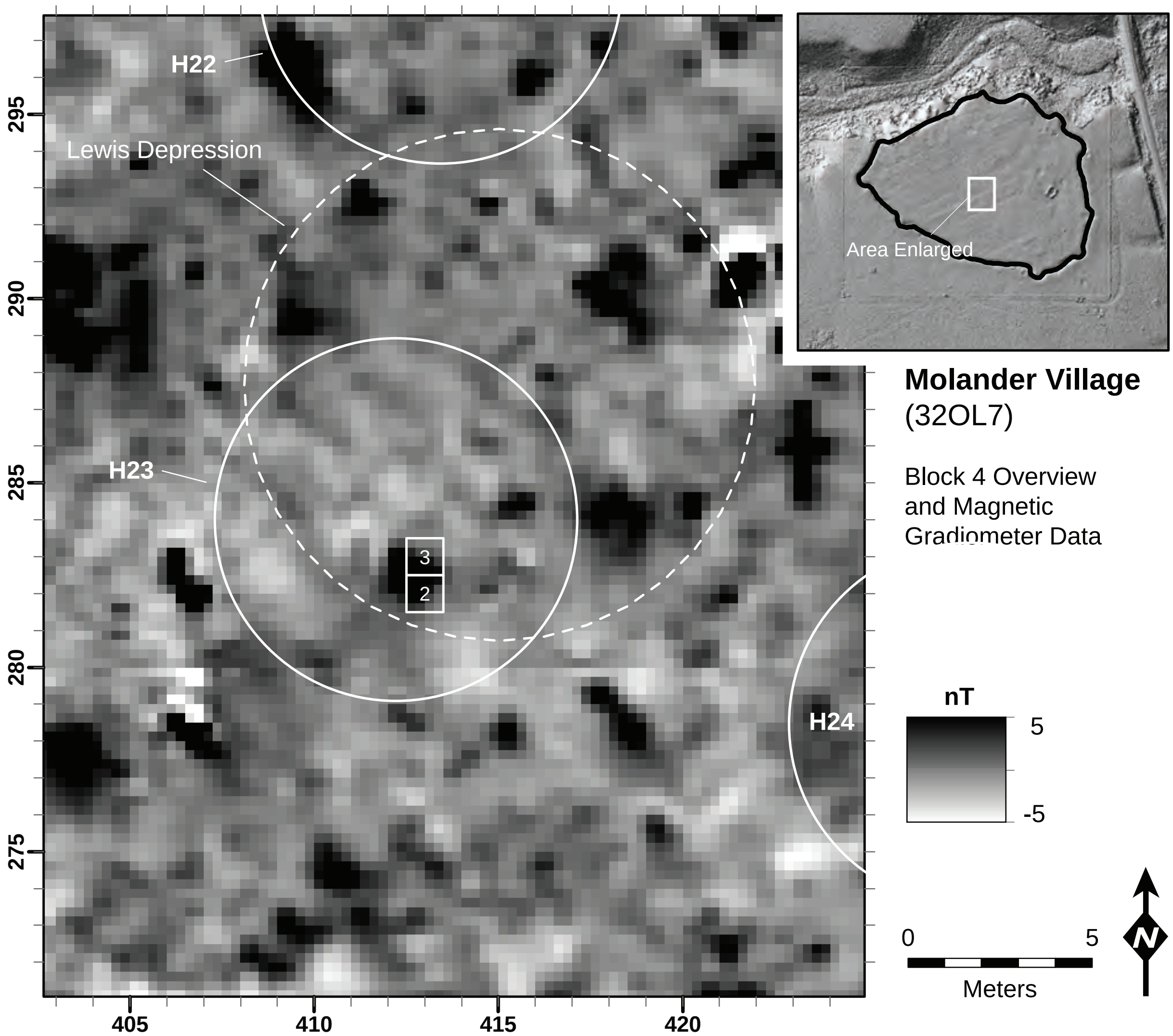

Figure 2.35. Map showing the location of Block 4.

ranging from 39 to 44 cm DD (98.50 to 98.45 m) (figure 2.36). The upper 16 to 20 cm of sediment consisted of homogeneous, compact gray-brown silt containing sparse artifacts and animal bones and was interpreted in the field as a plow zone. Numerous rodent burrows occurred within this stratum. The lower boundary was abrupt and smooth. Beneath the plow zone was a compact mottled cultural deposit containing ash lenses and scattered artifacts. An extensive network of animal burrows occurred throughout this lower deposit, as well as in the underlying features. Recent iron artifacts were recovered from both GL1 and GL2.

Feature 1, a probable post mold, was encountered at a depth of 26 cm DD (98.64 m) on the north side of Unit 2. The feature was about 25 cm in diameter and 15 cm deep. Its fill consisted of dark brown silt containing few artifacts. No remnants of the original post were present. Because the feature's origin occurred within the plow zone, it was thought in the field to have been associated with the site's recent historic component. Subsequent lab work identified a single G5 glass bead in the feature's fill. The fill also contained flaking debris. However, the field notes indicate that excavation of the feature almost certainly penetrated underlying village-age deposits. In addition, the fill likely represents material obtained from the site surface. Given its stratigraphic position, Feature 1 is interpreted as a late nineteenth or early twentieth century post mold.

As was the case for Block 3, continued excavation in Block 4 revealed a complex sequence of superimposed strata and features. A mottled cultural

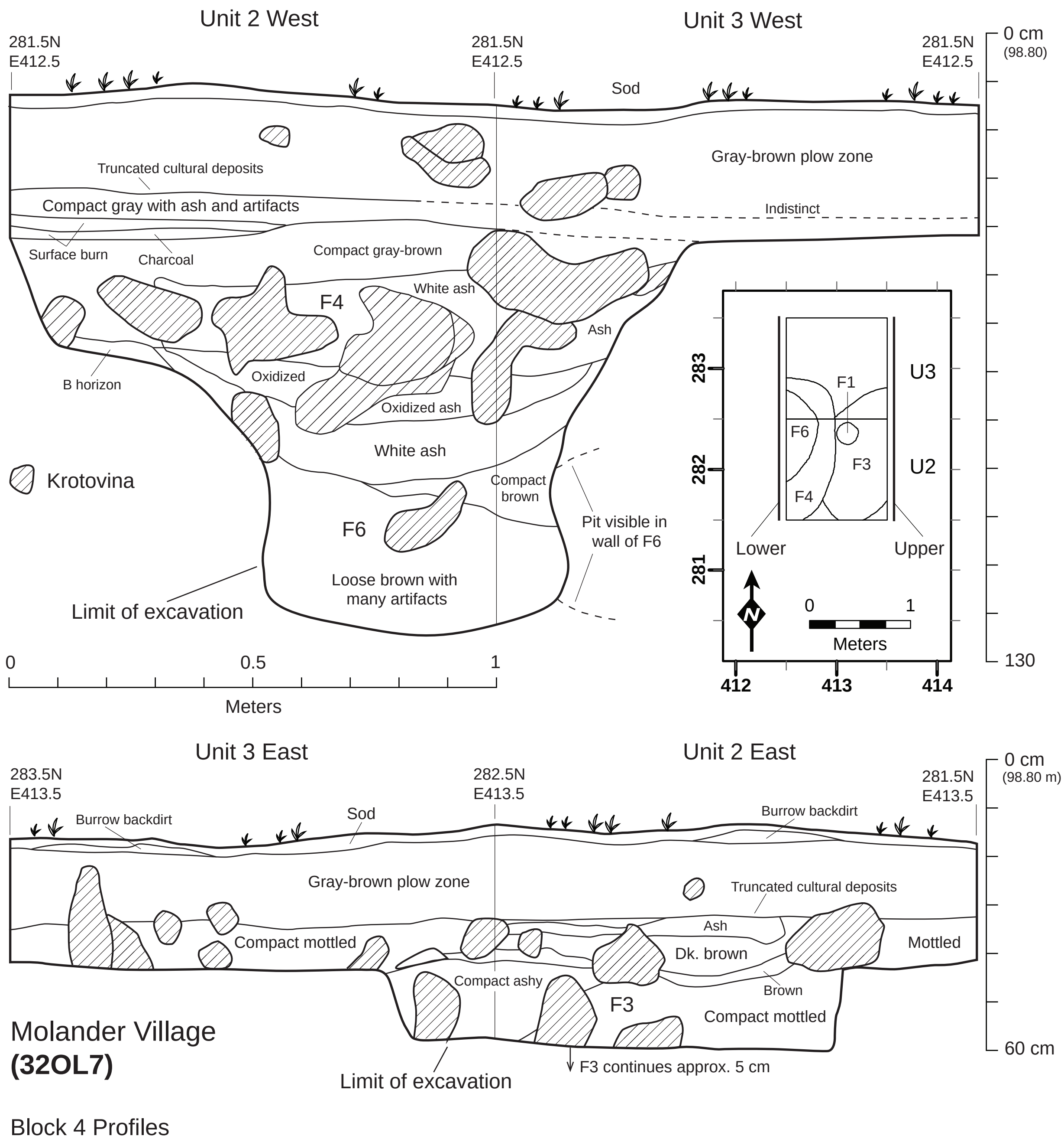

Figure 2.36. Profiles of Units 2 and 3 in Block 4.

deposit extended to a depth of about 62 to 68 cm DD (98.28 to 98.22 m or 50 to 55 cm below the modern surface). The lower boundary of that deposit rested on truncated B or C horizon terrace sediment. Only the upper approximately 10 cm of the deposit was excavated. No strata representing an earthlodge floor or floors were observed in Block 4, either in the upper exposed portion of the mottled cultural deposit or in the walls of the features that postdate it.

Feature 3 was exposed at the base of GL2 in Unit 2 (40 cm DD or 98.50 m). Feature 3 was a shallow oblong basin approximately 25 cm deep and about 130 cm long (figure 2.37). The feature's width could not be measured but may have been about 100 cm. The fill consisted of compact mottled gray-brown silt containing sparse animal bones, pottery, ash, and charcoal. Recent metal was recovered from FL2.

The relationship between **Feature 6** and Feature

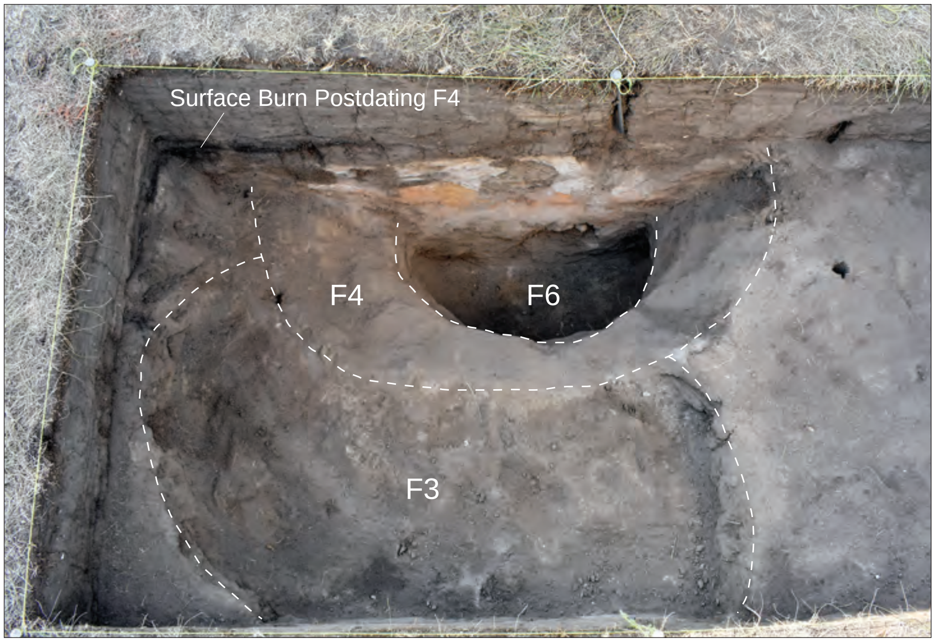

Figure 2.37. Photograph of intersecting features in Block 4.

3 could not be determined because the orifice of Feature 6 had been removed during the construction of Feature 4 (described later). If Feature 6 originated at the truncated terrace sediment, then it would have predated Feature 3. If so, Feature 6 would have been a shallow, slightly undercut pit roughly 55 cm deep. However, Feature 6 could also have originated within the mottled cultural deposits overlying intact terrace sediment, in which case it would have postdated Feature 3. If so, Feature 6 could have been as much as 85 cm deep. Only the bottom 30 to 35 cm of Feature 6 fill was preserved, which consisted of loose, light brown ashy sediment containing animal bones and artifacts. An unnumbered pit feature was visible in the north wall of Feature 6. The size and shape of this feature could not be determined. However, it is probable that it originated within the mottled cultural deposits overlying intact terrace sediment in Unit 3. This unnumbered feature was not sampled.

Feature 4 was superimposed onto Feature 6 and cut into Feature 3 and therefore was the most recent of the numbered features excavated in Block 4. Feature 4 was the remains of a large, deep hearth with steeply sloping upper walls and a flat to concave floor. The fill consisted of successive layers of gray ash, oxidized ash, and white ash, all capped with compact gray-brown silt. The presence of the cap suggests that the occupation may have continued after use of Feature 4 ceased. Less than 50 percent of the feature was exposed in Block 4; however, its diameter was estimated to be greater than 140 cm. The depth was at least 30 cm, but may have been as great as 53 cm. The different depth estimates reflect uncertainty about the context of the lower gray and oxidized ash layers. These strata may represent the oldest fill in Feature 4 or they may have been present in Feature 6 prior to the construction of Feature 4. During the field investigation, the latter scenario was thought to be more likely and so FL1 of Feature 6 incorporates all material below a depth of 72 cm DD (98.18 m). Subsequent analysis of the field data suggests that the former scenario—under which these ash layers comprise the lower portion of Feature 4—is more plausible. This interpretation lends support to the idea that Feature 6 predates Feature 3.

Feature 4 was interpreted in the field as the central hearth of an earthlodge. However, it was somewhat irregular in both plan and profile and was not lined with perimeter stones. The disturbed condition of the feature's edges could indicate that the perimeter stones had been removed. However, a more plausible explanation, based on data recently obtained from Awatixa Village (32ME11) at Knife River Indian Villages National Historic Site, is that Feature 4 was a large outdoor hearth rather than an interior central hearth (Mitchell *ed*. In prep.). Several features exhibiting similar size, morphology, and fill were documented at Awatixa Village. Like Feature 4 at Molander, the irregular, unlined, ash-filled basins at Awatixa were not associated with a prepared floor.

A thin layer of charcoal and burned earth capped

Feature 4 on the south. This layer, which was just a few centimeters thick, postdated the use of Feature 4. In turn, this thin surface burn was capped by mottled cultural deposits. This stratum likely represents an *in-situ,* village-age surface burn.

In sum, a thick, apparently unstructured cultural deposit and multiple overlapping village-age features were exposed in Block 4. Among the village-age features, the Feature 4 hearth was the most recent. The relative ages of Feature 6, a pit filled with domestic debris, and Feature 3, a shallow basin filled primarily with sediment, could not be determined. Feature 6 certainly postdates the unnumbed feature exposed in its wall but could have been constructed either before or after the deposition of the unstructured cultural deposit. Features 3 and 4 postdate the emplacement of the unstructured cultural deposit. The surface burn postdates Feature 4. A fourth numbered feature, a post mold designated Feature 1, was associated with the site's recent historic component.

No evidence for a prepared earthlodge floor was observed in Block 4. This may indicate that the deposits sampled in Block 4 represent an outdoor between-lodge work area. However, it is clear that stripping of the terrace surface occurred before the deposition of the unstructured cultural deposit. Similar stripping was observed beneath the floor of the Block 2 earthlodge. This could indicate that an earthlodge was at one time present in the Block 4 area. Alternatively, the stripped surface in Block 4 may represent a large borrow basin, which subsequently was used as a work area. In either case, the features and strata exposed in Block 4 are indicative of an extended period of occupation during which a wide variety of sequential uses occurred.

Small numbers of trade goods occurred throughout Block 4. Glass beads were recovered from GL2, GL3 and Feature 1. Trade metal was recovered from all three general levels and from Features 3 and 6. These distributions suggest that all of the features and strata exposed in Block 4 date to Molander's primary period of occupation.

Block 5 (Units 12 and 13)

Block 5 was a 1 x 2-m excavation located within an earthlodge depression on the north side of the village (figures 2.19 and 2.38). Lewis accurately mapped the depression and Kvamme's analysis of the magnetic data assigned it to the "high probability" category (H6). The western perimeter of the depression is slightly higher than the eastern perimeter (99.80 m compared to 99.55 m). The elevation of the deepest point in the depression is 99.40 m, yielding a depth range of 15 to 40 cm.

Visible in the DSM are low ridges and swales immediately south of Block 5, suggesting that this portion of the site may have been plowed. However, the clarity of the earthlodge depression indicates that if plowing occurred it was only intermittent or brief. Magnetic data, confirmed by coring, clearly reveal the locations of the earthlodge's central hearth, interior pits, and the perimeter of the floor. The central hearth, located about 3.5 m west-southwest of Block 5, exhibits a magnetic intensity of 9.9 nT. A sediment-filled pit located about 7 m west of Block 5 has a magnetic intensity of 7.2 nT, while another located 8 m southwest has an intensity of 5.7 nT. The ERT transect, described in the "Geophysical Survey Results" section, was placed across the depression, bisecting the central hearth and Unit 12. Two GPR anomalies located immediately outside the perimeter of the depression on the east and southeast were also cored. Both exhibit moderately high magnetic intensity (between 5 and 6 nT) and proved to be pit features filled primarily with sediment.

Block 5 was placed over a monopole anomaly with a magnetic intensity of 7.0 nT. Hand coring indicated that cultural deposits extended to a depth of at least 72 cm below the modern surface and contained abundant burned rock. Excavation began with the removal of three general levels to a depth of 45 cm DD (99.15 m). All three general levels spanned both excavation squares. Recent metal artifacts occurred in GL1 and GL2 and small fragments of rubber or rubberized fabric occurred in all three general levels. Village-age trade metal occurred in GL2 and GL3 and glass beads occurred in GL1 and GL2. No recent artifacts occurred in feature level samples. One feature sample contained a single glass bead.

A thin surface burn, measuring approximately 32 cm long, 22 cm wide, and 3 cm thick was observed in the southwest quadrant of Unit 13 at a depth of 30 to 33 cm DD (99.30 to 99.27 m). A larger, somewhat thicker surface burn, designated Feature 14 in the lab, was observed in the west half of Unit 12 at a depth of 35 to 40 cm DD (99.25 to 99.20 m). Roughly half of the burn was exposed in Block 5; the estimated diameter was 90 cm.

A complex sequence of thin strata was exposed during the general level excavation (figure 2.38). The uppermost consisted of compact brown to gray-brown

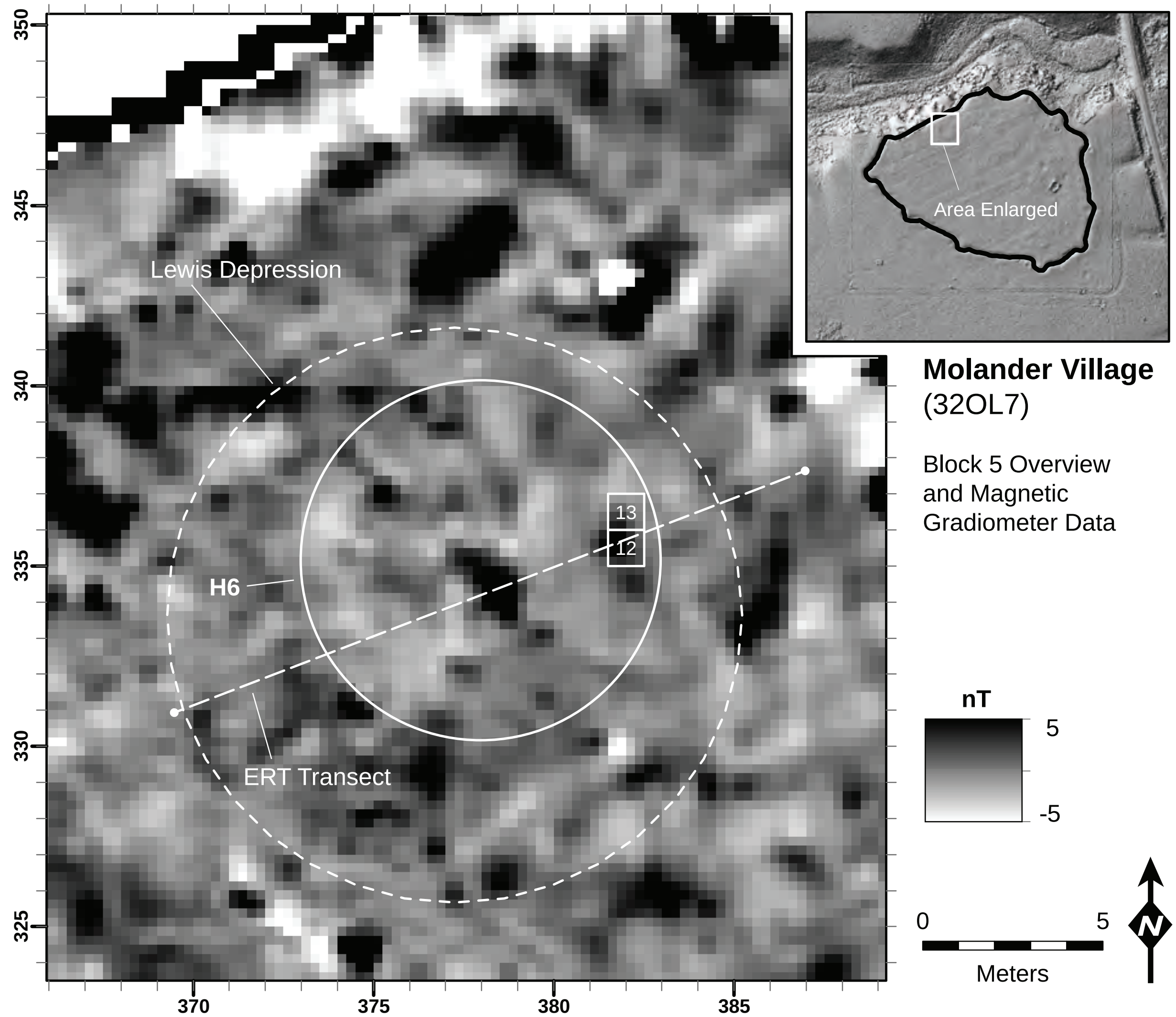

Figure 2.38. Map showing the location of Block 5.

silt containing scattered animal bones and village-age artifacts. This stratum varied in thickness from 7 to 14 cm, suggesting that it does not represent a plow zone. The upper few centimeters of the stratum were slightly darker, possibly indicative of post-occupation pedogenesis. Numerous animal burrows occurred throughout this upper layer and extended into the underlying cultural deposits and features.

Below this relatively homogenous layer was an earthlodge floor consisting of compact gray-brown stratum containing numerous thin, flat-lying stringers of white sediment (figure 2.40). The white sediment layers were generally 1 to 2 mm thick. Compact gray clay layers occurred between the stringers. The top of this floor surface occurred in GL1 at a depth of 26 cm DD (99.34 m). This upper floor had been repeatedly resurfaced, resulting in an accumulation of alternating gray and white micro-strata that together were 7 to 11 cm thick. Numerous animal burrows were present in the floor stratum, but isolated sections were preserved in the block's east and west profiles.

Both the smaller surface burn in Unit 13 and the larger surface burn in Unit 12 (Feature 14) occurred within these accumulated micro-strata and therefore postdated the initial construction of the floor but predated the last resurfacing event. These surface burns therefore occurred during the occupation of the house and do not represent catastrophic destruction of the earthlodge by fire.

Beneath the base of the upper floor was an 8- or 9-cm thick compact dark brown stratum that contained scattered artifacts. This stratum capped the earthlodge's lower floor surface. The lower floor was not prepared or coated but consisted only of truncated

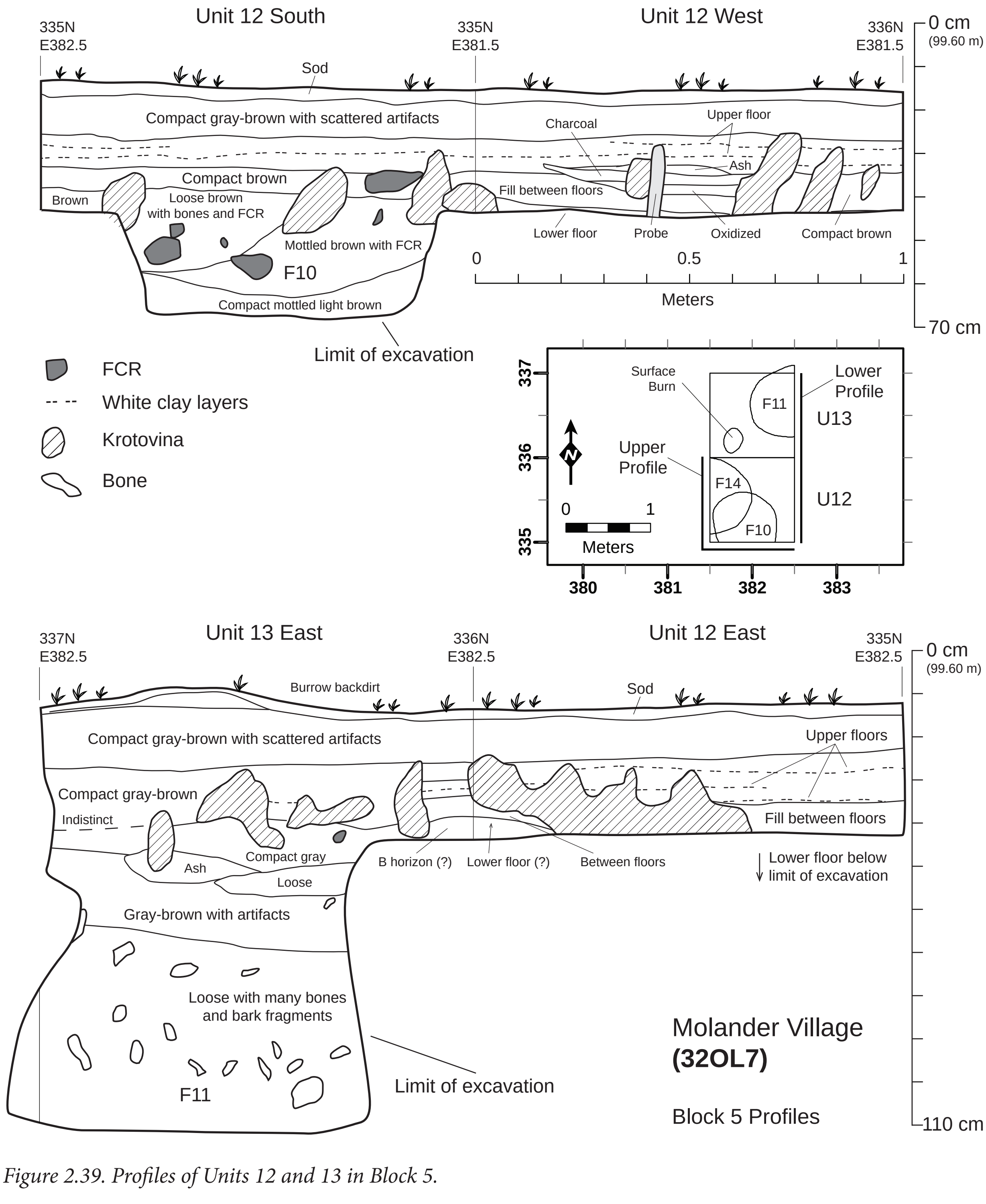

Figure 2.39. Profiles of Units 12 and 13 in Block 5.

B horizon terrace sediment. The extent of preconstruction surface stripping was not determined.

In addition to Feature 14 and the smaller unnumbered surface burn, three numbered cultural features were identified in Block 5, two of which were excavated separately. **Feature 10** was a shallow, flat-bottomed pit associated with the lower lodge floor (figure 2.41). The upper edges of the pit were poorly defined due to the presence of numerous krotovina. However, Feature 14, the large surface burn in Unit

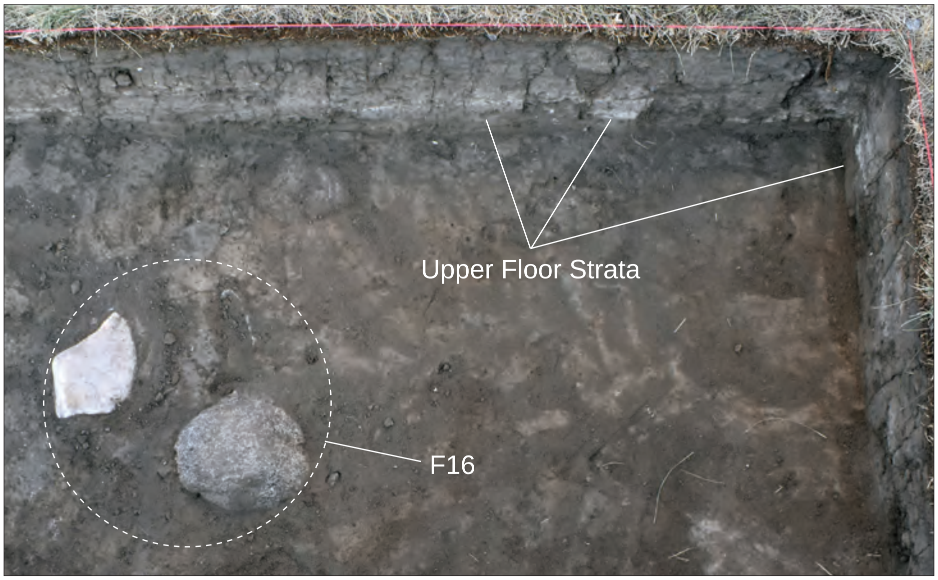

Figure 2.40. Photograph of the base of GL2 showing the upper earthlodge floor microstrata in the west and north profiles; view to the west.

12 that postdated the lowest floor but predated the most recent floor, was superimposed over Feature 10, indicating that the latter originated at the lower floor rather than the upper. The Feature 10 pit, which was slightly oblong, approximately 75 to 80 cm in diameter, and 25 cm deep, was filled with a large quantity of burned rock. Pottery, modified stone, and animal bones also were present. The fill of Feature 10 extended into a 16-cm diameter post hole; that original post may have supported a rack or other interior furniture that predated or was contemporaneous with the use of Feature 10.

Feature 11 was an undercut storage pit with a flat bottom located in the northeast quadrant of Unit 13 (figure 2.42). Like Feature 10, the upper edges of Feature 11 were poorly defined. However, the gray brown fill stratum between the lower and upper floors appeared to cap the fill of Feature 11, suggesting that

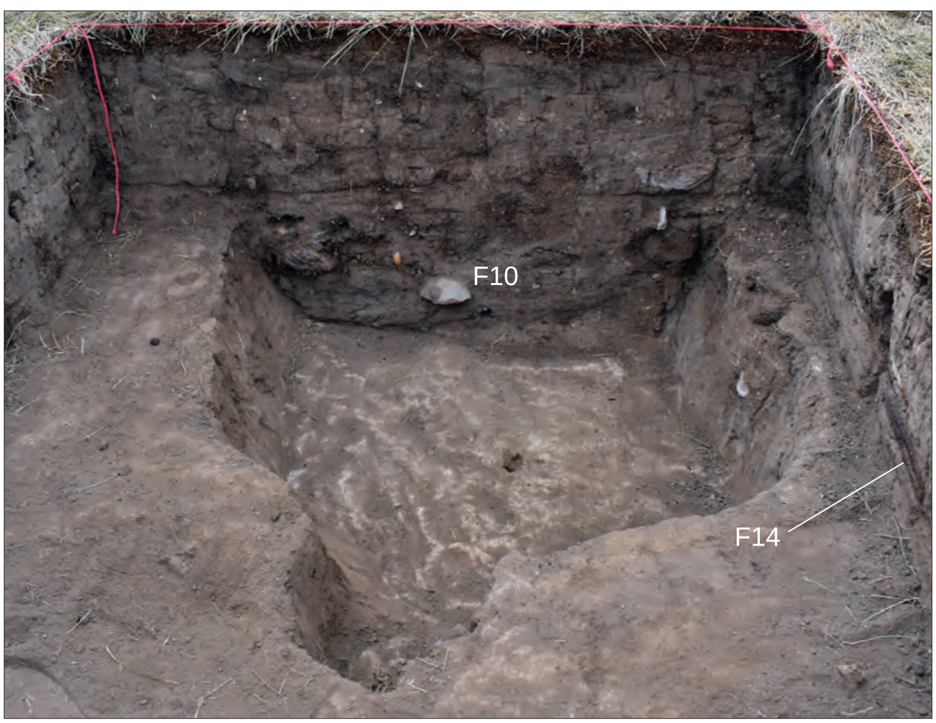

Figure 2.41. Photograph of Feature 10; view to the south.

Figure 2.42. Photograph of Feature 11; view to the northeast.

the pit was associated with the lower floor. Portions of the upper floor may also have been preserved above Feature 11 in the north wall of Unit 13.

Feature 11 was asymmetrical in cross section, with a slightly deeper undercut on the north than on the south. In its northwest quadrant, the upper rim of the pit had collapsed when it was still in use. Based on plan view dimensions, somewhat more than half of the feature was sampled. The east wall of Unit 13 appears to have approximately bisected the feature; the maximum observed diameter (at the base) was 83 cm. The estimated original depth was about 65 cm. Based on the formula for a truncated cone, the estimated original volume of Feature 11 was about 280 liters (0.28 m^3); the calculated sample volume was 196 liters. Based on volume calculations, the sample likely represents about 70 percent of the original volume.

The upper fill of Feature 11 consisted of compact gray brown silt containing animal bones and artifacts. The lower fill consisted of very loose silt containing many cottonwood bark fragments, abundant organic material, and numerous bones. The cottonwood bark fragments likely represent the remains of the pit lining; however, no intact lining was observed.

Feature 16, which was designated in the lab, was a tight cluster of three large, unmodified cobbles located in the southwest quadrant of Unit 13 (figure 2.43). A fourth unmodified cobble was located just north of the cluster. The tops of the clustered rocks were visible in GL2 immediately below the small surface burn at depths ranging from 35 to 39 cm DD (99.25 to 99.21 m) (figure 2.40). The bases of the clustered cobbles were located at depths of 44 to 49 cm DD (99.16 to 99.11 m). The cobbles were therefore resting on, or just below the lower lodge floor. The tops protruded into the micro-strata of the upper floor at the level of the Feature 14 surface burn. Feature 16 is interpreted as a pot rest used in conjunction with the upper lodge floor. One of the cobbles was made of limestone, was entirely encrusted with calcium carbonate, and weighed 2.2 kg. The other two were made of granite, were coated with carbonate on one face, and weighed 1.6 and 7.3 kg. The fourth cobble, which did not protrude through the upper floor micro-strata, was a carbonate encrusted limestone slab weighing 1.1 kg. None of the four were modified and all four were left in their original positions when Block 5 was backfilled.

Summary and Discussion

Data from the 2018 testing effort, in combination with topographic, geophysical, and hand coring data obtained in 2017 and 2018, provide insights into local geomorphic processes, the age and distribution of the site's pre-Plains Village occupation, the occupation history of the Plains Village component, earthlodge and fortification design and construction, and the processes and extent of post-occupation disturbance.

Geology and Geomorphology

Intact glacial till (Coleharbor Formation) deposits were observed in Block 1 (in the north wall of the

Figure 2.43. Photograph of Feature 16; view to the south.

village fortification, Feature 12) and in Block 2 (in the bottom of the Feature 7 storage pit). Additional data on the depth and surface morphology of the till were obtained from hand coring and from the 2018 GPR survey. The till is composed of clay, silt, and sand lenses along with cobbles and fine to medium boulders. The upper surface of the till varies greatly in depth. In the north wall of Feature 12 intact till was observed roughly 75 cm below the estimated elevation of the pre-village surface. The top of the boulder in Feature 7 may have been 85 or 90 cm below the pre-village surface. However, coring below the floor of Units 1 and 4 in Block 1 demonstrated that the upper surface of the till was greater than 145 cm below the pre-village surface and many cores taken from other parts of the site failed to encounter the till at all. Thus, the upper surface of the till appears to be uneven or hummocky, likely due to late Pleistocene or early Holocene surface erosion. A possible paleochannel in the till was inferred from GPR data from House 11, and possible channel deposits were encountered in cores taken from the southwest corner of the SHSND property, outside the village fortification.

Cobbles and boulders are scattered on the site surface and pebbles and cobbles of natural rock were encountered throughout the excavation blocks. These coarse clasts represent till brought to the surface when the fortification ditch and interior and exterior storage pits were excavated. The exterior ditch spoil bank is composed primarily of cobbles and boulders. The shallowness of the till may have limited the depths of storage features, judging by the relatively small size of the Feature 7 cache pit.

Two buried soils were observed in the section of Oahe Formation sediment exposed in the wall of Feature 7. The top of the upper soil, which was the less well-developed of the two, occurred at a depth of 39 cm below the modern ground surface or roughly the same depth below the estimated elevation of the pre-settlement surface. A more well-developed soil occurred at 84 cm below the modern surface. It is likely that this lower soil is equivalent to the paleosol observed in the coring transect on the west side of the site (figure 2.18 and table 2.5). A radiocarbon assay conducted on a bulk sample from the lower soil yielded an age of about 5400 B.P. or 6300 to 6000 cal B.P. The top of the lower soil was about 10 cm above the top of the large boulder in the bottom of Feature 7. This suggests that the late Pleistocene and early Holocene members of the Oahe Formation (the Mallard Island, Aggie Brown, and Pick City members) may not be present at Molander. The lower soil may correspond to the Thompson soil, which dates to about 5000 B.P. or a little earlier (Mandel 2012). If so, the fine-grained sediment on which the village was built corresponds to the Riverdale member of the Oahe Formation. The age of the upper paleosol was not measured.

Pre-Village Components

KRF flaking debris exhibiting moderate to pronounced patination—an indicator of relative antiquity—occurs in all five of the 2018 excavation blocks. That distribution suggests that one or more pre-Plains Village occupations of the T3 occurred across most or all of the area later occupied by the village and that the remains of those occupations were incorporated into the site's Late Plains Village deposits by the settlement's residents when they stripped the surface and excavated the fortification ditch, storage pits, and borrow pits.

No pre-Village diagnostic artifacts were recovered; however, circumstantial evidence brackets the site's likely pre-Village chronology. Ahler and others (1981:234; see also Root *et al*. 1986:440-446 and VanNest 1985) argue that assemblages containing substantial numbers of artifacts bearing moderate to pronounced patination are generally at least 1,500 years old. The absence of pottery body sherds exhibiting cord-roughened surfaces further suggests that the Molander occupation or occupations may have occurred during the Archaic. However, pottery is generally rare on Early and Middle Woodland sites in the region (2000 to 1500 B.P.) (e.g Ahler *et al*. 1981). The age of the lower buried soil exposed in Block 2 suggests that the pre-Village occupation of the site occurred after about 6300 cal B.P.

The number of pre-Plains Village components at Molander is unknown. However, patinated KRF artifacts definitely occurred within the remnant of pre-settlement soil preserved beneath the ditch spoil bank (exposed in Units 1 and 4 in Block 1) but not within the excavated ditch fill that makes up the spoil bank itself. (That buried soil is equivalent to the modern surface soil of the T3 terrace south and west of the fortified village.) Pre-Village artifacts could also be associated with one or both of the buried soils exposed in the wall of Feature 7 in Block 2, although no direct evidence for such an association was observed during the 2018 field investigation, with the possible exception of the undated feature or stratum exposed in the wall of Feature 9 in Block 3.

Late Plains Village Occupation History

The distributions of metal and glass trade goods suggest that a single Plains Village occupation is present at Molander. Although the density of trade goods is low, they were recovered from virtually every archaeological context investigated in 2018, including storage pits associated with the lower floors of earthlodges and the deep fill of the fortification ditch, as well as near-surface midden deposits. Pottery data, which are described in chapter 4, support the inference of a single Plains Village component. The likely age of the occupation is considered in chapter 3.

Stratigraphic data from Block 1 demonstrate that the fortification system was built early in the settlement's history, possibly even before earthlodges were put up. A small number of Plains Village-age artifacts—including one piece of probable trade metal—were recovered from the pre-settlement surface preserved beneath the ditch spoil bank. However, that surface was otherwise undisturbed. If a substantial Plains Village settlement had predated the construction of the ditch, that surface would no doubt have been impacted. In addition, evidence of a substantial occupation is ubiquitous within the area defined by the ditch but virtually absent from the area outside the ditch. One pit was encountered in the coring transect outside the ditch and thin cultural deposits may occur outside the ditch to the southwest, but no indications of earthlodges are visible in the magnetic gradiometry data from the area outside the fortification. Stine and others (2004) reports a possible earthlodge depression outside the fortification to the southeast; however, that depression is located outside the SHSND property and was not examined in 2018. Regardless, if the ditch had been constructed after the settlement was established, significant evidence of occupation likely would be present outside its perimeter, as is the case at other nearby settlements that include fortifications added late in their occupation histories (Ahler, *ed*. 2005; Mitchell, *ed*. 2007).

Stratigraphic data also provide evidence for the duration of Molander's Plains Village occupation. Both of the earthlodges investigated in 2018 (H26 in Block 2 and H6 in Block 5) exhibited two distinct floor surfaces. In both cases, the floors were separated by a layer of intentionally placed fill and all of the floors exhibited evidence of repeated re-surfacing or renewal. No evidence of catastrophic fires was observed in either Block 2 or Block 5, which if present might indicate that the structures were abandoned prematurely. Taken together, these observations suggest that at least two maximum earthlodge use-lives are represented. In addition, sediment rip-up clasts in the fill above the upper floor or H26 suggests that the occupation may have continued after the upper or second earthlodge was no longer in use.

The maximum use-life of an earthlodge is not known with certainty. Wilson (1934:372) offers a value of seven to ten years as an "ordinary" use-life.

Toom (1992) and Lensink (2005) suggest maximum use-lives of 15 to 20 years, although their estimates are for long-rectangular earth-banked lodges built with hardwood posts and Roper's (2005) analysis implies that those longer use-lives may be too long for the structures at Molander. Given a use-life of 10 years, the Plains Village occupation at Molander must have been at least 20 years long. Of course, it is possible that earthlodges were constructed elsewhere within the settlement either before or after the structures represented by the H6 and H26 depressions. For that reason, 20 years should be regarded as the site's minimum occupation duration.

A relatively brief occupation duration is supported in a general way by the absence of mounded midden deposits at the site. Moreover, the complex superpositioning of features observed in Blocks 3 and 4 need not require a longer duration: if a single storage pit remains serviceable for 4 or 5 years, then one might expect 4 or 5 superimposed pits to accumulate at any given location during a 20-year period, assuming that much of the village's non-residential area was given over to storage features (Ahler and Kvamme 2000).

Earthlodge and Fortification Design and Construction

Stratigraphic data from Block 2 show clearly that the pre-settlement surface was stripped away before the H26 earthlodge was built. Based on a comparison of soil data from Block 1 (Units 1 and 4) with soil data from the wall of Feature 7 in Block 2, it appears that all of the A horizon and about 20 cm of the B horizon were removed prior to construction. The floor of the H6 earthlodge exposed in Block 5 was also built on B horizon sediment, although the extent of B horizon removal was not calculated for that structure. For both cases, the extent of sediment removal can be compared to that observed in Block 3, which is interpreted as an area between earthlodges. In that block at least a portion of the pre-settlement A horizon appeared to have been preserved. In addition, coring data indicate that sampled hearth features are buried by 18 to 30 cm of sediment. That depth brackets the upper and lower floors of the H6 and H26 lodges; the Feature 13 exterior hearth in Block 3 was just 12 cm deep.

These data likely indicate that both earthlodges were built over pits as much as 25 or 30 cm deep. However, data from Block 1 (Units 7, 11, and 16) suggest that extensive surface stripping also occurred in at least some portions of the site. The presence of rip-up clasts, possibly representing sediment from the ditch excavation, in the fill above intact B horizon sediment in Block 1 suggests that at least some of that surface stripping may have occurred early in settlement's history, prior to or during the construction of the fortification but certainly before the ditch was filled with village debris. Overall, the elevation of the site surface is lower inside the ditch than it is outside (figures 2.5 and 2.23), which may indicate that surface stripping was a widespread phenomenon. Of course, much of the stripping may have occurred routinely throughout the period of occupation, as the residents excavated borrow basins to obtain sediment for earthlodge repair or reconstruction.

As noted in the "Late Plains Village Occupation History" section, both of the earthlodges investigated in 2018 contained prepared floors. Three different types of floor were observed during the 2018 testing. The upper floors in both the H6 earthlodge (Block 5) and the H26 earthlodge (Block 2) consisted of compact gray-brown stratum containing numerous thin layers of white sediment. The white sediment layers were generally 1 to 2 mm thick. Compact gray clay layers occurred between the white layers. Each pair of gray and white microstrata are believed to represent a single floor re-surfacing event, with the gray stratum laid down first as a base coat and filler and the white stratum laid down as a topcoat.

The lower floors of both earthlodges differed from the upper floors, as well as from each other. The lower floor of H26 consisted of platy gray clay laid directly on the truncated B horizon surface. A white top coat was lacking; it may never have been applied or may have been removed by foot traffic and not replaced before the earthlodge was dismantled and rebuilt. The platy character of the floor material may indicate that it was applied in a saturated or puddled state. The lower floor of H26 was unprepared and instead consisted simply of truncated B horizon sediment.

The extent of the 2018 testing effort was too limited to provide data on the sizes and main features of Molander's earthlodges. However, the 2018 GPR survey did provide important data on H11, located in the site's northeast quadrant. The GPR data reveal the lodge perimeter, the central hearth, and the southeast-facing entryway. Interior pits along the earthlodge walls may be represented by four discrete GPR anomalies. Significantly, the interior floor of H11 is approximately 18 m in diameter, some 50 percent larger in diameter and 225 percent larger in area than the H11 surface depression. The entryway of H11 is approximately 5 m in length.

Spoil from the excavation of the fortification ditch was piled primarily on the outside of the settlement. That arrangement differs from Heart and Knife region villages occupied prior to the widespread availability of firearms. However, the spoil bank consists almost exclusively of displaced till from the deepest part of the ditch. Oahe Formation sediment, which overlies the till on the T3 terrace, is not present above the pre-settlement surface and below the displaced till as would be expected if the ditch fill stratigraphy were directly inverted or "reversed." The magnetic data suggest that a portion of the upper ditch fill may have been piled on the inside, which is the usual configuration. However, analysis of the DSM suggests that much of the removed fill is missing from the area immediately inside and outside the ditch. That fine-grained fill may have been stockpiled for use in covering earthlodges. The fact that the till—which includes clasts up to 25 or 30 cm in diameter—was piled outside the village may simply reflect its unsuitability as a living and working surface.

Only limited data were obtained on the configuration of the fortification's palisade. A single post mold (Feature 2) was observed in the Block 1 excavation trench north of the ditch and that feature may or may not represent the position of the palisade. Additional analysis of the size and morphology of the fortification ditch is presented in chapter 11.

Feature Summary

The 2018 testing project exposed and sampled a total of 15 cultural features, including eight pits, two post molds, three hearths or surface burns, a rock cluster, and the surface-visible fortification ditch. Table 2.9 summarizes data on each of the identified features.

Post-Occupation Disturbance

Two processes were primarily responsible for post-occupation disturbance to Molander's Late Plains Village component. The more significant of the two was the establishment and operation of a homestead on the site in the late nineteenth and early twentieth centuries. The homesteaders built at least three and probably four or five structures on the eastern edge of the site, established two access roads across the southern edge of the site, installed two or more cross-fences, and excavated at least three and perhaps many more pits for trash and waste disposal. The homesteaders also plowed more than half of the site.

Two of the four 2018 excavation blocks (Blocks 4 and 5) were located within the plowed area as defined by characteristic features in the magnetic and microtopographic datasets. However, the effects of plowing are only readily apparent in Block 4. The uppermost stratum observed in that block was homogenous, contained relatively few artifacts, and was 20 to 25 cm thick. (The thickness of the plowzone may be slightly less than the original depth of plowing due to aeolian erosion during the period of cultivation.) An abrupt lower boundary occurred between the overlying homogeneous sediment and the underlying intact village-age deposits. In Block 5, the uppermost layer was similar in character but just 10 to 12 cm thick and the lower contact was less abrupt. In addition, a post-occupation A horizon may have begun to form in Block 5, possibly indicating that if plowing occurred there it was early in the occupation of the homestead. the depth of plowing in

A plowzone was not detected in Blocks 1, 2 or 3, all of which were located outside the inferred area of plowing. However, recent historic artifacts, including bottle glass, wire, and concrete, were relatively abundant in the upper levels of Block 1 and Block 2; none were observed in Block 3. The specific mechanism through which these materials were incorporated into subsurface strata was not determined. However, rodent burrowing—the second major process responsible for post-occupation disturbance—is the most likely cause. The strata containing recent historic artifacts also contained abundant village-age artifacts and numerous mammal-sized krotovina were observed during the excavation, particularly in the upper 30 cm of the site's deposits. Especially in Block 2, but also in Blocks 1, 4, and 5, intersecting burrows formed a nearly continuous "biomantle" in the upper 20 cm of sediment. The effects of rodent burrowing are complex and not fully understood but one common result of prolonged rodent activity is the formation of a homogenized layer of sediment known as a biomantle that extends to the depth of the animal's feeding tunnels, which generally occur between 10 and 30 cm below the surface (Mitchell and Sturdevant In Press).

At Molander, the approximate depth of the lower edge of the biomantle and the depths of the upper earthlodge floors (at least in Blocks 2 and 5) are roughly equivalent. That correspondence means that the preservation of the most recent earthlodge floors is poor, and notably poorer than the preservation of the lower floors, although the lower floors also have

Table 2.9. Summary data on identified cultural features.

Feature	Block	Unit(s)	Feature Type	Sampled Volume (L)	Dimensions (cm)	
					Maximum Depth	Maximum Diameter
1	4	2	Post mold (recent)	5.0	15	25
2	1	7	Post mold	4.3	23	23
3	4	2-3	Basin-shaped pit	172.2	25	130
4	4	2-3	Hearth	187.0	>30	>140
5	3	9-10	Pit	22.4[a]	40	75
6	4	2-3	Pit	130.4	55[d]	n/d
7	2	5-8	Cache pit	317.6	66	96
9	3	9-10	Cache pit	112.8[a]	70	60
10	5	12	Basin-shaped pit	71.2	25	80
11	5	13	Cache pit	196.2	65	83
12	1	14-16	Ditch	618.18	n/d	n/a
13	3	9	Hearth	0[b]	25	>55
14	5	12	Surface burn	0[b]	<5	90
15	3	9-10	Cache pit	0[c]	n/d	n/d
16	5	13	Rock cluster	0	n/a	n/a

[a] Additional feature fill included in mixed lots.
[b] Not excavated separately.
[c] Not excavated.
[d] See text.

been affected by burrowing. Nevertheless, sections of the upper floors are preserved.

The site's modern surface exhibits a nearly continuous distribution of rodent backdirt piles. However, very little evidence of active burrowing was observed in 2017 or 2018. This suggests that the population of burrowing mammals (northern pocket gophers) has varied over time. The period of maximum animal population likely predates the late 1990s, based on a qualitative assessment of aerial imagery available on Google Earth.

Prior summaries of Molander's Plains Village occupation suggested that the fortification ditch may have been modified or "cleaned out" when the property was acquired by the SHSND (e.g. Lehmer *et al.* 1978:434-435). As noted in chapter 1, Lewis's 1883 description of the site casts doubt on that possibility. Excavation data from Block 1 clearly demonstrate that the topographic expression of the ditch was not altered significantly after the Plains Village occupation ended. If the ditch had been re-excavated in the twentieth century, a substantial spoil pile would have been created. No evidence of such a pile was observed in Block 1, either inside or outside the village. Instead, the principal spoil bank consists mostly of till from the bottom of the ditch. Historic artifacts in the upper layers of ditch fill include items related to the homestead, which were deposited prior to SHSND acquisition of the property.

3

Collection Chronology and Analytic Units

Mark D. Mitchell

At least three archaeological components occur at Molander. The most recent consists of a homestead represented by a fieldstone house foundation, the remains of at least two outbuildings, several trash pits, and an extensive artifact scatter. The next oldest component consists of an earthlodge village represented by earthlodge depressions, a bastioned fortification system, and a thin but extensive midden deposit. The oldest component or components consist of one or more camps represented by a large but likely sparse scatter of chipped stone tools and flaking debris.

Collection Chronology

Theodore H. Lewis's map of the Molander site indicates that the homestead was established prior to October 1883. Albert Hansen occupied the property at least by December 1882 and purchased it from the Northern Pacific Railroad Company and The Farmers Loan and Trust Company, the first mortgage holder, in February 1888. Ten years later, in May 1898, Hansen sold the property to Gustav Molander, who in turn sold it to the State of North Dakota in December 1935. The artifacts in the 2018 collection associated with the recent historic homestead primarily date to the period between the late 1880s and the early 1920s.

The age of the site's oldest occupation or occupations is unknown but is roughly bracketed by a radiocarbon date and by patination data on flaking debris and stone tools. A probable maximum age of 6300 cal B.P. is provided by

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a bulk sediment date on the A horizon of a moderately well-developed soil formed in fine-grained deposits that directly overlie Coleharbor Formation till deposits. That soil may correspond to the Thompson paleosol, which formed near the base of the Riverdale member of the Oahe Formation.

A possible minimum age for the site's oldest occupation or occupations is provided by artifact patination data. Eighty percent of the patinated coarse-fraction flakes (G2-G3) exhibit moderate or pronounced patination on at least one face, as do 60 percent of the G4 flakes. Assemblages exhibiting this degree of surface patination are commonly considered to be at least 1,500 years old (Ahler *et al.* 1981:234; Root *et al.* 1986:440-446; VanNest 1985). The absence of Woodland pottery in the assemblage suggests that the Molander's pre-Plains Village component may be Archaic in age. The number of pre-Village occupations at Molander is not known, although circumstantial evidence suggests that at least two are present. Artifacts positively associated with the site's oldest component consist of patinated KRF and chalcedony flakes and chipped stone tools. No temporally diagnostic artifacts are associated with the site's oldest occupation.

Late Plains Village Component

Both historical and archaeological data bear on the age of Molander's Late Plains Village occupation. A minimum age and a probable date of abandonment are provided by historical maps and descriptions. Archaeological data provide estimates of the settlement's median age and occupation duration.

Historical Data

As detailed in chapter 1, a likely *terminus ante quem* of 1764 is provided by information recorded in William Clark's field notes. Clark reported that on October 23, 1804 the expedition "passed an old [village] of a Band of Me ne tarres Called Mah har ha where they lived 40 year ago (*i.e. 1764*) on the L. S. (*larboard or left side of the boat or, in this case, river right*)" (Clark 2005a; italicized text added). Molander is the only eighteenth-century site located on either bank along the stretch of river that the expedition traversed that day; their October 23 camp was located on the left (east) bank, immediately below what is now known as Painted Woods Lake, roughly 10 river-kilometers above Molander (figure 1.5).

Although a literal reading of Clark's journal entry only indicates that the Awaxawi were *in residence* at Molander in the mid-1760s, it is reasonable to infer that he meant that they lived there *until* the mid-1760s. Whether Clark meant to indicate that the Awaxawi abandoned the site *exactly* 40 years earlier, or *about* 40 years earlier is unknown.

As detailed in chapter 1, there is every reason to regard as accurate the information Clark reported in his October 23 field note. However, a map produced in 1791 by Edward Jarvis and Donald Mackay, which illustrates the situation Mackay observed when he visited the region in 1781 (Wood 2010), hints at the possibility that the Awaxawis remained at Molander until that time. Nevertheless, given the variable scale and schematic character of the Jarvis and Mackay map, it seems more parsimonious to infer that the Awaxawis were in residence at the Mahhaha site, or another nearby and possibly no longer extant site, when Mackay visited in 1781.

Molander was certainly abandoned prior to 1786 or 1787, when James Mackay traveled to the Knife region from the North West Company's Fort Espérance on the Qu'Appelle River (Wood 2003). Mackay reported that the Awaxawi were at the time living in one of five villages at the mouth of the Knife. Molander does not appear on a map of the region made by John Evans in the winter of 1796-1797, which shows the locations of five settlements near the mouth of the Knife River, six more (including the then-occupied Greenshield site) just above Painted Woods Lake, and one just below the mouth of the Heart River (figure 1.6). In addition, Toussiant Charbonneau, Lewis and Clark's interpreter, told Maximilian in the winter of 1833-1834 that the Awaxawis had established the Amahami site at the mouth of the Knife at least by the winter of 1797-1798 (Witte and Gallagher 2012:116, 121-122).

Archaeological Data

A median date for Molander's Plains Village occupation can be estimated from the density of metal and glass trade goods recovered during 2018. Since the 1980s, multiple analyses have contributed to the development of this semi-quantitative dating method. Ahler and Drybred (1993) were the first to explore patterns of chronological change in the types and densities of trade metal and glass beads in the northern Middle Missouri. Their primary sample of metal artifacts comes from four Late Plains Village sites, including Lower Hidatsa, Big Hidatsa, and

Sakakawea (Awatixa) villages located at the mouth of the Knife River and On-A-Slant Village located at the mouth of the Heart. Noting possible between-site differences in metal artifact fragmentation patterns, Ahler and Drybred chose to focus their density analysis, expressed in term of counts per cubic meter, on the coarse-fraction (G1-3) sample. They also analyzed temporal trends in patterned metal artifacts within a larger sample that includes nine additional Knife region sites. Their analysis of glass beads utilizes similar datasets: density data from the four primary sites, coupled with an analysis of temporal trends in bead size, color, and other properties within a larger sample that includes 11 additional sites.

Ahler and Drybred (1993:333) conclude that "beads and metal artifacts were integrated into the native cultures at different rates and in different ways." Metal artifacts appeared before beads, but only in very low numbers at first. The rate of metal artifact discard increased in the middle of the eighteenth century and remained steady thereafter. Glass beads followed a somewhat different pattern: as was true for metal artifacts the rate of bead discard increased in the middle of the eighteenth century, but after than time continued to increase exponentially. Ahler and Drybred (1993:336) further note that data on temporal trends in the type and density of metal and glass trade goods "provide relatively rigorous measures of temporal changes which may in turn be helpful for assessing the chronological placement of other archeological samples."

Ahler (1997) subsequently re-examined the relationship between trade goods densities and median dates for site-specific time periods at Sakakawea (Awatixa), Lower Hidatsa, and Big Hidatsa villages. Finding strong correlations between log-transformed artifact density values and median component (batch) dates (r^2= 0.949 for beads and 0.962 for metal), he used an equation derived from multiple linear regression to compute median dates for two post-1600 time periods at On-A-Slant Village.

Mitchell (2013a) used log-transformed density data to illustrate the utility of the density method for dating post-1600 sites in the Heart region. Mitchell's analysis (2013a:Figure 5.1) combined counts of metal artifacts in all size grades (G1-5) with counts of glass beads and for the first time integrated data from both the Knife and Heart regions in a single model. Mitchell's correlation is slightly lower than that of Ahler's On-A-Slant analysis but is still robust (r^2=0.82).

However, despite the observed strength of the relationship between recovered trade goods density values and median component age, there are a variety of reasons to use the method cautiously. Mitchell (2013a:92) notes that the specimens used to calculate density values are in fact fragments of what had once been complex artifacts comprised of both perishable and non-perishable components. The original form or provenance of those artifacts commonly is not known, and a wide variety of post-depositional processes affected the size, form, and distribution of recovered fragments. For those reasons, changes in trade goods densities do not directly monitor trade relationships or the processes of cultural or technological change that occurred during the fur trade era.

Moreover, density measurements for any artifact class reflect a variety of factors, including per capita discard rates, population, and component duratin (Surovell 2009). Spatial variations in artifact use and discard may also have a significant effect on density measurements, particularly in highly organized, long-term settlements such as an earthlodge village (Goulding 1980).

The density method should also be regarded as semi-quantitative. Linear regression is a robust statistical method that makes several assumptions about the structure of the analyzed dataset and about the relationships among variables. The dataset used in this analysis meets several of those assumptions, such as the assumptions of normality and of homoscedasticity (constant variance of errors). However, the two model variables—log-transformed density and median date—are not entirely independent. This is particularly true for the On-A-Slant Village sample because Ahler (1997) used the results of his regression to calculate median component (batch) ages. Values for a number of other samples are partially autocorrelated, because trade goods densities were used in combination with pottery and stratigraphic data to estimate median batch ages. However, batch ages were determined independently for most nineteenth-century samples, for which historical documentation is available.

Nevertheless, with these caveats in mind, the analysis of trade goods density values remains a valuable tool for estimating median date ranges of archaeological samples, just as Ahler and Drybred predicted.

The comparative dataset for the Molander analysis initially included 22 samples from nine sites. Two samples were included for Time Period 4 (TP4) at Big

Hidatsa Village (Batch 67), one of which comprised all materials assigned to that batch and another of which excluded materials from Archaeological Context 3 (AC3). Ahler and Drybred (1993:296-297) argue that the age of AC3 deposits—which contain a high density of metal artifact fragments—is uncertain and for that reason excluded them from their analysis. Both TP4 samples were initially retained in the current analysis to determine whether the AC3 deposits still represent an outlier within a larger dataset. In addition, all batches from Sakakawea (Awatixa) Village were combined into a single sample. Ahler and Drybred (1993) included four separate batch samples from Sakakawea (59-62) and Ahler (1997) included three (59-61). However, Sakakawea was occupied for less than 50 years and ongoing research at the site suggests that Ahler's batch definitions may require revision.

Two additional samples of containing trade goods, including one from Boley Village (TP2) and one from Double Ditch Village (TP3), were not included in the initial dataset. The TP2 sample from Boley is drawn from a single relatively small pit feature. The TP3 sample from Double Ditch includes many artifacts made from native rather than smelted copper, a circumstance that likely will require re-evaluation of the temporal context of some features assigned to that time period.

Two outliers were identified in a scatterplot of the initial 22 samples. As Ahler and Drybred previously observed, the comprehensive Batch 67 sample from Big Hidatsa exhibits an anomalously high density and was therefore removed in favor of the Batch 67 sample that excludes AC3. The single sample from Taylor Bluff (Batch 94) exhibits an anomalously low density. The Taylor Bluff density is just 13 percent of the TP1 sample from Big Hidasta (Batch 64), even though their median dates are essentially equivalent. This difference might be a product of sampling or it might indicate that the Taylor Bluff sample is in fact older than currently is estimated. (Pottery and modified stone data suggest that a mid-nineteenth century date for Taylor Bluff is appropriate, although the assemblage exhibits several atypical characteristics, including an unusually low proportion of small patterned bifaces and an unusually high proportion of unpatterned ground stone tools [see chapter 5].) Owing to uncertainty about its median age, the Taylor Bluff sample was excluded from the current analysis.

The remaining 20 samples from eight sites produce a coefficient of determination (r^2) of 0.902. Table 3.1 gives the model parameters, along with those of models developed by Ahler (1997) and Mitchell (2013a). (Although a quadratic solution yields a slightly higher coefficient of determination [r^2=0.908], a linear model was selected to permit the calculation of residual values and to simplify the calculation of Molander's median date range.) Figure 3.1 illustrates the model; green symbols represent Knife region samples, while orange symbols represent Heart region samples. The dashed lines that bound the regression line represent the upper and lower limits of the 95 percent confidence interval.

Figure 3.1 also illustrates two site-specific fit lines that reveal aspects of variability within the dataset. The slope of the Scattered Village fit line is somewhat lower than that of the overall regression line, but the density values for Scattered Village batches are higher than those for contemporaneous batches. This could indicate that the median dates for the Scattered Village time periods are too old. By contrast, the slope of the Lower Hidatsa Village fit line is greater than that of the regression line, but the density values for Lower Hidatsa batches are lower. This may indicate that the overall accumulation of trade goods at Lower Hidatsa was lower than at some other settlements, even if the rate of increase was higher.

Figure 3.2 overlays the Molander log-transformed density data on the northern Middle Missouri regression model. The calculated G1-5 metal and glass bead density for the 2018 sample from Molander is 19.179 specimens/m^3, which yields a $\log_{10}$ density value of 1.28. That density value intersects the regression at a median date of 1711 (1605 + 82.28(1.28)). By inspection, the range of median dates within the 95 percent confidence interval of the regression for that density value is 1663 to 1761.

Table 3.1. Regression model factors and coefficients of determination for trade goods density analyses.

Sample	Sites	Samples	Constant	B(x)	r^2
Ahler (1997)	3	13	1649.29	69.18($\log_{10}$(MetalG1-3/vol)) + 31.02($\log_{10}$(Beads/vol))	0.95 (beads); 0.96 (metal)
Mitchell (2013a)	6	17	1604.65	83.47($\log_{10}$(((MetalG1-5 + Beads)/vol))	0.82
This report	8	20	1605.20	82.28($\log_{10}$(((MetalG1-5 + Beads)/vol))	0.90

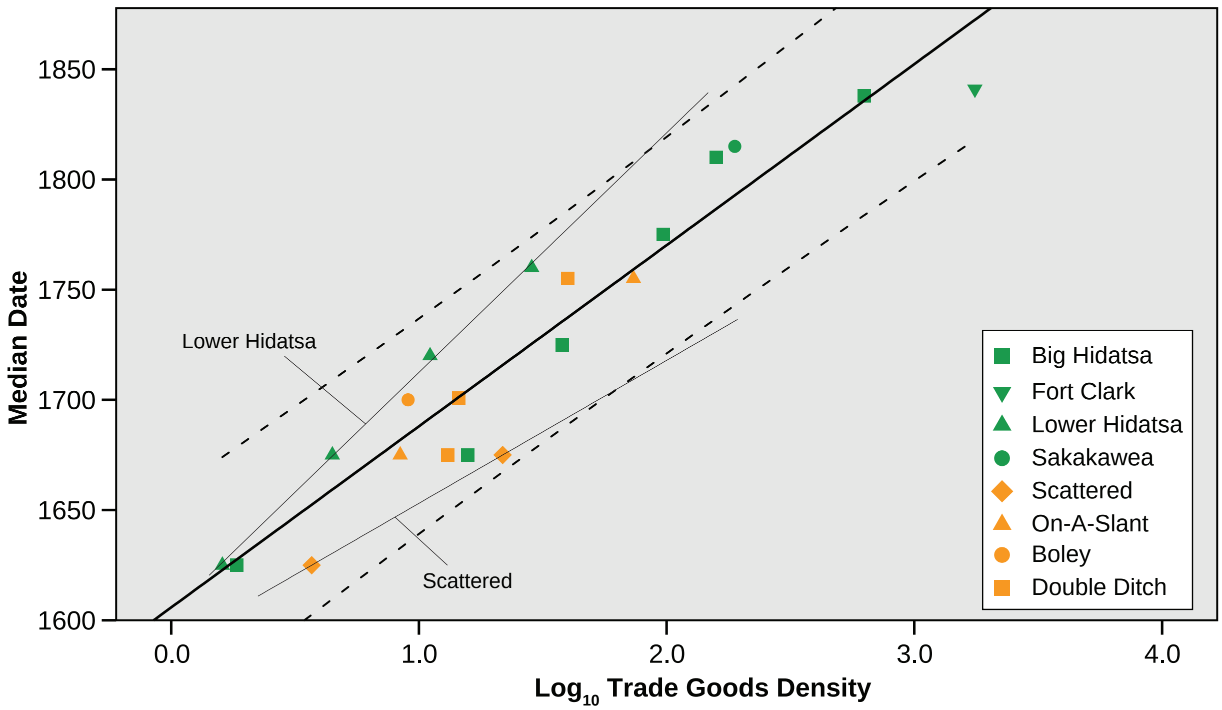

Figure 3.1. Bivariate plot of median calendar date and log_{10} density of G1-5 trade metal and glass beads for 20 batches from eight archaeological sites. Knife region sites are shown in green and Heart region sites are shown in orange. See text for explanation of reference lines.

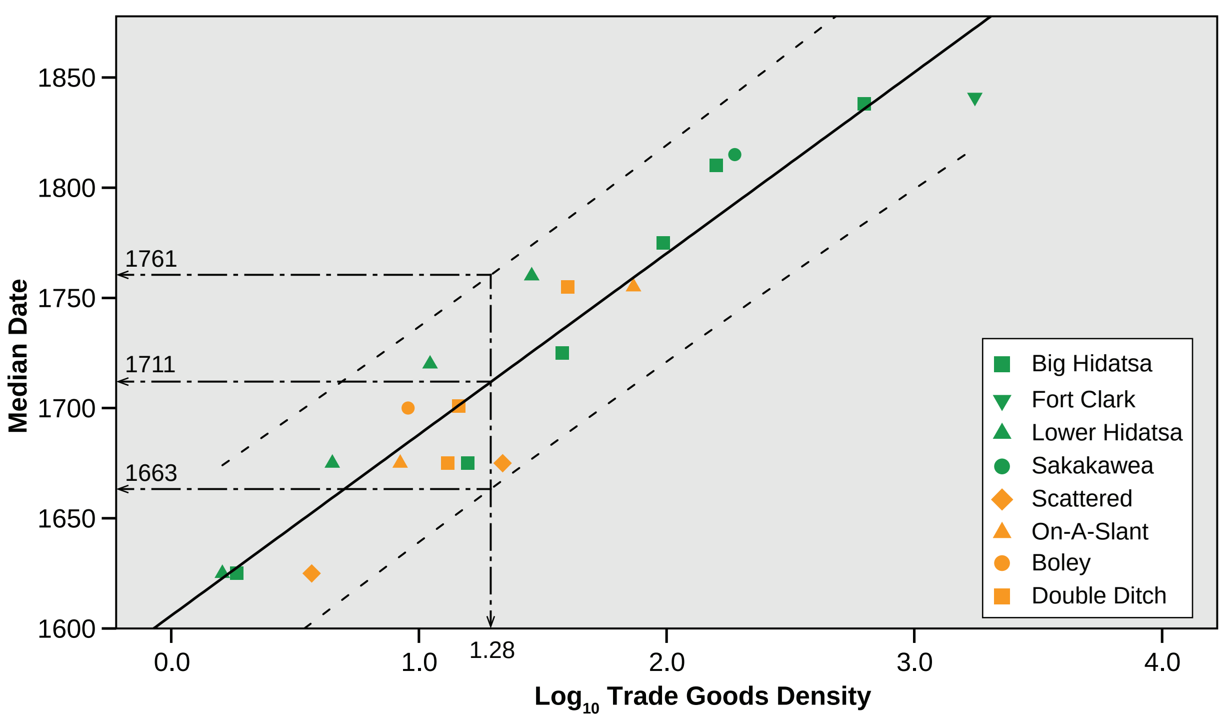

Figure 3.2. Bivariate plot of median calendar date and log_{10} density of G1-5 trade metal and glass beads for 20 batches from eight archaeological sites. Data for Molander are superimposed on the regression.

Other Chronological Data

Data on pottery, modified stone, and glass beads, which are described in detail in subsequent chapters, provide additional insights on the age of Molander's Late Plains Village occupation. Data on the sizes and types of glass beads recovered in 2018 confirm an eighteenth-century age for the occupation. Bead types indicative of an occupation during the first half of the 1700s are absent, although that absence could simply be a function of the small size of the assemblage.

Significant typological differences among contemporaneous pottery assemblages present challenges for the construction of regional ceramic chronologies (Mitchell 2013a). However, the mix of pottery types present in the Molander assemblage points to an eighteenth-century occupation. In addition, the virtual absence of "Normal" or "Classic" variety Le Beau ware vessels in the Molander assemblage may indicate that the median age of the Molander occupation was more recent than the median ages of TP1 at On-A-Slant Village or TP0 at Double Ditch Village, both of which are thought to span the period between 1725 and 1785.

Prior analyses of chipped stone raw material procurement in the Heart region, especially at Double Ditch Village, indicate a strong temporal pattern in the use of a toolstone known as smooth gray Tongue River silicified sediment (TRSS), the second most abundant raw material in the Molander assemblage (Ahler *et al.* 2004; Mitchell 2011a). From the 1500s through the mid-1700s, the abundance of smooth gray TRSS declined steadily from just under 40 percent to less than 20 percent. TRSS makes up roughly 8 percent of the Molander flake assemblage, a value consistent with eighteenth-century contexts at Double Ditch Village.

Occupation Duration

As described in chapter 2, stratigraphic data indicates that Molander's Plains Village occupation spanned at least two earthlodge use-lives. The most compelling evidence for this is the presence of two superimposed floors each in H26 (exposed in Block 2) and H6 (Block 5). None of the floors appear to have burned, suggesting that the deposits represent complete or nearly complete use-lives. Clasts of intact C horizon sediment in the fill above the upper floor of H26 further suggest that the site may have been occupied for some time after H26 was no longer in use.

The maximum use-life of an earthlodge is not known with certainty. Wilson (1934:372) offers a value of seven to ten years as an "ordinary" use-life. Toom (1992) and Lensink (2005) suggest maximum use-lives of 15 to 20 years, although their estimates are for long-rectangular, earth-banked lodges built with hardwood posts. Roper's (2005) analysis implies that those values may be too long for Molander's structures. Given a use-life of 10 years, the Late Plains Village occupation at Molander must have been at least 20 years in duration. Of course, it is possible that earthlodges were constructed elsewhere within the settlement, either before or after the structures represented by the H6 and H26 depressions. For that reason, 20 years should be regarded as the component's minimum duration; a duration of 30 years may be more realistic, given the small excavation sample size and resulting uncertainty about the temporal placement of H6 and H26 within the overall settlement occupation span.

Summary

Taken together, the archaeological data obtained during the 2018 field investigation offer no reason not to accept Clark's 1764 *terminus ante quem*, at least as an approximation. All of the available chronological data are consistent with a 30-year occupation that spanned the period between about 1735 and 1765. Based on the available archaeological and historical data, the Late Plains Village occupation at Molander was at least partially contemporaneous with occupations at six other settlements for which archaeological data are available (table 3.2). The ages of Molander's three components are summarized in table 3.3. Complete data on comparative batches are provided in appendix D.

Analytic Units

Nearly all of the artifact lots recovered in 2018 contain specimens associated with more than one of Molander's three primary occupations. For example, patinated KRF or chalcedony flakes occur in 66 of the 89 catalog lots (74 percent). Recent historic artifacts occur in 33 lots (37 percent). Accordingly, for particular analyses artifact attributes rather that stratigraphic data were used to partition the collected materials into analytic units. For example, the modified stone analysis partitioned the collection into two analytic units based on the presence of

Table 3.2. Inventory of components contemporaneous with the Plains Village occupation at Molander.

Region	Site Name	Smithsonian No.	Period	Batch No.[a]	Date Range
Heart	Double Ditch	32BL8	TP0	108	1725-1785
	On-A-Slant	32MO26	TP1	103	1725-1785
Knife	Big Hidatsa	32ME12	TP4 and TP3	67 and 66	1700-1790
	Lower Hidatsa	32ME10	TP2 and TP1	45 and 44	1700-1780
	Mahhaha	32OL22	TP1	29	1700-1780
	Nightwalker's Butte	32ML39	-	86	1700-1780
	Molander KNRI	32OL7	-	4	1700-1780
	Molander 2018	32OL7	PV	117	1735-1765

[a] See appendix D.

Table 3.3. Summary of Molander occupation chronology.

	Estimated Date (A.D./B.C)	
Component	Beginning	Ending
Recent Historic	1882	1935
Late Plains Village	1735	1765
Archaic/Woodland	4350 B.C.	A.D. 500

surface patination. Similarly, ferrous metal artifacts were assigned to "Plains Village" or "Recent Historic" analytic units based on the extent and type of surface corrosion. Details on the procedures used to partition the collection into analytic units, along with the rationale for applying them, are provided in subsequent chapters.

However, stratigraphic data were used to determine the proportion of excavated sediment that was deposited prior to the establishment of the Late Plains Village community. The purpose of this discrimination was to ensure that trade goods density calculations did not include the volume of natural terrace deposits underlying the settlement, which were exposed in Blocks 1 and 2. Accordingly, individual provenience lots were allocated either to a "pre-Plains Village" or a "Plains Village" temporal unit. In addition, a single catalog lot (CN1076 in Block 3), which consists of materials recovered from a deposit of uncertain age, was allocated to an "Unassigned" temporal unit. A total of 5,162 liters of excavated sediment was removed from proveniences allocated to the Plains Village temporal unit, which amounts to 84 percent of the total excavated volume.

Provenience units were also assigned to both specific and general depositional types and classified according to whether they occurred inside or outside an earthlodge. Three general deposit types are recognized: contained deposits, uncontained deposits, and mixed or unassigned deposits. Contained deposits occur within discrete features, such as storage pits or small borrow basins. Most contained deposits consist of discrete, basket-sized loads of domestic debris that accumulated rapidly. Artifacts in contained deposits generally are larger than those recovered from other deposit types and are mixed with ash, charcoal, faunal remains, and feces. Provenience lots from all of the numbered features investigated in 2018, apart from the fortification ditch (Feature 12), fall into the contained deposit class.

Uncontained deposits accumulated on surfaces or in large borrow basins or trenches, including fortification ditches. The rate at which these deposits accumulated varied significantly. Many defensive features were filled slowly by sediment deposited by wind and water, but domestic debris sometimes accumulated rapidly in large basins or in catastrophically burned lodges. Artifacts from uncontained contexts often are more fragmented and occur at lower densities than artifacts from contained deposits. The matrix of uncontained deposits generally consists of a mixture of sediment, ash, and charcoal, sometimes interspersed with discrete basket loads of primary domestic debris. Unconformities—representing temporal gaps of unknown duration—occur more frequently in uncontained deposits than contained deposits due to erosion and intentional sediment borrowing and transport. In the 2018 Molander collection, provenience lots from earthlodge floor deposits and exterior sheet midden deposits are allocated to the uncontained deposit class.

Mixed or unassigned deposits incorporate artifacts and sediment from two or more primary or secondary depositional contexts. Deposits derived from unknown, and possibly mixed, contexts also are included in this class, as are culturally sterile deposits. Provenience lots from Molander allocated to the unassigned deposit class include natural terrace deposits as well as the single lot in the unassigned temporal unit.

Table 3.4 is a crosstabulation of excavation volume data by temporal unit and general deposit type. Specific deposit type and general deposit type data for all excavated contexts are cross-tabulated in table 3.5.

Provenience lots allocated to the Plains Village temporal unit were also classified according to whether they were located on the interior or exterior of an earthlodge. Table 3.6 cross-tabulates specific deposit type with the provenience lots' relationship to an architectural feature.

Table 3.4. Excavation volume data (liters) organized by temporal unit and general deposit type.

	General Deposit Type			
Temporal Unit	Contained	Uncontained	Unassigned	Total
pre-Plains Village			984.5	984.5
Plains Village	1,549.2	3,612.9		5,162.1
Unassigned			13.1	13.1
Total	1,549.2	3,612.9	997.6	6,159.7

Table 3.5. Excavation volume data (liters) organized by general and specific deposit type.

	General Deposit Type			
Specific Deposit Type	Contained	Uncontained	Unassigned	Total
Cache Pit	779.1			779.1
Floor/Floor Fill		570.0		570.0
Midden		1,589.7		1,589.7
Midden and Floor		504.0		504.0
Pit	770.1			770.1
Surface		949.2		949.2
Terrace			984.5	984.5
Unassigned			13.1	13.1
Total	1,549.2	3,612.9	997.6	6,159.7

Table 3.6. Excavation volume data (liters) for Plains Village-age deposits organized by specific deposit type and relationship to earthlodge architecture.

	Earthlodge Relationship			
Specific Deposit Type	Inside	Outside	Unassigned/Unknown	Total
Cache Pit	513.8	265.3		779.1
Floor/Floor Fill	570.0			570.00
Midden		1,379.7	210.0	1,589.7
Midden and Floor	504.0			504.0
Pit	71.2	204.3	494.6	770.1
Surface	178.0	547.2	224.0	949.2
Total	1,837.0	2,396.5	928.6	5,162.1

4 Pottery

Mark D. Mitchell

The principal goals of northern Middle Missouri ceramic research have been chronological and taxonomic. Development of a "working culture-historic scheme or cultural chronology" was the primary aim of Ahler and Swenson's (1993:1) study of Knife region pottery, the largest and most comprehensive analysis undertaken in the northern Middle Missouri. More limited investigations, such as Ahler's (2001) study of museum collections from Plains Village sites in the Knife and Heart regions, have similarly focused on culture history. While primarily providing detailed descriptions of excavated collections, most site-specific analyses also have emphasized the identification of temporal patterning. Progress on ceramic culture history has been ongoing and although important questions remain the fundamental contours of stylistic change are now understood.

An important secondary goal of regional ceramic research has been the differentiation of Mandan and Hidatsa potting traditions. Progress on that goal has been spotty, primarily because the range of intra-tradition variation has only recently been appreciated. In addition, few assemblages from later Mandan sites were available when Ahler and Swenson conducted their regional study and determining the cultural affiliation of earlier sites was—and remains—challenging.

Regional research also has sought to understand how interaction with Europeans and Americans affected ceramic technology. Archaeologists have long recognized that significant changes occurred in Knife and Heart region pottery assemblages after 1650 or 1700, and that those changes accelerated in

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the nineteenth century after the advent of direct trade. Many argue that periodic outbreaks of European crowd diseases—coupled with economic changes prompted by the fur trade—were responsible, although Ahler and Swenson discuss an alternative hypothesis rooted in migration and cultural interaction. Evaluation of competing hypotheses has been hampered by the difficulty of comparing late-period Mandan pottery, samples of which mostly predate the period of direct trade, with late-period Hidatsa pottery, samples of which mostly postdate the advent of direct trade. A primary focus on pottery style, rather than technology, has also limited evaluation of alternative hypotheses (but see Hollenback 2012).

The analysis presented in this chapter has two primary goals. The first is to provide a basic description of the ceramic remains recovered during the 2018 fieldwork at Molander. The second is to determine the likely cultural affiliation of the site's primary occupation through synchronic comparisons with contemporaneous samples from Knife and Heart region sites across a range of stylistic and technological variables.

Five data tables in the project's database contain information about the pottery assemblage (appendices F and G). Data on ceramic category, vessel part, ochre staining, and surface treatment are contained in the "Pottery" table. University of Colorado student lab assistants collected those data, under the direction of PCRG Lab Supervisor Britni Rockwell. Vessel-specific data are contained in the "Pottery Vessel 1," "Pottery Vessel 2," and "Vessel Metric Data" tables. Data on unvesselized size grade 3 (G3) rim sherds are contained in the "Pottery G3 Rim" table. PCRG Research Director Mark Mitchell carried out the vessel matching study and collected typological, rim form, metric, and other data on the vessel assemblage. Mitchell also compiled the comparative data and wrote the chapter.

Overview of Analytic Methods

The analytic framework applied to the 2018 Molander pottery collection is a modified version of an attribute-based system that Stanley A. Ahler and Anthony Swenson (1985b) originally developed for their comprehensive quantitative and qualitative study of pottery recovered from four dozen sites located primarily in the Knife River region. Aspects of their system have been amended or altered over the last 20 years, primarily to accommodate differences between Knife and Heart region pottery assemblages, differences that were unknown when the system was first developed. New variables and attributes have been added to the original coding system as each successive project has revealed new ceramic types. The definitions of some variables and attributes have been clarified or amended.

The northern Middle Missouri ceramic coding system also now includes technological variables designed to study pottery production practices. Inspired in part by Ahler's (1984) Elbee site pottery analysis, technological variables were first incorporated in the northern Middle Missouri system during the Boley Village analysis (Ahler, Madden, and Mitchell 2006). Mitchell (2011a) later refined and slightly expanded the system's technological variables.

As has become common practice, a project-specific subset of the variables comprising the full ceramic coding system was applied to the 2018 Molander collection. The data collected capture basic information on the ceramic wares and varieties present and on selected morphological, metric, and technological attributes of the collection.

Rim and Body Sherd Separation and Body Sherd Analysis

The Molander pottery collection was first partitioned into four classes, including rim sherds and body sherds from full-sized vessels, all fragments of miniature vessels, and worked sherds. Slipped sherds and unidentified tempered objects, two other recognized ceramic classes, do not occur in the 2018 Molander collection. Some miniature vessels that exhibit manufacturing defects including poor paste preparation or haphazardly applied decorative motifs are interpreted as practice pieces made by children or novice potters (Mitchell 2013b:90-91), although others are well-made. Worked sherds include any rim or body sherd that exhibits post-breakage use-wear or modification.

Rim and body sherds from full-sized vessels were further classified according to the vessel zones present and to the angularity of the vessel shoulder. Each zone designates a vertical segment of a vessel's profile that is bounded by defined inflection points, which mark changes in the direction of the profile's curvature (Ahler and Swenson 1985b:5-7). Seven zones occur on northern Middle Missouri vessels. Zone 1 is the body of the vessel and zone 7 is the lip; all vessel forms incorporate these two zones. Zones

2 through 6 are special features of specific ceramic forms and may or may not be present in a particular vessel. The majority of pots, apart from simple bowls, exhibit a neck or mouth (zone 2) between zone 1 and zone 7. S-rim vessels, in which the upper rim curves inward, incorporate zone 3, the upper rim. Zone 4 is an outward curvature of the vessel wall, which only occurs on S-rim vessels and is located above zone 3. Pots incorporating zone 4 are known as "recurved S-rim" vessels. Zone 5 is a strap or coil of clay added to a vessel immediately below this lip, either on the exterior or the interior. Zone 6 (a fillet) is a strap of clay added to the exterior of zone 2, the neck.

Sherds that exhibit only zone 1 are regarded as "body sherds." Those exhibiting any other zone, or combination of zones, are regarded as "rim sherds." Rim sherds are further partitioned into "neck sherds," which exhibit only zone 2 or zones 1 and 2, "lip sherds" (only zone 7), and "multi-zone sherds" (any combination of zones 2 through 7).

Body sherds were further classified according to the presence of an angular shoulder. A small minority of northern Middle Missouri pots exhibit a sharply angular shoulder, where the curvature of the vessel wall changes abruptly and the angle between the upper and lower sections of zone 1 is close to 90 degrees. Commonly, a row of finger or tool impressions is applied to the apex of the shoulder.

Body sherds were quantified by exterior surface treatment and by the presence of pigment, primarily hematite or limonite. Surface treatment data were not collected on size grade 3 (G3) body sherds. Specimens in each sort class in size grades 1 and 2 (G1 and G2) were counted and weighed. G3 body sherds (zone 1 only) were weighed but not counted; for this class, estimated counts were calculated using a mean per-sherd weight of 0.5 g. G3 sherds in other sort classes were counted. (Weight data on G3 neck, lip, and rim sherds in the 2018 Molander assemblage, which were counted, suggests that a mean weight of 1 g/sherd, rather than 0.5 g/sherd, is a more appropriate value. However, the 0.5 g/sherd value was retained to estimate G3 body sherd counts for this analysis to permit density comparisons among assemblages.)

Metric data on simple-stamp spacing on size grade 1 body sherds and maximum vessel wall thickness on size grade 2 body sherds were not collected. Prior analyses have shown that the spacing of lands and grooves cut into the wooden paddles used to manufacture Plains Village pots varied over time (Ahler and Madden 2005). However, little is known about synchronic, between- or within-site variation in stamp spacing and the short duration of the Molander occupation precludes meaningful diachronic analysis. Recent work also has shown that maximum wall thickness data primarily reflect between-site pottery production practices, rather than regional temporal differences, and so cannot be used to seriate northern Middle Missouri ceramic assemblages (Ahler, Madden, and Mitchell 2006:112).

Vessel Matching and Coding

The modified Ahler and Swenson coding system was applied to vessels rather than individual rim sherds. Prior to analysis, individual catalog lots of neck, lip, and multi-zone sherds were closely examined and combined where possible into groups representing distinct pottery vessels. In a few instances, parent vessels were created by physically joining individual rim sherds (a "nuclear sherd family" [Orton *et al.* 1993:172]). More commonly, though, rim sherds exhibiting equivalent formal, technological, and decorative attributes were combined into a virtual parent vessel (an "extended sherd family" [Orton *et al.* 1993:172]). Many of the Molander vessels include both sherds that directly re-fit and those that exhibit comparable attributes.

The matching technique used to combine Molander rim sherds into vessels varied slightly from that used for other recent pottery analyses (e.g. Mitchell *et al.* 2007; Mitchell 2013b). The vesselization process began by affixing small paper labels to all of the G1 and G2 neck and multi-zone rim sherds. All multi-zone rims from each of the five excavation blocks were then examined simultaneously and only those sherds exhibiting clear, well-marked similarities were grouped into vessels. Neck (zone 2) sherds were then examined for re-fits or matches to the vessels created from multi-zone rims. Unmatched neck sherds were then removed from the vessel inventory and coded separately by surface treatment and pigment staining.

All G3 neck, lip, and multi-zone sherds were then systematically compared against the inventory of re-fit or virtual vessels created from G1 and G2 sherds and matching specimens were added. Unmatched G3 neck sherds were coded separately by surface treatment and pigment staining. No vessels consist solely of G3 sherds. Instead, unmatched G3 lip and multi-zone sherds were were coded against a limited subset of rim analysis variables. The decision to collected limited data on G3 lips and multi-zone sherds was prompted by the observation made during prior analyses that the vesselization process systematically excluded certain types of pots from the vessel inventory (Mitchell *et al*. 2007). Specifically, small, straight-rim pots may be more common in the G3 sample than they are in the G1-G2 sample. These vessels include small, special-purpose pots as well as undersized practice pieces.

Finally, the resulting numbered vessels consisting of G1 and G2 sherds, and in some cases G3 sherds, were then coded individually. Nominal data were collected on rim form class; pottery type; on the condition and shape of zones 3, 5, and 7; on types of appendages present; and on the number, spacing, and diameter of decorative cord impressions. Orifice sizes were estimated for the most complete vessels in the collection. Descriptions of pottery variables and attributes are provided in appendix G. The defining characteristics of relevant pottery wares and varieties also are described in appendix G.

Collection Summary

The 2018 Molander pottery assemblage consists of approximately 7,300 sherds that together weigh 8.3 kg (table 4.1). Counts for G3 sherds are largely derived from estimates; values for the numbers of G1 and G2 sherds represent actual counts. Pottery sherds are unevenly distributed among the five excavation blocks. More than one-third were recovered from Block 2 and more than half of the Block 2 sherds came from Feature 7, an interior storage pit. Another quarter of the assemblage was recovered from Block 5, nearly half of which came from Feature 11. Together, Features 7 and 11 account for 31 percent of the total assemblage, including 59 percent of the G1 sherds.

Just under 6 percent of the assemblage consists of rim sherds (including necks and multi-zone rims) from full-sized vessels (table 4.2, upper section). Worked sherds and fragments of miniature vessel together amount to just over 0.1 percent of the assemblage. The balance consists of body sherds (zone 1 only) from full-sized vessels.

Sherds exhibiting angular shoulders are virtually absent from the assemblage (table 4.2, lower section). The collection includes 245 potentially vesselizable G1 and G2 neck and multi-zone rim sherds, as well as 183 G3 neck, lip, and rim sherds could be added to vessels created through G1 and G2 sherd matching.

The matching process yielded a total of 75 different pottery vessels consisting of 144 G1 and G2 sherds. (Initially, 76 vessels were defined but during the coding process a single G2 sherd designated Vessel 33 was combined with two G2 sherds representing Vessel 44; Vessel 33 was thereafter eliminated.)

Forty-nine of the 75 vessels are represented by a single G1 or G2 multi-zone rim sherd (table 4.3). Another 13 consist of two matched sherds, while a further 13 consist of three or more matched sherds. The largest number of matched sherds is 12 (Vessel 22). Following the initial matching process, a total of 10 G3 sherds were added to seven different vessels. Another 83 G3 lip and multi-zone rim sherds were not assigned vessel numbers but were coded against a limited set of vessel variables.

The degree of fragmentation of the 2018 Molander pottery assemblage is similar to that of other recently obtained Heart region assemblages. Table 4.4 lists sherd weight distributions by size grade for Molander and five collections from four other sizes. Weight distributions for the Molander assemblage are similar to those for the Double Ditch Village collections.

Body and Neck Sherd Surface Treatment

Table 4.5 cross-tabulates exterior surface treatment

Table 4.1. Pottery sherd count and weight data organized by size grade and excavation block.

	Count				Weight (g)			
	Size Grade				Size Grade			
Block	G1	G2	G3	Total	G1	G2	G3	Total
1	4	94	1,056	1,154	105.8	378.6	543.6	1,028.0
2	30	322	2,157	2,509	574.5	1,090.6	1,105.9	2,771.0
3	18	138	899	1,055	355.9	583.3	474.5	1,413.7
4	5	83	602	690	71.2	270.5	301.1	642.8
5	31	292	1,563	1,886	612.3	1,076.4	802.7	2,491.4
Total	88	929	6,277	7,294	1,719.7	3,399.4	3,227.8	8,346.9

Table 4.2. Ceramic class (upper section) and vessel part (lower section) data, organized by size grade.

	Size Grade				
Class or Vessel Part	G1	G2	G3	Total	Percent
Body sherd from normal vessel	36	735	6,091	6,862	*94.1*
Rim sherd from normal vessel	51	190	181	422	*5.8*
Miniature sherd	-	2	3	5	*0.1*
Worked sherd	1	2	2	5	*0.1*
Total	88	929	6,277	7,294	*100.0*
Body sherd (zone 1 only)	36	734	6,093	6,863	*94.1*
Body sherd with angular shoulder	-	2	1	3	*<0.1*
Neck sherd (zone 2 or zones 1 and 2)	20	119	90	229	*3.2*
Lip sherd (zone 7 only)	-	-	26	26	*0.4*
Rim sherd (zones 2 and above)	32	74	67	173	*2.4*
Total	88	929	6,277	7,294	*100.0*

Table 4.3. Number of sherds comprising re-fit or virtual vessels.

Number of Sherds	Number of Vessels
One sherd	49
Two sherds	13
Three or more sherds	13
Total	75

and vessel part data for 997 body and neck sherds. Just less than two-thirds of the sherds exhibit simple-stamping. Another 29 percent exhibit plain exterior surfaces. All other surface treatments comprise less than 1 percent of the assemblage.

Comparative surface treatment data are presented in table 4.6. All of the listed site batches date to the eighteenth century. The upper section includes three Heart region sites, while the lower section includes eight Knife region sites. Within each section, batches are sorted by decreasing proportions of simple-stamped sherds. Comparable data on the 2018 Molander assemblage are listed in the table's bottom row.

Heart region assemblages feature high proportions of simple-stamped sherds (greater than 80 percent) and small but consistent proportions of decorated (incised, tool-marked, or cord-impressed) sherds. By comparison, most Knife region assemblages feature lower proportions of simple-stamped sherds and decorated sherds are comparatively rare. Check-stamped sherds are rare in all eighteenth-century assemblages.

Surface treatment proportions for three Knife region assemblages differ from the regional means. The Greenshield site assemblage exhibits the lowest ratio of plain to simple-stamped sherds among Knife region assemblages. (Note, however, that Nicholas and Johnson's [1986] surface treatment data yield a higher ratio, even when sherds exhibiting brushed treatment are excluded.) Greenshield likely dates to the 1790s (Chomko 1986). Although multiple components may be present, the largest and best-known represents a Sahnish (Arikara), rather than Mandan or Hidatsa, occupation.

Table 4.4. Proportional weight distributions of pottery sherds according to size grade for the Molander 2018 collection and five Heart region collections. Samples are arranged by decreasing proportions of G1 sherds.

	Size Grade			
Village	G1	G2	G3	Sample Size (g)
Boley	*31.6*	*39.9*	*28.5*	18,949
Double Ditch (2004)	*27.6*	*38.6*	*33.8*	128,729
Molander	*20.6*	*40.7*	*38.7*	8,347
Double Ditch (2002-2003)[a]	*20.5*	*41.4*	*38.1*	193,816
Chief Looking's	*18.5*	*45.6*	*35.9*	12,488
Larson	*11.1*	*35.4*	*53.6*	27,880

[a] Priority 1 contexts only.

Table 4.5. Surface treatment data for body (zone 1) and neck (zone 2) sherds. Body sherd counts include G1 and G2 specimens; neck sherd counts include G1, G2, and G3 specimens. Counts exclude worked and miniature vessel sherds. Values in *italics* represent within-vessel-part (column) proportions.

	Vessel Part	
Surface Treatment	Body	Neck
Plain	224	144
	29.1	*63.7*
Simple-stamped	500	5
	64.9	*2.2*
Check-stamped	2	-
	0.3	-
Brushed	1	57
	0.1	*25.2*
Decorated[a]	2	1
	0.2	*0.4*
Cord-impressed	-	1
	-	*0.4*
Eroded	42	18
	5.4	*8.0*
Total	771	226

[a] Includes incised and tool-marked specimens.

The other two Knife region batches featuring low plain-to-simple-stamped sherd ratios are those from Molander (KNRI) and Mahhaha (TP1) obtained by the Upper Knife-Heart project (Ahler and Swenson 1993; Wood 1986a) Differences between the 1968 and 2018 Molander assemblages could be a product of archaeological sampling; however, as table 4.7 shows, proportions of plain and simple-stamped sherds vary only modestly among the 2018 excavation blocks, a pattern which suggests that sampling is not the cause of the difference. It is possible that differences in field recovery methods are responsible, although G3 sherds are not included in the data presented in table 4.6 and so size-dependent bias is probably not the cause of the difference.

The reason for the low ratio of the Mahhaha assemblage is unclear. However, Mahhaha is a complex multi-component site that has been impacted by a homestead, by highway and railroad construction, and by plowing (Wood 1986a). Although the deposits were stratified, the extent of disturbance may have been somewhat greater than Ahler and Swenson (1993) assumed when they partitioned the collection into analytic batches.

Table 4.6. G1 and G2 body sherd surface treatment data for eighteenth-century batches from the Knife and Heart regions. Data for Knife region sites are from Ahler and Swenson (1993:Table 17.1, Table 17.2). Heart region data are from Ahler and others (2006:Table 18), Speakman and others (1997:Table 45), and Ahler and Madden (2005:Table 21).

		Surface Treatment				
Site	Period	Plain	Simple-stamped	Check-stamped	Decorated	Sample Size
Boley	1675-1725	*7.8*	*89.0*	*0.0*	*3.2*	1,004
On-A-Slant	1725-1785	*12.6*	*84.3*	*0.0*	*3.1*	1,354
Double Ditch	1725-1785	*14.7*	*81.6*	*0.8*	*2.9*	2,656
Heart Region Means		*11.7*	*85.0*	*0.3*	*3.1*	5,014
Greenshield	1780-1800	*10.0*	*87.0*	*0.0*	*0.0*	939
Mahhaha	1700-1780	*11.0*	*83.0*	*2.0*	*1.7*	359
Molander KNRI	1700-1780	*14.0*	*81.0*	*2.0*	*0.1*	677
Nightwalker's Butte	1700-1780	*20.0*	*78.0*	*0.0*	*0.0*	1,227
Big Hidatsa	1745-1790	*25.0*	*72.0*	*1.0*	*0.3*	2,046
Lower Hidatsa	1700-1740	*32.0*	*67.0*	*0.0*	*0.4*	902
Big Hidatsa	1700-1745	*31.0*	*67.0*	*1.0*	*0.1*	1,596
Lower Hidatsa	1740-1780	*33.0*	*61.0*	*0.0*	*1.9*	721
Knife Region Means		*22.0*	*74.5*	*0.8*	*0.6*	8,467
Molander 2018	1735-1765	*30.7*	*68.6*	*0.3*	*0.3*	728

Table 4.7. G1 and G2 body sherd surface treatment for the 2018 Molander collection organized by excavation block.

	Surface Treatment				
Block	Plain	Simple-stamped	Check-stamped	Decorated	Sample Size
1	*55.9*	*44.1*			59
2	*29.1*	*70.5*		0.4	254
3	*25.9*	*73.2*		*0.9*	112
4	*33.3*	*63.8*	*2.9*		69
5	*27.8*	*72.2*			234
Total	*30.7*	*68.6*	*0.3*	*0.3*	728

Overall, the 2018 Molander body sherd assemblage is more like eighteenth-century Knife region assemblages than eighteenth-century Heart region assemblages. Molander's ratio of plain to simple-stamped sherds (roughly 0.45) is closer to the Knife region ratio of 0.29 than to the Heart region ratio of 0.14. Decorated body sherds, which are relatively common in Heart region assemblages, are virtually absent from the 2018 Molander assemblage, as they are from most Knife region assemblages.

Vessel Analysis

Table 4.8 provides a breakdown of the 75 identified vessels in the Molander 2018 sample according to rim form class. Straight-rim vessels comprise 56 percent of the assemblage, while S-rim vessels comprise 43 percent. A single bowl is present in the collection. Table 4.9 provides rim form class data on 83 unmatched (unvesselized) G3 rim sherds. Fourteen of the 83 can be positively allocated to either a straight rim group (six sherds) or an S-rim group (eight sherds). However, most of the 46 lip and brace fragments likely represent straight rim vessels, suggesting that vessels of that type are overrepresented in the unmatched G3 sherd assemblage and therefore underrepresented in the vessel assemblage.

Table 4.10 compares the proportional distribution of rim form classes in the 2018 Molander assemblage to distributions in eight Knife region and three Heart region batches, all of which date to the eighteenth century. Data for Double Ditch and On-A-Slant villages are taken from Mitchell (2011a). Data for Boley Village are taken from Ahler, Madden, and Mitchell (2006). Knife region data are compiled from Ahler and Swenson (1993:Table 17.1 and Table 17.2). To simplify the comparison, frequencies of certain fragmentary rim forms, as well as those incorporating fillets (which are uncommon on Knife region vessels and absent on contemporaneous Heart region vessels), are excluded from the data shown in table 4.10. In addition, the frequencies of vessels featuring interior braces are combined with those of unbraced vessels in the same basic rim form class.

Marked differences in the distributions of rim form classes exist between contemporaneous Heart and Knife region assemblages. Simple (unbraced) S-rim vessels make up half to two-thirds of Heart region assemblages. Knife region assemblages exhibit similar proportions of braced straight-rim

Table 4.8. Pottery rim form class frequencies.

Rim Form Class	Frequency
Bowl	1
Straight rim	12
Straight rim with brace	27
S-rim	21
S-rim with exterior brace	6
Zone 2-3 fragment	2
Lip fragment with exterior brace	1
Zone 3 fragment	1
Straight rim with interior brace	1
S-rim with interior brace	2
Straight rim with brace and fillet	1
Total	75

Table 4.9. Rim form class frequencies of unmatched G3 rims.

Rim Form Class	Frequency
Lip	23
Straight rim	5
Straight rim with brace	1
S-rim	5
Lip with brace or brace fragment	46
Zone 3 fragment	3
Total	83

Table 4.10. Comparison of eighteenth-century vessel assemblages according to collapsed and adjusted rim form classes. Batches within each regional group are sorted by decreasing proportions of simple (unbraced) S-rim vessels.

			Rim Form Class						
Region	Batch	Site	Straight Rim	Straight Rim + Brace	S-Rim	S-Rim + Brace	Recurved S-Rim	Recurved S-Rim + Brace	Sample Size
Heart	108	Double Ditch	*3.0*	*20.8*	*62.2*	*6.3*	*6.3*	*1.5*	336
	112	Boley	*3.1*	*24.6*	*50.8*	*15.4*	-	*6.2*	65
	103	On-A-Slant	*2.9*	*23.5*	*47.1*	*13.2*	*7.4*	*5.9*	68
Knife	45	Lower Hidatsa	*14.9*	*44.8*	*34.3*	*4.5*	-	*1.5*	67
	29	Mahhaha	*20.5*	*43.2*	*29.5*	*6.8*	-	-	44
	44	Lower Hidatsa	*15.2*	*48.5*	*24.2*	*10.6*	*1.5*	-	66
	67	Big Hidatsa	*17.6*	*58.8*	*16.7*	*5.9*	-	*1.0*	102
	4	Molander KNRI	*20.6*	*61.9*	*14.4*	*1.0*	*1.0*	*1.0*	97
	66	Big Hidatsa	*12.6*	*63.0*	*12.6*	*10.4*	*1.5*	-	135
	86	Nightwalker's Butte	*23.2*	*70.7*	*3.7*	-	*1.2*	*1.2*	82
	19	Greenshield	*6.3*	*72.6*	*2.1*	*15.8*	*2.1*	*1.1*	95
-	117	Molander 2018	*18.6*	*40.0*	*32.9*	*8.6*	-	-	70

vessels. Unbraced straight rims make up one-sixth to one-quarter of Knife region assemblages but only 3 percent of Heart region assemblages. Conversely, recurved S-rim vessels make up roughly 6 to 13 percent of Heart region assemblages, but just 1 to 2 percent of Knife region assemblages. As is true for surface treatment, the Greenshield site assemblage stands out within the Knife region group: Greenshield exhibits the lowest percentage of simple straight rims and the highest proportions of braced straight rims and braced S-rims.

Overall, the 2018 Molander assemblage has more in common with Knife region assemblages than Heart region assemblages. Although its percentage of braced straight rim vessels is lower than any of the Knife region batches, and its percentage of S-rim vessels is higher than all but one, the proportions for Molander are nevertheless distinct from those of any of the Heart region sites. The proportions that Ahler and Swenson (1993) recorded for their Molander sample differ from those recorded for the 2018 sample. The Knife region assemblage most like the 2018 Molander assemblage is Batch 29 from Mahhaha.

Wares and Varieties

Table 4.11 lists the frequencies of the wares represented in the 2018 Molander assemblage. The characteristics of northern Middle Missouri pottery wares are summarized in appendix G.

Just over one-third of the vessels are assigned to the Knife River ware group (figures 4.1 and 4.2). Knife River ware vessels are medium- to large-sized jars exhibiting evenly out-curving rims and prominent exterior braces. Prior Heart region analyses have partitioned Knife River ware vessels into two varieties, including Knife River Large (or Classic) and Knife River Intermediate (or Indeterminate) (Ahler *et al.* 2002:11.19-11.20). The Knife River Intermediate group was created to isolate vessels that exhibited greater technical quality and decorative elaboration than Knife River Classic vessels, but lower technical quality and decorative elaboration than Knife River Fine vessels. However, the metric and morphological distinctions between the two Knife River ware varieties (Large and Intermediate) have never been specified and so the Molander analysis recognizes only the Knife River Large variety (see appendix G for additional discussion). Two decorative types are present in the Molander assemblage: five of the

Table 4.11. Pottery ware frequency data.

Pottery Ware	Frequency
Late Straight Rim	15
Late S-rim	21
Le Beau	3
Knife River	27
Knife River Fine	1
Transitional	4
Sperry	4
Total	75

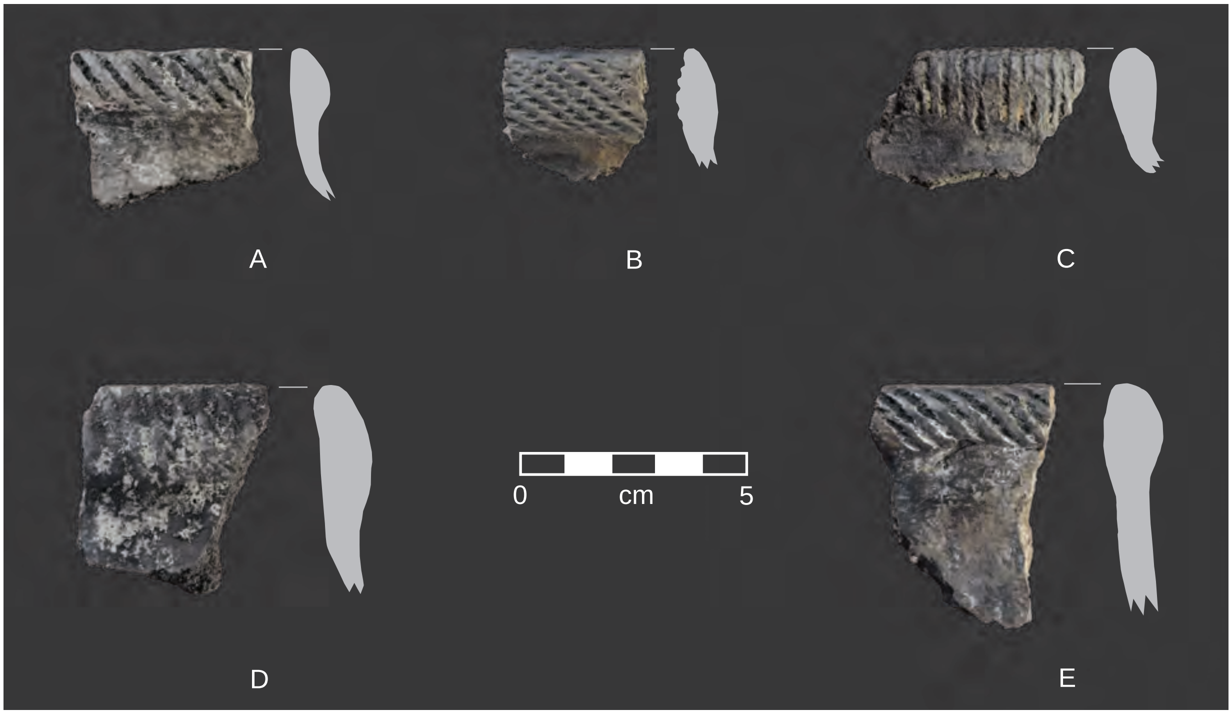

Figure 4.1. Photographs of Knife River ware vessels. A: Vessel 47; B: Vessel 7; C: Vessel 2; D: Vessel 48; E: Vessel 63. Profile exteriors to the right.

27 Knife River ware vessels lack applied decoration, while 21 exhibit cord-impressed decoration. The decorative type of one Knife River ware vessel could not be determined.

Unclassified S-rim vessels comprise 28 percent of the 2018 Molander assemblage (figure 4.3). Both the unclassified S-rim and unclassified straight rim categories are catch-all groups that include a wide variety of vessel forms that do not exhibit the defining attributes of one of the named wares. Vessels commonly are assigned to the unclassified S-rim group if they exhibit zone 3 proportions or shapes that differ markedly from those defined for Le Beau ware (the most abundant S-rim ware in post-1500 contexts), Sperry ware, or Transitional Ware. Crucial to the definition of Le Beau ware is a tall, gently curving zone 2 and a relatively shorter and evenly curving zone 3. Many of Molander's unclassified S-rim vessels exhibit a barely distinguishable ("faint") zone 3 (figure 4.3[a and b]) or an angular lower zone 3 boundary (figure 4.3[c]).

A diversity of rim forms and decorative types are present among the vessels assigned to the unclassified S-rim ware group (table 4.12). The most common combination is a simple (unbraced) S-rim lacking decoration (38 percent). Four of the unclassified S-rim ware vessels exhibit bracing, including two with exterior braces and two with interior braces. Twenty-eight percent exhibit cord-impressed decoration, while half as many exhibit paddle-stamped decoration (following decorative attributes defined by Ahler and others [2002]).

Fifteen unclassified straight rim ware vessels occur in the 2018 Molander assemblage. Vessels are assigned to this group if they lack the defining attributes of Knife River ware—the only well-defined straight rim ware in eighteenth-century assemblages—which include a tall, gently curving zone 2 and a prominent exterior brace. One vessel assigned to the unclassified straight rim group is a bowl (figure 4.4[a]). Twelve others are simple (unbraced) straight rim vessels. Two of the 15 exhibit braces, including one with an interior brace and one with an exterior brace. Nearly three-quarters (11 of the 15) lack applied decoration. Three others are cord impressed and one is paddle stamped.

The remaining 12 vessels in the 2018 Molander assemblage are assigned to three different S-rim ware groups and one straight rim ware group. Four Transitional ware vessels occur in the assemblage (figure 4.4[b]). Transitional ware, a braced S-rim form, is present in low numbers in many Heart

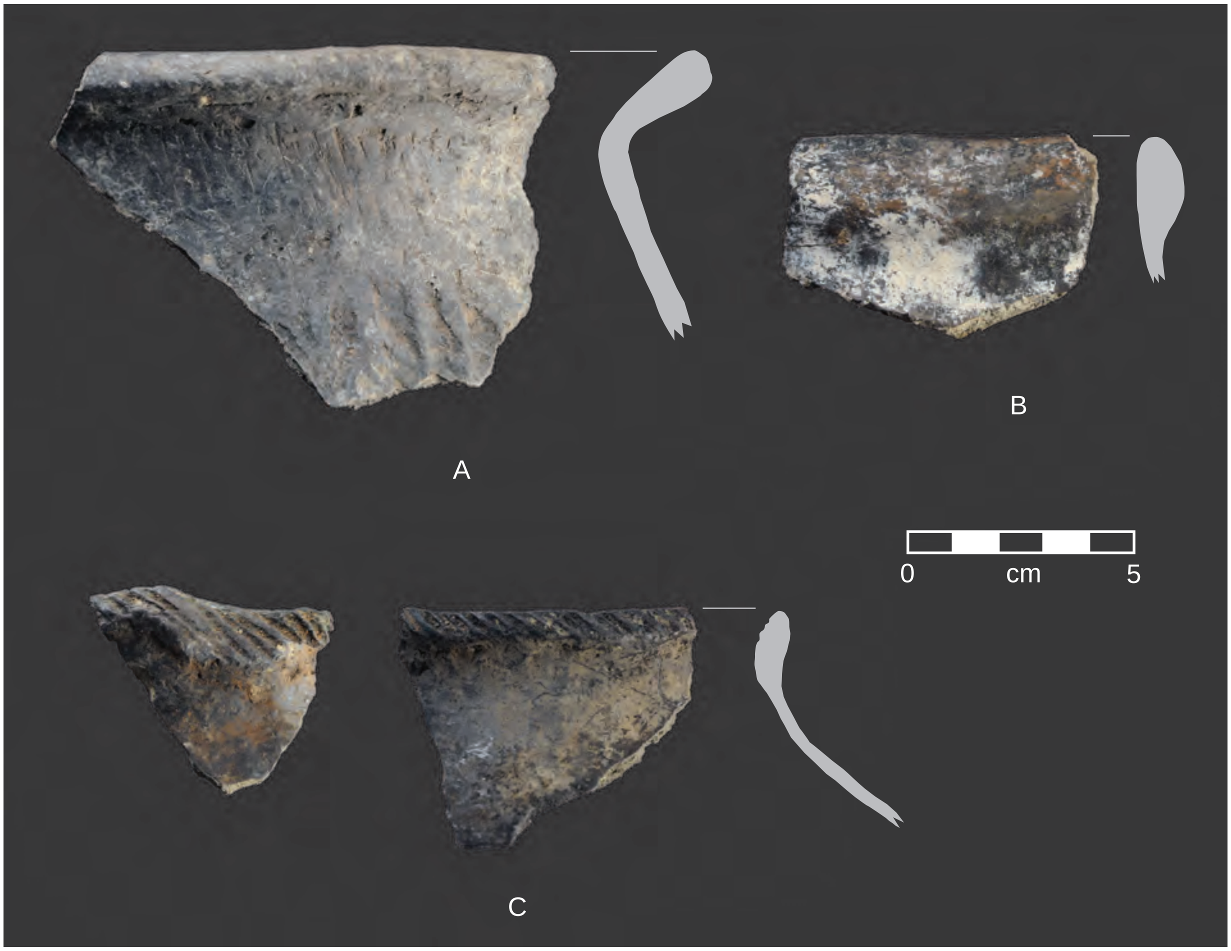

Figure 4.2. Photographs of Knife River ware vessels. A: Vessel 51; B: Vessel 53; C: Vessel 73. Profile exteriors to the right.

and Knife region assemblages. Ahler and Swenson (1985b:27) suggest that it was a "minority ware" that first appeared during the early post-contact period; however, recent research suggests that its origins lie in the 1500s or earlier (Mitchell 2013b). As is typical for Transitional ware, all four of the Molander specimens are decorated with diagonal cord impressions.

Another four of the Molander vessels are assigned to Sperry ware (figure 4.5[b]). Ahler (2001) first identified Sperry ware as a possible sub-class of the Le Beau Normal variety (subware). Ahler and Warner (2003) later formalized the Le Beau Sperry variety for the multi-year Double Ditch Village analysis. Analysis of Double Ditch collections demonstrated that Sperry variety vessels appeared in the late 1600s or early 1700s and continued to be an important component of the ceramic assemblage throughout the eighteenth century. Mitchell's (2011a) analysis later demonstrated that the defining attributes of Sperry vessels are significantly different from those of Le Beau vessels and therefore that Sperry should be regarded as a separate ware rather than as a variety of Le Beau ware, a re-definition anticipated by Ahler and Madden (2005:190, 192) (see appendix G).

Three of the Sperry vessels from Molander are simple S-rims, while the fourth is represented by a zone 2-3 rim fragment. All four exhibit most or all of the characteristic attributes of Sperry ware, which include an uneven zone 3 curvature, with a subangular lower boundary; a slight thickening of the upper portion of zone 3; exterior surface burnishing or polishing; a smudged interior; and a wavy lip or asymmetrical orifice. Light brushing on zone 2 is also a common feature of Sperry ware vessels that is present on several specimens in the Molander assemblage. However, unlike the majority of Sperry ware vessels from Double Ditch and other Heart region sites, which generally exhibit three to five horizontal cord

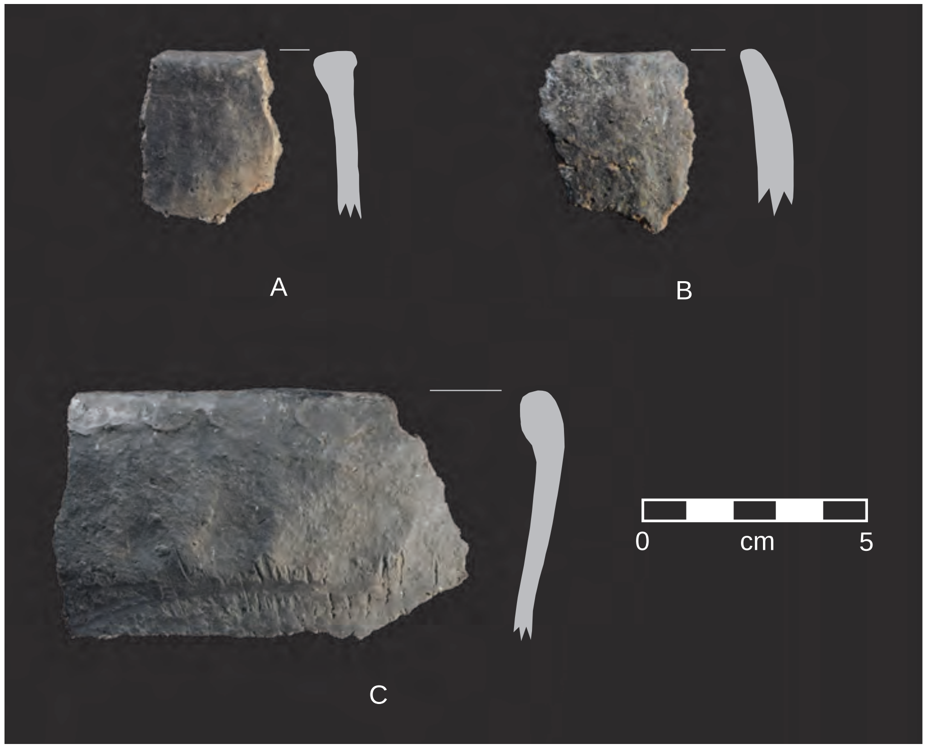

Figure 4.3. Photographs of Unclassified S-rim ware vessels. A: Vessel 18; B: Vessel 74; C: Vessel 22. Profile exteriors to the right.

Table 4.12. Cross-tabulation of rim form class and dominant decorative type for unclassified S-rim ware vessels.

	Decorative Type					
Rim Form Class	Plain	Cord Impressed	Finger Impressed	Simple Stamped	Multiple	Total
S-rim	8	4		2	1	15
S-rim with exterior brace	1	1				2
S-rim with interior brace			1	1		2
Zone 2-3 fragment	1					1
Zone 3 fragment		1				1
Total	10	6	1	3	1	21

impressions centered in zone 3, all of the Molander specimens are undecorated.

Three Le Beau ware vessels occur in the 2018 Molander assemblage. All three are simple S-rim vessels and all three are undecorated. One is assigned to the Le Beau High Rim variety, while two are assigned to the Le Beau Plain variety. The former exhibits a very short zone 3 with a relatively small height-to-inflection ratio. The latter is an undecorated version of Le Beau Classic or Normal.

A single Knife River Fine ware vessel is present in the 2018 Molander assemblage (figure 4.5[a]). As is common for the ware, the Molander specimen is a small, highly decorated jar with an angular shoulder. Knife River Fine vessels are often well made. Most were not designed for a culinary application, but instead may have been used to store special dry goods or minerals.

Regional Ware and Variety Comparisons

Typological comparisons among eighteenth-century pottery assemblages are complicated by analytical changes in the defining characteristics of various wares and varieties that have occurred over the last 20 years. The primary driver of these changes has been the findings of recent Heart region pottery analyses. As previously unknown forms have been recognized, the definitions of some wares have changed, and new varieties have been created to accommodate them.

Figure 4.4. Photographs of an Unclassified straight rim ware bowl (A: Vessel 14) and a Transitional ware vessel (B: Vessel 68).

Overall, the precision of many ware and variety definitions has increased. New Heart region samples have also prompted a reconsideration of some of the findings of prior Knife region ceramic research.

Among the most significant changes are those to the definition and interpretation of Knife River ware. As detailed in appendix G, changes in the attributes used to allocate vessels to the Knife River ware group are great enough to effectively preclude direct comparisons between published ware distributions for Knife and Heart region assemblages.

Another significant change is the identification of new pottery wares and varieties. For example, Stanton ware and Sanger ware were anticipated by Ahler and Swenson's (1993) regional analysis but not named or formally defined until later (Ahler 2001); the Le Beau Fine ware group was created for the On-A-Slant Village analysis (Speakman *et al.* 1997); and Sperry ware was recognized as distinct ware group (Mitchell 2011a). Several new Le Beau varieties also were defined (Ahler and Warner 2003; Ahler, Warner, and Smail 2002). In addition, the characteristics of certain wares and varieties were clarified or narrowed (Ahler 2001; Mitchell *et al.* 2007).

Taken together, the overall effect of these changes is that it is possible to directly compare the 2018 Molander assemblage with Heart region assemblages but that comparisons with Knife region assemblages can only be partial and qualified. Unfortunately, the number of Heart region batches dating to the eighteenth century is small, whereas the number of eighteenth-century Knife region batches is large. This obviously limits the comparative context for understanding the 2018 Molander assemblage. This section therefore includes selected comparisons to Knife region assemblages.

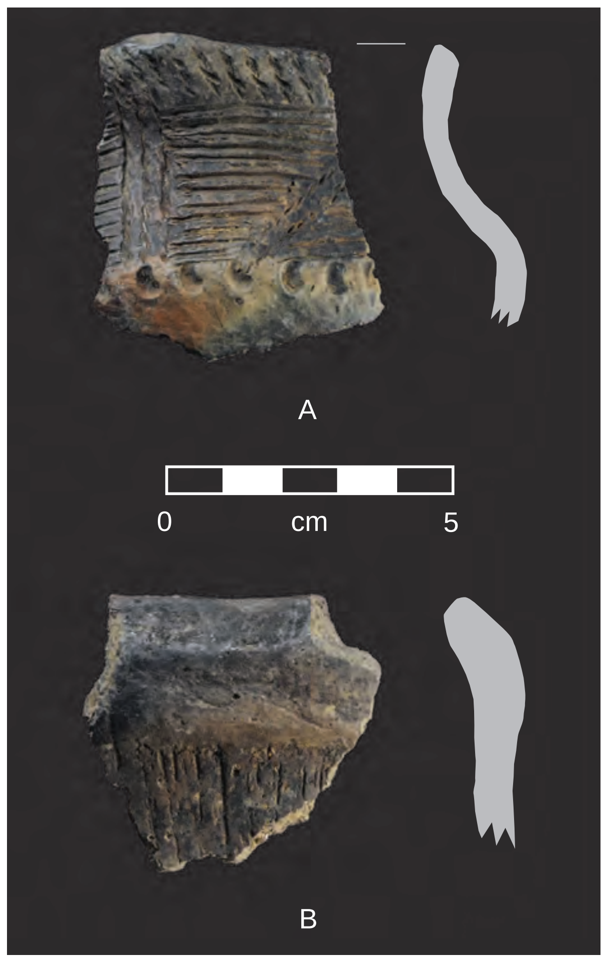

Figure 4.5. Photographs of a Knife River Fine ware vessel (A: Vessel 72) and a Sperry ware vessel (B: Vessel 75).

Table 4.13. Proportional distribution of pottery wares in the 2018 Molander assemblage and in four eighteenth-century samples from Heart region sites. Data for On-A-Slant Village are from Mitchell (2011a) and Speakman and others (1997). Double Ditch Village data are from Ahler and Madden (2005). Boley Village data are from Ahler, Madden, and Mitchell (2006).

	Site Sample				
Pottery Ware	On-A-Slant (TP1 2011)	On-A-Slant (TP1 1997)	Double Ditch (TP0)	Boley (TP1)	Molander 2018
Unclassified Straight Rim	*4.4*	-	*4.6*	*2.9*	*20.0*
Unclassified S-rim	*4.4*	*3.4*	*0.5*	*7.1*	*28.0*
Le Beau	*66.2*	*72.4*	*35.6*	*55.7*	*4.0*
Knife River	*14.7*	*12.9*	*34.0*	*22.9*	*36.0*
Knife River Fine	*7.4*	*9.5*	*1.5*	*0.0*	*1.3*
Transitional	*2.9*	*1.7*	*2.6*	*11.4*	*5.3*
Sperry	-	*n/a*[a]	*21.1*	-	*5.3*
Sample Size (Vessels)	68	116	194[b]	70	75

[a] Sperry ware was not recognized during the original On-A-Slant Village analysis.
[b] Number of rim sherds, rather than vessels.

Table 4.13 compares the proportions of wares present in the Molander assemblage with those present in four Heart region samples. In most respects, the Molander assemblage is unlike any of the contemporaneous Heart region samples. Unclassified straight and S-rim vessels are uncommon at Heart region sites, but together make up a plurality of the Molander vessels. The Heart region samples are dominated by Le Beau ware, a type that is barely represented in the Molander assemblage. However, there are several similarities. Knife River Fine ware vessels are present in small numbers in most assemblages. Transitional ware also occurs in each.

Perhaps the most surprising finding is the presence of Sperry ware vessels in the Molander assemblage. Mitchell (2013a) argues that Sperry ware was produced by specialists potters working in just one or perhaps a few villages and was distributed to other communities through local markets. The presence of Sperry ware pots at Molander suggests that the residents maintained social connections to Heart region communities and may have participated in the Heart region market system (Mitchell 2013a).

Ware distribution data for eighteenth-century batches from four Knife region sites, along with Ahler and Swenson's (1993) data for Molander (Batch 4), are presented in table 4.14. As is true for several other measures, the 2018 Molander assemblage differs from the prior Molander assemblage. Some of the differences are definitely attributable to coding system changes. Ahler and Swenson (1985a:Table 26; 1985b:26) assigned both simple straight rim and braced straight rim vessels to the Knife River ware group, whereas the current system assigns simple straight rim vessels to the Unclassified Straight Rim ware group. The absence of Transitional ware in the

Table 4.14. Proportional distribution of pottery wares in five eighteenth-century Knife region assemblages. Data modified from Ahler and Swenson (1993:Table 17.1 and Table 17.2).

	Pottery Ware							
Site	Unclass. Str.	Unclass. S	Le Beau	Knife River	Deapolis	Knife River Fine	Transitional	Sample Size
Molander KNRI	0.9	15.0	1.9	70.1	12.1	-	-	107
Mahhaha	*19.1*	*31.9*	*4.3*	*34.0*	*10.6*	-	-	47
Lower Hidatsa[a]	*1.9*	*3.1*	*35.8*	*39.5*	*14.2*	*1.2*	*4.3*	162
Big Hidatsa[b]	*0.3*	*5.0*	*13.6*	*62.5*	*8.3*	-	*10.3*	301
Nightwalker's Butte	*3.3*	*5.4*	-	*77.2*	*10.9*	*3.3*	-	92

[a] Batches 44 and 45 combined.
[b] Batches 66 and 67 combined.

Molander KNRI sample coupled with the presence of Deapolis ware could also reflect coding differences. Both wares exhibit thickened upper rims, but Transitional ware is an S-rim type while Deapolis ware is a straight rim type. Vessels exhibiting faint S-rims (small zone 3 inflection) could be mis-allocated. Although both wares are relatively well defined, this seems like a possible explanation; however, there is at present no robust way to evaluate that possibility.

The Mahhaha assemblage is similar in most respects to the 2018 Molander assemblage, apart from the presence of Deapolis ware. (The occurrence of Deapolis ware at Mahhaha could support the mis-allocation explanation for the differences between the two Molander assemblages.) The Big Hidatsa and Lower Hidatsa assemblages exhibit much higher proportions of Le Beau ware and correspondingly lower proportions of Knife River ware. Proportions of the latter would be even lower under the current ware definition. The Nightwalker's Butte assemblage lacks Le Beau ware entirely.

Whether Sperry ware vessels are present in Knife region assemblages is not known. If they are, Ahler and Swenson (1993) would have classified them as Le Beau ware. One would need batch-specific data on zone 3 shape and zone 3 decorative pattern to begin to determine whether Sperry ware might be present.

Fillets (zone 6) were rarely applied to eighteenth-century Knife region vessels and never applied to contemporaneous Heart region vessels. The presence of a single filleted vessel in the 2018 Molander assemblage (Vessel 5) points to connections with Knife region pottery technology.

Overall—and notwithstanding the variability present in both Heart and Knife region assemblages—the 2018 Molander assemblage has much more in common with Knife region pottery than it does with Heart region pottery.

New Type Classification

Data on decorative technique and pattern were not collected on the 2018 Molander assemblage. However, limited decorative data are provided by the "New Type Classification" variable that has been coded for many collections. The variable classifies vessels by dominant decorative technique and is therefore a typological variable that could be used to differentiate pottery varieties (subwares). For example, an undecorated Le Beau ware vessel might be assigned to a "Le Beau Plain" variety, while a similar pot decorated with cord impressions might be assigned to a "Le Beau Cord Impressed" variety. For the most part these type designations have not been used in practice. Instead, the New Type Classification variable has been used to simplify comparisons of decorative technique.

Table 4.15 provides new type classification data for the 2018 Molander assemblage, along with data for seven Knife region batches and two Heart region batches. Two of the Molander vessels are excluded, including one unclassifiable vessel and one vessel with an especially complex decoration. Ahler and Swenson (1985b) did not recognize the "punctate" and "simple-stamped" categories as types. (Ahler and Swenson (1993:Table 17.2) report proportions as integers; proportions for other samples are reported to the nearest one-tenth of a percent.)

Overall, plain vessels are more common in Knife region assemblages. Knife region pottery also exhibits a wider variety of dominant decorative types. The large proportions of pinched vessels in Knife region assemblages may reflect coding inconsistencies. Pinching is considered both a secondary decorative technique and a type of orifice modification (a "wavy" rim). For the Molander 2018 assemblage, otherwise undecorated vessels exhibiting wavy rims were allocated to the "plain" new type classification. Plain vessels may also be undercounted in Knife region assemblages because Ahler and Swenson (1985b:30) allocated vessels represented by small sherds lacking applied decoration to the "unclassifiable" category, rather than to the "plain" category.

Although the range of dominant decorative techniques is low in the Molander 2018 assemblage, it bears a greater resemblance to Knife region batches than it does to Heart region batches. It is most similar to the Mahhaha and Molander KNRI batches, particularly given the effects of the identified coding inconsistencies as well as the fact that simple stamping was not identified as a dominant decorative type for the Knife region analysis.

Appendages and Orifice Modifications

Table 4.16 lists the frequencies of observed pottery vessel appendage types and orifice modifications arranged by ware group. Appendages of various types occur on pots representing all of the major wares. These include features that occur in low numbers on individual vessels, such as a spout, as well as those that occur in larger numbers, such as a wavy or pinched rim.

Table 4.15. Proportional distributions of dominant decorative techniques among eighteenth-century Heart and Knife region batches. Data for Heart region batches from Mitchell (2011a). Data for Knife region batches from Ahler and Swenson (1993:Table 17.1 and Table 17.2).

	New Type Classification										
Site and Batch	Plain	Cord Impressed	Tool Impressed	Incised	Pinched	Punctate	Stab-and-Drag	Cord-Wrapped Tool	Finger Impressed	Dentate	Simple Stamped	Sample Size
On-A-Slant (TP1 2011)	*17.6*	*61.8*	*1.5*		*7.4*	*4.4*			*7.4*			68
Double Ditch (TP1 2011)	*4.8*	*93.4*	*0.3*	*0.3*					*0.6*		*0.6*	334
Mahhaha (29)	*27*	*44*	*7*	*7*	*5*	n/a	*2*		*7*		n/a	47
Molander KNRI (4)	*25*	*46*	*3*	*2*	*22*	n/a			*2*		n/a	106
Lower Hidatsa (44)	*23*	*55*	*3*	*3*	*10*	n/a		*1*	*4*	*1*	n/a	77
Lower Hidatsa (45)	*20*	*61*	*1*	*1*	*5*	n/a		*1*	*5*	*3*	n/a	87
Nightwalker's Butte (86)	*15*	*48*	*13*		*14*	n/a			*8*	*4*	n/a	91
Big Hidatsa (67)	*13*	*69*	*3*		*8*	n/a		*1*	*3*	*3*	n/a	127
Big Hidatsa (66)	*12*	*66*	*4*	*1*	*10*	n/a			*3*	*3*	n/a	174
Molander 2018 (117)	*45.2*	*47.9*							*1.4*		*5.5*	73

Table 4.16. Cross-tabulation of vessel wares and appendage or orifice modification types for the Molander 2018 assemblage.

	Appendage or Orifice Modification Type					
Ware Group	Spout	Castellation	Wavy Rim	Asymmetrical	Not Observed	Total
Unnamed Straight Rim			2		13	15
Unnamed S-rim			5	4	12	21
Le Beau					3	3
Knife River	1	2			24	27
Knife River Fine		1				1
Transitional			1		3	4
Sperry			1	2	1	4
Total	1	3	9	6	56	75

Table 4.17. Proportional distribution of appendage or orifice modification types among eighteenth-century pottery assemblages from sites in the Knife and Heart regions. Sites are arranged within regions by decreasing proportions of the "not observed" appendage type category. Data for On-A-Slant and Double Ditch villages are from Mitchell (2011a). Data for Knife region sites are from Ahler and Swenson (1993:Table 17.1 and Table 17.2).

		Appendage or Orifice Modification Type								
Region	Site (Batch)	Node	Tab	Handle	Spout	Castellation	Pinched (Wavy)	Asymmetrical	Not Observed	Sample Size
Heart	On-A-Slant (103)	1.5				1.5	1.5	1.5	93.9	66
	Double Ditch (107)	0.3		0.6	1.5	1.3	19.8	1.6	74.4	313
Knife	Mahhaha (29)				2	2	5	n/a	91	47
	Lower Hidatsa (45)						9	n/a	91	87
	Lower Hidatsa (44)	2			2		13	n/a	83	77
	Big Hidatsa (66)	1			4	5	21	n/a	69	174
	Big Hidatsa (67)	3			3	7	19	n/a	68	127
	Molander KNRI (4)	1		1	4	4	23	n/a	67	106
	Nightwalker's Butte (86)		6	4	1	7	17	n/a	65	91
-	Molander 2018 (117)				1.3	4.0	12.0	8.0	74.7	75

Comparative Heart and Knife region data are presented in table 4.17. Overall, appendages or orifice modifications are less common in Heart region assemblages. The single exception to this trend is the large proportion of vessels exhibiting wavy or pinched rims in the Double Ditch Village assemblage (TP1 or Batch 107). That value is almost entirely due to the large number of Sperry ware pots in the TP1 assemblage, most of which exhibit wavy or asymmetrical rims. (Wavy or pinched rims exhibit recurrent evenly spaced orifice modifications, while asymmetrical rims exhibit fewer, and often irregularly spaced, orifice modifications; Sperry ware vessels can exhibit either of those attributes.)

Pinched rims are generally more common on Knife region pots and appendages occur with greater frequency. Spouts and castellations—both of which occur in low numbers on individual vessels—are frequent features of Knife region pots. (Ahler and Swenson [1993] did not recognize the asymmetrical rim category.) The Molander 2018 assemblage also includes a relatively large number of appendages and pots exhibiting modified rims.

Brace Width

The presence of a prominent exterior brace is a defining characteristic of Knife River ware, although brace widths vary due to differences in vessel size. Figure 4.6 illustrates the distributions of brace widths for three samples of Knife River ware vessels, including 18 from Molander, 216 from seven contemporaneous Knife region batches, and 48 from two contemporaneous Heart region batches. One

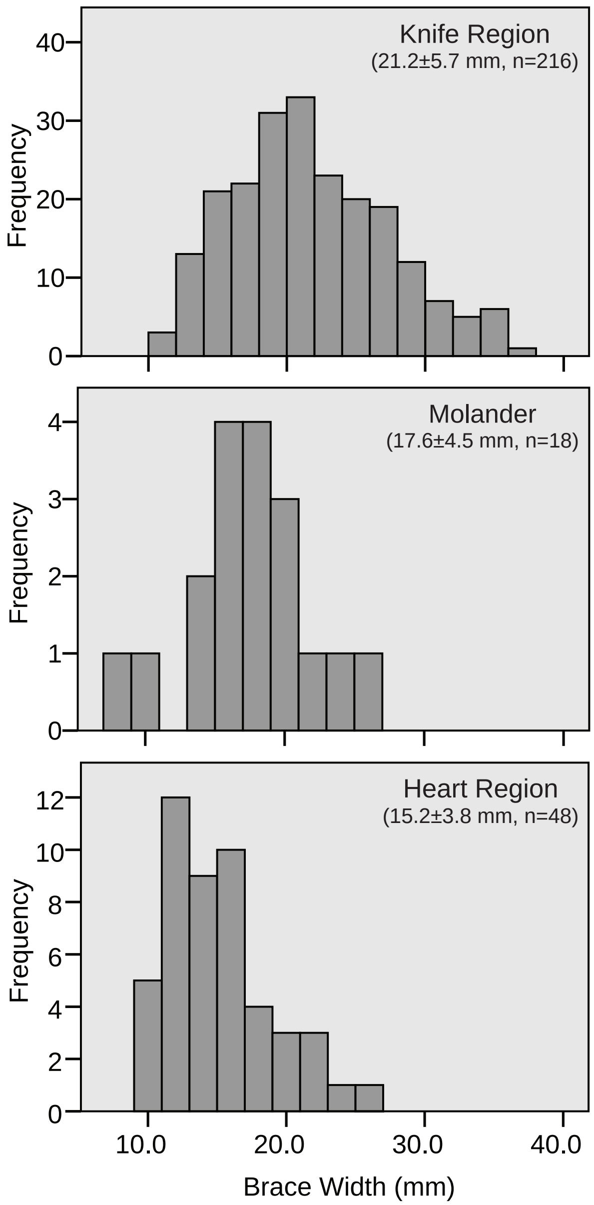

Figure 4.6. Histograms showing the distribution of brace (zone 5) widths for three pottery samples.

outlier from Big Hidatsa Village (which measured 75 mm in width) was removed from the Knife region sample. Brace widths were measured to different levels of precision: Knife region vessels were measured to the nearest millimeter, while Heart region and Molander vessels were measured to the nearest 0.1 millimeter.

Mean brace width is lowest for the Heart region sample and highest for the Knife region sample, with the 2018 Molander assemblage exhibiting an intermediate value. The sample means are significantly different (table 4.18). Pairwise comparisons also yield significant differences (Heart-Molander: t=-2.211; df=64; p=0.031; Molander-Knife: t=2.558; df=232; p=.011).

These data suggest that systematic differences could exist between Knife River ware vessels produced in the Heart region and those produced in the Knife region. The intermediate value for the Molander assemblage could indicate that pots were obtained from producers in both regions or that potting knowledge was derived from sources in both regions. Additional analysis of decorative pattern and other variables will be needed to evaluate those possibilities.

Vessel Size

Just seven Molander vessels are represented by sherds large enough to estimate orifice diameter. Figure 4.7 illustrates the distribution of diameters, along with distributions for contemporaneous Heart and Knife region batches. Mean values for the Heart and Knife region samples are significantly different (table 4.19). That difference could be due to functional, technological or aesthetic factors, although the smaller sizes of vessels in the Knife region sample also could reflect temporal trends. The Heart region sample includes two eighteenth-century batches, one from On-A-Slant Village and one from Double Ditch Village. However, the Double Ditch sample (TP1) actually dates to the late 1600s and early 1700s. By contrast, the Knife region sample includes multiple batches that date to the late 1700s, including Big Hidatsa TP3, Lower Hidatsa TP1, Molander KNRI, and Mahhaha TP1. Several previous studies have suggested that mean orifice diameters decreased between the seventeenth and nineteenth centuries (Mitchell 2011b).

The Molander sample mean is not significantly different from either of the regional samples. Although that result may primarily reflect the small size of the sample, it is nevertheless not possible use the Molander data to judge the merits of the competing explanations—either technological and aesthetic or temporal—for the difference. However, the intermediate value for the Molander assemblage may lend some support to the temporal explanation.

Production Skill

Characterization of a vessel's technological properties—which reflect paste preparation techniques, vessel construction and decoration

Table 4.18. Comparison of mean brace widths among three samples of Knife River ware vessels.

					95% Confidence Interval for Mean			
Brace Width	N	Mean	Std. Dev.	Std. Error	Lower Bound	Upper Bound	Minimum	Maximum
Knife Region	216	21.16	5.716	0.389	20.391	21.924	10.00	36.00
Heart Region	48	15.18	3.771	0.544	14.086	16.276	9.60	25.00
Molander 2018	18	17.62	4.541	1.070	15.361	19.877	7.44	25.55
Total	282	19.91	5.829	0.347	19.231	20.598	7.44	36.00

Brace Width	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	1503.867	2	751.934	26.081	.000
Within Groups	8043.675	279	28.830		
Total	9547.542	281			

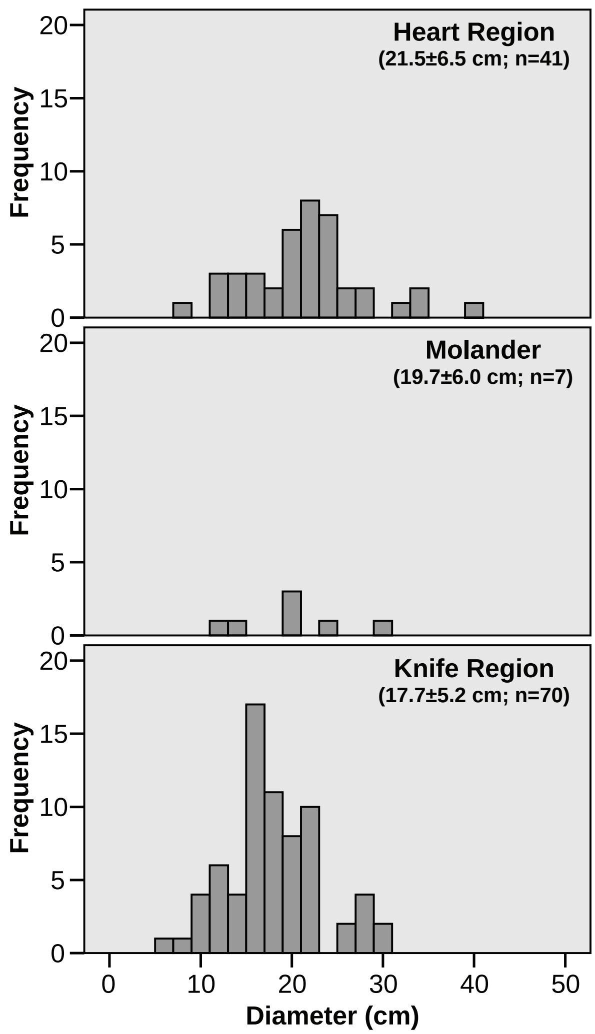

Figure 4.7. Histograms showing the distributions of vessel orifice diameters for three pottery samples.

methods, and firing practices—is an increasingly important aspect of Plains ceramic analyses. Assessments of technical quality, and therefore producer knowledge and skill, are especially critical for eighteenth- and nineteenth-century assemblages, owing to the importance that models of fur trade-induced technological change place on changes in ceramic production.

Mitchell's (2011a) measure of production skill, which is used in this analysis, combines data on multiple dimensions of pottery technology (table 4.20). Comparative data are available for seventeenth- and eighteenth-century Heart region assemblages, but not for contemporaneous Knife region assemblages.

Table 4.21 gives the proportional distribution of production skill categories for the Molander 2018 assemblage and two Heart region samples. The comparatively high proportions of vessels assigned to the "indeterminate" category in the Heart region samples reflects a more conservative approach to the evaluation of production skill taken in Mitchell's (2011a) regional study. Nevertheless, the difference between the Molander assemblage and the Heart region assemblages is clear: the overall production skill reflected in Heart region pottery is higher than the production skill reflected in Molander pottery.

Assessing the reason for that difference is complicated by the lack of Knife region data. One could conclude that the lower skill expressed in the Molander assemblage primarily reflects change over time, in keeping with the expectations of models of fur trade-era technological change. However, it is clear that at least at On-A-Slant Village high quality pottery was produced throughout the eighteenth century, and so it is possible than the overall skill of Heart region pottery production was higher than that of Knife region pottery production, even prior to the

Table 4.19. Comparison of mean orifice diameters between Heart and Knife region samples.

Region	N	Mean	Std. Deviation	Std. Error Mean
Knife Region	70	17.74	5.166	0.617
Heart Region	41	21.46	6.531	1.020

						95% Confidence	
	t	df	Sig. (2-tailed)	Mean Diff.	Std. Error	Lower	Upper
Equal variances assumed	-3.316	109	.001	-3.721	1.122	-5.944	-1.497
Equal variances not assumed	-3.120	69.293	.003	-3.721	1.192	-6.099	-1.342

Table 4.20. Pottery production skill categories (adapted from Mitchell 2011a:Table A3.11).

Category	Definition
Non-functional	Generally a pinch pot or practice piece made using non-standard vessel forming techniques. Paste is poorly mixed, often with little or no temper. Voids from organic debris often are present. Wall thickness varies significantly. Little or no attention paid to surface finish. Decoration is atypical or poorly applied. Temper particles protrude. Lip is uneven in horizontal plane.
Poorly Made	Paste is poorly mixed and temper is poorly sorted or unevenly distributed. Firing is poorly controlled, resulting in an underfired vessel with comparatively soft paste. Vessels walls vary in thickness. Decoration is haphazardly applied and little attention is given to surface finish. Temper particles can be seen on the vessel surface. Lip is uneven in horizontal plane.
Serviceable	Walls vary somewhat in thickness. Temper is moderately well sorted and distributed, with only a few large particles (greater than half the thickness of the wall) present. Vessel walls are not fully compacted. Straps and coils are not fully bonded or blended into vessel wall. Firing is fairly well-controlled, but paste is not sintered. Decoration is uneven or asymmetrical.
Well Made	Walls are uniform in thickness. Temper is well sorted and paste is thoroughly mixed. Walls are compact, with few voids. Straps and coils are well bonded and blended. Firing is complete and well-controlled and paste is at least partially sintered. Decoration is carefully applied.
Exceptional	Walls are uniform and thin relative to vessel size. Temper is well sorted and paste is thoroughly mixed. Walls are very compact. Firing is complete and well controlled and paste is sintered. Straps and coils are well bonded and blended. Decoration is very well executed and symmetrical.
Indeterminate	Sherd is too small or fragmented to code. Also used for sherds exhibiting contrasting properties.

Table 4.21. Proportional distribution of production skill categories among three samples.

	Production Skill Category						
Sample	Non-Functional	Poorly Made	Serviceable	Well Made	Exceptional	Indeterminate	Sample Size
Molander 2018	-	*18.7*	*53.3*	*26.7*	-	*1.3*	75
Heart Region post 1700	-	*1.3*	*19.7*	*41.7*	*7.8*	*29.5*	396
Heart Region 1600-1700	*0.1*	*2.2*	*27.3*	*37.9*	*7.7*	*24.8*	820

advent of the fur trade. Multiple lines of evidence point to the economic importance of specialized craft production in the Heart region. Similar economic processes could have operated in the Knife region, although specific data supporting that conclusion are not current available. However, if the production skill of Knife region pottery was generally lower than that of Heart region pottery, then the difference between the Molander assemblage—which exhibits many of the characteristics of pottery made in the Knife region—and contemporaneous Heart region samples may primarily reflect economic practices rather than technological change prompted by epidemic disease outbreaks or the fur trade.

Cordage Analysis

Data were collected on cordage impression widths—a proxy for cordage diameter—and on final twist direction, a technological attribute. Recorded impression widths represent the mean of three measurements made on three different impressions. Commonly, measurements are made on the clearest horizontal impressions. Decorative bands composed of multiple parallel horizontal impressions are a common decorative feature of Heart region pottery; however, that particular pattern is relatively rare in the Molander assemblage. As a result, width measurements mostly were made on diagonal cord impressions on vessel braces. Many such impressions are slightly distorted compared to horizontal impressions and so measurements were made on horizontal impressions when both horizontal and diagonal impressions were present. Only vessel fragments preserving at least three separate and reasonably distinct impressions were measured.

Table 4.22 and figure 4.8 provide data on impression widths for the Molander 2018 sample and samples from contemporaneous Knife and Heart region batches. Molander vessels exhibit the widest cord impressions, followed by Knife region vessels. The difference between the Heart and Knife region samples is significant (*t*=5.156; *df*=658; *p*=0.000). However, it is unclear whether this is due to differences in cordage technology or to the aesthetics of different pottery wares. The Heart region sample is dominated by Le Beau ware, while the Knife region assemblage is dominated by Knife River ware. The cord size difference is not likely due to temporal changes: Ahler and Swenson (1993:Figure 17.14[b]) document a small but steady decrease in cord diameter from the 1200s to the 1800s.

The Molander mean impression width is greater than the Knife region mean but the two distributions are statistically equivalent (*t*=1.636; *df*=381; *p*=0.103). Thus, the size of the Molander cordage is comparable to the size of Knife region cordage and significantly larger than Heart region cordage.

Table 4.23 provides data on the proportion of vessels decorated with cords exhibiting S-twist final twist direction. Vessels decorated with cords for which final twist direction could not be determined, as well as those decorated with both Z- and S-twist cords, are excluded from table 4.23; the proportion of vessels decorated with Z-twist cords is therefore the inverse of those decorated with S-twist cords. The factors affecting the choice to produce Z- or S-twist cordage are not well understood, but may include the type of plant fibers used, producer handedness, or learning frameworks.

Like all northern Middle Missouri pottery

Table 4.22. Mean cord impression widths (cord diameters) for the Molander 2018 sample and contemporaneous Knife and Heart region batches.

Sample	Width (mm)	Sample Size
Molander 2018	2.44±.47	27
Knife Region	2.26±.57	356
Heart Region	2.04±.51	304

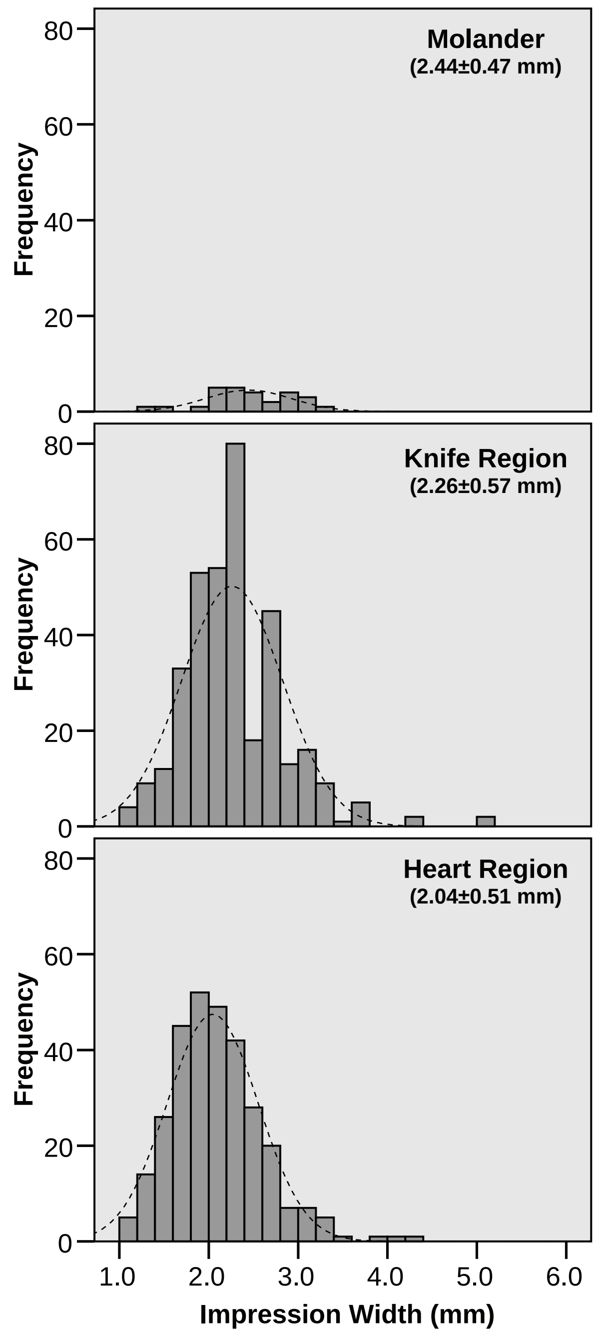

Figure 4.8. Histograms showing the distributions of cord impression widths for three pottery samples.

Table 4.23. Proportion of vessels decorated with cords exhibiting S-twist final twist direction in the Molander 2018 sample and in contemporaneous Heart and Knife region samples.

Sample	Percent S-Twist	Sample Size
Molander 2018	*21.9*	32
Knife Region	*9.9*	375
Heart Region	*7.7*	350

assemblages, the Molander assemblage is primarily decorated with Z-twist cordage. However, Ahler and Swenson (1993:Figure 17.14[b]) show that the proportion of S-twist cordage increased after 1700, reaching a high point in the most recent nineteenth-century samples. The proportion of S-twist cordage decoration at Molander is the greater than any of the eighteenth-century samples that Ahler and Swenson studied, apart from the Greenshield site sample, and higher than many of their nineteenth-century samples. (Greenshield is not included in the data presented in table 4.23).

Discussion

Although variability occurs within both Heart and Knife region pottery, by most measures the Molander 2018 pottery assemblage has more in common with Knife region pottery than it does with Heart region pottery. Whether characterized in terms of body sherd surface treatment, vessel rim form, ware and variety categories, dominant decorative technique on the rim, appendages, or cordage size, the Molander assemblage analyzed in this chapter fits comfortably within the range of variation present in Knife region batches but is distinctly different from those of Heart region batches. However, interesting and potentially informative differences do exist between the Molander 2018 assemblage and selected Knife region batches.

Surprisingly, one aspect the differences between the Molander 2018 assemblage and the previously studied Knife region batches is its lack of congruity with the Molander assemblage obtained in 1966 and 1968 by the State Historical Society of North Dakota and the Upper Knife-Heart Project. The distributions of body sherd surface treatment classes, rim form classes, and pottery wares all differ between the two samples. Although changes in the ceramic coding system might explain the different wares present, the reason or reasons for the different distributions of body sherd surface treatment classes and rim form classes are not clear. Reexamination of the existing Molander collection may shed light on these issues. Reanalysis of the potentially related Mahhaha (TP1) assemblage may also be informative.

Although direct comparison of contemporaneous Knife and Heart region batches was not a primary goal of this analysis, the results do point to potentially significant differences between them across a range of measures. Data on the mostly unstudied TP0 assemblage from Double Ditch Village would greatly enhance a general understanding of the differences between Knife and Heart region pottery dating to the eighteenth century. Reanalysis of selected Knife region batches using the current ware and variety definitions, as well as the recently developed technological variables, also would be highly informative.

While this analysis establishes a clear connection between the characteristics of the Molander vessel assemblage and Knife region potting practices, the presence of Sperry ware pots at Molander indicates that the community's residents maintained economic—and perhaps social—connections to contemporaneous Heart region settlements. Other characteristics of the Molander assemblage, such as relatively small braces on Knife River ware pots or the presence of vessels with faint S-rims and simple-stamped decoration, also could point to economic or social connections with Heart region communities.

5

Modified Stone

Mark D. Mitchell

The fur trade's impact on northern Middle Missouri economic practices has long been a subject of archaeological investigation. One of the most visible and most widely discussed impacts was changes in stone tool production. Data from sites near the mouth of the Knife River show that the economic importance of stone working began to decline even before the establishment of fur trade posts in the region during the 1790s (Ahler and Toom 1993). By the second half of the nineteenth century, little of what had once been a highly sophisticated chipped stone industry remained intact. The stone tool assemblage from Like-A-Fishhook Village—the last earthlodge village in the Northern Plains—is dominated by ground stone tools and contains just a handful of chipped stone items, most of which are scavenged and re-purposed Archaic-era projectile points (Smith 1972).

Archaeological research on fur trade-era stone tool production has sought to characterize the nature and scope of change and to assess its timing. Goulding's (1980) study of collections from the Lower Hidatsa and Sakakawea sites was among the first in the northern Middle Missouri to systematically address the topic. Although limited by small sample sizes, Goulding concluded that tool technology and patterns of raw material procurement remained stable during the period despite an overall decline in the scope of production.

Ahler and Toom's (1993) larger study of assemblages from several dozen Knife region sites focused on changes in stone tool function and technology and in raw material use resulting from the adoption of metal tools supplied by the fur trade. They also examined changes in tool technology and function

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thought to reflect shifts in domestic economic production stimulated by the fur trade.

Ahler and Toom conclude that the production of chipped stone tools shifted steadily from primarily complex, patterned forms to simple, expedient forms. Flintknappers increasingly relied on local, often lower-quality, raw materials. Both producer skill and technical knowledge declined. However, in contrast with flaked stone tools, use of ground stone tools continued. Some types of ground stone tools may have become more important and several new types were introduced. Ahler and Toom detected limited fur trade-induced changes during the seventeenth century. The pace of change increased during the eighteenth century, especially after the smallpox epidemic of the early 1780s and the roughly concurrent establishment of regular direct trade and local trading posts. They note, however, that despite changes in emphasis "all components of the native lithic technological system remained in place" until the second half of the nineteenth century (Ahler and Toom 1993:255).

Modified stone data from Molander, which was occupied during a period of accelerating change in stone tool technology, offer an opportunity to evaluate and expand on Ahler and Toom's and Goulding's conclusions. The Molander modified stone datasets are designed to address two primary analytic domains: raw material usage and production technology. Data on the types of local or near-local toolstone present in the collection can be used to identify the resource zones or "lithic territories" from which the settlement's residents most frequently obtained raw materials. In addition, data on the types of exotic raw materials can be used to identify trade connections between the residents of Molander and other groups outside the local resource area. Stone tool technology data offer insights into the kinds of productive activities taking place within the village and on the organization of stone tool production. Data on artifact densities can be used to assess changes in the intensity of production.

The chapter begins with an overview of the methods used to study modified stone remains, then presents basic data on the chipped stone flaking debris and stone tool assemblages. Selected comparisons are made between the Molander assemblage and those from other settlements in the Knife and Heart regions.

PCRG lab assistants conducted basic sorting. Britni Rockwell, PCRG's Lab Supervisor, collected data on the flaking debris assemblage. PCRG Research Director Mark Mitchell separated stone tools from flaking debris, collected data on the stone tool assemblage, compiled comparative datasets, and wrote the chapter.

Flaking Debris and Stone Tool Analysis Methods

The methods used to study the Molander modified stone assemblage were pioneered by Stanley A. Ahler. The roots of Ahler's system lie in his study of the Rogers Shelter collection (Ahler 1971). Subsequently, he greatly expanded the scope and rigor of the system for his dissertation research, which focused on two Extended Coalescent sites located in the Grand-Moreau region (Ahler 1975a, 1975b). Ahler and his colleagues further refined the system during numerous studies of Plains Village, Plains Woodland, and earlier assemblages in the Knife and Heart regions and elsewhere (Ahler 1986, 1989a, 1989b, 1992, 1995, 2002a; Ahler, Kellet, and Crawford 2003; Ahler *et al.* 1997; Ahler, Ritter, and Crawford 2003; Ahler *et al.* 1994; Ahler and Toom 1993).

In Ahler's system, modified stone is first partitioned into two classes: chipped stone flaking debris and stone tools. A tool is defined as any intentionally shaped object, an item exhibiting use-wear, or a remnant nodule of raw material from which flakes were removed (Ahler and Swenson 1985a:79-85). Intentionally shaped objects range in complexity from simple flakes exhibiting one or more retouched edges to items produced by flaking, pecking, grinding, or some combination of techniques. Flakes, by contrast, are detached pieces discarded during lithic reduction, which therefore lack evidence of use or modification other than that produced by transport, tramping, or other post-depositional factors (Shott 2004). In addition, stone tool raw materials, including Knife River flint (KRF) and various types of chert, occur naturally in the till (Coleharbor Group) underlying Molander. Most pieces of flakeable stone exhibiting polished arises and flake scars, carbonate encrustation, or unusual fracture patterns were regarded as unmodified and assigned to the natural rock sort class. Several larger pieces (G1) of unmodified KRF and silicified wood likely were transported to Molander, judging by their quality and lack of carbonate coating, and are included in the analysis.

The Molander analysis emphasizes the assemblage's technological, rather than functional, properties. Technological analysis of stone tools focuses mainly on how they were manufactured. The most important production variable is technological class, which is defined primarily by the dominant method used to manufacture it and secondarily by the form of the raw material blank (Ahler *et al*. 1994). Each method encompasses a sequence of production techniques, ranging from simple and expedient to complex and sequential. For example, patterned large thin bifaces are produced by the staged application of soft-hammer percussion flaking and, to a lesser degree, pressure flaking on flake blanks or tabular pieces of stone. Unpatterned flake tools, by contrast, exhibit only simple edge modification, either through use or by marginal retouch.

Assessing tool technological class requires data on the methods used to manufacture a tool as well as inferences about the intended outcome of the manufacturing process. Determining manufacturing stage and technological trajectory in turn depend on the concept of *patternedness*. Patterned tools exhibit bilateral symmetry, whereas unpatterned tools are asymmetrical, with their form dictated mainly by the shape of the original input blank. Use-wear traces, though not rigorously quantified in this analysis, provide additional information about whether the production process was complete when an artifact was lost or discarded (use phase). Data were also collected on raw material type, raw material form (original input blank), burning, the presence of cortex, and, for tools made from cryptocrystalline materials, intentional heat treatment (Ahler 1983). Dorsal and ventral (or reverse and obverse) surface patination intensities were recorded for artifacts made from KRF and related chalcedonies and silicified wood (VanNest 1985). A note was made for each artifact exhibiting post-patination flake removals.

Technological analysis of the flaking debris assemblage focuses on flake size and weight distributions. The suite of variables coded for all size grades includes raw material type, and cortex. Selected variables were also coded for coarse-fraction (G1-3) flaking debris, including intentional heat treatment (on KRF artifacts) and burning. Patination was coded for all unburned flakes made from KRF and related chalcedonies but was assessed in two different ways depending on artifact size grade. For unburned coarse-fraction flakes, patination intensity was coded separately for the dorsal and ventral surfaces. For unburned G4 flakes, maximum observed patination intensity on either face was recorded. Finally, counts and weights were recorded for each sort group.

Lists of the variables and attributes coded in the stone tool and flaking debris studies are provided in appendix H. Additional discussion on the variables and attributes applied to the collection are presented in Ahler (2002a), Ahler and others (1994), Ahler, Kellet, and Crawford (2003), and Ahler and Toom (1993).

Collection Summary

The 2018 modified stone assemblage consists of 2,689 flakes that together weigh 485 g and 142 stone tool specimens that weigh 2,920 g. Nine tools exhibit two different production modes, yielding a total of 151 technological cases; unless otherwise noted, tool data presented in this chapter represent case counts rather than specimen counts. Sampling procedures were not applied to the assemblage and so the reported values represent actual counts of flakes and tools rather than estimates.

Approximately 16 percent of the flakes and 3 percent of the tool specimens exhibit surface patination. As discussed in the previous section and in chapter 2, patination of KRF and related chalcedonies occurs slowly and mostly progressively over time. Only rarely do Plains Village-age KRF artifacts exhibit any degree of patination (Mitchell and Lee 2013; Mitchell and Sturdevant In Press). Moderate to pronounced patination, which was observed on most of the patinated Molander specimens, commonly occurs only in assemblages that are at least 1,500 years old (Ahler *et al*. 1981; VanNest 1985). For these reasons, patinated specimens are isolated from the balance of the assemblage and assigned to the site's pre-Plains Village component or components.

It is at least logically possible that some of the flakes or tools made from non-cryptocrystalline raw materials—which do not develop patinated surfaces regardless of their age—could predate Molander's Plains Village component. However, data from Archaic and Woodland components on the Cross Ranch in northeastern Oliver County demonstrate that regional pre-Plains Village assemblages consist almost exclusively of KRF (Ahler *et al*. 1981; Ahler *et al*. 1982).

Conversely, is it probable that some unpatinated KRF flakes and tools in the assemblage do predate the Plains Village period. Table 5.1 compares the distributions of patinated chalcedony flakes assigned to each of the two analytic units defined in chapter 3 on the basis of stratigraphy. Note that one-fifth of the

Table 5.1. Proportional distributions of patinated chalcedony[a] flakes assigned to each analytic unit.

	Analytic Unit		
Patination	pre-Village	Plains Village	Total
Unpatinated	*20.9*	*80.9*	*79.0*
Patinated	*79.1*	*19.1*	*21.0*

[a] Including KRF, clear/gray, yellow/brown, and dark brown chalcedonies.

KRF and chalcedony flakes from pre-Plains Village stratigraphic contexts do not exhibit patination. Some fraction of those unpatinated items may date to the Plains Village period and were simply mixed with the site's older near-surface assemblage immediately prior to or during the construction of the fortification ditch. However, data from Cross Ranch and elsewhere show that unpatinated flakes and tools can occur in assemblages of any age (Ahler *et al*. 1982:260; Root *et al*. 1986:440-446; VanNest 1985). One could therefore assume that as much as 20 percent of the unpatinated artifacts made from KRF and related chalcedonies recovered from Plains Village stratigraphic contexts in fact date to earlier occupations. However, there is no sound method for determining which fifth should be excluded. For that reason, all unpatinated KRF and chalcedony specimens are included in the analysis of the Plains Village assemblage (including the small number assigned to the pre-Village analytic unit based on stratigraphic data), while all patinated specimens are excluded.

Tables 5.2 and 5.3 summarize count and weight data on the flake and tool assemblages respectively by excavation block, size grade, and analytic unit. The collection is unevenly distributed among the excavation blocks. Roughly two-fifths of the flakes and half of the tools assigned to the Plains Village analytic unit come from Block 2. Most of those come from Feature 7, a cache pit located inside an earthlodge. Nearly two-thirds of the flakes and all of the tools assigned to the pre-Village analytic unit come from Blocks 1 and 5.

Pre-Plains Village Assemblage

The pre-Plains Village assemblage consists of 434 flakes and four stone tools made from KRF or related chalcedonies. Ninety-six percent of the flakes (*n*=418) and three of the four tools are made from KRF. The other tool is made from silicified wood and the patinated non-KRF flakes are made from clear/gray (*n*=8), yellow/brown (*n*=6) and dark brown (*n*=2) chalcedony.

Table 5.4 presents the distribution of patination intensities recorded for flakes. For G2 and G3 flakes, patination intensity was assessed separately for the dorsal and ventral faces. For G4 flakes, the maximum observed patination intensity on either face was recorded. Moderate or pronounced patination on at least one face was observed on 78 percent of the G2 and G3 flakes and on 61 percent of the G4 flakes.

Patinated tools include three G3 use-modified flake tools, one of which was made from silicified wood, and a G3 KRF core fragment. Each tool exhibits moderate patination on at least one face. No diagnostic tools occur in the pre-Village assemblage.

Plains Village Assemblage

The balance of the chapter focuses on the Late Plains Village analytic unit, which consists of 2,255 flakes and 147 stone tool technological cases.

Raw Material Usage

Table 5.5 presents a cross-tabulation of raw material type and size grade for Plains Village-age flaking debris. Eighteen different raw materials are represented, although one consists of a single flake made from historic glass; this specimen is excluded from subsequent analyses in this chapter but is described in chapter 9.

The most abundant of the 17 types of naturally occurring toolstone is KRF, which makes up two-thirds of the assemblage. Smooth gray Tongue River silicified sediment (TRSS) is the next most abundant at about 8 percent, followed by porcellanite (gray and red or purple) at just over 5 percent. As a group, imported materials make up 8 percent, while coarse local materials make up 5 percent.

Several raw materials are unevenly distributed among the five excavation blocks (table 5.6). Among materials that make up at least 1 percent of the assemblage, flakes made from smooth gray TRSS, Swan River chert, and gray silcrete are highly concentrated. The distributions of the latter two materials in particular likely reflect discard of waste material from single flintknapping events.

Different materials were used in somewhat different ways. Figure 5.1 illustrates mass analysis data for the seven raw materials that make up at least 2 percent of the assemblage. Sources of all

Table 5.2. Flake count and weight data organized by excavation block and size grade. Upper panel lists data on specimens assigned to the Plains Village analytic unit[a], while the lower panel lists data on specimens assigned to the pre-Village analytic unit.

	Counts					Weight (g)				
	Size Grade					Size Grade				
Block	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
1	1	8	109	350	468	33.20	40.70	57.88	11.45	143.23
2		13	101	749	863		72.00	50.24	22.84	145.08
3		2	29	202	233		3.80	10.49	6.59	20.88
4		1	53	388	442		2.10	19.43	9.52	31.05
5		10	43	196	249		63.60	17.72	5.47	86.79
Total	1	34	335	1,885	2,255	33.20	182.20	155.76	55.87	427.03

	Counts					Weight (g)				
	Size Grade					Size Grade				
Block	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
1		1	30	130	161		25.00	8.35	3.79	37.14
2			15	56	71			4.52	1.07	5.59
3		1	1	12	14		2.40	0.50	0.21	3.11
4			8	68	76			3.03	1.25	4.28
5		1	12	99	112		2.20	2.23	3.47	7.90
Total	-	3	66	365	434	-	29.60	18.63	9.79	58.02

[a] Includes a single unpatinated KRF flake assigned to the "unassigned" analytic unit (CN1076).

Table 5.3. Tool technological case count and specimen weight data organized by excavation block and size grade. The upper panel lists data on specimens assigned to the Plains Village analytic unit, while the lower panel lists data on specimens assigned to the pre-Village analytic unit.

	Case Counts					Specimen Weight (g)				
	Size Grade					Size Grade				
Block	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
1	1	4	12	5	22	63.19	32.75	8.87	0.88	105.69
2	8	29	26	8	71	1,357.16	167.84	25.85	0.93	1,551.78
3	2	3	6	2	13	320.45	18.76	14.02	0.14	353.37
4	2	1	7	3	13	81.42	31.80	8.09	0.20	121.51
5	9	8	8	3	28	709.94	62.72	10.73	0.20	783.59
Total	22	45	59	21	147	2,532.16	313.87	67.56	2.35	2,915.94

	Case Counts					Specimen Weight (g)				
	Size Grade					Size Grade				
Block	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
1			3		3			3.47		3.47
5			1		1			0.99		0.99
Total	-	-	4	-	4	-	-	4.46	-	4.46

seven are considered "local" or "near-local," apart from porcellanite, which was likely imported from eastern Montana or northeastern Wyoming. The data show that on-site tool manufacture focused on the later stages of production (Ahler *et al.* 1997). Materials exhibiting lower G4:G1-G3 ratios were more commonly reduced by percussion (silcrete and TRSS), while those with higher ratios were more commonly reduced by pressure (porcellanite). The high percentage of cortical G4 flakes made from

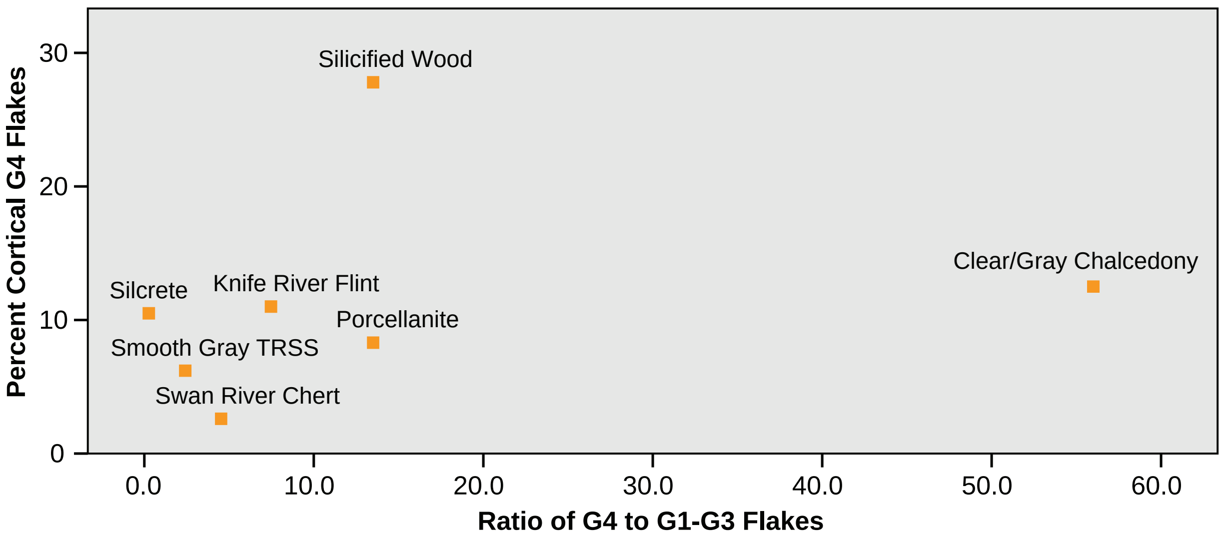

Figure 5.1. Scatterplot illustrating flaking debris mass-analysis data. Each of the included material types represents at least 2 percent of the assemblage.

Table 5.4. Distributions of patination intensity values among coarse fraction (G2-G3) and fine fraction (G4) flakes assigned to the pre-Village analytic unit. Cell values represent flake counts.

	Intensity (G2-G3 Dorsal)					
Intensity (G2-G3 Ventral)	None	Light	Moderate	Pronounced	Total	G4 Patination Intensity
None	n/a	7	4		11	n/a
Light	3	5	5	4	17	144
Moderate		4	13	11	28	71
Pronounced			8	5	13	150
Total	3	16	30	20	69	365

silicified wood likely reflects the small nodule size of that material. The high G4:G1-G3 ratio of clear/gray chalcedony may also reflect small nodule size.

The raw material distribution of chipped stone tools differs somewhat from that of flaking debris (table 5.7). Proportionally fewer tools than flakes were made from KRF. By contrast, higher proportions of tools were made from TRSS and porcellanite. The difference between the proportions of TRSS tools and flakes is especially notable. This may indicate that TRSS tools, and possibly porcellanite tools, were imported to the site in finished or partially finished form. However, the data indicate that all materials, regardless of source, were to varying degrees reduced on-site.

Lithic Territories

Raw material data can be used to map the "lithic territory" to which Molander's flintknappers had access, either through direct procurement or trade. Figure 5.2 illustrates the sources of raw materials commonly used in the northern Middle Missouri (see also Johnson 2019). To simplify comparisons among sites, each raw material type is assigned to one of six raw material groups. The groups comprise raw materials from sources located in different directions and at different distances from the northern Middle Missouri towns. The two most abundant materials in the Molander assemblage—KRF and smooth gray TRSS—are considered "near-local" raw materials: although they can be found in surface lag or alluvial deposits within a few kilometers of the Missouri River valley, they are most abundant 30 to 80 km away (Ahler *et al.* 2002:12.6). KRF, the sole constituent of the Near-local Northwest group, is a distinctive, high-quality, blonde to dark brown chert, which may derive from the HS bed of the Eocene/Paleocene Golden Valley Formation (Clayton *et al.* 1970). It could also have formed in the Oligocene/Miocene Arikaree

Table 5.5. Distribution of flaking debris raw material types by size grade.

Raw Material Type	Size Grade G1	G2	G3	G4	Total	Percent
Smooth Gray TRSS	1	11	42	130	184	*8.2*
Coarse Yellow TRSS			2	7	9	*0.4*
Coarse Red TRSS			1		1	*<0.1*
Orthoquartzite				4	4	*0.2*
Swan River Chert		2	15	77	94	*4.2*
Chert/Jasper			1	31	32	*1.4*
Clear/Gray Chalcedony			1	56	57	*2.5*
Yellow/Light Brown Chalcedony			3	32	35	*1.6*
Dark Brown Chalcedony		1	16	25	42	*1.9*
Gray Porcellanite			5	56	61	*2.7*
Red or Purple Porcellanite			3	52	55	*2.4*
Obsidian				1	1	*<0.1*
Knife River Flint		13	164	1,322	1,499	*66.5*
Historic Glass				1	1	*<0.1*
Metaquartzite		1	3	5	9	*0.4*
Silicified Wood		1	3	54	58	*2.6*
Moss Agate		1	2	8	11	*0.5*
Antelope Chert		1	3	5	9	*0.4*
Silcrete		3	71	19	93	*4.1*
Total	1	34	335	1,885	2,255	*100.0*

Table 5.6. Proportional distribution of raw materials among five excavation blocks; materials comprising less than 1 percent of the assemblage are excluded. Standard residual values discussed in the text are highlighted.

Raw Material	Measure	Excavation Block 1	2	3	4	5	Count
Smooth Gray TRSS	Percent	*18.5*	*37.0*	*3.3*	*10.3*	*31.0*	184
	Std. Residual	-0.7	-0.3	-3.0	-2.9	8.3	
Swan River Chert	Percent	*4.3*	*9.6*	*80.9*	*1.1*	*4.3*	94
	Std. Residual	-3.5	-4.5	21.1	-4.1	-1.9	
Chert/Jasper	Percent	*56.3*	*21.9*	*18.8*	*0.0*	*3.1*	32
	Std. Residual	4.4	-1.5	1.5	-2.5	-1.3	
Clear/Gray Chalcedony	Percent	*10.5*	*54.4*	*8.8*	*24.6*	*1.8*	57
	Std. Residual	-1.7	2.0	-0.4	0.8	-2.1	
Yellow/Light Brown Chalcedony	Percent	*17.1*	*28.6*	*11.4*	*34.3*	*8.6*	35
	Std. Residual	-0.5	-0.9	0.2	1.9	-0.4	
Dark Brown Chalcedony	Percent	*26.2*	*23.8*	*9.5*	*19.0*	*21.4*	42
	Std. Residual	0.8	-1.5	-0.2	-0.1	2.1	
Porcellanite	Percent	*14.7*	*51.7*	*6.0*	*22.4*	*5.2*	116
	Std. Residual	-1.4	2.3	-1.5	0.7	-1.9	
Knife River Flint	Percent	*17.5*	*42.2*	*8.0*	*22.7*	*9.7*	1,499
	Std. Residual	-2.8	2.5	-2.9	2.6	-1.4	
Silicified Wood	Percent	*27.6*	*27.6*	*5.2*	*24.1*	*15.5*	58
	Std. Residual	1.1	-1.3	-1.2	0.8	1.1	
Silcrete	Percent	*91.4*	*2.2*	*0.0*	*1.1*	*5.4*	93
	Std. Residual	14.9	-5.6	-3.1	-4.0	-1.6	
Total	Percent	*20.8*	*38.2*	*10.5*	*19.7*	*10.9*	2,210

Figure 5.2. Map showing the source locations of stone tool raw materials used in the northern Middle Missouri (adapted from Mitchell 2011a:Figure 21).

Formation, which forms the caprock of the Killdeer Mountains (Murphy 2001). Secondary deposits of KRF cobbles are common in Pleistocene alluvium in portions of the Knife River basin, especially in Dunn and Mercer Counties. Dozens of quarry localities are known in this area, dubbed the "primary source area" (PSA) which runs roughly from the Killdeers eastward to the town of Hazen, and from the Little Missouri River south to the divide between the Heart River and Knife River basins. Although the Knife River towns are closer to the primary source area than the Heart River towns, the difference is not as large as their relative positions on the Missouri might suggest. The distance from the mouth of the Heart to the center of the PSA is about 125 km, while the distance from the mouth of the Knife is about 75 km.

Smooth gray TRSS, an opaque, mottled, light-gray-to-black stone similar in texture to fine-grained quartzite, is the major constituent of the Near-local Southwest raw material group. Coarse silcrete, a

Table 5.7. Distribution of raw materials used to produce chipped stone tools, organized by size grade.

	Size Grade					
	G1	G2	G3	G4	Total	Percent
Smooth Gray TRSS	5	12	8	3	28	*21.9*
Coarse Yellow TRSS	1				1	*0.8*
Coarse Red TRSS	1				1	*0.8*
Swan River Chert			3	1	4	*3.1*
Chert/Jasper		2	1		3	*2.3*
Yellow/Light Brown Chalcedony		2			2	*1.6*
Porcellanite		3	5	3	11	*8.6*
Knife River Flint	4	19	33	12	68	*53.1*
Metaquartzite	2			1	3	*2.3*
Silicified Wood	1	2	1	1	5	*3.9*
Moss Agate		1	1		2	*1.6*
Total	14	41	52	21	128	*100.0*

possibly geologically related material exhibiting moderately conchoidal fracture, is also included in this group. The only well-documented TRSS quarry is located in northwestern South Dakota (Keyser and Fagan 1987), although it is certain that high-quality TRSS can be found across a broad area west and south of the Heart region (Ahler 1977), including localities in the valley of the Heart River (Ahler *et al*. 2002:12.3; Jackson *et al.* 2001).

A third raw material group, the Near-local West group, consists of silicified wood and translucent, gray, yellow, and brown chalcedonies. These toolstones occur in surface lag deposits in parts of southwestern North Dakota and northwestern South Dakota, and in alluvial deposits in the tributaries of the Heart, Little Heart, and Cannonball rivers (Ahler 1977). The distribution of these materials overlaps to some extent with those of KRF on the north and TRSS on the south and east. The properties of some of the materials included in the Near-local West group grade into those of KRF, creating the possibility of misclassification (Ahler 2002a).

In contrast to near-local raw materials, exotic materials only can be obtained from sources much farther away to the west and southwest. Exotic or imported materials from western sources in present-day Montana, northern Wyoming, and western North Dakota include porcellanite, Rainy Buttes silicified wood, Antelope chert, moss agate, non-volcanic natural glass, and obsidian (Ahler *et al*. 2002). Another imported raw material group consists of raw materials from sources located to the southwest, including cherts and orthoquartzes from the Hartville Uplift in eastern Wyoming (Reher 1991) and from the Black Hills in Wyoming and South Dakota (Ahler 1977). Some orthoquartzites could also derive from western sources but are conventionally included in the southwestern group because they occur most commonly there (Ahler *et al*. 2002). Plate chalcedony from the Big Badlands of southwest South Dakota and northwest Nebraska, and Bijou Hills silicified sediment from southern South Dakota round out the Exotic Southwest group. The distances to these sources from the Knife region towns are essentially the same as the distances from the Heart region towns.

A sixth raw material group consists of local materials found in Missouri River gravels, Wisconsinin or older till deposits, or bedrock outcrops close to the Missouri. Swan River chert, which varies in texture from quartzite to microcrystalline chert, is grouped with local materials, though it also is found in till deposits throughout northern North Dakota (Low 1996). Swan River chert modules may also be present in till deposits in the KRF primary source area south of the Missouri. Local raw materials are excluded from the comparison discussed in this section.

Figure 5.3 illustrates near-local and exotic raw material group data for Molander and four contemporaneous northern Middle Missouri communities. The Molander assemblage shares characteristics with both the Heart region and Knife region communities. Like those of the Heart region towns (On-A-Slant and Double Ditch villages), Molander's flaking debris assemblage includes lower proportions of KRF (Near-local Northwest) and significant proportions of TRSS (Near-local Southwest). By contrast, the Knife region towns (Big Hidatsa and Lower Hidatsa) are dominated

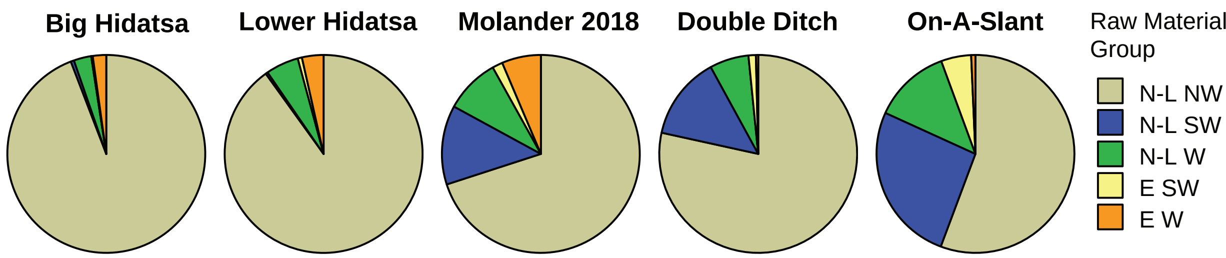

Figure 5.3. Pie chart illustrating the provenance of raw materials represented in the Molander flaking debris assemblage and in assemblages from four contemporaneous settlements (N-L=near-local; E=exotic/imported).

by KRF and include only negligible proportions of TRSS. However, the types of exotic toolstone in the Molander assemblage more closely resemble those of the Knife region towns than they do those of the Heart river towns. Imported materials from western sources are more abundant at Molander and the Knife River settlements than they are in the Heart River settlements, which primarily feature imported materials from southwestern sources.

The assemblage differences between the Heart region and the Knife region that are apparent among eighteenth-century settlements also are characteristic of earlier assemblages from those regions. Table 5.8 lists the proportions of near-local and exotic raw materials for each region over time. Patterns of raw material use in the Knife region were highly stable. KRF makes up more than 90 percent of the assemblages and Near-local Southwest (TRSS) and Exotic Southwest materials only are trace components. Flintknappers in the Heart region made much greater use of Near-local Southwest and Exotic Southwest materials and Exotic West materials are minor components of those assemblages. Temporal patterns also are evident in the Heart region assemblages, especially a decline in the use of TRSS and a concurrent increase in the use of KRF (Ahler *et al*. 2004; Mitchell 2013a). The Molander assemblage fits well into those temporal patterns.

A variety of factors could explain the similarities and differences between the Molander assemblage

Table 5.8. Comparison of regional raw material use over time. Values represent column (regional period) propotions.

Region		Regional Period 1500-1600	1600-1700	1700-1800	1800-1900	Mean	Sample Size
Knife Region	Near-Local SW	*0.4*	*0.7*	*0.5*	*0.2*	*0.6*	914
	Near-Local W	*6.1*	*3.2*	*3.8*	*4.6*	*3.7*	6,044
	Near-Local NW	*91.8*	*93.4*	*92.7*	*92.5*	*93.0*	152,018
	Exotic SW	*0.4*	*0.4*	*0.4*	*1.0*	*0.5*	758
	Exotic W	*1.2*	*2.2*	*2.7*	*1.6*	*2.3*	3,745
Subtotal		*100.0*	*100.0*	*100.0*	*100.0*	*100.0*	163,479
Heart Region	Near-Local SW	*30.3*	*19.0*	*16.0*		*21.7*	167,660
	Near-Local W	*11.4*	*11.9*	*7.6*		*11.2*	86,596
	Near-Local NW	*53.7*	*63.9*	*74.1*		*62.4*	481,934
	Exotic SW	*3.9*	*4.0*	*1.9*		*3.7*	28,775
	Exotic W	*0.7*	*1.2*	*0.4*		*1.0*	7,431
Subtotal		*100.0*	*100.0*	*100.0*		*100.0*	772,396
Molander	Near-Local SW			*12.9*		*12.9*	277
	Near-Local W			*9.0*		*9.0*	192
	Near-Local NW			*70.0*		*70.0*	1,499
	Exotic SW			*1.7*		*1.7*	36
	Exotic W			*6.4*		*6.4*	137
Subtotal				*100.0*		*100.0*	2,141

and contemporaneous assemblages to the north and south. Perhaps the most parsimonious explanation is that the area of direct procurement that Molander's flintknappers accessed to obtain near-local raw materials was essentially identical to the lithic territory utilized by Heart region flintknappers, while Molander's trade connections—through which exotic materials were obtained—were more similar to those of the Knife region settlements.

Burning and Heat Treatment

Data on burning and heat treatment were collected on the coarse-fraction flake sample, which includes 370 specimens. Just 14 percent of the G1-G3 flakes are burned and only one-third of the material types include one or more burned specimens. Evidence of burning is even less common among tool cases: just four of 147 are burned. Only two of the four are made from a cryptocrystalline stone.

Evidence of heat treatment is also scant: just two KRF flakes exhibit definite evidence of heat treatment and one exhibits possible evidence. Two KRF tools and two Swan River chert tools exhibit possible evidence; no definitive examples were observed.

Tool Recycling

Recycling and re-use of tools can be measured in several ways. For example, the use-life of a flake tool can be extended by re-sharpening its existing working edges or by increasing the number of working edges. Many tool forms can be re-purposed for a new function by additional flaking or other modification. A special case of re-purposing is the collection and re-flaking of found objects originally produced hundreds or thousands of years earlier.

Two examples of the latter mode of recycling were observed in the 2018 assemblage, including an unfinished small patterned biface, which broke during remanufacture, that was made on a patinated KRF flake tool (figure 5.4), and an unpatterned flake tool made on a patinated KFR flake. Those two examples amount to 1.6 percent of the chipped stone tool assemblage. Comparable values have been recorded for eighteenth-century components at Big Hidatsa (1.7 percent) and Lower Hidatsa (1.2 percent) villages.

One-quarter of the flake tools were re-touched by pressure flaking; the remainder exhibit only use-modification. The number of working edges was determined for 27 of the 31 unpatterned flake tools. Twenty of the 27 (74 percent) exhibit a single working edge; none exhibit three or more working edges. These data suggest limited re-use of existing tools.

Figure 5.4. Unfinished small patterned biface made from a patinated KRF flake tool.

About 6 percent of the tool specimens (*n*=9) exhibit evidence of re-purposing or re-manufacturing. Five of the nine re-purposed tools are cores or expedient bifaces that were converted to unpatterned scraping or cutting tools. Two are re-purposed production failures of small patterned bifaces. One re-purposed tool is a broken hammer converted to an abrading tool.

The frequency of re-purposing recorded for the 2018 Molander assemblage confirms the broad temporal pattern for the region. For example, the proportion of multi-case tools in Mitchell's (2011a, 2013a) sample of tools from four Heart region sites, including On-A-Slant, Scattered, Double Ditch, and Bypass villages, ranges from 0.3 percent to 2.1 percent. The proportion for the 2008 assemblage from Chief Looking's Village is 1.6 percent (Mitchell and Lee 2013). Ahler and Toom (1993) report similarly low values for pre-1700 Knife region sites. (The frequency of recycling was directly coded for Knife region assemblages; multiple case data for tools from sites in the Knife River Indian Villages National Historic Site reflect functional rather than technological analyses.) By contrast, tool recycling increased to between 3 and 6 percent in the Knife region after 1700 (Ahler and Toom 1993:Figure 18.12[a]).

Stone Tool Technology

Table 5.9 presents a cross-tabulation of stone tool raw materials and technological classes for the 147 cases comprising the chipped and ground stone tools assigned to Molander's Plains Village component. Nine different technological classes and 14 different raw materials are represented.

Small Patterned Bifaces

Twenty-six small patterned bifaces occur in the 2018 assemblage (figure 5.5). Eighty-five percent are arrow point fragments. The remaining four items include a drill fragment and three small cutting tools, one of which was made on a recycled patinated KRF flake tool. Seven of the small bifaces, all arrow point fragments, were made from imported raw materials. Four were made from Swan River chert, which nominally is regarded as a locally available raw material. The remaining 15 were made from near-local materials, primarily KRF.

Table 5.10 compares raw material provenance data for Molander's small patterned biface assemblage with regional data. Although the Molander assemblage is comparatively small, the high proportion of small bifaces made from imported materials is notable. Six of the seven made from imported materials were made from porcellanite. In the Heart region sample, just 16 of the 62 imported specimens (26 percent) were made from porcellanite. By contrast, in the Knife region sample 53 of the 70 imported specimens (76 percent) were made from porcellanite. The similarity of the Molander and Knife region assemblages supports the conclusion that Molander's trade relationships were more akin to those of the Knife region communities than those of the Heart region communities.

Just under one-third of the small patterned bifaces in the Molander assemblage were broken during manufacture, including those made from local, near-local, and imported stone. Although a slightly lower proportion of small bifaces made from imported materials were broken in manufacture—suggesting that some may have come to the Missouri River villages as finished tools—these use-phase data point to on-site production from materials obtained through a variety of procurement processes. The distribution also mirrors those of Heart and Knife region samples, indicating both regional and temporal continuity in the organization of small patterned biface production (table 5.11).

Table 5.12 provides data on the distribution of production skill classes among 13 side-notched arrow points from Molander, along with comparative data from four Heart region sites (Mitchell 2011a). Mitchell (2013a) argues that the proportion of arrow points exhibiting high production skill increased after 1600 in the Heart region, a pattern driven by the increasing prevalence of specialist producers. The Molander assemblage exhibits a similar proportion of high-skill points, indicating that skilled producers continued to operate during the eighteenth century. However, the proportions of points exhibiting limited and moderate skill also increased, suggesting that less-experienced producers were also working at the site.

Molander's arrow points are comparable in size and morphology to those recovered from Heart region sites. Figure 5.6 illustrates the distributions of three measurements—notch depth, notch width, and blade length. In each case, the mean value for the Molander assemblage is nearly identical to the mean values for sixteenth-, seventeenth-, and eighteenth-century components at three Heart region sites. The smaller range of variation for the Molander assemblage reflects its size.

Large Patterned Bifaces

The large patterned biface assemblage includes one fragment of indeterminate morphology; one ovoid, pointed specimen; one side-hafted knife, and one notched, triangular knife. Four different raw materials are represented: three are made from near-local materials (KRF, TRSS, and yellow/brown chalcedony) and one is made from chert, a possibly imported material. Three were finished; the unfinished specimen remains usable.

The triangular knife, which is illustrated in figure 5.7, superficially resembles some Late Woodland Avonlea points, such as specimens from the Gull Lake site (Kehoe 1973). However, it differs from the Avonlea point type in both size and technological characteristics. The Molander specimen is 1.5 to 1.75 times longer than most Avonlea points (e.g. Roll 1988:Table 6). It is also 1.3 to 1.4 times as wide and 2.5 to 3 times as thick. The Molander specimen is made from low- to moderate-quality smooth gray TRSS and exhibits sequential step fractures on both faces. The flaking pattern is haphazard and a portion of the ventral surface of the flake from which it was made is preserved on one face. The notches are asymmetrical

Table 5.9. Cross-tabulation of stone tool raw materials and technological classes. Local raw materials are shown in **bold**, imported materials are shown in *italics,* and near-local materials are shown in regular text.

	Technological Class										
Raw Material Type	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Unpatterned Flake Tool	Large Bifacial Core Tool	Non-bipolar Core	Bipolar Core/ Tool	Unpatterned Ground Stone	Retouched Plate Tool	Total	Percent
Smooth Gray TRSS	2	1	7	6		12				28	*19.0*
Coarse Yellow TRSS					1					1	*0.7*
Coarse Red TRSS					1					1	*0.7*
Swan River Chert	4									4	*2.7*
Chert/Jasper[a]		1		1		1				3	*2.0*
Yellow/Brown Chalcedony		1		1						2	*1.4*
Porcellanite	6			2		3				11	*7.5*
Granitic								4		4	*2.7*
Coarse Porous Sandstone								1		1	*0.7*
Clinker								14		14	*9.5*
Knife River Flint	13	1	4	21		23	3		3	68	*46.3*
Metaquartzite			1					2		3	*2.0*
Silicified Wood						4		1		5	*3.4*
Moss Agate	1		1							2	*1.4*
Total	26	4	13	31	2	43	3	22	3	147	*100.0*
Percent	*17.7*	*2.7*	*8.8*	*21.1*	*1.4*	*29.3*	*2.0*	*15.0*	*2.0*	*100.0*	

[a] Opaque red and yellow cherts are conventionally assigned to the "Exotic Southwest" raw material group (e.g. Ahler *et al.* 2004); however, their provenance is generally not known and some may derive from local sources (Root *et al.* 1999).

Figure 5.5. Small patterned bifaces in the 2018 Molander assemblage. ***Top left****: unfinished biface made from moss agate;* ***top right****: side-notched arrow point made from Swan River chert;* ***middle row****: side-notched arrow points made from porcellanite;* ***bottom row****: side-notched arrow points made from KRF.*

Table 5.10. Provenance of raw materials used to produce small patterned bifaces in two regional assemblages and the 2018 Molander assemblage.

	Raw Material Zone			
Sample	Near-Local	Imported	Coarse Local	Sample Size
Heart Region[a]	*92.7*	*6.6*	*0.6*	937
Knife Region[b]	*90.0*	*9.6*	*0.4*	737
Molander	*57.7*	*26.9*	*15.4*	26

[a] Double Ditch, Scattered, On-A-Slant, and Bypass villages (Mitchell 2013a)

[b] Big Hidatsa Village (Ahler and Swenson 1985a) and Lower Hidatsa Village (Ahler and Weston 1981).

Table 5.11. Proportional distribution of small patterned biface use-phase classes in two regional samples and the 2018 Molander assemblage.

	Use Phase			
Sample	Unfinished, Usable	Unfinished, Unusable	Finished, Usable	Finished, Unusable
Heart Region[a]	*2.5*	*47.8*	*10.2*	*39.5*
Knife Region[b]	*2.7*	*41.8*	*7.9*	*47.6*
Molander	-	*30.8*	*3.8*	*65.4*

[a] Double Ditch, Scattered, On-A-Slant, and Bypass villages (Mitchell 2011a).
[b] Big Hidatsa Village (Ahler and Swenson 1985a) and Lower Hidatsa Village (Ahler and Weston 1981).

Table 5.12. Proportional distribution of arrow point production skill classes. Heart region data from Mitchell (2011a); specimens in the original dataset from Bypass Village are excluded.

		Skill Class					
Sample	Regional Period	Limited	Moderate	Average	High	Indeterminate	Sample Size
Heart Region	post-1700	*0.0*	*0.0*	*70.2*	*29.8*	*0.0*	47
	1600-1700	*0.6*	*9.4*	*55.3*	*34.6*	*0.0*	159
	pre-1600	*3.6*	*8.9*	*75.0*	*12.5*	*0.0*	56
Molander	post-1700	*7.7*	*15.4*	*38.5*	*30.8*	*7.7*	13

and extremely small. The base and lateral margins are not ground. Only limited use-wear is present on the blade margins; however, the blade has been extensively resharpened. These data suggest that the Molander specimen is not a projectile point, but instead is a small hafted knife.

Unpatterned Bifaces and Retouched Plate Tools

Thirteen unpatterned or expedient bifaces are present in the assemblage (figure 5.8). More than half were made from smooth gray TRSS. One was made from moss agate, an imported material. Eighty-five percent were finished and unusable when discarded; just one was broken during manufacture.

Three retouched plate tools occur in the assemblage. Like unpatterned bifaces, plate tools are expedient forms. Both unifacial and bifacial edges occur within the class, but all are made on thin tabular pieces of stone. All three of the plate tools from Molander were made from KRF.

Unpatterned Flake Tools

Just over one-fifth of the assemblage consists of unpatterned flake tools. Ninety percent were made from near-local raw materials. Two were made from porcellanite and one was made from chert. As noted in the "Tool Recycling" section, just 8 of the 31 specimens exhibit deliberate pressure retouch, while the balance exhibits use-modification only. Roughly three-quarters of the specimens for which the number of working edges could be determined (n=27) exhibit a single working edge, a pattern suggestive of comparatively casual, non-intensive use.

Large Core Tools

The 2018 assemblage includes two unpatterned thick bifacial core tools. One is made from coarse yellow TRSS (figure 5.9), while the other is made from coarse red TRSS. On Callahan's (1979:Table 3) ease of workability scale, coarse TRSS ranges from 4.5 to 5.5—the scale's maximum value. Tough materials like coarse TRSS exhibit only moderate conchoidal fracture and controlled reduction is difficult. However, such materials are ideal for heavy chopping, scraping, and pounding tasks. Both Molander specimens exhibit substantial rounding and smoothing use-wear on their working edges, along with chipping and numerous perpendicular micro-fractures indicative of repeated impacts.

Non-bipolar Cores and Bipolar Core Tools

Nearly one-third of the Molander assemblage consists of core fragments and raw material nodules. Nearly half are G2 in size; another 30 percent are G3. Just two of the 43 non-bipolar cores are G4 in size.

The Molander analysis recognizes five core

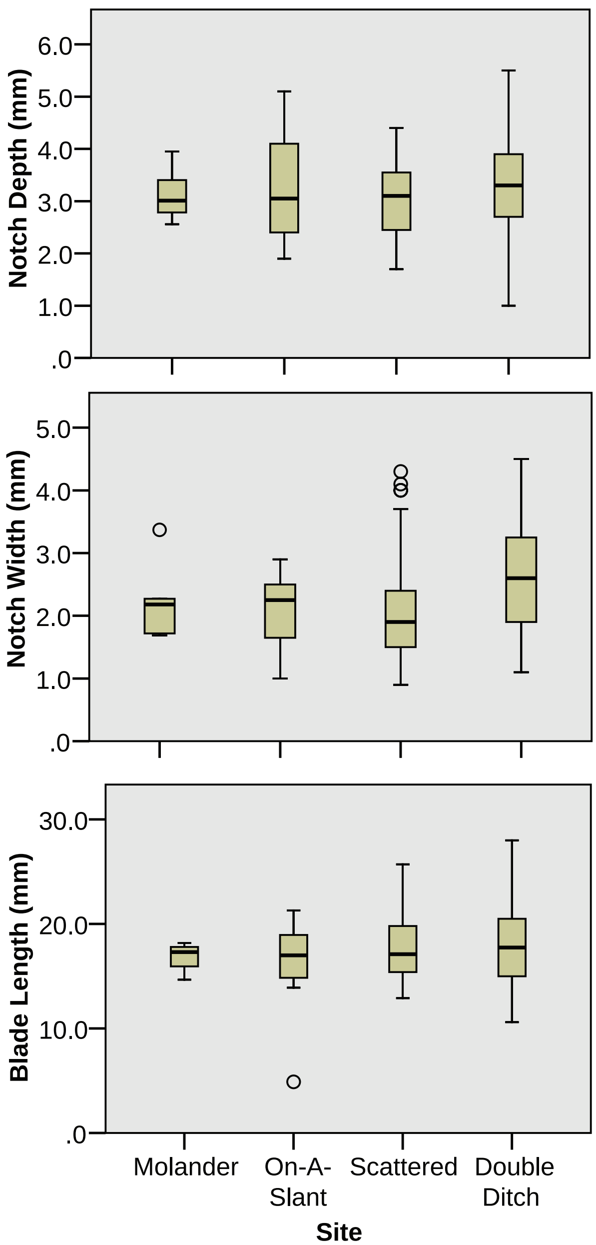

Figure 5.6. Box-and-whisker plots showing distributions of three measurements made on arrow points in the 2018 Molander assemblage at in assemblages from three Heart region sites.

Figure 5.7. Hafted knife (large patterned biface) in the 2018 Molander assemblage made from smooth gray TRSS.

subclasses: multi-directional freehand cores exhibiting at least three productive flake removals; tested cobbles exhibiting one or two flake removals; irregular battered pieces lacking effective flake removals; unorientable fragments; and unmodified toolstone manuports. Table 5.13 cross-tabulates core subclass and raw material type. About one-third consist of productive cores (figure 5.10). Nine were made from smooth gray TRSS, five were made from KRF, and two were made from porcellanite, an imported stone.

Another fifth of the cases in the non-bipolar core class consists of irregular battered pieces. Ahler and others (2004:196) describe specimens of this type as "aimlessly flaked freehand percussion pieces" and interpret them as products of novice or inexperienced flintknappers. Seventy-five percent of the irregular battered pieces in the Molander assemblage were made from KRF. Ahler and others (2004) similarly observe that KRF makes up most of the aimlessly flaked pieces at Double Ditch Village. However, irregular battered pieces make up just 4 percent of the cores in the 2003 assemblage from Double Ditch, while they make up 19 percent of the Molander cores (Ahler *et al*. 2004:Table 39; the Double Ditch analysis only recognizes three core subclasses, including cores, tested cobbles, and aimlessly flaked pieces).

The balance of the modified specimens in this technological class primarily consist G3-sized fragments of cores. These pieces are too small or fragmented to assign to one of the more meaningful subclasses and in fact most could be regarded as "shatter," a class of flaking debris. Most were made from KRF. Thin fragments of silicified wood lacking a working edge are also coded as unorientable core fragments.

Figure 5.8. Various stone tools in the 2018 Molander assemblage. ***Top left****: non-bipolar core re-purposed as an expedient scraping or cutting tool;* ***top right****: unpatterned biface re-purposed as an expedient scraping or cutting tool;* ***lower****: unpatterened biface exhibiting extensive smoothing use-wear. All artifacts made from smooth gray TRSS.*

Figure 5.9. Various stone tools in the 2018 Molander assemblage. ***Top****: large core tool made from coarse yellow TRSS;* ***bottom****: unpatterned abrading tool made from clinker.*

The core class also includes three nodules of unmodified stone, including one KRF nodule and two silicified wood nodules. Although these materials occur naturally in the till underlying Molander, the size and quality of these specimens suggests that they were transported to the site for the purpose of stone tool production but never utilized. None of the specimens exhibit adhering carbonate, a common characteristic of pebbles and cobbles displaced from till deposits.

Three specimens exhibiting bipolar flaking occur in the tool assemblage. All three were made from KRF. Tools of this type may represent wedges, or they may represent nodules reduced by bipolar percussion.

Unpatterned Ground Stone

Fifteen percent of the 2018 assemblage consists of unpatterned ground stone specimens. Abrading tools or tool fragments made from clinker make up about

Table 5.13. Cross-tabulation of core subclass and raw material type.

	Raw Material Type					
Core Subclass	Smooth Gray TRSS	Chert/Jasper	Porcellanite	Knife River Flint	Silicified Wood	Total
Core	9		2	5		16
Tested Cobble		1		1		2
Irregular Battered Piece	1		1	6		8
Unoriented Fragment	2			10	2	14
Unmodified Raw Material				1	2	3
Total	12	1	3	23	4	43

two-thirds of the collection. The balance consists of five hammer stones, multiple fragments of a millingstone or handstone, and a probable whetstone. One of the hammer stones exhibits possible grinding on one face and another was recycled into an abrading stone. A small, complete hammer stone weighing just 37.7 g exhibits nearly continuous fine battering along its edge (figure 5.11).

The whetstone was made from silicified wood and exhibits limited smoothing on all four faces and rounding on all four edges (figure 5.11). Rounding is especially prominent on two edges. Ahler (1988:139, Figure 31) identified five nearly identical specimens in the stone tool assemblage from Taylor Bluff Village at Knife River Indian Villages National Historic Site. Ahler argues that these tools "were used primarily for sharpening metal knives." Whetstones made from coarse silicified wood were also recovered from the Fort Clark trading post (Ahler, Badorek, and Ritter 2003) and Mih-Tutta-Hangkusch (Mitu′ahakto′s or Fort Clark Village) (Mitchell 2014a).

Regional Technological Comparison

Regional assemblage-level data provide context for assessing the technological characteristics of the 2018 Molander collection. The comparative dataset discussed in this section derives from multiple sources. Data for sites in the Heart region were compiled by Mitchell (2011a:Table 14). In that compilation, counts of selected tool classes from some sites were adjusted to account for minor differences in tool class definitions used by different analysts. Data for sites in the Knife region were compiled from multiple technical reports, in combination with the batch definitions developed by Ahler and Swenson (1993) as reported in appendix D.

Because Technological Class 12 (Retouched Plate Tools) was only recognized after the analyses of Knife region sites were complete, all tools assigned to that class in Heart region assemblages were re-assigned to Technological Class 3 (Unpatterned Bifaces). This re-assignment closely conforms to regional usage during the 1980s (e.g. Ahler and Swenson 1985a:Table B-3).

Regional technological data are summarized in table 5.14. Site-specific data are presented in table 5.15. In both tables, comparable data for Molander are given in the lowermost row.

These data reveal significant differences in assemblage composition at multiple levels, including site-specific, between-region, and temporal differences. Turning first to the regional data in table 5.14, persistent differences in selected technological classes exist between Knife and Heart region assemblages. Small patterned bifaces—primarily arrow points—are roughly 50 percent more abundant in Heart region assemblages and large patterned bifaces are roughly twice as abundant. By contrast, unpatterned bifaces and unpatterned flake tools are more abundant in Knife region assemblages. Table 5.16 and figure 5.12 emphasize these differences.

These regional differences were both widespread and persistent. The proportions shown in table 5.15 indicate that assemblages from virtually all Heart region sites contain more patterned bifaces (small and large) than assemblages from Knife region sites. Conversely, virtually all Knife region assemblages contain more unpatterned bifaces and unpatterned flake tools. Figure 5.12 shows that these differences persisted over time, from the 1500s into the 1700s. Although no Heart region sites were occupied during the 1800s, the Knife region proportions for that period continued the pattern apparent for earlier periods.

Table 5.15 also reveals notable between-site differences. Bipolar tools are notably common at Scattered Village, a pattern discussed at length by Ahler and others (2002) and Mitchell (2013a). Patterned flake tools (end scrapers) are over-represented in the eighteenth-century assemblage from Boley Village (Ahler *et al.* 2006; Mitchell 2013a). These site-specific

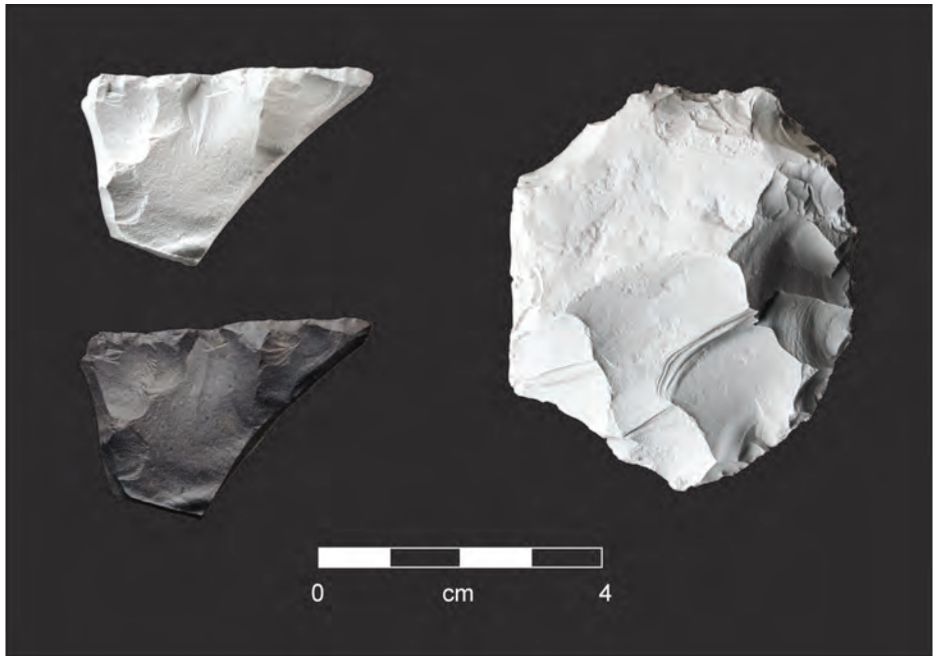

Figure 5.10. Non-bipolar cores in the 2018 Molander assemblage. ***Left****: two views of a tabular core made from porcellanite (lower image is natural color);* ***right****: lenticular core made from KRF.*

Figure 5.11. Various stone tools in the 2018 Molander assemblage. ***Top****: two views of a pebble hammer (unpatterned ground stone) made from metaquartzite;* ***bottom****: two views of a whetstone made from coarse silicified wood.*

Table 5.14. Proportional distributions of adjusted technological classes among time period samples from Knife and Heart region sites.

		Adjusted Technological Class[a]										
Region	Time Period	Patterned Small Biface	Patterned Large Biface	Unpatterned Biface	Patterned Flake Tool	Unpatterned Flake Tool	Bifacial Core-Tool	Non-Bipolar Core	Bipolar Core/Tool	Unpatterned Ground Tool	Patterned Ground Tool	Sample Size
Heart	1700-1800	*18.3*	*11.8*	*2.7*	*4.7*	*37.5*	*0.7*	*8.8*	*1.3*	*13.4*	*0.7*	1,212
	1600-1700	*18.2*	*13.2*	*6.3*	*5.7*	*29.8*	*0.5*	*6.7*	*7.6*	*10.9*	*1.1*	7,262
	1500-1600	*15.5*	*12.6*	*6.9*	*4.3*	*35.5*	*0.4*	*6.3*	*3.9*	*13.6*	*1.0*	3,543
Subtotal		*17.4*	*12.9*	*6.1*	*5.2*	*32.3*	*0.5*	*6.8*	*5.9*	*12.0*	*1.0*	12,017
Knife	1800-1900	*10.5*	*4.0*	*9.3*	*3.4*	*31.6*	*1.1*	*5.6*	*1.1*	*29.0*	*4.4*	976
	1700-1800	*12.4*	*5.1*	*9.9*	*5.4*	*50.4*	*0.5*	*5.8*	*0.9*	*8.9*	*0.6*	2,139
	1600-1700	*12.3*	*7.1*	*7.9*	*4.8*	*55.7*	*0.3*	*4.6*	*0.7*	*5.9*	*0.6*	2,189
	1500-1600	*9.5*	*7.7*	*7.2*	*7.0*	*53.1*	*0.2*	*6.4*	*1.3*	*7.2*	*0.3*	610
Subtotal		*11.8*	*6.0*	*8.8*	*5.0*	*49.6*	*0.5*	*5.4*	*.9*	*11.0*	*1.2*	5,914
Molander	1700-1800	*17.7*	*2.7*	*10.9*	-	*21.1*	*1.4*	*29.3*	*2.0*	*15.0*	-	147

[a] See text.

Table 5.15. Proportional distributions of adjusted technological classes among site samples organized by time period. Heart region sites are shown in the upper rows and Knife region sites are shown in the lower rows.

		Adjusted Technological Class[a]										
Site Name	Regional Period	Patterned Small Biface	Patterned Large Biface	Unpatterned Biface	Patterned Flake Tool	Unpatterned Flake Tool	Bifacial Core-Tool	Non-Bipolar Core	Bipolar Core/Tool	Unpatterned Ground	Patterned Ground	Sample Size
Double Ditch	1700-1800	*18.5*	*11.8*	*2.4*	*4.2*	*38.6*	*0.5*	*8.5*	*0.6*	*14.2*	*0.5*	949
	1600-1700	*19.7*	*11.9*	*3.8*	*3.4*	*39.7*	*0.2*	*8.6*	*0.9*	*10.9*	*0.8*	2,453
	1500-1600	*14.6*	*11.2*	*3.6*	*3.4*	*44.9*	*0.1*	*8.7*	*0.7*	*12.0*	*0.8*	768
On-A-Slant	1700-1800	*17.5*	*11.8*	*3.8*	*6.5*	*33.5*	*1.5*	*9.9*	*3.8*	*10.3*	*1.5*	263
	1600-1700	*20.7*	*16.0*	*2.3*	*3.5*	*39.2*	*1.2*	*6.8*	*1.6*	*7.3*	*1.4*	694
	1500-1600	*17.0*	*10.0*	*2.1*	*3.8*	*41.5*	*2.4*	*5.2*	*1.7*	*14.9*	*1.4*	289
Boley	1600-1700	*14.7*	*13.3*	*10.2*	*14.7*	*21.2*	*1.3*	*9.3*	*4.3*	*9.7*	*1.3*	626
	1500-1600	*13.0*	*12.2*	*9.1*	*6.5*	*33.0*	*0.4*	*7.4*	*4.8*	*13.0*	*0.4*	230
Scattered	1600-1700	*17.3*	*13.5*	*8.1*	*6.1*	*22.5*	*0.3*	*4.9*	*14.2*	*11.9*	*1.3*	3,489
	1500-1600	*15.9*	*17.7*	*8.6*	*6.0*	*26.4*	*0.4*	*4.4*	*9.4*	*10.1*	*1.0*	1,127
Larson	1500-1600	*15.9*	*9.3*	*8.3*	*2.8*	*37.0*	-	*6.5*	*0.9*	*18.1*	*1.2*	1,129
Big Hidatsa	1800-1900	*8.4*	*4.5*	*9.5*	*3.2*	*45.2*	*0.7*	*6.1*	*0.7*	*17.4*	*4.3*	442
	1700-1800	*12.6*	*3.3*	*9.9*	*5.8*	*52.5*	*0.2*	*5.5*	*0.9*	*8.6*	*0.8*	1,321
	1600-1700	*9.5*	*5.2*	*4.7*	*5.5*	*65.0*	-	*3.9*	*0.5*	*5.0*	*0.6*	934
Lower Hidatsa	1700-1800	*12.2*	*8.2*	*9.9*	*4.8*	*47.2*	*1.1*	*6.1*	*0.9*	*9.4*	*0.2*	818
	1600-1700	*14.4*	*8.5*	*10.3*	*4.2*	*48.8*	*0.6*	*5.2*	*0.8*	*6.6*	*0.6*	1,255
	1500-1600	*9.5*	*7.7*	*7.2*	*7.0*	*53.1*	*0.2*	*6.4*	*1.3*	*7.2*	*0.3*	610
Sakakawea	1800-1900	*17.0*	*5.5*	*12.1*	*3.4*	*19.5*	*1.7*	*4.6*	*1.4*	*30.7*	*4.0*	348
Taylor Bluff	1800-1900	*3.2*	-	*3.8*	*3.8*	*21.5*	*1.1*	*6.5*	*1.6*	*53.2*	*5.4*	186
Molander	1700-1800	*17.7*	*2.7*	*10.9*	-	*21.1*	*1.4*	*29.3*	*2.0*	*15.0*	-	147

[a] See text.

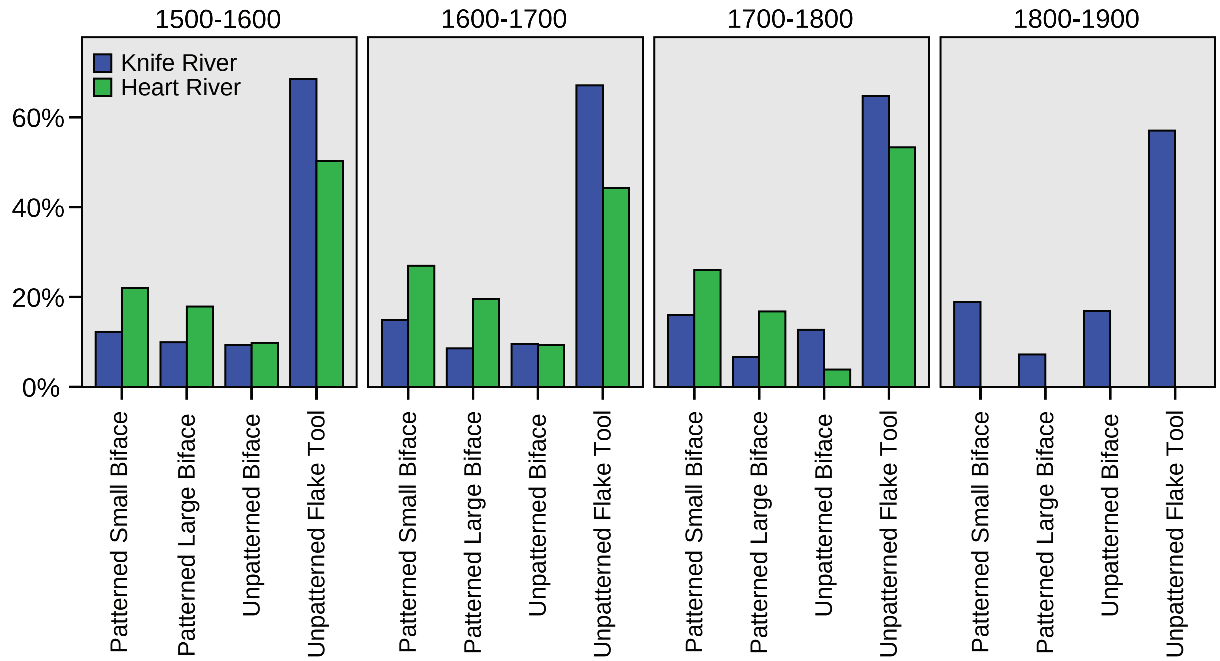

Figure 5.12. Bar chart illustrating the proportional distribution of four technological classes in two regional assemblages during for periods.

Table 5.16. Proportional distribution of selected technological classes among Knife and Heart region sites organized by period.

Region	Regional Period	Adjusted Technological Class[a] Patterned Small Biface	Patterned Large Biface	Unpatterned Biface	Unpatterned Flake Tool	Sample Size
Heart	1700-1800	*26.1*	*16.8*	*3.9*	*53.3*	852
	1600-1700	*27.0*	*19.5*	*9.3*	*44.2*	4,901
	1500-1600	*22.0*	*17.9*	*9.8*	*50.3*	2,500
Subtotal		*25.4*	*18.8*	*8.9*	*47.0*	8,253
Knife	1800-1900	*18.9*	*7.2*	*16.9*	*57.0*	540
	1700-1800	*16.0*	*6.6*	*12.7*	*64.7*	1,667
	1600-1700	*14.8*	*8.6*	*9.5*	*67.1*	1,819
	1500-1600	*12.3*	*9.9*	*9.3*	*68.5*	473
Subtotal		*15.5*	*7.8*	*11.6*	*65.1*	4,499
Molander	1700-1800	*35.1*	*5.4*	*17.7*	*41.9*	74

[a] See text.

differences reflect aspects of the organization of craft production. Other specific differences may reflect sampling or other factors.

The data in tables 5.14 and 5.15 also hint at several temporal differences. Determining whether these patterns also reflect cultural differences is confounded in part by the lack of Heart region samples dating to the nineteenth century. (Even for the 1700s, the Heart region sample is relatively limited because technological class data are not available for the large TP0 (1725-1785) assemblage from Double Ditch.)

The most notable of the temporal patterns occurs in the proportions of unpatterned and patterned ground stone tools. Ground stone tools are moderately more common in Heart region than Knife region assemblages prior to 1800. However, after 1800, the proportion of ground stone tools increases dramatically. This shift is especially notable at Big Hidatsa Village and is also reflected in the assemblages from Awatixa (Sakakawea) and Taylor Bluff villages. Although not included in the regional dataset, a similar pattern has been observed in both the Mandan and Sahnish components at Fort Clark (Mitchell 2014a). The increase in the frequency of ground stone tools culminates at Like-A-Fishhook Village, where they make up 65 percent of the assemblage (Ahler and Toom 1993).

Several factors promoted the proportional increase in ground stone tools. One was the replacement of chipped stone tools by edged metal tools: as the production of chipped stone tools declined, the proportion of the assemblage made up of ground stone tools increased. Another factor was the need for new types of stone tools for sharpening edged metal tools.

No patterned ground stone specimens occur in the 2018 Molander assemblage and patterned ground stone makes up less than 2 percent of all Heart and Knife region assemblages predating 1800. After 1800, the proportion made up of patterned ground stone items in Knife region assemblages increases to 4 or 5 percent. Ahler and Toom (1993:255) suggest that that increase was also tied to the availability of metal tools, which greatly simplified the production of pipes, tablets, shaft abraders, and other shaped stone pieces.

Figure 5.12 also suggests possible minor temporal changes in the proportions of small patterned bifaces (an increase), large patterned bifaces (a decrease), and unpatterned bifaces (an increase).

Although the Molander assemblage is the smallest of those reported in table 5.15—and therefore possibly the most subject to sampling issues—the proportions reflect aspects of both Heart and Knife region assemblages. Like most Heart region assemblages, the Molander collection includes a relatively large proportion of projectile points and a low proportion of unpatterned flake tools. However, it also includes a relatively low proportion of large patterned bifaces and a high proportion of unpatterned bifaces, a pattern characteristic of most Knife region assemblages.

The proportion of the Molander assemblage made up of non-bipolar cores is nearly three times that of the next highest value. This may reflect the vagaries of archaeological sampling, although coding procedures may also be partly responsible: as discussed previously, the Molander stone tool analysis identified five technological sub-classes, including unoriented core fragments. Knife region tool analyses, as well as some Heart region analyses, likely would have classified a portion of those items as flaking debris rather than as tools.

The proportion of the Molander assemblage made up of ground stone tools is somewhat higher than the proportions for most Heart region assemblages and much higher than those for Knife region assemblages pre-dating the nineteenth century. This proportion, coupled with the presence of a specialized whetstone, supports the inference that the Molander assemblage dates to the middle of the eighteenth century, when metal tools were becoming more widely available.

Modified Stone Density

Ahler and Toom (1993) argue that overall chipped stone tool production declined during the fur trade-era. The decline in production was minimal during the seventeenth century, modest during the eighteenth, and dramatic during the nineteenth. Goulding (1980) identifies variations in densities of chipped stone artifacts that may in part reflect changes in the scope of production. However, he recognizes that a variety of other factors likely contributed to the density variations he observed.

To provide context for flake density values for the 2018 Molander collection, a comparative dataset was compiled from a variety of sources. The dataset consists of count and weight data on G1-G4 flaking debris from 32 batches at 11 sites, in addition to Molander. Six sites are located in the Heart region, while five are located in the Knife region.

Figure 5.13 illustrates the major temporal trends in the dataset. Overall, mean flake density increased in the 1600s, then declined slightly in the 1700s prior to a major decline in the 1800s. The seventeenth-century increase could be related to in the increasing importance of craft production fueled by regional trade (Mitchell 2013a), while the nineteenth-century decline reflects the effects of direct and local trade in metal tools.

However, figure 5.13 also illustrates the extent of variability in the dataset. Figure 5.14 breaks down the eighteenth-century sample by batch. The flake density at Molander is the lowest of the eighteenth-century batches, and just 3.4 percent of the density of the early eighteenth-century sample from Lower Hidatsa Village (437 flakes/m^3 compared to 12,960 flakes/m^3, the second-highest value in the dataset). These data indicate that factors other than the scope of production affected flake density values. While the very low values for nineteenth-century components

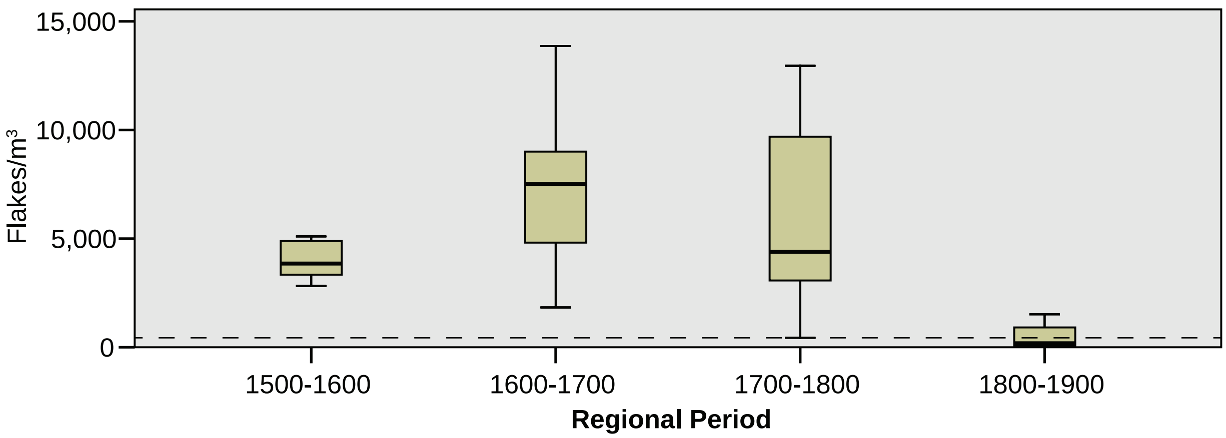

Figure 5.13. Box-and-whisker plot illustrating flaking debris density data for 12 Knife and Heart region sites. The dashed line represents the density calculated for the 2018 Molander collection.

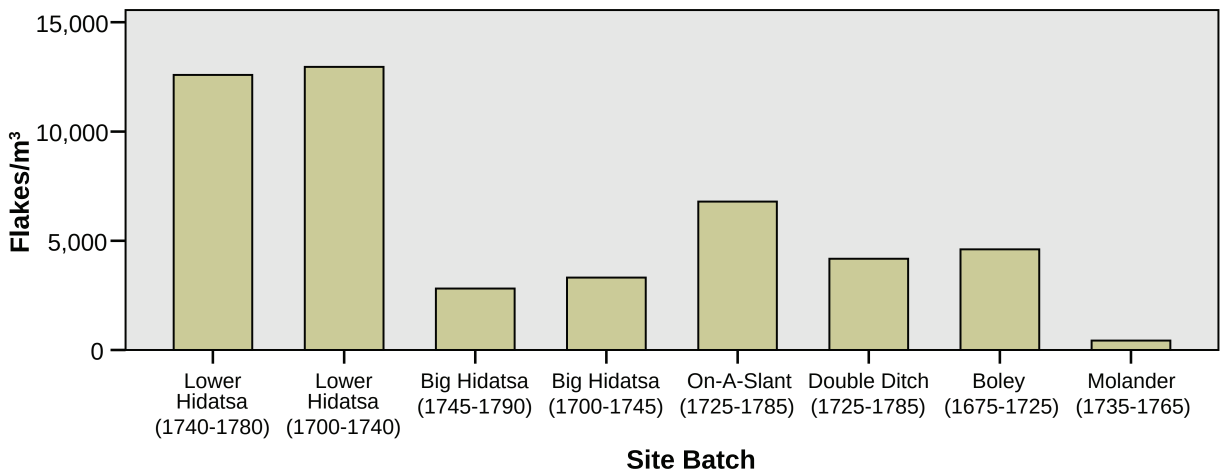

Figure 5.14. Bar chart illustrating the range of flaking debris density values for eight Knife and Heart region batches.

(187 to 1,512 flakes/m^3) almost certainly reflect the effects of the fur-trade, data from earlier time periods do not clearly point to changes in the scope of stone tool production.

Summary

Analysis of the small modified stone assemblage recovered in 2018 yields insights on Molander's lithic raw material territory, on the organization of stone tool production, and on the effects of the fur trade on northern Middle Missouri economies. Some of these findings have implications for the cultural context of Molander's Plains Village occupation. Modified stone data also provide circumstantial evidence for the site's occupation history.

The complete 2018 collection consists of 2,689 flakes and 151 stone tool cases. Based on the presence of surface patination, 434 flakes (16 percent of the total) and four stone tool cases (3 percent) are assigned to one or more pre-Plains Village occupations. No temporally diagnostic specimens are present in the pre-Plains Village assemblage. The balance of the modified stone assemblage is assigned to a single Late Plains Village occupation that likely dates to the middle decades of the eighteenth century.

The proportions of different raw materials present in the flaking debris assemblage reflect Molander's unique geographical location and cultural position within the northern Middle Missouri. Molander's inventory of near-local raw materials is similar to that of the Heart region settlements occupied between

1500 and 1780. KRF constitutes roughly two-thirds of the Molander assemblage, but smooth gray TRSS and various chalcedonies are important constituents. The same is true of Heart region assemblages. By contrast, Knife region near-local raw material assemblages consist almost entirely of KRF and smooth gray TRSS is virtually absent.

At the same time, Molander's inventory of imported or exotic raw materials is more similar to that of the Knife region settlements. Stone imported from western sources is uncommon in the Heart region but relatively common at Molander and in the Knife region.

That pattern suggests that Molander's flintknappers exploited a direct procurement zone nearly identical to that of Heart region flintknappers, no doubt with their consent. Molander's trade connections, however, were more similar to those of the Knife region settlements. This suggests that both geography and cultural identity shaped Molander's lithic raw material procurement.

Raw material provenance had only limited effects on the organization of stone tool production. The presence of imported materials in the flaking debris assemblage points to on-site reduction of those materials. The tool assemblage includes cores, unpatterned flake tools, and unpatterned bifaces made from imported materials. This suggests that nodules of raw material, rather than finished or semi-finished tools, were acquired through trade. Whether the villagers obtained stone from visiting traders, or whether they obtained stone at rendezvous away from the Missouri, the haul capacity on regional trade routes must have been substantial.

The technological characteristics of the Molander tool assemblage may also reflect aspects of both Knife and Heart region assemblages. Notable interregional differences include higher proportions of small and large patterned bifaces in the Heart region and higher proportions of unpatterned bifaces and flake tools in the Knife region. The proportions of small patterned bifaces and unpatterned flake tools in the Molander assemblage mirror those of the Heart region, while the proportions of large patterned bifaces and unpatterned bifaces mirror those of the Knife region. However, it remains unclear whether these similarities and differences primarily reflect Molander's geographical and cultural positions or whether they reflect fur trade-induced temporal patterns. The relatively high proportion of small patterned bifaces seems to reflect long-standing differences between the Heart and Knife regions, but the overall expedient character of the assemblage (represented by a high proportion of unpatterned bifaces and a low proportion of large patterned bifaces) could reflect either the long-standing Knife region pattern or a shift toward expediency encouraged by the advent of metal tools.

The 2018 tool assemblage conforms to many of Ahler and Toom's (1993) expectations for the effects of the fur trade on stone tool production. Expedient technological practices are well represented. Unpatterned bifaces are relatively common, particularly compared to Heart region sites. Aimlessly flaked or irregularly battered nodules make up a significant share of the non-bipolar core class. Unpatterned flake tools primarily reflect expedient, one-time use. Large patterned bifaces are uncommon.

Tool re-purposing also conforms to regional temporal patterns: the re-purposing rate at Molander is higher than in earlier Heart or Knife region assemblages and comparable to the rate in nineteenth-century assemblages. Re-purposing at Molander also includes re-manufacturing of scavenged ancient stone pieces, a practice that was virtually unknown before the 1700s.

However, the Molander tool assemblage also demonstrates that skilled production of small patterned bifaces continued into the eighteenth century. By most measures the Molander arrow point assemblage is comparable to earlier Heart region assemblages, apart from the fact that notable proportions of the Molander assemblage were made from both imported and local raw materials. The apparently limited changes in arrow production reflected in the Molander assemblage indicate that the introduction of metal tools during the fur trade effected different aspects of chipped stone tool production in different ways.

The density of flakes observed during the 2018 investigation at Molander is the fifth lowest among 33 batches in the interregional dataset. Both of the sites exhibiting lower densities—Taylor Bluff Village and Fort Clark Village—were occupied during the nineteenth century. If one assumes that density values reflect the overall extent of stone tool production, that finding could indicate that the occupation at Molander occurred during the mid- to late-eighteenth century. However, extreme variability in density values for components otherwise judged to be contemporaneous indicates that flake density is affected by a variety of factors other than the extent of production.

Ahler and Swenson (1985a:167-169) identify a stone tool generalized functional class, which they call the "Post-Contact Group," that they argue is diagnostic of the fur-trade era. The group includes gunflints, striker flakes, and aimlessly flaked practice pieces. The latter occur in the Molander assemblage, but the former two types are absent. However, one could include whetstones used to sharpen edged metal tools in the post-contact group and one specimen of that type is present in the Molander collection. Ahler and Toom (1993) also identify an increase in the proportion of unhafted scraping tools as an indicator of the fur trade era. No scraping tools occur in the Molander assemblage and no unpatterned flake tools exhibiting use-wear typical of hide scraping were observed in the 2018 collection, although data on tool function were not systematically collected. However, this absence almost certainly reflects the idiosyncrasies of archaeological excavation unit placement. Patterned flake tools (hafted end scrapers) consistently make up about 5 percent of every northern Middle Missouri assemblage, regardless of region or period and there is no reason to think that they should not occur at Molander.

6

Vertebrate Remains

Carl R. Falk

This chapter provides a descriptive account for nearly 30 kg of bone recovered during the archaeological investigation of Molander Village in August 2018. Modified bone and antler remains are detailed in chapter 7. Vertebrate materials, consisting largely of fragmented bison (*Bison bison*) bone, are well preserved. The remains of a variety of smaller-bodied mammals, as well as fish and birds, also are well preserved. After review of laboratory procedures, succeeding sections present bone weight and count information, identification of vertebrate taxa, and examination of specimen distributions within a framework that provides a consistent structure for analysis of all material remains. A final section provides general comparison of the Molander sample with materials recovered from late prehistoric and historic village sites found along the Missouri River within the Knife River and Heart River regions.

Sixteen 1 x 1-m excavation units, distributed among five blocks (see chapter 2, figure 2.19, table 2.6), were excavated during the 2018 program. Three general periods of site use are recognized based on geomorphological and stratigraphic studies, a variety of geophysical surveys, the recovery of temporally diagnostic artifacts, and observation of visible surface features (see chapter 3, table 3.3). Site use begins at some point during the Archaic or later Woodland periods, followed by a single but substantial late Plains Village occupation, and continuing with homesteading operations in the late nineteenth and early twentieth centuries. More recent management and alterations of the site are not considered here. A few specimens from contexts assigned to an Archaic or Woodland period of site use were recovered. These materials are reported

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in a separate section. However, nearly all vertebrate remains are from deposits directly associated with the late Plains Village occupation and are the focus this chapter. None of the vertebrate materials recovered during the 2018 investigation can be linked to post-village period homestead activities. Finally, bone recovered in 1968 from a single test unit placed in village deposits located outside the fortification ditch is referenced as appropriate.

Laboratory Preparation

Initial laboratory processing of screened materials was completed in Broomfield, Colorado under the supervision of PCRG Lab Manager Britni Rockwell. Following standardized practices, all bone remains were size graded over nested screens by catalog lot. The resulting size grade 1, 2, and 3 fractions were further divided into burned and unburned portions and quantified by weight for each size grade. Counts were recorded for grade 1 (G1) specimens, but not for grade 2 (G2) and grade 3 (G3) pieces. In addition, potentially identifiable skeletal specimens were sorted from the grade 4 (G4) fraction but not from the grade 5 (G5) fraction. When recognized, modified bone specimens were set aside for further study.

Size G1-3 remains, along with potentially identifiable G4 specimens, were forwarded to the author for further processing and analysis. Upon receipt, the collection was organized by block, excavation unit, and catalog lot. Each batch was carefully checked for the presence of tools, tool fragments and other modified pieces unrecognized in the preliminary sort. Identifiable G1-4 specimens were separated by class and element identifications and taxonomic assignments were recorded for each specimen. A specimen was considered "identifiable" if the skeletal element or element group (e.g., rib, thoracic vertebra, proximal phalange, etc.), side (left, right, axial), and portion (proximal, distal, cranial, caudal, etc.) could be determined with reasonable certainty. Generally, phalanges, sesamoids, and distal metapodial fragments were not sided. Information was recorded for evidence of burning, tool marks, carnivore and rodent gnawing (Haynes 1980), and surface characteristics (acid-etched, corroded, rounded and/or polished edges) indicating partial digestion and a likely scatological origin. Fracture patterns (e.g., transverse, oblique, spiral, and comminuted) were not systematically recorded. Specimen data, along with catalog number, size grade, and basic provenience information, were recorded on lab worksheets and later transferred to a permanent database (Excel 2013) for inclusion with site records. The entire collection, organized by catalog lot and size grade, was packed for return to the State Historical Society of North Dakota and permanent storage.

Element and taxonomic identifications were completed largely through use of a collection of modern reference skeletons maintained by the author. Taxonomic identifications for buteonine hawks and shorebirds were evaluated and verified through comparison to research materials curated by the Division of Zoology, University of Nebraska State Museum (Lincoln, Nebraska). John R. Bozell (Nebraska State Archeology Office, History Nebraska) and Thomas Labedz (Collections Manager, Division of Zoology, University of Nebraska State Museum) assisted with this phase of the work; their efforts are acknowledged and much appreciated. Taxonomic nomenclature generally follows the American Fisheries Society (2013) for fish, Johnson (2015) for amphibian and reptiles, Chesser and others (2019) for birds, and Seabloom (2011) for mammals.

Weight and Count Data for Recovered Bone

A total of 29.933 kg of unmodified bone was recovered during the 2018 field investigation. Table 6.1 summarizes counts for G1 specimens and weights for G1-3 remains by excavation block. Excavation Units 12 and 13 in Block 5 contributed nearly half (48.2 percent) of the 2018 sample; 87.6 percent of the Block 5 sample was recovered from a single cache pit (Feature 11) in Unit 13. Block 2 (Units 5, 6, and 8) yielded an additional 28.0 percent of sample. A Block 2 cache pit (Feature 7) contributed 74.5 percent of the block total.

G1 specimen counts total 363; G2 and G3 specimens are not counted. Based on size grade weight and count relationships developed for Chief Looking's Village (Falk 2013a:138), the 2018 Molander sample is estimated to contain roughly 2,100 G2 and 19,500 G3 specimens.

Overall, 5.4 percent of the recovered specimens are burned or partially burned. The relative percentage of burning varies by excavation block with the highest value, 40.0 percent, calculated for Block 4. Feature 4 in Block 4 is identified as a hearth. Lower values are recorded for Block 2 (10.1 percent), and especially for Block 1 (1.6 percent) and Block 5 (1.6 percent). Burned bone is most common in the G3 fraction (8.4

percent). Six partially burned specimens represent 5.8 percent of the G1 sample.

Table 6.2 presents G1-3 count and weight data organized by deposit type. Material recovered from terrace, minor pit, midden or floor, surface, and floor or floor fill deposits contribute just under 20 percent of the total. Cache pit deposits from three features (Features 7 and 11, noted above, and Feature 5 in Block 3) provide 67.4 percent of the combined sample. Midden deposits add an additional 12.7 percent. The relative percentage for burned bone is highest for pit deposits, represented by a series of small basins and postmolds recorded in Block 1 (Feature 2, a postmold), Block 4 (Feature 1, historic postmold filled with village deposits, and basin Features, 3, 4, and 6), and Block 5 (Feature 10, basin).

Table 6.3 presents collapsed size G1-3 weights and excavated volumes by specific deposit type and analytic unit, allowing calculation of bone density values. The combined sample, including Block 1 pre-village period terrace deposits, shows a density value of 4.86 g/l. With the exclusion of pre-village remains, contexts assigned to the village period occupation of the site yield a bone density of 5.8 g/l (29,808 g/5,162.1 l). Table 6.3 mirrors data presented in table 6.2 with cache pit deposits yielding the largest proportion of the sample and showing the highest density value, 25.92 g/l. Bone density values for other deposit types range from a low of 0.13 g/l in pre-village terrace deposits to 3.64 g/l in village floor/floor fill deposits.

Table 6.4 organizes the size grade data for deposits assigned to the village occupation, focusing on the relationship of areas sampled to known structures. Terrace deposits are excluded. Cache pits located inside recognized earthlodges yielded 63.6 percent of the total sample. Midden deposits lying outside the lodges contributed an additional 12.0 percent of the sample with floor/fill and mixed midden/floor deposits adding 7.0 percent and 3.9 percent, respectively. Over half (53.2 percent) of bone from Feature 4, an unassigned pit (basin hearth) in Block 4, is burned. Burned bone is recorded in unassigned midden (30.8 percent) and unassigned surface (15.8 percent), outside cache pits (4.1 percent), outside surface (4.0 percent), and mixed inside midden/floor (3.9 percent) deposits.

Table 6.1. Counts (G1) and weights (G1-3) for unmodified vertebrate remains organized by excavation block and size grade.

	Count	Weight by Size Grade (g)					
Block	G1	G1	G2	G3	Total Weight (g)	Percent Total	Percent Burned
1	36	782	1,291	2,044	4,117	*13.8*	*1.6*
2	100	3,377	2,616	2,397	8,390	*28.0*	*10.1*
3	19	502	739	817	2,058	*6.9*	*4.7*
4	3	43	219	694	956	*3.2*	*40.0*
5	205	8,098	4,001	2,312	14,412	48.2	1.6
Total	363	12,802	8,866	8,264	29,933	*100.1*	*5.4*
Percent Total		*42.8*	*29.6*	*27.6*			
Percent Burned		*5.8*	*2.2*	*8.4*			

Table 6.2. Counts (G1) and weights (G1-3) for unmodified vertebrate remains organized by specific deposit type.

		Count	Weight (g)				
Specific Deposit Type	Analytic Unit	G1	G1	G2	G3	Total Weight	Percent Total
Surface	Village	8	137	497	974	1,608	*5.4*
Midden	Village	36	836	1,231	1,723	3,790	*12.7*
Midden/Floor	Village	13	296	368	489	1,153	*3.8*
Floor/Floor Fill	Village	16	406	770	902	2,078	*6.9*
Cache Pit	Village	286	11,070	5,650	3,471	20,191	*67.4*
Pit	Village	4	57	304	627	988	*3.3*
Terrace	Pre-Village	-	-	46	79	125	*0.4*
Total		363	12,802	8,866	8,265	29,933	*99.9*

Table 6.3. Bone weight, excavated volume, and bone density by analytic unit and specific deposit type.

Specific Deposit Type	Analytic Unit	Weight (g)	Excavated Volume (liters)	Density (g/l)
Surface	Village	1,608	949.2	1.69
Midden	Village	3,790	1,589.7	2.38
Midden/Floor	Village	1,153	504.0	2.29
Floor/Floor Fill	Village	2,078	570.0	3.64
Cache Pit	Village	20,191	779.1	25.92
Pit	Village	988	770.1	1.28
Terrace	Pre-Village	125	984.5	0.13
Total		29,933	6,159.7	4.86

Table 6.4. Counts (G1) and weights (G1-3) for unmodified vertebrate materials from village deposits organized by size grade, specific deposit type, and relationship to recognized structures.

Deposit Type—Earthlodge Relationship	Count	Weight (g)					
	G1	G1	G2	G3	Weight (kg)	Percent Total	Percent Burned
Cache Pit—Outside	14	354	466	408	1,228	*4.1*	*5.2*
Cache Pit—Inside	272	10,716	5,184	3,063	18,963	*63.6*	*5.0*
Pit—Outside	0	0	0	60	60	*0.2*	*1.0*
Pit—Inside	4	57	195	150	402	*1.4*	*1.2*
Pit—Unassigned	0	0	109	417	526	*1.7*	53.2
Surface—Outside	7	128	335	736	1,199	*4.0*	*2.8*
Surface—Inside	0	0	100	105	205	*0.7*	*3.9*
Surface—Unassigned	1	9	62	133	204	*0.7*	*15.8*
Midden—Outside	34	802	1,183	1,577	3,562	*12.0*	*1.7*
Midden—Unassigned	2	34	48	146	228	*0.8*	*30.8*
Midden/Floor—Inside	13	296	368	489	1,153	*3.9*	*4.0*
Floor/Fill—Inside	16	406	770	902	2,078	*7.0*	*3.6*
Total	363	12,802	8,820	8,186	29,808	*100.1*	*5.4*

Bone recovered from a single 5 x 5-ft test unit excavated in 1968 by a University of Missouri field crew provides an opportunity to examine bone density from an area located in the northeastern corner of the site outside the fortification ditch. The deposit was dry screened over ¼-in square mesh, yielding a sample partially analogous to G1-3 waterscreen sample collected in 2018. Based on information given by Wood (1986:4, Table 1), supplemented by the author's field and laboratory notes (Falk 1969), the volume of excavated deposits totaled between 37.5 to 50 ft^3 (1,060 to 1,420 l). Approximately 3,800 g of bone were recovered, yielding bone density values of 35.8 to 26.8 g/l. The lower value is in line with the value calculated for cache pit deposits screened in 2018 (table 6.3). The 1968 test shows that cultural deposits found outside the fortification ditch may hold significant concentrations of bone, particularly in comparison to midden deposits sampled within the village proper. Bone from areas outside, but adjacent to the village proper, may shed additional light on the transport and processing of game, as well as patterns of trash disposal.

Bone from Pre-Village Terrace Deposits

Materials from the terrace deposits are assigned to an analytic unit representing occupation or use of the site area during the Archaic or Woodland periods (see chapter 3). Excavation of nearly a cubic meter of terrace deposits yielded 125 g of bone (table 6.2) from Block 1 levels. Bone density within terrace deposits is low, especially when compared with other deposit types (table 6.3). Three specimens from the terrace deposits are considered identifiable for the present study. A right humerus from an unidentified mouse (Cricetidae) was sorted from the G4 fraction in Unit 1 (GL5). The specimen is unburned and well preserved. The crown of a deciduous tooth representing an unidentified large canid (*Canis* sp.) was recovered from Unit 4 (GL2); this specimen is unburned. Finally, a near complete proximal sesamoid, identified as bison (*Bison bison*), is from Unit 4 (GL2). The specimen is unburned but shows surface erosion characteristic of partially digested bone.

Careful examination of bone materials recovered from the 2018 tests shows no clear, consistent, or significant physical differences (e.g., color, root etching, differential weathering) between the small sample of terrace materials and remains from deposits associated with the late period village occupation. It is probable that most, if not all, bone remains found in terrace deposits represent an accumulation of intrusions, the combined result of animal burrowing and human activities during later periods. At best, the temporal and cultural associations of the identified specimens are uncertain but it is thought that identified pieces are intrusions into the pre-village terrace originating from overlying village deposits.

Species Representation and Abundance in Plains Village Deposits

A total of 29.808 kg of bone was recovered from deposits associated with the late Plains Village occupation of the site (table 6.4). Table 6.5 summarizes counts for identified Plains Village specimens (NISP) organized by size grade and broad taxonomic-based groupings, an approach initiated by Lee and Ahler (2003:199-203) to provide a basic summary of assemblage composition. Groupings include large artiodactyls (bison and elk), small artiodactyls (mule deer, white-tailed deer, and pronghorn), large canids (domestic or feral dog, coyote, and gray wolf), medium to small mammals (leporids, squirrels, foxes, mustelids, and mephitids), fish, birds, reptiles and amphibians, and micromammals (shrews, pocket gophers, New World rats and mice, and Old World rats and mice).

As expected, G1 and G2 fractions are dominated by the remains of large artiodactyls (95.7 percent) with small artiodactyls (2.7 percent), medium-small sized mammals (0.8 percent), and birds (0.8 percent) completing the sample. The G3 sample is mixed, with birds, medium-small sized mammals, and fish making-up nearly three-quarters of the total. Artiodactyls are also well represented. Large canid remains are few and herpetofauna are absent. G4 specimens account for 37.0 percent of the identified sample. Micromammals comprise 51.9 percent of the G4 fraction. Bird, fish, and medium-small sized mammal specimens also are present in significant numbers while large canids are represented by a single G4 specimen. Reptile and amphibian remains are limited to the G4 fraction.

Burned bone is uncommon with only 35 specimens, 3.0 percent of the total, recorded. Large canids show the highest proportion of burning (16.7 percent) but this value is somewhat misleading as it represents a single burned specimen. Burned remains comprise 11.4 percent of the bird sample, followed by small to medium-sized mammals (7.9 percent), and small artiodactyls (6.7 percent). Burned large artiodactyl (4.2 percent), fish (2.8 percent), and micromammal (0.4 percent) remains are less common. Amphibian and reptile remains are not burned.

A more detailed accounting of identified specimens is provided below by vertebrate class. Estimates for minimum number of individuals (MNI)—the minimum number of individuals necessary to account for all specimens identified for each taxon—are calculated for the combined sample. MNI estimates take into account the side, portion,

Table 6.5. Vertebrate specimens (NISP) organized by descriptive group and size grade.

	Size Grade						
Descriptive Group	1	2	3	4	Total	Percent Total	Percent Burned
Large Artiodactyls	254	238	29		521	*45.0*	*4.2*
Small Artiodactyls	4	10	13		27	*2.6*	*6.7*
Large Canids			5	1	6	*0.5*	*16.7*
Medium-Small Mammals		4	49	46	99	*8.8*	*7.9*
Fish			41	65	106	*9.2*	*2.8*
Birds	2	2	66	74	144	*12.5*	*11.1*
Reptiles/Amphibians				16	16	*1.4*	-
Micromammals			9	225	234	*19.9*	*0.4*
Total	260	254	212	427	1,153	*99.9*	*3.0*
Percent Total	*22.6*	*22.0*	*18.4*	*37.0*	*100.0*		

percentage representation, and relative maturity of each specimen. Relative maturity is based on dental evidence, the degree of ossification, and epiphyseal fusion. Element–specific landmarks (e.g., condyle, epicondyle, crest, foramen, fossa, tuberosity, etc.) were recorded for each specimen as observed. Practical considerations precluded cross-site examination of all specimens representing individual elements or element portions. As much as possible, specimens were rejoined, matched, and paired within excavation units, and particularly within cache pits, a deposit type that yielded the majority of identified specimens. Given significant spatial distancing between blocks (see figure 2.19) and the limited number and size (1 x 1-m) of individual units within each block, MNI values as presented are quite conservative. MNI estimates calculated separately for each excavation block and aggregated by block would likely yield somewhat higher MNI values, particularly for taxa occurring in comparatively low frequency but found through multiple blocks. Estimates aggregated by deposit type, archaeological context, or other potentially meaningful units would also increase values. However, for this study NISP values, taken with MNI estimates, for the combined sample provide a basic and useful starting point for assessment of taxonomic abundance both within and between excavated units.

Fish

Table 6.6 summarizes identified fish remains organized by taxonomic group and excavation block. Fish ribs, rays, spines, minor pterygiophores, and indeterminate vertebral fragments are not tabulated. A fossilized shark (Chondrichthyes) tooth recovered from Block 1 midden deposits is not tabulated. Table I.1 (appendix I) provides the same data broken down by size grade. Three specimens are burned. Fish remains are present in each excavation block but especially abundant in Block 2 where they are concentrated in Feature 7, a cache pit. Fourteen vertebrae and a parasphenoid fragment from Block 2 are assigned to the Class Osteichthyes and likely represent one or more of the taxa presented in table 6.6.

Nearly all fish bone (86.8 percent) is from contained deposits and concentrated in features located inside identified earthlodge structures (table 6.7), particularly Feature 7 containing 74.5 percent of the total fish sample. Nine specimens from floor and floor/fill deposits contribute an additional 8.5 percent. The remainder of the fish sample is from deposits located outside earthlodges or from unassigned and/or unknown contexts. Table I.2 (appendix I) summarizes specimen counts by individual feature and deposit type. Identified specimens are described in more detail below.

Cyprinidae. The cyprinid family, a large group comprised of the true minnows, carps, and their relatives, is well represented in the sample by 52 specimen—40 of these are in Feature 7. Identified specimens include basioccipitals (4), exoccipitals (2), maxilla (1), dentary (1), frontals (2), lower pharyngeals, (6), hyomandibulars (4), quadrate (1), ceratohyals (2), cleithra (8), coracoid (1), opercles (6), interopercles (2), and vertebrae (12). A minimum of four individuals are present based on the right opercle and right cleithrum. An ash-encrusted pharyngeal tooth from Feature 11 (Block 5) is burned. Based on tooth patterns for identified lower pharyngeals (5th ceratobranchial) and morphological characters for the basioccipital and cleithrum, the sample includes both creek chub (*Semotilus atromaculatus*) and flathead chub (*Platygobio gracilis*). These relatively large-bodied chubs are reported from a number of village sites throughout the Middle Missouri subarea, particularly where fine-screen recovery techniques were employed (Falk 1997:144, 2002:7.6, 2013a:141; Falk and Semken 2014:111; Miller 1964:233-237).

Catostomidae. The sucker family is represented by a single caudal vertebra and a near complete cycloid scale recovered from floor and floor/fill deposits in Block 2 and Block 5, respectively. Sucker remains are regularly found, often in substantial numbers, in waterscreened assemblages within the Heart River and Knife River regions (Ahler *et al*. 1993:267; Falk 1997:145, 2002:7.6, 2013a:141-142; Falk *et al*. 1980:570, 1991:267; Snyder 1988). The near absence of sucker bones at Molander is interesting and may reflect sampling error, but other factors, including resource availability and subsistence preferences, might be considered.

Ictaluridae. Thirty-six ictalurid specimens were identified. Twenty-six of these, primarily vertebrae and pectoral spine fragments, are referred to the family rank, Ictaluridae. One of the pectoral spine fragments is from Feature 12 (ditch) midden deposits and shows evidence of partial digestion. Six specimens, including (two basioccipitals, basipterygium, dorsal spine, lacrimal, and opercle) are referred to the genus *Ictalurus*, identified here as channel catfish. One basioccipital, from Feature 3

Table 6.6. Specimen counts (NISP) and minimum number of individuals (MNI) for identified fish remains organized by excavation block.

	Excavation Block						
Taxon (common name)	1	2	3	4	5	Total	MNI
Osteichthyes (bony fish)		15				15	-
Cyprinidae (cyprinids)	1	44	2		5	52	4
Catostomidae (suckers)		1			1	2	1
Ictaluridae (North American catfish)	1	20	4		1	26	-
Ictalurus cf. *I. punctatus* (channel catfish)	1	2	1	1	1	6	2
Noturus flavus (stonecat)		3	1			4	1
Sander sp. (sauger, walleye)		1				1	1
Total	3	86	8	1	8	106	9
Percent of Total	*2.8*	*81.1*	*7.6*	*0.9*	*7.6*	*100.0*	

Table 6.7. Distribution of identified fish remains organized by general deposit type and relationship to recognized structures.

	Contained		Uncontained				
Taxon	Outside	Inside	Floor Inside	Surface Outside	Midden Outside	Unassigned/Unknown	Total
Osteichthyes		13	2				15
Cyprinidae	2	44	5		1		52
Catostomidae			2				2
Ictaluridae	4	21			1		26
Ictalurus cf. *I. punctatus*	1	3			1	1	6
Noturus flavus		3		1			4
Sander sp.		1					1
Total	7	85	9	1	3	1	106
Percent Total	*6.6*	*80.2*	*8.5*	*0.9*	*2.8*	*0.9*	*99.9*

(Block 4), is burned and a dorsal spine, from Feature 7 (Block 2) is cut with a metal knife. Four specimens (complex vertebra, pectoral spine, 2nd pterygiophore, and supraethmoid-ethmoid complex are identified as stonecat (*Noturus flavus*). Specimens representing the genus *Ictalurus* are ubiquitous in Plains Village assemblages throughout the Middle Missouri (Ahler *et al*. 1993:267; Falk 2002:7.6-7.7, 2013a:142; Falk *et al*. 1991; Snyder 1988). Stonecat also are reported (Falk 2002:7.7, 2013a: 142; Falk and Semken 2014:111), but less commonly. Two specimens identified as channel catfish are included in the vertebrate sample recovered from Molander Village in 1968 (Falk 1969).

Percidae. A single specimen, a burned dentary fragment from Feature 7, is referred to the genus *Sander*. Either walleye (*Sander vitreus*) or sauger (*S. canadensis*) may be represented. Both species are considered native to North and South Dakota (North Dakota Game and Fish Department 1994). Specimens representing the genus *Sander* are reported from a number of sites within the Heart River and Knife River regions (Falk 1997:147, 2002:7.7, 2013a:142-143; Falk *et al*. 1980:570, 1991), usually in comparatively low numbers.

Amphibians and Reptiles

Herpetofauna are limited to 16 specimens (table 6.8). Twelve amphibian bones were sorted from the G4 screen fraction. Eight vertebrae from Feature 11, a Block 5 cache pit, appear to represent a single tiger salamander (*Ambystoma* sp.). Both western tiger salamander (*A. mavortium*) and the eastern tiger salamander (*A. tigrinum*) are found in North Dakota though neither is firmly documented in Oliver County (Johnson 2015). All specimens are well preserved, unburned, and probably of recent origin. Two unburned specimens, a near complete humerus and a vertebra fragment, are referred to the genus *Anaxyrus* and represent either Great Plains toad (*A. cognatus*) or Woodhouse's toad (*A. woodhousii*). These specimens are from surface and midden

Table 6.8. Specimen counts (NISP) and minimum number of individuals (MNI) for identified herpetofauna remains organized by excavation block.

	Excavation Block						
Taxon (common name)	1	2	3	4	5	Total	MNI
Ambystoma sp. (tiger salamander)					8	8	1
Anaxyrus sp. (toad)	2					2	1
Lithobates pipiens (northern leopard frog)				1	1	2	1
Total (amphibian)	2			1	9	12	3
Percent Total	*16.7*	-	-	*8.3*	*75.0*	*100.0*	
Colubridae (colubrid snakes)	1			3		4	2
Total (reptile)	1			3		4	2
Percent Total	*25.0*	-	-	*75.0*	-	*100.0*	

deposits in Block 1. Finally, a proximal humerus and near complete ilium are identified as northern leopard frog (*Lithobates pipiens*). These specimens are also unburned. The ilium, also from Feature 11, and the humerus, from unassigned surface deposits, are well preserved and may be of recent origin.

Reptile bone is limited to four G4 vertebrae representing unidentified colubrid snakes. Isolated vertebrae were recovered from Feature 3 and Feature 4 in Block 4, as well as from Block 4 midden deposits. A single specimen was found in Block 1, Feature 12 (ditch) midden deposits (table 6.9). A minimum of two colubrids are represented based on the relative size of identified vertebrae. None of the specimens are burned; the specimen from Block 4 midden deposits appears to be partially digested. Table 6.9 summarizes identified amphibian and reptile specimens by general deposit type. None of these materials can be directly associated with the period of village occupation.

Birds

Table 6.10 provides a full summary of identified avian specimens organized by excavation block. Bird remains were recovered from each block. Block 2 remains comprise 35.4 percent of the combined sample with Block 5 adding an additional 29.9 percent. Table I.3 (appendix I) summarizes specimen counts by size grade and records percentages of burned bone for each taxonomic group. Nearly all identified specimens are from the G3 (45.8 percent) and G4 (51.4 percent) fractions. Sixteen specimens (11.1 percent), including eight passerine and three woodpecker specimens, are burned. Ten specimens, primarily foot bones (phalanges) and ribs, were identified to element but could not be confidently assigned to taxonomic units below the class rank. A rib from Feature 9 shows a probable cut mark from a metal knife and one phalange is burned.

Table 6.11 shows the distribution of bird remains by deposit type. Paralleling the distribution of fish remains, the greater part of the sample (78.4 percent) is from contained feature deposits with the largest proportion recovered from features located inside identified house structures. In-house floor and floor/fill deposits add eight specimens (5.6 percent). Uncontained (surface and midden) deposits and unassigned contexts contribute an additional 23 specimens (16 percent). Table I.4 (appendix I) further details specimen counts by individual features and deposit type and highlights the concentration of bird remains in three cache pits, including Features 5 (Block 3), 7 (Block 2), and 11 (Block 5). Feature 5 lies outside the identified earthlodge structure.

Anatidae. Three specimens (cervical vertebra, proximal scapula, and proximal coracoid) are referred to the family Anatidae (ducks, geese, and swans). The coracoid and scapula, both from Feature 11, compare well with mallard (*Anas platyrhynchos*) but other large-bodied ducks cannot be excluded. The vertebra is from Feature 5. Waterfowl are consistently represented in varying frequencies in most village deposits (Falk 2002:7.16-7.17, 2013a:144; Falk *et al*. 1980:570-571; Lehmer *et a*l. 1978:171-172; Parmalee 1980; Snyder 1988:183).

Accipitridae. The sample includes 26 pieces assignable to the family Accipitridae (hawks, kites, eagles, and allies). Three pieces (coracoid fragment and two foot phalanges) are tentatively identified to the family rank. The coracoid is incompletely ossified and represents a juvenile. The phalanges may be from a medium-sized raptor such as the northern harrier.

Northern harriers (*Circus hudsonius*) are represented by nine elements. Two wing elements,

Table 6.9. Specimen counts (NISP) for identified herpetofauna remains organized by general deposit type and relationship to recognized structures.

	Contained		Uncontained				
Taxon	Outside	Inside	Floor Inside	Surface Outside	Midden Outside	Unassigned/Unknown	Total
Ambystoma sp.	8						8
Anaxyrus sp.				1	1		2
Lithobates pipiens	1					1	2
Total (amphibian)	9			1	1		12
Percent Total	*75.0*		-	*8.3*	*8.3*	*8.3*	*99.9*
Colubridae					1	3	4
Total (reptile)					1	3	4
Percent Total	-		-	-	*25.0*	*75.0*	*100.0*

Table 6.10. Specimen counts (NISP) and minimum number of individuals (MNI) for identified bird remains organized by excavation block.

	Excavation Block						
Taxon (common name)	1	2	3	4	5	Total	MNI
Aves (undetermined)	2	3	3	1	1	10	-
Anatidae (waterfowl)			1		2	3	1
Accipitridae (Accipitrids)			1		2	3	-
Circus hudsonius (northern harrier)		2	1		6	9	2
Buteo sp. (broad-winged hawk)		6			8	14	1
Tetraoninae (grouse)			1	1	1	3	1
Rallidae (rails, gallinules, and coots)			2			2	1
Charadriiformes (charadriiform)		1	1			2	2
Ectopistes migratorius (passenger pigeon)		2		1		3	1
Bubo sp. (horned owls)	1					1	1
Picidae (woodpeckers)		11				11	2
Passeriformes (passerines)	3	15	22	6	4	50	7
Pica hudsonia (black-billed magpie)		1			19	20	3
Corvus brachyrhynchos (American crow)	2					2	1
Corvus corax (common raven)		10		1		11	2
Total	8	51	32	10	43	144	25
Percent Total	*5.6*	*35.4*	*22.2*	*6.9*	*29.9*	*100.0*	

a left ulna, and left distal carpometacarpus were recovered from Feature 7. The ulna's olecranon shows a transverse cut mark from an unidentified tool. A second left carpometacarpus, indicating a second individual, was found in Block 3 general level deposits. Six complete or nearly complete specimens (left femur, right femur, right fibula, pelvis, left tibiotarsus, and right tibiotarsus) are from Feature 11 (Block 5). Carnivore gnawing is evident on the distal end of the right tibiotarsus. Northern harriers, formerly known as marsh hawks, are well documented in North Dakota through most the year (North Dakota Game and Fish Department 2016; Stewart 1975:102-103; Wood 1923:37).

The buteonine hawks are represented by 14 specimens. Feature 7 yielded six complete elements from the left wing of a single individual (radius, ulna, carpal radial, ulnar carpal, carpometacarpus, and phalanx 1-digit 2). Eight specimens (left humerus, pelvis, four articulating caudal vertebrae, right distal femur, and right tibiotarsus diaphysis) are recorded for Feature 11. A single bird could account for the recorded specimens. Standard measurements were taken for the major elements and compared with measurement data presented by McNall (2016). Based on these data, along with morphological comparisons with in-hand specimens, three species are likely candidates: red-tailed hawk (*B. jamaicensis*), rough-legged hawk (*B. lagopus*), and Swainson's hawk (*B. swainsoni*). Red-tailed and Swainson's hawk are found throughout North Dakota with records for Morton County (Stewart 1975:92-94). The red-tailed hawk is reported year-round while Swainson's hawk is recorded in the spring, summer, and fall. The rough-legged hawk is a winter resident and an uncommon spring and fall migrant (North Dakota Game and Fish Department 2016; Wood 1923:40). The ferruginous hawk (*B. regalis*), the largest member of the genus *Buteo* and an uncommon summer resident, was also considered but discounted based on comparative measurements. Specimens representing a variety of accipitrids, including northern harrier, red-tailed hawk, and other buteonine hawks, are commonly recovered from village sites within the Middle Missouri subarea (Falk 2002:7.16-7.17; 2013a:144; Parmalee 1977, 1980). Three wing elements identified as red-tailed hawk are included in the 1968 sample from Molander (Falk 1969).

Tetraoninae. The grouse subfamily is represented by three specimens, a proximal fragment of a left phalange 1-digit 2, a right tibiotarsus diaphysis, and a proximal fragment of a foot phalange. The tibiotarsus compares well with a sharp-tailed grouse (*Tympanuchus phasianellus*); this specimen is from Feature 3 (Block 4). The wing element, from Feature 9 (Block 3) is burned. The foot phalange, recovered from the floor/floor fill deposits of Block 5, shows evidence of partial digestion. Sharp-tailed grouse are permanent residents in the project area and relatively common in Middle Missouri Village assemblages (e.g., Falk 2002:7.16-7.18; Parmalee 1977).

Rallidae. Two specimens, a near-complete tarsometatarsus and a right distal tibiotarsus, are identified as sora (*Porzana carolina*), again based on comparison with UNSM collections. The sora is common through the Prairie Pothole region of North Dakota and recorded as fairly common locally in the general project area during the early spring, summer, fall months (North Dakota Game and Fish Department 2016; Stewart 1975:123).

Charadriiformes. The charadriiform group includes, in part, the waders, gulls, and their allies. Two specimens are assigned to this group. The sternal portion of a left coracoid recovered from Feature 5 (Block 3) is referred to the subfamily Charadriinae and identified as American golden plover (*Pluvialis dominica*) based on comparison with specimens curated by the University of Nebraska State Museum (UNSM). The golden plover is considered a spring and fall migrant; Wood (1923:33-34) reports a specimen at Fort Berthold in McLean County on September 16, 1856. A second piece, a burned sternum fragment

Table 6.11. Specimen counts (NISP) for identified bird remains organized by general deposit type and relationship to recognized structures.

	Contained		Uncontained					
Taxon	Outside	Inside	Floor Inside	Surface Inside	Surface Outside	Midden Outside	Unassigned/ Unknown	Total
Aves	3	2	2			2	1	10
Anatidae	1	2						3
Accipitridae	1	1	1					3
Circus hudsonius		8			1			9
Buteo sp.		14						14
Tetraoninae	1		1				1	3
Rallidae					2			2
Charadriiformes	1	1						2
Ectopistes migratorius		1	1				1	3
Bubo sp.						1		1
Picidae		11						11
Passeriformes	21	17	1	1	2	2	6	50
Pica hudsonia		18	2					20
Corvus brachyrhynchos						2		2
Corvus corax		10					1	11
Total	28	85	8	1	5	7	10	144
Percent Total	*19.4*	*59.0*	*5.6*	*4.2*	*4.2*	*4.9*	*6.9*	*100.0*

from Feature 7, is identified to the ordinal rank and represents a second individual.

Columbidae. The remains of passenger pigeon (*Ectopistes migratorius*) were found in Block 2 general level deposits (right tarsometatarsus), Feature 4 (left distal ulna), and Feature 7 (right distal tibiotarsus). The specimen from Feature 4, a basin hearth, is burned. The bones of passenger pigeon are reported from several village sites along this stretch of the Missouri river (Falk 2002:7.19; Falk *et al.* 1991, Parmalee 1980). In a summary of animals in the vicinity of Fort Clark, Maximillian (Witte and Gallaher 2012:139) notes "Wild pigeons [passenger pigeons] are frequent in the forest during summer." Steward (1975:153-154; citing Cooper [1859]) reports "Small flocks and quite a number of nests…along the Missouri River between Fort Pierre [in South Dakota] and Fort Berthold in Mercer County, North Dakota."

Strigidae. A single specimen recovered from Block 1 ditch (Feature 12) midden deposits represents the owl family. The proximal femur fragment including the femur head with a characteristic deep trough-like fovea capitus is tentatively identified as horned owl, either great horned owl (*Bubo virginianus*) or snowy owl (*B. scandiacus*). The great horned owl is a year-round resident in North Dakota while the snowy owl is a winter resident (North Dakota Game and Fish Department 2016; see also Hagen and Grondahl 2020).

Picidae. The woodpecker group is represented by 11 specimens from Feature 7. Identified pieces include the right coracoid, sternum, left proximal humerus, right distal humerus, right ulna, right distal ulna (burned), left femur, right distal femur, left proximal tibiotarsus, and right proximal tibiotarsus (burned). Based on the right ulna, two individuals are represented. Except for the burned distal ulna, the identified pieces appear to be from the same individual. Considering both morphology and measurement data for complete and near-complete specimens the remains are identified as northern (or common) flicker (*Colaptes auratus*), the "golden-winged woodpecker," or "fat-bird" noted by Wilson (Weitzner 1979:197). Formerly, the red-shafted flicker and yellow-shafted flicker were listed as separate species, but recent research recognizes them as the same species (Chesser *et al.* 2019). Northern flickers are common to fairly common breeders throughout North Dakota and are well documented in the project area (Allen 1875:63; Stewart 1975:171-173; Wood 1923:48-49). Parmalee (1980) and Falk (2002:7.19) report archaeological specimens from Bagnell and Chief Looking's Village, respectively.

Passeriformes. Eighty-three specimens represent passerines, including 33 pieces referred to the family Corvidae, represented in project area by four well documented species (Steward 1975:193-198; Wood 1923:53-55): blue jay (*Cyanocitta cristata*), black-billed magpie (*Pica hudsonia*), northern raven (*Corvus corax*), and American crow (*C. brachyrhynchos*). Twenty specimens are identified as black-billed magpie. The Block 2 sample is limited to the diaphysis of a left tibiotarsus found in Feature 7. The remaining 19 specimens are from Block 5. Two of these, a mandible fragment and right distal carpometacarpus, are from general level midden and floor deposits, while 17 specimens are from Feature 11. The feature sample includes two premaxilla fragments, a left mandible, right quadrate, right coracoid, sternum fragment, right humerus, right ulna, right carpometacarpus, right phalanx 1-digit 2, left femur, left proximal tibiotarsus, right proximal tibiotarsus, right tarsometatarsus, two right distal tarsometatarsi, and a proximal row foot phalange. Carnivore gnawing is evident on the left tibiotarsus. The right tibiotarsus is burned. A minimum of three magpies is indicated by right tarsometatarsi found in Feature 11. The remains of black-billed magpie are reported from village deposits in both the Knife River and Heart River regions (Falk 2002:7.16; Falk *et al.* 1991; Parmalee 1980).

A right ulna and cervical vertebra recovered from Feature 12 (ditch deposits) in Block 1 are identified as American crow. Crow remains are reported from the several area sites (Falk 2002:7.16; Falk *et al.* 1980:573; Parmalee 1980:77), generally in lower frequency than either northern raven or black-billed magpie.

Eleven specimens are identified as northern raven. With a single exception, a fully ossified left radial carpal from Block 4 surface deposits, all specimens are from Feature 7. The Feature 7 specimens are incompletely ossified and represent a single immature or juvenile bird. Identified Feature 7 specimens include a thoracic vertebra, right proximal radius, right radius diaphysis, right distal radius, right proximal ulna, right distal ulna, right radial carpal, left coracoid, right coracoid, and left scapula. The vertebra shows a cut mark from a metal knife on the ventral surface of the centrum. A minimum of two individuals is indicated by relative age differences between the two radial carpals. Northern ravens are commonly recovered from Plains Village sites throughout the

Middle Missouri subarea (Falk 2002:7.16, 2013a:144-145; Parmalee 1977, 1980)

Identification of the remaining 50 passerine specimens was not systematically pursued below the ordinal rank. Preliminary examination of these materials, however, indicates that at least three family groups are represented: Alaudidae (larks), Passerellidae (American sparrows), and Icteridae (icterids). Specific taxa noted but not quantified include the red-winged blackbird (*Agelaius phoeniceus*) and western meadowlark (*Sturnella neglecta*), and possibly the horned lark (*Eremophila alpestris*). Nine specimens are burned and a single specimen show evidence of partial digestion.

Mammals

Specimen counts for identified mammal remains are summarized by taxon and excavation block in table 6.12. Over-all, 887 specimens are recorded with considerable variability noted between excavation blocks. Samples from Block 2 (36.5 percent) and Block 5 (36.6 percent) comprise nearly three-quarters of the total count with the remainder distributed among Blocks 1, 3, and 4. Table I.5 (appendix I) summarizes specimen counts by size grade and records percentages of burned bone for each taxon. The size grade distribution of identified mammal remains mirrors information presented in table 6.5 with G1 and G2 fractions contributing 57.5 percent of the total and consisting largely of the remains of large bodied artiodactyls. The G3 sample (11.8 percent) contains a mix of small to medium-sized animals, as well as fragments of minor elements for larger animals. Micromammals dominate a G4 fraction that contributes 30.7 percent of the identified sample. Thirty-four identified mammal bones are burned, comprising just 3.8 percent of the total. Tool marks and other descriptive information are noted by taxonomic group below.

Table 6.13 presents the distribution of identified mammal remains by general deposit type and spatial association with defined architectural features. Over 70 percent of the total sample is from contained feature deposits and 62.0 percent of the total is from features located inside identified house structures. Specimens from inside house floor and floor/fill deposits and inside surface deposits contribute an additional 11.3 percent. Materials from uncontained surface (3.0 percent) and midden (7.8 percent) deposits, and unassigned contexts (7.1 percent) complete the sample. Table I.6 (appendix I) further details specimen counts by individual features and deposit type and highlights the concentration of mammal remains in excavated features, especially Feature 7 (Block 2) and Feature 11 (Block 5) that together contributed nearly 60 percent of the identified mammal sample.

Soricidae. Two G4 specimens, a complete right mandible with full dentition and an atlas, represent the shrew family. Both specimens are from Feature 9 (Block 3), are unburned, and well preserved. The mandible is similar to modern masked shrew (*Sorex cinereus*) materials. However, adequate materials for the prairie shrew (*S. haydeni*) are lacking. Based on comments by Seabloom (2011:63-64) and Semken (2002:8.2), either species may be represented.

Leporidae. Twenty-two specimens represent the leporid family. Nine specimen are referred to the genus *Lepus* and identified as white-tailed jackrabbit (*L. townsendii*), a species found throughout North Dakota (Bailey 1926:141-142; Seabloom 2011:337) and regularly reported from archaeological sites within the general project area (Cruz-Uribe 2002:6.4; Falk 2013a:146; Falk *et al*. 1980:571; Snyder 1988:184). Four specimens (right maxilla, left premaxilla, right premaxilla, and lumbar vertebra) are from Feature 11. Additional materials include a lumbar vertebra, left metatarsal 3, left metatarsal 5, unsided distal metapodial, and distal phalange; the phalange may be partially burned. A jackrabbit humerus was recovered from Molander during the 1968 test investigation (Falk 1969).

Four pieces (two unsocketed teeth, rib shaft, and atlas) are referred to the genus *Sylvilagus* which includes three species in North Dakota: desert cottontail (*S. audubonii*), eastern cottontail (*S. floridanus*), and mountain cottontail (*S. nuttallii*). The eastern cottontail is widely distributed throughout the state and the most likely candidate. Desert cottontail are generally associated with the more arid portions of southwestern North Dakota but might be found the general project area (Bailey 1926:134, 138; Seabloom 2011:340-341). The mountain cottontail is found in extreme western North Dakota (Seabloom 2011:346-347). The rib shaft, from Feature 9 (Block 3) shows a tool mark from a metal knife. Cottontail remains are commonly recovered from village sites within the Heart River and Knife River regions (Cruz-Uribe 2002:6.4; Falk 2013a:146; Falk *et al*. 1980:571).

Finally, a distal metapodial and eight phalanges are identified to the family rank. Most specimens are likely cottontail but identification is uncertain. Two

Table 6.12. Specimen counts (NISP) and minimum number of individuals (MNI) for identified mammal remains organized by excavation block.

	Block						
Taxon (common name)	1	2	3	4	5	Total	MNI
Soricidae (shrews)			2			2	1
Leporidae (leporids)	1	6			2	9	
Sylvilagus sp. (cottontail)	2		1	1		4	1
Lepus cf. *L. townsendii* (white-tailed jackrabbit)		4		1	4	9	1
Sciuridae (squirrels)	1	4	3		4	12	
Neotamias minimus (least chipmunk)	3	3				6	2
Urocitellus richardsonii or *Poliocitellus franklinii* (Richardson's or Franklin's ground squirrel)		18	1			19	3
Ictidomys tridecemlineatus (13-lined ground squirrel)		4	2	2	7	15	3
Thomomys talpoides (northern pocket gopher)	1	2		18		21	3
Cricetidae (New World mice, rats, and voles)	7	91	55	14	43	210	16
Rattus sp. (Old World rats)	1					1	1
Canis sp. (coyote, wolf, domestic dog)	3	2			1	6	1
Vulpes velox (swift fox)		1	10	4	7	22	3
Lontra canadensis (North American river otter)		1				1	1
Mustela nivalis (least weasel)				1		1	1
Mephitis mephitis (striped skunk)				1		1	1
Cervus canadensis? (elk)		1				1	1
Odocoileus sp. (deer)		1				1	1
Antilocapra americana (pronghorn)		22	2			24	2
Odocoileus sp./*Antilocapra americana*	1		1			2	
Bison bison (bison)	19	77	24	7	238	365	7
Bison bison/*Cervus canadensis*	27	86	12	10	20	155	
Total	66	323	113	59	326	887	49
Percent Total	*7.4*	*36.5*	*12.8*	*6.7*	*36.6*	*100.0*	

phalanges show evidence of partial digestion and a third, from Feature 11 (Block 5) is partially burned.

Sciuridae. The squirrel family is represented by 52 specimens. Twelve specimens (frontal, right maxilla, right mandible, 2 isolated teeth, 2 atlases, thoracic vertebra, 2 lumbar vertebrae, left innominate, and an unsided metapodial) are identified to the family Sciuridae. The remaining 40 pieces are assignable to lower taxonomic ranks.

Fifteen specimens are identified as thirteen-lined ground squirrel (*Ictidomys tridecemlineatus*). These remains include an unsocketed tooth, left mandible, right mandible, atlas, axis, cervical vertebra, left distal humerus, two left radii, two right radii, three left innominate, and right femur. The femur appears partially digested. A minimum of three individuals are present based on the left innominate. Thirteen-lined ground squirrels are found "…in grassy habitats throughout North Dakota" (Seabloom 2011:230) and relatively common in area sites (Falk 201a3:147; Semken 1997, 2002; Snyder 1988:144). The humerus of a thirteen-lined ground squirrel was recovered from Molander during the 1968 investigation (Falk 1969).

Six specimens (left femur, right femur, right proximal femur, left tibia, 2 right tibiae) are very tentatively identified as least chipmunk (*Neotamias minimus*). This small sciurid is found in most counties, including Morton County, south and west of the Missouri River (Seabloom 2011:234). A right femur and left tibia from Block 1 midden deposits show evidence of partial digestion. Two individuals are represented based on right femora and right tibiae.

Feature 7 (Block 2) yielded 18 specimens representing a minimum of two large-bodied squirrels, either Franklin's ground squirrel (*Poliocitellus franklinii*) or Richardson's ground squirrel (*Urocitellus richardsonii*). A minimum of two animals is indicated by two left mandibles, 2 left maxillae, and two left and two right femora. An additional left mandible,

Table 6.13. Distribution of identified mammal remains organized by general deposit type and relationship to recognized structures.

	Contained		Uncontained					
Taxon	Outside	Inside	Floor Inside	Surface Inside	Surface Outside	Midden Outside	Unassigned/ Unknown	Total
Soricidae	2							2
Leporidae		1	4	3		1		9
Sylvilagus sp.	1					2	1	4
Lepus cf. *L. townsendii*		4	2	2			1	9
Sciuridae	3	6	1	1		1		12
Neotamias minimus		3				3		6
U. richardsonii or *P. franklinii*		18			1			19
Ictidomys tridecemlineatus	1	9	2			1	2	15
Thomomys talpoides		2			1		18	21
Cricetidae	41	119	14	1	7	10	18	210
Rattus sp.						1		1
Canis sp.		3				3		6
Vulpes velox	9	5	3		1		4	22
Mustela nivalis							1	1
Lontra canadensis			1					1
Mephitis mephitis							1	1
Cervus canadensis		1						1
Odocoileus sp.				1				1
Antilocapra americana		22			1	1		24
Odocoileus sp./*A. americana*	1				1			2
Bison bison	13	291	20	5	6	23	7	365
Bison bison/*Cervus canadensis*	7	66	40		9	23	10	155
Total	78	550	87	13	27	69	63	887
Percent Total	*8.8*	*62.0*	*9.8*	*1.5*	*3.0*	*7.8*	*7.1*	*100.0*

representing a third animal, was recovered from general level deposits in Block 3. Range maps for both species, formerly assigned to the genus *Spermophilus*, show distributions north and east of the Missouri River (Seabloom 2011:221, 225). Bailey (1926:55-56) reports a more eastern distribution for Franklin's ground squirrel. No attempt was made to separate or further identify these remains. Preliminary analysis of a sizeable sample of spermophilid remains (Richardson's ground squirrel?) from Chief Looking's Village suggest a likely subsistence role for these large-bodied squirrels. A significant percentage of the Chief Looking's specimens, particularly the metapodials and phalanges, are burned and recovered remains fit well with descriptions of squirrel hunting and consumption detailed in ethnographic accounts (Falk 2013a:147-148). However, none of the Molander specimens are burned and many show little or no soil staining, suggesting perhaps a more recent origin for identified remains.

Geomyidae. Two pocket gophers are recorded in North Dakota, the plains pocket gopher (*Geomys bursarius*) and the northern pocket gopher (*Thomomys talpoides*). The geographic range of the plains pocket gophers is restricted to the eastern portion of the state while the northern pocket gopher is widely distributed in the state and well documented in the project area (Seabloom 2011:252-257). (The type locality for the subspecies *T. t. rufescens* is near present day Fort Clark, North Dakota [Bailey 1926:130; Verts and Carraway 1999]). Twenty-one specimens representing a minimum of three northern pocket gophers were recovered from five features and surface midden deposits in Blocks 1, 2 and 4 (table 6.12; see also, table I.6, appendix I). Identified specimens include: 3 right lower incisors, 4 vertebrae, 3 left humeri, 2 left radii, right radius, left ulna, right ulna, left innominate, 3 metapodials, and 2 terminal phalanges. With a single exception, an innominate from Feature 6 (block 4), the specimens are unburned. Two metapodials appear to be partially digested. Pocket gophers, and ground squirrels, are undoubtedly responsible for the large number of animal burrows (krotovina) encountered in nearly all excavated deposits (chapter 2).

Cricetidae. The family Cricetidae encompasses, in part, the New World mice, rats, and voles. Seabloom (2011) lists 11 species belonging to this group in North Dakota, nearly all are reported from Oliver County. Except for the Bushy-tailed woodrat (*Neotoma cinerea*) and the muskrat (*Ondatra zibethicus*)—neither present in the Molander sample—cricetids are small bodied rodents generally averaging between 14 g to less than 50 g in weight. Based on the initial examination of the small rodent sample, 210 specimens were referred to the cricetid group. Nearly all specimens are well preserved and show little or no staining. None of the specimens are burned. Evidence of partial digestion was recorded for seven pieces. The identified remains are distributed unevenly across the site with 82.4 percent of the total recovered from contained feature deposits. Specimen concentrations are noted for three cache pits: Feature 7 (Block 2), Feature 9 (Block 3), and Feature 11 (Block 5).

Systematic and detailed analysis of materials provisionally assigned to the cricetid group was not pursued for this study, partly due to time constraints but also the lack of an adequate reference collection. The possibility that specimens representing the family Heteromyidae (the pocket mice and kangaroo rats) were overlooked or unrecognized during the preliminary identification process is acknowledged and a more detailed analysis of these remains is warranted. Nonetheless, preliminary observations suggest most animals are members of the genus *Peromyscus*, with both the deer mouse (*P. maniculatus*) and white-footed mouse (*P. leucopus*) logical possibilities. *Peromyscus* remains are common in village assemblages in the project area where fine-screen recovery practices are implemented, and often constitute the largest proportion of identified micromammals (Semken and Falk 1987, 2014). Based on left and right mandibles, a minimum of 12 deer mice is estimated. If initial identifications are correct, high counts for *Peromyscus* may suggest infestation of the village, or parts of the village, by animals attracted by a reliable food source.

In addition to deer mice, eight mandibles and four maxillae, representing a minimum of four animals, are identified as vole. Prairie voles (*Microtus ochrogaster*), meadow voles (*M. pennsylvanicus*), and the southern red-backed vole (*Myodes gapperi*) are all possibilities. Each species has been reported from sites in the general project area (Semken 1997, Semken and Falk 1987, 2014; VanNest and Semken 1988).

Muridae. A single tooth (right M1) recovered from Block 1 midden deposits is referred to the genus *Rattus* and is likely from a Norway rat (*R. norvegicus*). The Norway rat, an invasive Old World species, may have entered North Dakota during the early nineteenth century (Seabloom 2011:324) and is now established throughout the state. Norway rat is reported from Sakakawea and Big Hidatsa (Ahler *et al*. 1993:269) and is relatively common in screened deposits from historic period sites (Falk and Semken 2014:114). The origin of the Molander specimen is uncertain but its presence is likely related to late nineteenth and early twentieth century homesteading activities.

Canidae. Presently, four canid species are considered native to North Dakota including the coyote (*Canis latrans*), gray fox (*Urocyon cinereoargenteus*), swift fox (*Vulpes velox*), and red fox (*V. vulpes*) (Seabloom 2011). The gray wolf (*C. lupus*), locally extinct by the late nineteenth century, may be returning to the state (Bailey 1926:150, Seabloom 2011:123). Finally, though not classified as a native animal, domestic dogs (*C. familiaris*) have been present in the Northern Plains for millennia and a close relationship with Plains Village groups—prehistoric, protohistoric, and historic—is well documented (Morey 1986).

Against this background, the canid sample from Molander, limited to 28 specimens, is a surprisingly small one, particularly for the larger-bodied species. Twenty-two specimens, nearly three-quarters of the canid sample, are identified as swift fox and 77.2 percent of these are from feature deposits (table I.6). Identified specimens include 2 unsocketed teeth, 3 atlases, 7 lumbar vertebrae, 3 ribs, proximal right ulna, proximal left ulna, left radial carpal, 2 right tibia diaphyses, medial row phalange, and terminal phalange. A minimum of three individuals is indicated by the atlas. Five specimens are burned, two ulnae from Feature 6 (Block 4) and three vertebra from Feature 9 (Block 3). The two phalanges appear to be partially digested.

Six specimens (thoracic vertebra arch fragment, proximal right 4th metacarpal, distal metapodial, proximal row phalange, medial row phalange, and palmar sesamoid) are referred to the genus *Canis*. The distal metapodial, from Feature 7, is burned. The thoracic vertebra fragment shows evidence of carnivore gnawing and the medial row phalange appears partially digested. Identification beyond the genus rank is uncertain but at least two specimens, the distal metapodial and medial row phalange, likely represent a large dog or gray wolf. The low specimen counts for large-bodied canids contrasts with the sample recovered in 1968; 17 specimens representing a minimum of two individuals were recorded (Falk 1969).

Mustelidae. Seabloom (2011) lists ten mustelid species, grouped within six genera, as native to North Dakota. Two species, each represented by a single specimen, are included in the Molander sample. A complete left metacarpal 3 from midden and floor deposits in Block 2 is identified as river otter (*Lontra canadensis*). River otters were formerly known from major North Dakota waterways and are reliably documented in the project area through historic accounts (Bailey 1926:180), but otter remains are rarely represented in archaeological collections (Angus 1975:22; Semken and Falk 1987:295). A second mustelid, the least weasel (*Mustela nivalis*), is represented by an edentulous mandible from Feature 3 (Block 4). The least weasel does not appear to be common in the counties bordering the Missouri River, but Bailey (1926: 171) notes a specimen taken at Fort Clark by Maximilian in 1833.

Mephitidae. Presently, two mephitids are recorded for North Dakota, the striped skunk (*Mephitis mephitis*), found throughout the state, and the eastern spotted skunk (*Spilogale putorius*), a comparatively recent arrival restricted to the southeastern corner of the state (Seabloom 2011). A burned right distal humerus from Feature 3 (Block 4) is identified as striped skunk. The remains of striped skunk are reported from many village sites, though specimen counts are generally low (Cruz-Uribe 2002:6.3-6.4; Falk 2013a:148; Falk *et al*. 1980:572; Schubert and Cruz-Uribe 1997:110).

Cervidae. Four members of the cervid family are listed in North Dakota (Seabloom 2011). Based on historic accounts (Bailey 1926:33-43), three species, elk (*Cervus canadensis*), mule deer (*Odocoileus hemionus*), and white-tailed deer (*O. virginianus*) might be anticipated in archaeological samples recovered from locations within the general area. A fourth cervid, moose (*Alces americanus*), is strongly associated with forested areas in the northern and eastern portions of the state and is not reported from Morton or the surrounding counties.

The genus *Odocoileus* is represented by a single specimen, an unsided distal phalange fragment from Block 2 surface deposits. Either mule deer or white-tailed deer might be represented. Deer remains, routinely reported as *Odocoileus*, are found in village deposits in the Knife River region (Angus 1975:29; Falk *et al*. 1980:572; Lehmer *et al*. 1978:168; Snyder 1988:185; Warren 1986:165) as well as in the Heart River region (Falk 2013a:146; Cruz-Uribe 2002: 6.4; Schubert and Cruz-Uribe 1997:108). With rare exceptions (Warren 1986:165) deer species is not identified. Ten specimens recovered during the 1968 investigation were identified by the author as deer (Falk 1969), however, these identifications should be reexamined to consider the possibility that some specimens are in fact pronghorn.

At Molander, elk remains are near absent. Two elk antler tools are described in Chapter 7, and the unmodified sample includes a single specimen, a left cuboid (fused central and 4th tarsals) fragment, tentatively identified as elk. The specimen, from Feature 7 (Block 2), is burned. Taxonomic assessment of complete and near complete elk and bison skeletal remains is readily accomplished with adequate comparative materials but the process can be challenging when faced with small, fragmented specimens – even with the aid of detailed osteology manuals available for the two species (Balkwill *et al*. 1992; Brown and Gustafson 1979; Lawrence 1968; Olsen 1960). The possibility of additional, unrecognized elk remains is considered below in the presentation for identified bison remains.

The rarity of elk bones at Molander is consistent with findings from several large, well-studied faunal samples from late prehistoric and historic village sites in the Heart River and Knife River regions where NISP values for elk range from one to six specimens and MNI estimates generally indicate one or two individuals. Specific examples include On-A-Slant Village (Shubert and Cruz-Uribe 1997:108), Scattered Village (Cruz-Uribe 2002:6.4), Chief Looking's Village (Falk 2013a:149), White Buffalo Robe (Falk *et al*.1980:572), Amahami (Lehmer *et al*. 1978:4), and Taylor Bluff (Snyder 1988:184). The pattern is similar for the Ice Glider site, a mid-nineteenth century Yanktonai winter encampment located about 17 km upstream from Molander. Warren (1986:165) reports six, possibly seven, pieces of elk bone representing at least one individual. Somewhat higher specimen frequencies are reported for the Bagnell site (Angus 1975), and for the Lower Hidatsa, Big Hidatsa, and Sakakawea Village sites (Ahler *et al*. 1993:266-267), but in each case specimen counts do not exceed 2 percent of the combined NISP for bison and elk. Moving north to the Garrison region, the proportion of elk represented at Nightwalkers Butte in the Bull Pasture is notably higher, with 117 elk specimens (MNI 9) representing 18.8 percent of the combined NISP for bison and elk reported by White (1955).

Antilocapridae. Twenty-four specimens are identified as pronghorn (*Antilocapra americana*), a grassland species well documented in the western regions of the state during the early historic period (Bailey 1926:27-28) and commonly represented in previously cited prehistoric and historic period assemblages. Two examples, a left distal metacarpal fragment and a distal fragment of an intermediate row phalange, are from Block 3 midden and surface deposits. The metacarpal shows tooth marks indicating carnivore gnawing and a possible tool mark.

The remaining 22 pronghorn specimens, representing what appears to be a single postnatal individual, are from levels 3 and 4 of Feature 7 (Block 2). Identified pieces consist of 12 cranial specimens, including a partial left mandible and fragmented left and right maxillae, and 10 fragmented post-cranial specimens (left ulna diaphysis, thoracic vertebra, four ribs, distal femur, left distal metatarsal, right metatarsal diaphysis fragment, and proximal phalange fragment). The distal metatarsal is burned. Following review of relevant studies (Dow and Wright 1962; Fenner and Walker 2008; Lubinski 2001), the age at death for this animal is cautiously estimated to be between three to four weeks. The estimate is based on the partial eruption of dp2 and dp3, the absence of significant wear on cusp enamel (dentine is not exposed), and general size comparison between the fragmented Molander specimens and available, but limited, comparative materials. Accepting Seabloom's (2011:378) assertion that "In North Dakota, fawns are born from mid-May to early June" a death date between early-mid June to late June or early July is a reasonable conjecture. An earlier or later birthdate would of course affect the suggested death date. Pronghorn are consistently represented in village assemblages in the two-region area (Angus 1975:24; Falk 2013:146; Falk *et al*. 1980:572; Schubert and Cruz-Uribe 1997:109; Snyder 1988:185; Warren 1986:165).

Finally, two specimens, a right femur diaphysis fragment from Block 1 surface deposits, and a distal metapodial condyle fragment from Feature 5 (Block 3), are identified as from small to medium sized artiodactyls, either pronghorn or deer. The metapodial shows evidence of partial digestion.

Bovidae. Largely extirpated in North Dakota during the closing decades of the nineteenth century, bison (*Bison bison*) were abundant throughout the Great Plains during the prehistoric and early historic periods. The remains of bison, or American Buffalo, dominate the Molander sample as they do nearly every Plains Village faunal assemblage throughout the Middle Missouri Subarea. In this study, 365 specimens are identified as bison based on comparisons to modern skeletal materials and review of morphological characters considered by Balkwill *et al*. (1992), Brown and Gustafson (1979), Lawrence (1968), and Olsen (1960). An additional 155 specimens are provisionally identified as bison but these remains could not be positively identified based on observable morphological features. Nearly three-quarters of the additional group consists of fragments of ribs, vertebrae, and phalanges, with cranial and long bone pieces completing the sample. Conceivably, either bison or elk could be represented: these remains are recorded as *Bison bison*/*Cervus canadensis* in tables 6.12 and 6.13, and in appendix I (tables I.5 and I.6). Nonetheless, I consider virtually all specimens in this second series to be bison and the two groups are combined (NISP 520) and treated as bison in the following discussion.

Table 6.14 organizes counts for specimens showing evidence of partial or complete burning, cut marks, carnivore chewing or gnawing, rodent gnawing, and partial digestion. Burned bison materials are recorded for Features 4 (NISP=1), 5 (NISP=2), 6 (NISP=1), 7 (NISP=7), and 11 (NISP=6), as well as for uncontained floor/fill (NISP=3), and midden deposits (NISP=3). Specimens with cut marks are concentrated in Feature 7 (NISP=11) and Feature 11 (NISP=14), with single examples found in Feature 5, Feature 9, Feature 12 (ditch), and uncontained general level deposits.

Specimens showing evidence of carnivore gnawing are from feature deposits (NISP=18), and uncontained floor/fill (NISP=2) and surface deposits (NISP=1). The single example of gnawing by a small rodent, found in uncontained midden deposits, is a bit of a surprise given the relatively large numbers of rodents recovered during the excavation. Four partially digested specimens, all sesamoid bones, are from uncontained general level deposits. The low frequency of partially digested bison bone (0.2 percent) is intuitively consistent with the comparative

Table 6.14. Specimen counts for identified bison remains exhibiting modification by human or animal agents.

Identified Specimen	NISP	Burning	Cut Marks	Carnivore Gnawing, Chewing	Rodent Gnawing	Partial Digestion
skull	34		2			
scapula	5		1			
humerus	16	1		1		
radius	21	1	1			
ulna	10	2				
carpals	15		3			
metacarpal	8	1		1		
atlas	4		1			
cervical vertebra 3-7	10		2	1		
thoracic vertebra	44	1	3	2		
lumbar vertebra	21		1	3		
rib	69	1	3	9	1	
femur	14	1	2	1		
patella	3		1	1		
tibia	28		2	1		
calcaneus	6	1	1			
astragalus	5	1	2			
metatarsal	7		1			
phalange 1	40	2	3			
phalange 2	19	2		1		
phalange 3	13	1				
proximal sesamoid	24	6				3
distal sesamoid	8	2				1
other specimens	96					
Totals	520	23	29	21	1	4
Percent Total		*4.4*	*5.6*	*4.0*	*0.2*	*0.8*

rarity of large canid remains, though the larger proportion (4.0 percent) of specimens showing tooth marks and other evidence of carnivore gnawing may weaken the suggested.

Based on patterns of epiphyseal fusion and dental evidence (Duffield 1973; Frison 1982; Frison and Reher 1970; Frison *et al*. 1976; Fuller 1959; Winchell 1963), the Molander bison sample is comprised primarily of specimens representing adult, sub-adult, and juvenile animals, but also includes materials indicating one fetal and one postnatal individual. Data regarding epiphyseal fusion for identified specimens are recorded in Excel files accompanying the Molander collection and site records but are not analyzed in the present study.

Table I.8 (appendix I) provides specimen descriptions and age estimates for ten mandibles and three maxillae. Five age grouping are indicated, though the fragmented character of the specimens and a lack of known-age comparative materials impact the accuracy of the age estimates. Group 1: A maxilla fragment from Feature 7 appears to represent a fetus in the final months of gestation. Group 2: Three mandibles, all from Feature 11, are estimated to be from animals 0.5 to 1.0 year of age. Group 3: A third group represents animals from 1.0-3.0 years and includes one mandible from Block 2 general level deposits, two mandibles from Feature 7, and a maxilla from Feature 11. Group 4: Two mandibles and one maxilla, all from Feature 11, appear to represent animals 4-7 years of age. Group 5: A final group includes two mandibles, one from an animal at least eight years of an age found in Feature 11, and one from an animal at least ten years of age recovered from Feature 12 (the ditch).

In addition to the maxilla fragments note above, 17 specimens representing fetal or postnatal (neonatal), individuals were identified. These remains are summarized in appendix I (table I.8). The sample of fetal bone is limited to four specimens found within Feature 7 (nasal, maxilla, thoracic vertebra, and distal radius), and four specimens from Feature 11 (2 lumbar vertebrae, humerus diaphysis [burned], and tibia diaphysis). Eight additional specimens could represent either fetal or postnatal individuals. A distal humerus from Feature 11 and a phalange 1 from Block 1 surface deposits are from slightly older postnatal animals. The fetal specimens from Feature 7 closely resemble available late or near-term individuals, as do the fetal materials from Feature 11. The small, fragmented sample of fetal remains from Molander is difficult to assess and the seasonal implications of recovered remains are uncertain, especially in light of recent discussions concerning variability in the bison breeding season and subsequent birthing (e.g., Walde 2006). If recovered fetal specimens do represent one or more late or near-term fetuses, a conception date from mid-summer to early fall and a projected gestation period of 285 days (Seabloom 2011:383), a late winter or early spring death date might be hypothesized. Specimens representing a postnatal pronghorn from Feature 7 levels containing bison fetal remains muddle the picture.

Table 6.15 presents a summary of specimen counts for bison by identified element or element group (i.e., cranial elements, vertebra combined by type, carpals, and tarsals—excluding the calcaneus, and astragalus which are listed separately). A more detailed specimen summary organized by excavation block is provided in appendix I (table I.7). Here, percent NISP simply underlines the most commonly represented elements in the assemblage; ribs, first row phalanges, cranial and mandible fragments, thoracic vertebrae, indeterminate vertebra fragments, and tibiae all exceed a 5.0 percent representation level. Percent completeness for each element provides a measure of fragmentation by element or element group. As might be expected, small, relatively compact elements—patellae, lateral malleoli, tarsals, carpals, sesamoid bones, phalange 2, and phalange 3—record higher completeness values. There are no complete mandibles, long bones, innominate bones, or vertebrae, and few complete cranial elements, scapulae, ribs, or phalange 1. The disparity in completeness for phalange 1 suggests removal of feet via blows struck at the articular juncture of phalange 1 and distal metacarpal and/or metatarsal. A compete scapula, recovered from Feature 11, may be tool stock saved for manufacture of a digging tool.

Table 6.15 provides additional units of comparison derived from specimen counts presented here and in table I.7 (appendix I). The minimum number of elements (MNE) simply represents the numbers of each element that would be necessary to account for all complete or fragmented specimens recorded for an element or group of elements. The minimum number of individuals (MNI) indicates the number of individual animals necessary to account for specimens recorded for each element or element group. As noted earlier in the chapter, specimen counts and MNI (and MNE) estimates are based on the combined five-block sample and include consideration of side, element portion, element-specific landmarks, relative maturity, and percentage representation for each specimen. Percent MNI is also provided. Finally, the minimum number of animal units (MAU) necessary to account for recorded specimens is presented. MAU is calculated by dividing each MNE value by the number of times an element occurs in the skeleton (Lyman 1994:510). MAU values are normed by dividing each value by the highest MAU (in this case 5.0) and multiplying by 100. Here, the resulting value is presented as percent MAU and serves to organize table 6.15.

However quantified, data in table 6.15 provides information concerning the presence and relative abundance of identified elements and element portions displayed both in simple counts (NISP) and measurements derived from these counts (MNE, MNI, and MAU). Accounting for the near-certain impact of sampling errors, these values at least partially reflect decisions by Villagers regarding what is hunted and what portions of prey animals, in this case bison, are recovered and returned to the village. The highest MNI value, based on the mandible, is nine. Twenty-nine specimens, including dentition, provide a MNE value of 10, and a MAU value of 5.0. Data points in table 6.15, ordered by MAU and percent MAU, show comparatively high values for mandible, tibia, skull, radius, phalange 1, and tarsals, Nine additional elements record percent MAU values of at least 50.0. How to understand or interpret these values, or MNI or MNE, is problematic beyond the obvious, particularly in the absence of an analytical structure.

A recent study by Jack Brink (2004), based on a descriptive account of a bison hunt by Buffalo Bird Woman as recorded by Gilbert Wilson (1924), may be useful in this regard. The hunt, undertaken by a mixed group of Hidatsa men and women departing from Like-A-Fishhook Village around April 1870, was completed on foot with horses appearing only

Table 6.15. Skeletal part representation for identified bison from the 2018 investigation.

Identified Specimens	NISP	% NISP	% Complete	MNE	MNI	%MNI	MAU	%MAU
mandible	29	*5.6*	*0.0*	10	9	*100.0*	5.0	*100.0*
tibia	28	*5.4*	*0.0*	8	6	*66.7*	4.0	*80.0*
skull	34	*6.5*	*8.8*	8	5	*55.6*	4.0	*80.0*
radius	21	*4.0*	*0.0*	7	5	*55.6*	3.5	*70.0*
phalange 1	40	*7.7*	*5.0*	27	4	*44.4*	3.4	*68.0*
tarsals	10	*1.9*	*90.0*	10	3	*33.3*	3.0	*60.0*
lumbar vertebra	21	*4.0*	*0.0*	13	3	*33.3*	2.6	*52.0*
scapula	5	*1.0*	*20.0*	5	3	*33.3*	2.5	*50.0*
humerus	16	*3.1*	*0.0*	5	4	*44.4*	2.5	*50.0*
ulna	10	*1.9*	*0.0*	4	3	*33.3*	2.0	*50.0*
innominate	7	*1.3*	*0.0*	5	3	*33.3*	2.5	*50.0*
femur	14	*2.7*	*0.0*	4	3	*33.3*	2.0	*50.0*
lateral malleolus	4	*0.8*	*100.0*	4	3	*33.3*	2.0	*50.0*
calcaneus	6	*1.2*	*50.0*	5	4	*44.4*	2.5	*50.0*
astragalus	5	*1.0*	*40.0*	5	3	*33.3*	2.5	*50.0*
phalange 2	19	*3.7*	*68.4*	17	3	*33.3*	2.1	*42.0*
atlas	4	*0.8*	*0.0*	2	2	*22.2*	2.0	*40.0*
carpals	15	*2.9*	*73.3*	14	4	*44.4*	2.0	*40.0*
metacarpal	8	*1.5*	*0.0*	3	2	*22.2*	1.5	30.0
patella	3	*0.6*	*66.7*	3	2	*22.2*	1.5	*30.0*
metatarsal	7	*1.3*	*0.0*	3	2	*22.2*	1.5	*30.0*
proximal sesamoid	24	*4.6*	*83.3*	24	2	*22.2*	1.5	*30.0*
phalange 3	13	*2.5*	*61.5*	10	2	*22.2*	1.2	*24.0*
hyoid	2	*0.4*	*0.0*	2	1	*11.1*	1.0	*20.0*
axis	1	*0.2*	*0.0*	1	1	*11.1*	1.0	*20.0*
rib	69	*13.3*	*2.9*	28	3	*33.3*	1.0	*20.0*
sacrum	2	*0.4*	*0.0*	1	1	*11.1*	1.0	*20.0*
distal sesamoid	8	*1.5*	*75.0*	8	1	*11.1*	1.0	*20.0*
cervical vertebra 3-7	10	*1.9*	*0.0*	6	2	*22.2*	0.9	*18.0*
thoracic vertebra	44	*8.5*	*0.0*	9	3	*33.3*	0.6	*12.0*
caudal vertebra	3	*0.6*	*0.0*	3	2	*22.2*	0.6	*12.0*
costal cartilage	2	*0.4*	*0.0*	2	1	*11.1*		
vertebra – indeterminate	28	*5.4*	*0.0*					
distal metapodial	8	*1.5*	*0.0*					
Totals	520	*100.1*						

during the closing days. Drawing on narrative details, Brink seeks to identify those portions of the bison carcass that were retained and transported, and those portions discarded and rejected by the hunting party. He assumes "that the selection and rejection of carcass portions by the Hidatsa, as told in the stories of Buffalo Bird woman, are indicative of long-held patterns of the nutritional use of large game animals" (Brink 2004:175). Using values taken from Emerson (1990) for muscle weight, weight of total fat tissue, mussel weight plus fat tissue weight, mussel plus total fat weight, and fat weight as a percentage of unit weight, he evaluates the hunter's choices in terms of nutritional value. He was able to determine that "percentage of fat content is a fairly accurate predictor of bison carcass part retention by the Hidatsa" and that the "other indices…were not especially useful predictors of carcass part use" (Brink 2004:179). He continues to discuss a number of important practical and culturally-based considerations that likely influenced Hidatsa decision making in these matters, as well as stressing obvious difficulties and limitations when considering only bone remains when many body parts lack a clear skeletal association.

The situation at Molander is no less complicated. Table 6.16 repeats skeletal part representation along with body part utility models, each providing a measure of the relative value of specific body parts, represented here by elements or element groups, in relation to specific carcass products or combination of products. Data points are taken directly from Emerson (1990:624, 839, 842, and 845). Values for complete elements are an average of entries for the proximal and distal portions of each element. The four models are Averaged Total Products [(S) MAVGTP], Averaged Marrow Fat [(S) MAVGMAR], Averaged Total Fat [(S) MAVGTF], and Averaged Skeletal Fat [(S) MAVGSKF]. Each model is modified to account for riders, elements or units with low value utility transported due to a close relationship to elements or units of higher value (Emerson 1990:603). The threshold is somewhat arbitrary but values in table 6.16 greater than 50.0 are highlighted.

Visual inspection of recorded data points for each utility model reveals that elements with high averaged marrow (weight of marrow fat) and averaged skeletal fat yields (weight of marrow and grease fat) show relatively high MAU values. These data may partially support Brink's suggestion regarding a key role for the percentage of fat content. The pattern for averaged total fat (based on total skeletal, intramuscular, intermuscular, subcutaneous, and body cavity fat)

Table 6.16. Skeletal part representation and body part utility models for bison. Utility model values from Emerson (1990). Utility model values >50.0 are highlighted.

Identified Specimens	NISP	MNE	MNI	MAU	%MAU	Averaged Total Products	Averaged Marrow	Averaged Total Fat	Averaged Skeletal Fat
mandible	29	10	9	5.0	*100.0*	14.2			
tibia	28	8	6	4.0	*80.0*	33.1	92.2	21.2	87.6
skull	34	8	5	4.0	*80.0*	14.2		16.7	
radius	21	7	5	3.5	*70.0*	14.3	59.2	10.1	63.3
phalange 1	40	27	4	3.4	*68.0*	2.4	12.9	3.1	23.5
tarsals	10	10	3	3.0	*60.0*	6.0	55.2	10.1	51.6
lumbar vertebra	21	13	3	2.6	*52.0*	82.9		99.5	18.3
scapula	5	5	3	2.5	*50.0*	31.6	36.9	16.7	53.7
humerus	16	5	4	2.5	*50.0*	28.4	70.4	16.2	86.4
ulna	10	4	3	2.0	*50.0*	14.3	59.2	10.1	63.3
innominate	7	5	3	2.5	*50.0*	54.7	6.7	54.0	70.6
femur	14	4	3	2.0	*50.0*	69.4	97.7	38.7	100.0
lateral malleolus	4	4	3	2.0	*50.0*				
calcaneus	6	5	4	2.5	*50.0*	13.6	55.2		51.6
astragalus	5	5	3	2.5	*50.0*	13.6	55.2		51.6
phalange 2	19	17	3	2.1	*42.0*	2.4	12.9	3.1	23.5
atlas	4	2	2	2.0	*40.0*	6.4		5.9	1.6
carpals	15	14	4	2.0	*40.0*	6.6	36.2	5.6	39.2
metacarpal	8	3	2	1.5	*30.0*	18.2	23.7	3.5	26.7
patella	3	3	2	1.5	*30.0*				
metatarsal	7	3	2	1.5	*30.0*	6.0	32.9	5.5	34.0
proximal sesamoid	24	24	2	1.5	*30.0*				
phalange 3	13	10	2	1.2	*24.0*	2.4	12.9	2.1	23.5
hyoid	2	2	1	1.0	*20.0*				
axis	1	1	1	1.0	*20.0*	7.8		7.1	1.1
rib	69	28	3	1.0	*20.0*	100.0		93.0	38.7
sacrum	2	1	1	1.0	*20.0*	54.7	6.7	54.0	70.6
distal sesamoid	8	8	1	1.0	*20.0*				
cervical vertebra 3-7	10	3	2	0.6	*12.0*	56.6		50.7	3.3
thoracic vertebra	44	9	3	0.6	*12.0*	84.7		100.0	16.8
caudal vertebra	3	3	2	0.6	*12.0*	1.5		1.8	2.9

and averaged total products (all carcass resources) is clearly different with high values recorded for elements with the lowest MAU values (ribs, sacrum, cervical vertebra, and thoracic vertebra). Both models show high values for lumbar vertebrae. The averaged total products value is comparatively high for the femur as is the average fat value for the innominate. Taken together, the information presented in tables 6.15 and 6.16 may suggest that Molander's residents placed a premium on the transport of carcass parts yielding substantial quantities of marrow and grease fat. Certainly, elements with high marrow cavity volumes, such as femur, tibia, humerus, and to a lesser degree, radius (Emerson 1990:337), show high MAU values at Molander. Clearly, however, Villagers also transported carcass parts with moderate to low values for marrow and grease fat but with higher values for other utility values represented by the total products and average fat models.

Regional Comparison

Table 6.17 presents a comparison of percentage representations for fish, bird, and mammal remains from 12 components defined for seven Northern Middle Missouri villages. Heart River samples are drawn from two presumed Mandan villages, Chief Looking's (Falk 2013a:140, Table 9.4) and Larson (Falk 2007a:166, Table 9.3). The Knife River sample includes materials from five Hidatsa villages: Lower Hidatsa, Big Hidatsa, Molander, Sakakawea, and Taylor Bluff. Information for each of these sites is taken from this report, and Ahler and others (1993:267-268, Table 19.2). While sampling design and the extent of work vary between sites, recovery methods and initial collection processing are similar for all samples. However, sorting procedures, analytic focus, and reporting details are inconsistent for G4-5 fractions and G4-5 data are not presently available by component for the Taylor Bluff, Sakakawea, Lower Hidatsa, and Big Hidatsa samples.

To minimize differences, particularly for fish, bird and small to medium-sized mammal remains, table 6.17 data are limited to identified G1-3 specimens. A more inclusive listing in table I.10 (appendix I) combines available information for 25 components representing 11 sites and includes four sites not represented in table 6.17. The additional sites are On-A-Slant (Schubert and Cruz-Uribe 1997:108, 117; Falk 1997:148), Scattered (Cruz-Uribe 2002:6.4; Falk 2002:7.8, 7.21), Double Ditch (Falk and Ahler 2005:254-257), and Boley (Falk 2006:176-179) villages.

Data presented in table 6.17 shows that while specimens from each general taxonomic grouping are recorded for all assemblages, the proportional representation is unequal. Relatively high proportions of fish are reported for Sakakawea and Taylor Bluff, and especially for Chief Looking's Village where fish comprise 25.8 percent of the sample. Comparatively low proportions of fish are recorded for Molander, Big Hidatsa and Lower Hidatsa components, and Larson. Review of proportions for fish in table I.10 shows consistently high values for On-A-Slant, Boley (TP 3), Chief Looking's, Scattered, and Double Ditch, all villages located in the Heart River region. To some degree, comparisons are misleading, since specimen counts for Scattered, Boley, and Double Ditch villages do not include G5 remains as they do for On-A-Slant, and Chief Looking's. The available data suggests that fishing was significant for Mandan villagers in the vicinity of the Heart River. Wilson (Weitzner 1979:199) remarks that some informants suggested the "Mandan preferred fishing to hunting. Because fish were a more important part of their economy, the Mandan….exposed themselves to Hidatsa mockery." Falk and others (1991) report significant numbers of fish from G4-5 samples at Sakakawea, and to lesser extent Lower Hidatsa and Big Hidatsa. Unfortunately, these data are not organized by component and difficult to evaluate at present. However, G1-3 data from Sakakawea and Taylor Bluff indicate fishing may have been significant for some Hidatsa groups and review of Wilson's notes (Weitzner 1979:199-210) suggests a potentially important role for fishing, at least during the historic period.

With respect to birds, the G1-3 sample from Molander shows a greater relative abundance (9.8 percent) in comparison to all components, followed by Chief Looking's and Larson. Based on table 6.17, bird remains are proportionately more common in early sites than in the later nineteenth century villages. This observation is generally supported by information presented in appendix I (table I.10). However, more detailed analysis will be necessary to understand the distribution of bird remains both between and within village sites. Many species almost certainly played a role in subsistence but others more likely represent individuals taken primarily for plumage, skins, and select bones for manufacture of tools and ornaments (see Weitzner 1979:196-199).

Small to medium-sized mammals comprise

Table 6.17. Comparison of relative proportions of G1-3 fish, bird, and mammal remains from village sites in the Knife River and Heart River regions, organized by component and vertebrate group. The total number of identified specimens (NISP) is given for each component.

Component	Fish	Bird	Small-Medium Mammal	Large Canid	Small Artiodactyl	Large Artiodactyl	NISP
AD 1800s							
Taylor Bluff	*10.4*	*2.1*	*2.9*	*3.3*	*1.1*	*80.2*	994
Big Hidatsa (TP1)	*1.5*	*1.1*	*1.1*	*7.0*	*5.1*	*84.3*	470
Sakakawea	*11.8*	*1.2*	*1.7*	*15.8*	*1.7*	*67.8*	2,762
Big Hidatsa (TP2)	*3.6*	*1.4*	*1.0*	*9.6*	*2.6*	*81.9*	1,100
AD 1700s							
Molander	*5.7*	*9.8*	*7.4*	*0.7*	*3.8*	*72.7*	717
Lower Hidatsa (TP1-2)	*2.9*	*2.6*	*0.6*	*4.4*	*7.6*	*81.8*	1,409
Big Hidatsa (TP3-4)	*5.8*	*2.5*	*2.0*	*11.6*	*3.1*	*75.0*	1,920
AD 1600s							
Lower Hidatsa (TP3-4)	*2.7*	*1.9*	*0.8*	*11.4*	*10.0*	*73.2*	1,551
Big Hidatsa (TP5-6)	*5.6*	*3.2*	*2.8*	*18.8*	*4.2*	*65.4*	500
AD 1500s							
Lower Hidatsa (TP5-6)	*1.3*	*0.5*	*0.9*	*3.1*	*1.1*	*93.1*	1,003
Larson	*1.5*	*5.6*	*10.4*	*22.6*	*5.4*	*54.5*	1,498
Chief Looking's	*25.8*	*6.0*	*12.9*	*8.8*	*7.3*	*39.2*	804

12.9 percent of G1-3 specimens at Chief Looking's Village. The proportion of small to medium-sized mammals is more pronounced in table I.10 where this group makes-up a full 50.0 percent of the identified sample. Values in both tables reflect an unusually large number of ground squirrel and swift fox bones identified from a single feature (Falk 2013a:151). Returning to table 6.17, samples from Larson (10.4 percent) and Molander (7.4 percent) show relatively high proportions for small to medium-sized mammals in comparison to assemblages from Big Hidatsa, Lower Hidatsa, and Sakakawea. The relative positions of Chief Looking's, Larson, and Molander are unchanged with the addition of G4-5 samples (table I.10) and the Knife River samples consistently show low proportional representation.

The remains of large canids—coyote, gray wolf, or domestic dog—are relatively common at Larson Village where they represent 22.6 percent of the G1-3 sample. Large canids are well represented in the earliest periods at Big Hidatsa (TP5-6, 18.8 percent and TP3-4, 11.6 percent), becoming somewhat less common in later periods (TP2, 9.6 and TP1, 7.0 percent). The lowest proportional value is found at Molander with only 0.7 percent of the G1-3 sample identified as large canid, a pattern unchanged with the addition of G4 materials (table I.10).

Proportional representation for small artiodactyls—deer and pronghorn—ranges from 10 percent to 1.1 percent across the 11 component sample (table 6.17). Relatively high values are recorded for Lower Hidatsa TP3-4 (10.0 percent) and TP1-2 (7.6 percent), and Chief Looking's (7.3 percent). The lowest values (1.1 percent) are for Taylor Bluff and Lower Hidatsa TP5-6. Generally, small artiodactyl remains are more common in early deposits and less common in later, nineteenth century, contexts—but the pattern is not strong.

The remains of large artiodactyls, chiefly bison but including elk as discussed in an previous section of this chapter, dominate G1-3 samples presented in table 6.17, comprising from 93.1 percent to 39.2 percent of the total for each component. The Knife River components, beginning with Lower Hidatsa TP5-6 (93.1 percent) and continuing through Big Hidatsa TP5-6 (65.4 percent) show high percentage values in comparison to the two Heart River region components. Large artiodactyl materials at Larson makeup 54.5 percent of the site total and at Chief Looking's Village they comprise but 39.4 percent of the total. The strikingly low value for large artiodactyls at Chief Looking's Village reflects the concentration of fish and small to medium-sized mammals (ground squirrel, swift fox) remains. The lower percentage value for Larson can be partially attributed to comparatively high values for small to medium-sized mammals, and large canids. Review of percentage values in table I.10 (appendix I) shows a similar pattern. Sites located within the Knife River region show relative proportions for large artiodactyl remains from 93.1 percent for Lower Hidatsa TP5-6 to 57.7 percent for Molander. Proportional values for 15 Heart River region components range from a high of 53.4 percent for Boley TP2 to a low of 7.3 percent for Chief Looking's. The high proportions of large artiodactyl remains recorded for all Knife River sites, particularly during the last half of the eighteenth century and throughout the nineteenth century, underscore the economic importance of bison for subsistence and non-subsistence uses, but perhaps also may reflect demands related to the developing fur trade. The increasing presence of horses and firearms after the mid-eighteenth century, along with the growing importance of buffalo robes as articles of trade beginning in the 1830s, may have played a role (Thiessen 1993).

Summary and Conclusions

Over 29.9 kg of unmodified bone was recovered from 16 1 x 1-m test units distributed among five excavation blocks during investigation of Molander Village in 2018. The recovered sample includes 363 G1 specimens and an estimated total of nearly 21,600 G2 and G3 specimens. Burned and partially burned bone contributes 5.4 percent of the total sample. Overall, bone density is 4.86 g/l with the highest density value recorded for Plains Village period cache pits (25.92 g/l).

A small portion of the recovered bone (125 g) is from terrace deposits exposed in Block 1; 4.2 percent of this sample is burned. Materials from terrace deposits are linked to use of the site area during the Archaic or Woodland periods. Three pieces of bone from terrace deposits were identified: a mouse or vole humerus, a tooth fragment from a large-bodied canid, and a bison sesamoid. Bone recovered from terrace deposits appears to be intrusive from overlying village deposits.

The bulk of the vertebrate faunal sample (29.8 kg) is from deposits representing the Plains Village occupation of the site. The largest quantity of bone (67.7 percent) was recovered from cache pit deposits located both within and outside of defined house structures. Bone was found also in basin pits, house floor and floor/fill, midden, terrace, and surface deposits. Minor concentrations of burned bone are from a basin hearth, midden, and surface deposits. A total of 1,153 specimens were identified from Plains Village deposits. Burned pieces are uncommon with 35 specimens representing 3 percent of the total. Mammals are well-represented and include large artiodactyls (NISP=521), small artiodactyls (NISP=27), large-bodied canids, small to medium-sized mammals (NISP=99), and micromammals (NISP=234). Fish (NISP=106), amphibians (NISP=12), reptiles (NISP=4), and birds (NISP=144) complete the assemblage.

The sample of fish bone is dominated by cyprinids (MNI=4) with both creek chub and flathead chub identified. The catfish family is represented by channel catfish (MNI=2) and stone cat (MNI=1). The sucker and perch families are each represented by single specimens. Fish remains are concentrated in Feature 7, associated with the lower house floor in the House 26 depression. Feature 7 yielded 74.5 percent of the identified sample. Review of information compiled by Gilbert L. Wilson (Weitzner 1979:199-210) reveals the potential economic (and social) importance of fish and fishing for some Hidatsa (and Mandan) villagers. Though concentrated in a single feature, the identified sample provides clear evidence for fishing during the late Village period.

The amphibian sample consists of 12 specimens representing tiger salamander (NISP=8), Great Plains toad or Woodhouse's toad (NISP=2), and northern leopard frog (NISP=2). Four vertebrae representing two unidentified colubrid snakes comprise the sample of reptile bone. None of the specimens are burned and all are well preserved. A comparatively recent origin for these remains is indicated.

The sample of identified bird remains consists of 144 specimens representing a minimum of ten family groups. Bird bones are found throughout the deposits but are concentrated in three cache pits, Features 5, 7, and 11, yielding 72.2 percent of the site total. Passerines dominate the sample and include black-billed magpie (MNI=3), American crow (MNI=1), and common raven (MNI=2). The remaining passerine materials are not identified below the ordinal rank but at least three species are recognized: red-winged blackbird, western meadowlark, and horned lark. Woodpeckers are represented by 11 specimens from Feature 7, all identified as northern flicker (MNI=2). The accipitrids are represented by nine northern harrier, and 14 buteonine specimens. The harrier remains (MNI=2) include wing elements from Feature 7 and leg elements and pelvis from

Feature 11. The hawk remains, assigned to the genus *Buteo*, may represent red-tailed hawk, Swainson's hawk, or rough-legged hawk. Six specimens are from Feature 7, and eight pieces are from Feature 11; a single bird may account for the identified specimens. The sample also includes waterfowl (MNI=1), grouse (MNI=1), American golden plover (MNI=1), sora (MNI=1), passenger pigeon (MNI=1), and horned owl (MNI=1). While many of the identified specimens represent birds undoubtedly hunted for food, including small passerines, northern flickers, ducks, and grouse, others such as harriers, hawks, magpies, and raven, were likely taken for skins, plumage, and bone (Weitzner 1979:196-199).

With respect to mammals, bison remains dominate the Molander sample. In sum, 520 specimens representing a minimum of nine individuals were identified. The identified specimens represent a mix of adult, subadult, and juvenile animals. Fetal and postnatal individuals also are recorded. Preliminary analysis of bison element representation and abundance suggests that villagers may have placed a premium on the transport of parts yielding high quantities of marrow and grease fat. Elk, deer, and pronghorn are minor components of the identified sample. Nearly all pronghorn remains are attributed to a single postnatal individual, estimated to be three to four weeks of age. Reliable identifications for elk and deer are limited to single elements. The remains of large canids are few with six specimens scattered in feature and midden deposits. The Molander sample includes a variety of small to medium-sized mammals including cottontail, white-tailed jackrabbit, swift fox, river otter, least weasel, and striped skunk. A variety of ground squirrels, northern pocket gopher, mice, and voles are also included in the collection, as is a single tooth from a non-native rat.

7

Modified Bone and Antler

Carl R. Falk

This chapter reports bone tools, ornaments, and related items recovered during the 2018 archaeological investigation of Molander Village. The analysis provides a basic descriptive account of modified remains with emphasis given to choice of raw materials, the manufacturing process, specimen function, and the distribution of specimens within archaeological contexts sampled. Finally, the Molander assemblage is compared with remains from a series of interconnected village occupations located within the Garrison, Knife River, and Heart River regions.

Initial sorting and processing of the 2018 collection was completed by personnel working in PCRG's Broomfield lab. Final separation of modified and unmodified specimens was accomplished by the author in conjunction with sorting and analysis of unmodified bone remains (chapter 6). Modified specimens were recorded using a classification system employed in the analysis of collections from the Boley, Larson, and Chief Looking's village sites (Ahler and Falk 2006; Falk 2007b, 2013b). This approach is a direct outgrowth of earlier work with materials from the On-A-Slant Village (Ahler and Ryser 1997, Moore 1985), Scattered Village (Ahler and Falk 2002), and Double Ditch Village (Ahler 2003, 2004, 2005) sites.

Variables and attribute codes used to record Molander specimens are presented in appendix J (table J.1). Analysis emphasizes functional classification at both general and specific levels. Function is partially derived from consideration of specimen form, but also from attention to evidence of modifications resulting from the manufacture and subsequent use of each

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specimen. Particular attention is given to identifying evidence for the use of stone or metal tools in the manufacturing process based primarily on research by Bradfield (2015), Fisher (1995), Greenfield (1999), and Walker and Long (1977). Contributions by Ahler and Falk (2002), Griffitts (2007), Moore (1985), Weston (1986), and Weston and Ahler (1993) are also considered. All materials were examined macroscopically, with a 10x hand lens, and, as appropriate, with a stereo zoom binocular microscope (10x-70x). As a rule, grouping specimens within general functional classes was completed without the detailed microscopic examination which was often required for assignment of individual pieces to specific functional classes.

Additionally, modified bone resulting from a University of Missouri testing program completed in 1968 is occasionally referenced (Wood 1986a). The 1968 test, a single 5 x 5-ft unit, was placed outside the fortification ditch, along the northeastern margin of the site. The 1968 sample was not examined directly for this study. However, the author's laboratory notes were consulted (Falk 1969), expanding the available sample with materials from an area of the village not tested in 2018. An inventory of the 1968 collection is summarized in appendix J (table J.2).

Modified Bone from the 2018 Investigation

The 2018 sample includes 52 specimens. Table 7.1 summarizes specimen counts by size grade for each of the five excavation blocks and for archaeological contexts within each block. Nineteen size grade 3 specimens comprise 36.5 percent of the combined sample. Fourteen size grade 1 specimens contribute an additional 26.9 percent of the total. Size grade 2 and size grade 4 pieces total 21.2 percent and 15.4 percent, respectively. Modified bone was not recovered from size grade 5 screen residues. Modified materials are recorded for each excavation block but are unevenly distributed across excavation units. Block 5, especially Feature 11 (a large, undercut storage pit), contributed nearly a third of the sample (30.8 percent) while 26.9 percent of the total was found in Block 2. Feature 7, a bell-shaped storage pit, yielded eight of the 14 Block 2 specimens. Materials also were found in Block 3 (17.3 percent), Block 1 (13.5 percent), and Block 4 (11.5 percent). Three Block 4 specimens are burned, one from Feature 3 (a shallow basin) and two from Feature 4 (hearth).

Table 7.2 present a full listing of the 2018 sample grouped by function. Specimen counts for six generalized classes and 19 specific functional classes are organized by five use-phase classes. Two use-phase classes contribute over 92 percent of the collection. Twenty use-phase 3 (finished, usable) specimens, representing 11 functional classes, comprise 38.5 percent of the total. Broken and discarded fragments (use-phase 4 – finished, not usable) make-up 53.8 percent of the modified bone sample. With one exception, digging tools are represented by unusable fragments. Broken and unusable fragments represent at least five functional classes. With the exception of an uncompleted squash knife (use-phase 1), an unknown tool broken or rejected during the manufacture process (use phase 2), and two pieces of manufacturing discard (use phase 5), evidence for the manufacture of tools and non-utilitarian pieces is minimal, at least within areas of the village sampled during the 2018 investigation.

Table J.3 (appendix J) offers more detail regarding specimen fragmentation and supplements use-phase data presented in table 7.2. In each case, the portion of the item present is recorded for each generalized functional group. Nineteen complete or near complete pieces comprise over a third (36.5 percent) of the modified sample. The remaining 33 specimens are various fragments, including 11 specimens classified as indeterminate with respect to portion.

Table 7.3 summarizes taxonomic group assignments for modified specimens, again organized by generalized functional class. Taxonomic identifications are varied with 17 specimens identified to species or genus. Eight specimens are identified simply as mammal and three as bird, and in one case vertebrate class could not be determined. Thirty-one objects manufactured from skeletal elements identified as from bison (*Bison bison*), elk (*Cervus canadensis*), or an indeterminate large artiodactyl comprise 59.6 percent of the sample. With the exception of two pieces of modified elk antler, it is likely that most, if not all, large artiodactyl pieces are in fact bison. This assertion is reinforced by the near absence of identified elk bone, and the dominance of identified bison remains, in the sample of unmodified bone reported in chapter 6. Bison elements were selected for use as digging implements, as well as a wide variety of patterned and expedient tools. Elk antler is represented by a single patterned tool (hammer or billet) and an unknown, likely utilitarian piece. Deer antler tine is used for pressure flaking tools; either mule deer (*Odocoileus hemionus*) and/or white-tailed deer (*O. virginianus*)

Table 7.1. Modified bone specimens organized by size grade and excavation context.

		Size Grade					
Block	Context	G1	G2	G3	G4	Total	Percent
1	General Level (Floor/Midden)			2	1	3	
	F12 – Ditch	2	1		1	4	
Subtotal		2	1	2	2	7	*13.5*
2	Surface				1	1	
	General Level		1	1	3	5	
	F7 – Cache Pit	2	4	2		8	
Subtotal		2	5	3	4	14	*26.9*
3	General Level (Midden)			3		3	
	F5, F9, F13 (mixed) – Cache Pit	3		3		6	
Subtotal		3		6		9	*17.3*
4	F3 – Basin Pit			2		2	
	F4 – Basin Hearth	1	1			2	
	F6 – Pit (F4 mixed?)		1	1		2	
Subtotal		1	2	3		6	*11.5*
5	General Level (Floor/Midden)		2			2	
	F11 – Cache Pit	6	1	5	2	14	
Subtotal		6	3	5	2	16	*30.8*
Total		14	11	19	8	52	*100.0*
Percent		*26.9*	*21.2*	*36.5*	*15.4*	*100.0*	

could be represented. Antler from an unidentified cervid (most likely elk) was used to manufacture a decorative bracelet. Additional ornamental and non-utilitarian pieces were manufactured from the bones of large and small artiodactyls, canids, leporids, and small and/or medium-sized mammals, as well as those of large bird.

Details concerning skeletal elements selected for modification are organized by vertebrate group in appendix J (table J.4). Identified bison elements comprise 19.2 percent of the total and include the mandible, scapula, humerus, rib, and metatarsal. Nineteen specimens (36.5 percent of the total) are classified as large artiodactyl and with element identifications for rib, thoracic vertebra, scapula, humerus, and metatarsal. One metatarsal fragment and one metapodial fragment are identified as small artiodactyl, either deer or pronghorn (*Antilocapra americana*). Several small to medium-sized animals are represented in the modified collection. Ornamental pieces were manufactured from canid metapodials, possibly domestic dog (*Canis familiaris*) or gray wolf (*C. lupus*), as well as from the humerus of a large leporid (*Lepus* sp.).

Digging Tools

Seven specimens are classified as patterned digging tools and comprise 13.5 percent of the 2018 sample; digging tools are absent from the 1968 collection. A nearly complete and usable tool is from Feature 7, a bell-shaped storage pit associated with the lower floor of House 26. The tool is manufactured from the right scapula of a bison. The spine has been removed and caudal, cranial, and dorsal borders trimmed to produce an elongate, rectanguloid form (figure 7.1). The presence of overlapping, worn, and polished planar scars along spine and border margins indicates use of a comparatively straight-edged metal tool in shaping this piece (Ahler and Falk 2002:13.9-13.14). The distal end of the finished tool is thin, and sharp. The costal margin of the glenoid is slightly faceted, either to enable, or because of, hafting; the faceted area is lightly polished. Intact borders are rounded and polished. Evidence of lateral notching is uncertain although a slightly cupped area along the cranial border may be evidence of hafting (see Weitzner 1979:190, Figure 1). Costal surfaces, and much of the lateral surface, show high, glossy polish characteristic of scapular digging tools. A distal portion of the caudal border appears to have broken at some point but the broken edges are smoothed and show light

Table 7.2. Modified bone organized by use phase and generalized and specific functional class.

General and Specific Functional Class	Use-Phase: Unfinished Usable	Unfinished Not Usable	Finished Usable	Finished Not Usable	Manufacture Debris	Total	Percent
Digging Tools							
cultivating tool			1	6		7	*13.5*
Pressure Flakers							
narrow exped. flaker			2			2	*3.8*
Other Patterned Tools							
abrader			2			2	*3.8*
pick			1			1	*1.9*
hammer/billet				1		1	*1.9*
squash knife	1		2	1		4	*7.7*
flesher				1		1	*1.9*
handle				1		1	*1.9*
knife handle			1			1	*1.9*
Other Expedient Tools							
scraper-soft mat.			1	1		2	*3.8*
exped. awl/punch			2			2	*3.8*
Ornamental and Non-Utilitarian							
bead			3			3	*5.8*
bracelet (strip)				1		1	*1.9*
tube			3			3	*5.8*
gaming piece			2			2	*3.8*
incised piece				1		1	*1.9*
unk, nonutilitarian				4	1	5	*9.6*
Unknown, Utilitarian							
unk, utilitarian		1		10	1	12	*23.1*
unspec. antler tool				1		1	*1.9*
Total	1	1	20	28	2	52	*99.7*
Percent	*1.9*	*1.9*	*38.5*	*53.8*	*3.8*	*99.9*	

polish suggesting continued use of the implement. Specimen length is 320 mm. with a maximum distal width of 99.8 mm.

The remaining six specimens are tool fragments. One consists of a portion (length 84 mm) of the ventral end of the left scapula of a bison. The costal margin of the glenoid is faceted, worn, and polished. The tool was broken just above the supraglenoid tuber. Both lateral and costal surface of the neck show slight wear and light polish. This specimen is from mixed feature deposits (F5, 9, and 13) in Block 3. A second specimen consists of a distal scapula blade fragment, tentatively identified as bison. The costal and lateral surfaces are worn and show polish, and a remaining tool margin is rounded and polished. This specimen, from Feature 12 (ditch deposits in Block 1), is 107.2 mm in length. Finally, four small (size grades 2 and 3), thin fragments show worn, chipped, and rounded margins, along with the high, glossy polish. These are discarded fragments of scapular digging tools.

Pressure Flakers

Two specimens, fashioned from deer antler tine, are classified as narrow expedient pressure flakers. Both pieces are from Feature 7, Block 2. The specimens are slightly curved with lengths of 102.7 mm and 104.4 mm, and average maximum diameters of ca. 17-18 mm. The surfaces of both specimens are smoothed and lightly polished, possibly from use as hand-held tools. The distal end of each tine is slightly rounded and shows scarring consistent with use against a hard surface. The proximal ends are broken and portions of the original surface are weathered and cracked.

Figure 7.1. Bison scapula digging tool. Image on the left shows the entire tool, including the planar scaring indicating removal of the spine. Image on the right is a close-up of the modified working surface. Right image is not to same scale.

Table 7.3. Modified bone organized by generalized functional class and taxonomic grouping.

	Generalized Functional Class						
Vertebrate Group	Digging tools	Pressure Flakers	Other Patterned Tools	Other Expedient Tools	Ornamental Non-utilitarian Items	Unknown, Utilitarian Tools	Total
Bison bison	2		2	2			6
Bison bison?	1		3				4
Cervus canadensis			1			1	2
Cervidae					1	1	2
Odocoileus sp.		2					2
Lrg. artiodactyl	4		5	2	3	5	19
Small artiodactyl						2	2
Canis sp.					2		2
Lepus sp.					1		1
Lrg. mammal					2	2	4
Sm./med. mammal					2		2
Mammal?						2	2
Large bird					3		3
Indeterminate					1		1
Total	7	2	11	4	15	13	52

Other Patterned Tools

Two cancellous abrading tools were recovered from Feature 11 (Block 5). The first specimen from is fashioned from the lateral tuberosity and a lateral section of the head of a right humerus. The specimen is tentatively identified as bison. The working surface of the tool includes a flattened, slightly concave, exposure of cancellous tissue roughly 60 mm in diameter. The ridged structure of the cancellous tissue is worn smooth but striations are not evident, perhaps suggesting use against a soft material. The specimen is 89 mm in length, 69.5 mm in width and 31.5 mm in thickness. The second abrader is manufactured from the head of a left humerus, likely from a bison but elk cannot be discounted. The lateral tuberosity and medial tuberosity have been removed leaving a tool roughly oval in outline and biconvex in cross-section (figure 7.2). The tool's working surface is rounded with cancellous ridges showing smoothing and slight polish, again indicating use of the tool against comparatively soft surfaces. The working surface of this tool is 60-65 mm in diameter. The specimen has a maximum length of 82.0 mm, a width of 75.6 mm, and a thickness of 44.5 mm.

The spine from a left scapula, tentatively identified as bison, was recovered from Feature 12 (Block 1). This specimen is classified as a pick. The long, slightly curved spine edge is trimmed, showing flat, planar scars from use of a metal tool. The opposing border shows similar scarring, beginning at the thickened spinal tuberosity and continuing toward the tool's distal end. The acromion shows flake scars and is rounded and worn. Overall, the spine's surface is worn and lightly polished. Unfortunately, the distal tip of the tool is missing, apparently damaged during excavation. However, the overall form, extensive modification, and worn surfaces strongly argue for classification of this pieces as a hand-held pick.

An extensively fragmented antler tool, only partially reconstructed from about 45 pieces of compact and trabecular bone, was found in Feature 4 (Block 4). This specimen is tentatively classified as an antler hammer or billet. The tool is fashioned from the basal section of a shed elk antler, the beam removed just above the junction of the brow tine. Unmatched antler fragments found within the feature may be part of the tine. Flat chop marks, likely from the use of a metal tool, partially encircle the piece about 60 mm above the base. The cornet encircling the base of the burr is removed with only a few worn and rounded knobs remaining. The base is smooth and slightly convex with minor striations and pitting indicating possible use as a hand-held percussion flaking tool. Estimated measurements are 90 mm in length, 70 mm in width, and a thickness of 65 mm. Portions of this tool, represented by discolored trabecular bone, appear burned.

Figure 7.2. Cancellous abrading tool manufactured from a left humerus, likely bison. The left image shows the head of the humerus. The top of the right image shows the abrading wear on the cancellous bone.

Four specimens are classified as scapula cutting tools or squash knives. A specimen recovered from Feature 7 (Block 2) is manufactured from the left scapula of a large artiodactyl. The original tool included a section of the infraspinous fossa and adjoining caudal border. The specimen is considered finished and functional although excavation and post-excavation processing damaged the tool and portions of the cutting edge, the caudal border, and angle are missing. Opposing faces of the blade are cut and scraped to produce a sharp, slightly beveled edge; the edge is worn and slightly rounded. The medial surface along the caudal border and extending into the subscapular fossa is worn smooth and shows polish. Incomplete measurements include a length of 122.0 mm, width of 91.0 mm, and a thickness of 11.5 mm.

A second squash knife was found in Feature 5, Block 3. This tool is manufactured from the right scapula of a large artiodactyl, tentatively identified as bison. The specimen retains the dorsal portion of the scapular spine and a section of the narrow supraspinous fossa. Minor portions of the dorsal spine, cranial angle, and cranial border are missing and broken, a probable result of excavation damage. The cranial border has been scraped and ground, thinning and sharpening the working edge. Striations and chatter marks are evident on the lateral and medial surfaces. Specimen measurements are length 152.0 mm, width 63.3 mm, and thickness 32.5 mm. Smoothing and polish evident on the ventral end of the cranial border and on broken remnants of the subscapular fossa also may indicate use as a scraping tool against comparatively soft materials.

A third specimen from Feature 11 (Block 5) is an unfinished tool classified as a squash knife. Fashioned from the right scapula of a large artiodactyl, the piece is a roughly triangular section of the infraspinous fossa, with adjoining caudal border, and caudal angle. The lateral surface of the border is trimmed, exposing the cancellous tissue. The dorsal border shows scoring with a metal tool perpendicular to the long axis of the element where the thicker bone has been snapped off. Transverse tool marks are evident on the medial surface of the caudal border. The margin of the blade is not sharpened. Specimen length is 178 mm, width is 83.4 mm, and thickness is 15.5 mm.

A fourth and final piece, from Block 5 general level deposits, is a small scapular blade fragment showing a thin, straight, worn, and rounded margin tentatively classified as cutting tool. The scapula is from a large artiodactyl. Measurements are 37.4 mm in length, 9.4 mm in width, and a thickness of 2.9 mm.

A fleshing tool, manufactured from the right metatarsal of a bison, was recovered from Feature 11 (Block 5). The incomplete specimen, essentially a fragment of the original diaphysis, is the distal end of the tool (figure 7.3). Employing a metal tool, a straight transverse bevel was cut through the diaphysis from the dorsal surface through to the plantar surface

Figure 7.3. Interior (left) and profile (right) views of a fleshing tool manufactured from the right metatarsal of a bison.

resulting in a thin margin that was subsequently ground to produce a sharp, slightly convex working edge. Eleven V-shaped notches cut into the sharpened edge are about 2-3 mm in depth and spaced roughly 2.0 mm apart, creating a serrated appearance. The plantar face of the element shows chatter marks. Remaining tool surfaces are smooth, heavily worn, and polished. The proximal end of the tool is missing, as are associated tarsal bones that may have formed a handle. This incomplete specimen measures 144.9 mm in length, 34.2 mm in width, and has a thickness of 26.1 mm.

A highly polished rib segment from Feature 11 (Block 5) could be part of the handle portion of a knife, part of a rib shaft straightener, or the handle of an unidentified tool type. The rib is from a large artiodactyl. Portions of the cranial and caudal borders are cut to produce a flat narrow edge 3-7 mm in width. Smoothed-over and polished planate scars document the use of a sharp-edged metal knife. One end of the tool is broken. The opposite end is rounded with irregular but worn and lightly polished margins. This incomplete specimen is 101.9 mm in length, 19.2 mm in width, and 9.8 mm in thickness.

Perforated ribs, commonly known as shaft straighteners, are absent in the 2018 sample from Molander. A single example, manufactured from a rib section from a large artiodactyl, was recovered in 1968 (table J.2, appendix 2). Two perforations are recorded for this broken specimen.

Knife Handle

A knife handle was recovered from Feature 7, Block 2 (figure 7.4). The specimen is manufactured from the dorsal spine of a thoracic vertebra taken from a large artiodactyl, either bison or elk. The cranial border of the spine is trimmed and scraped, producing a flat narrow margin 3-5 mm in width. The presence of smoothed-over flat scars suggests use of a sharp-edged, metal tool. The thick caudal border is more extensively trimmed, exposing cancellous tissue along the length of the piece; the width of the prepared border varies from 6-10 mm. Compact bone along trimmed edges is worn smooth. The spine's slightly convex surfaces along the median plane show numerous irregular striations, subsequently worn and polished. The proximal end of the tool is split and a small fragment is missing. A furrow, 4-6 mm in depth and 85 mm in length, slices into the exposed cancellous tissue along the caudal border, terminating at the broken distal end of the tool. The groove is 1.5-2.0 mm in width and seems intended to hold a thin metal blade. Length of the incomplete specimen is 163 mm. Slight wear noted on broken edges at the distal end of the tool suggests possible use after it was broken.

Three knife handles, each slotted for insertion of a metal blade, were recovered from the site during the 1968 investigation (table J.2, appendix J). One specimen, also manufactured from the dorsal spine of a thoracic vertebra (bison?), is complete and 270 mm in length. A single groove, cut through the caudal border is 1.5 mm in width, 7 mm in depth and 139 mm in length. The remaining pieces are knife handle fragments, both manufactured from rib sections, each with furrows cut to a depth of 4-7 mm. One of the specimens has a second furrow cut on the opposing margin.

Other Expedient Tools

Four specimens are included in this group: two scraping tools and piercing tools. The first, from Feature 5 (Block 3), is a portion of the ascending

Figure 7.4. Knife handle manufactured from the dorsal spine of a thoracic vertebra of a large artiodactyl. Top image shows the extensive trimming along the caudal border. Bottom image shows the furrow sliced into the edge, presumably used to hold a thin metal blade.

ramus of a right mandible from a bison. The condylar process and a portion of the mandibular foramen remain; the coronoid process is missing. The ramus is fractured above the tooth row and the broken medial surface is worn smooth and polished suggesting use as a scraping tool for use with comparatively soft materials. Measurements for this tool are length 188.0 mm, width 74.0 mm, and thickness 44.0 mm. The second specimen in this group, from general level deposits in Block 5, is a portion of a rib from a large artiodactyl. The piece is a fragment of a tool possibly used as a scraper against more resistant materials. The remaining distal edge is crushed, worn, and lightly polished. Incomplete measurements are length 42.4 mm, width 17.7 mm, and thickness 9.1 mm.

Two Feature 11 (Block 5) tools are classified as expedient awls/punches. The first specimen is a spine segment broken from the right scapula of a large artiodactyl. The dorsal end of the unaltered spine tapers to a narrow point. The point, the tools distal end, is slightly worn and rounded, and shows light polish as do adjacent margins. The tool appears to have been used to perforate a relatively soft material. Specimen length is 191 mm, width 28.8 mm, and thickness 11.5 mm. The second piece also is the spine from the right scapula of a bison. The dorsal end of this spine tapers to a thick, blunt tip. The tip is lightly worn and slightly rounded. The body of the tool is lightly weathered and polish is not evident. Tool length is 343 mm, width is 36.0 mm, and thickness is 21.5 mm.

Three tools, classified as expedient awls or punches, are included in the sample from the 1968 investigation. Two complete specimens (lengths 201 mm and 96 mm) are scapular spines from large artiodactyls. A third specimen, a distal fragment, is a splinter from the long bone of a large artiodactyl. Each of these pieces show wear consistent with the specimens recovered in 2018.

Ornamental and Non-Utilitarian Pieces

Fourteen specimens are classified as ornamental or non-utilitarian items and comprise 27.4 percent of the modified sample. The sample includes three beads, an antler bracelet, three tubes, two gaming pieces, four bead or tube fragments, a highly decorated incised piece, and a piece of manufacturing discard, likely from the manufacture of beads or tubes. Following previous studies the distinction between bead and tube is based on a simple length-to-diameter ratio: tube length is greater than three-times specimen diameter and bead length is less than three-times specimen diameter (Ahler and Falk 2002:13.29-13.31; Ahler 2003:212).

A small bead cut from the metapodial of an indeterminate small- to medium-sized mammal was recovered from a Block 2 general level (figure 7.5). The ends and body of the bead are worn and polished. Specimen length is 2.7 mm and average diameter is 3.3 mm. A second bead, manufactured from the metapodial of a large canid is from Feature 5 in Block 3. Shallow transverse cuts perpendicular to the long axis ring each end of the diaphysis; the cuts average about 1.0 mm in depth. The unwanted sections were broken off leaving remnants of uncut bone (figure 7.6[a]). Bead surfaces, including cut ends, are worn and show polish. Specimen length is 19.3 mm and average diameter is 8.1 mm. A third

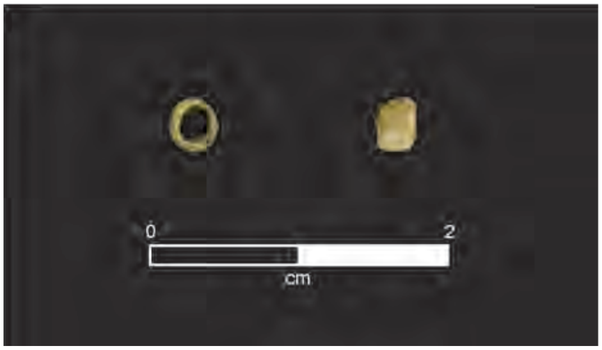

Figure 7.5. Two views of a small bead cut from a metapodial of a small- to medium-sized mammal. Note the wear and polish on both the body and ends of the bead.

bead was recovered from Feature 11, Block 5. The exterior surface and ends of this specimen are heavily worn and polished leaving no obvious traces of manufacture (figure 7.6[b]). The specimen appears to have been fashioned from the diaphysis of a metapodial from an indeterminate small to medium-sized mammal, perhaps a small canid (*e.g.* swift fox, *Vulpes velox*) or leporid. Specimen length is 9.4 mm and average diameter is 4.8 mm.

A decorated antler bracelet strip segment was found in Feature 11, Block 5 (figure 7.7). This incomplete piece is 58 mm long, 11.0 mm wide, and 3.3 mm thick. One end of the segment is cut perpendicular to the long axis with edges rounded and slightly worn. Beginning at the finished end, the

Figure 7.6. Selected ornamental and non-utilitarian modified bone artifacts in the 2018 Molander collection. Beads (a-b) and tubes (c-d) in the collection show both evidence of manufacture (a and c) and heavy polish (b and d). Gaming pieces, or suspected gaming pieces, are shown in e and f. Discarded bead or tube manufacturing debris is shown in g, which is a specimen from the right humerus of a jackrabbit.

Figure 7.7. Two pieces of a decorated antler bracelet strip. Note the shallow holes drilled at the terminal end of each groove on the left side of the image.

convex face is decorated with three incised grooves parallel to the long axis of the strip. The incisions are 45 to 47 mm in length, 1.0 to 1.5 mm in width, and 0.5 mm in depth. A perforation, .5 mm in diameter, is located in the middle groove 6.0 mm from the finished end and appears to have been drilled from opposing faces. Shallow holes, measuring about 0.8 mm in diameter, are drilled at the terminal end of each groove. A second set of shallow holes are located about 14 mm from the first set and appears to mark the beginning of a second set of grooves. The specimen is broken at this point but the evidence suggests if the pattern repeated, the original piece could have been just over 100 mm in length. This specimen shows a recent diagonal transverse break, likely a result of excavation or post excavation processing.

Two small tubes, one from Feature 12 in Block 1 and one from a Block 2 general level are fashioned from small to medium-sized mammal metapodial shafts; a cottontail-sized mammal is indicated. The Feature 12 specimen is incomplete with one end broken and showing several transverse tool marks (figure 7.6[c]). The opposite end is ringed by cut marks and a remnant of uncut bone remains at the snapped end; both the cut mark and remnant are worn and polished. Length of the incomplete specimen is 12.4 mm with an average diameter of 3.1 mm. The Block 2 specimen is complete with a length of 12.8 mm and an average diameter of 3.2 mm. Although the surface is somewhat eroded, fine striations and surface polish are apparent. A third specimen, also from Feature 12, is manufactured from the diaphysis of left tibia of a small canid, possibly swift fox (figure 7.6[d]). Each end of the specimen is rounded, worn, and polished but remnants of encircling cut marks and the uncut, broken bone are discernable. The original shaft is well worn and polished. Specimen length is 26.9 mm with an average diameter of 7.2 mm.

Three specimens, described as tubular beads, and two larger tube fragments, possibly broken whistles, are included in the sample collected in 1968 (table J2, appendix J). Specimen descriptions are inadequate to allow further classification.

Two specimens are classified as gaming pieces. A small disc-shaped item is fashioned from the split rib of a large mammal, possibly bison. Edges were cut and ground to produce an irregular but near-circular form (figure 7.6[e]). The smooth obverse face shows a few unpatterned striations and is worn and polished but otherwise undecorated. The reserve face consists of exposed cancellous tissue that is ground and flattened; striations are visible on the bony ridges. The specimen is 13.2 to 14.6 mm in diameter with a thickness of 2.8 mm. The 1968 Molander sample includes two similar circular pieces (each with a diameter of diameter 12 mm), also manufactured from large artiodactyl split rib sections. Both specimens are undecorated.

A small rectangular specimen, cut from a rib or possibly an indeterminate long bone section, is included here (figure 7.6[f]). Both ends of the piece are ringed with cuts leaving remnants of compact bone. The smooth obverse face is weakly convex with longitudinal striations. The reverse face exposes cancellous tissue that is ground and worn flat. The cross-section is weakly plano-convex with beveled edges producing a near trapezoidal appearance in end view. The specimen is 19.7 mm in length, 12.3 mm in width and 4.9 mm in thickness. Here the specimen is coded as a finished gaming piece, but it may be an unfinished, or perhaps a stage in the manufacture of an unknown non-utilitarian item.

A highly polished segment of an incised piece, fashioned from the split rib of a bison or elk, was recovered from Feature 7 (Block 2). One end is undamaged, slightly tapering to a rounded end, and polished; the opposite end is broken (figure 7.8 [left]). The section of rib remaining is slightly curved lengthwise with one smooth and opposing face with traces of cancellous tissue evident. Obverse (smooth) and reverse (with cancellous tissue) surfaces are decorated with incised linear patterns. A series of parallel diagonal lines, spaced 10-11 mm apart, are cut along the length of the slightly concave obverse face. Six to eight opposing diagonal hatch marks are lightly incised above (or below, depending on orientation) each of the more deeply cut base lines.

A nearly identical pattern is illustrated by Brower (1904: xxiv) who identifies the piece as a "decorated Mandan bone paint stick" (figure 7.8 [right]). The Molander specimen has two lightly incised bands on the reverse surface. The first, beginning nearly 50 mm from the finished end, consists of two straight lines spaced 6.5 mm apart and cut at right angles to rib edges. A diagonal cross-hatched pattern—essentially a series of overlapping 'X's—decorate this band. The second band is located about 5 mm above the first and continues past the fractured end. This decorative element consists of two straight lines spaced rouhgly 8mm apart, again cut at right angles to rib edges. The space between band lines features a single 'X' and a series intersecting parallel and perpendicular lines forming a rectilinear pattern that appears to have been added following the incised lines forming the 'X'.

The character of incised decorations, as well as remnants of chatter marks on both faces, and tool marks along specimen edges, speak to the use of a metal knife during the manufacturing process. The incomplete length of this piece is 75.4 mm. Specimen

Figure 7.8. Incised bone tool manufactured from a bison or elk rib (left) and an illustration from Brower (1904:xxiv) showing a nearly identical incision pattern on the face of the tool.

width is 17.0 mm and thickness 4.0 mm. In general form and appearance, the Molander specimen is similar to Hidatsa bone stick dice described by Culin (1975:186), although the dice illustrated are apparently manufactured from elk antler rather than bison rib. Similar forms, manufactured from split bison ribs, are reported for the 'Blackfoot nation' (Culin 1975:56-58) and are well represented in collections from Fort Union Trading Post National Historic Site (Hunt 1985, Hunt and Perry 1986:11-14, Thiel 1998:22-28).

Five additional specimens are grouped as unknown, non-utilitarian. Four pieces are fragments of beads or tubes. A small burned fragment from a Block 2 general level show longitudinal striations. The piece is 4.9 mm in length. Taxon and element are indeterminate. A specimen from Feature 5 (Block 3) is an ulna diaphysis fragment (indicated by the presence of two quill knobs) from a medium to large-sized bird; irregular striations and polish are present on the convex surface. Incomplete specimen length is 21.9 mm. A third piece, from Feature 6 (Block 4), is a long bone diaphysis fragment from a large bird. Specimen length is 12.2 mm. One end shows a shallow cut perpendicular to the long axis of the element, perhaps an ulna or humerus, and a small remnant of uncut bone. The cut end is rounded and worn and the convex surface shows light polish. The fourth specimen, from Feature 11 (Block 5) is a long bone diaphysis section from a medium to large-sized bird. One end of the shaft is ringed and the unwanted portion removed; the outer surface is worn smooth and polished. Incomplete length is 14.4 mm. The fifth specimen—also from Feature 11 (Block 5)—is a discard, likely from the manufacture of a bead or tube. The diaphysis of the right humerus of a jackrabbit, almost certainly a white-tailed jackrabbit (*Lepus townsendii*), is ringed ca. 25 mm above the distal condyles and shows remnants of uncut bone remaining after the desired section was removed (figure 7.6[g]). Length of the discarded piece is 25.1 mm.

Unknown, Utilitarian Pieces

Twelve specimens, nearly a quarter (23.1 percent) of the modified sample, are classified as utilitarian items of unknown function. Two Block 4 specimens are burned, one from Feature 3 and one from Feature 4. Nine pieces are small fragments of unknown tools and show striations, worn, rounded, crushed edges, and/or lightly polished surfaces. Two pieces appear to be debris discarded during the manufacturing process and a third piece is a flake resulting from use, resharpening, or otherwise altering an unknown tool. The final piece is classified as an unspecified antler tool. Fragments from a modified elk antler were recovered from Feature 6 (Block 4). Several of the unmatched fragments show naturally channeled or 'guttered' surfaces that have been worn smooth, possibly a result of prehension, but further modification is not evident. Antler fragments found in Feature 4 (Block 4) may be part of this tool but refits or reliable matches were not identified. In addition, some of the fragments found in Feature 6 may be part of the antler hammer or billet recovered from Feature 4.

Evidence for Use of Stone and Metal Tools

Table 7.4 summarizes counts for specimens showing evidence of stone or metal tool modification. Eleven specimens (21.2 percent) show cut marks indicating use of metal tools—knives, hatchets, or axes—at some stage in the manufacturing process. A twelfth piece (1.9 percent) evinces both metal tool and stone tool marks. Four specimens (7.7 percent) show probable metal tool marks but certitude is lacking. In simple terms, straight, narrow slices, generally with clean V-shaped profiles were judged to reflect use of a comparative thin metal knife. If the knife was not sharp, or was otherwise damaged, resulting tool marks could be more problematic. The presence of flat (planar) scarring or smooth, wider and deeper notching may reflect use of a heavier tool, one with a thick flat blade, such as a metal axe. Scraping with a metal tool also may produce distinctive chattermarks, sharp, distinctive ridges perpendicular to the long axis of the worked area. Five modified pieces (9.6 percent) exhibit cut marks resulting from use of a stone tool. Tools marks are indeterminate for 31 specimens, nearly 60 percent of the sample.

Distribution of Recovered Specimens

This section considers the intra-site distribution of modified specimens. All modified materials are from deposits assigned to the Plains Village occupation of the site; pre-village and unassigned contexts are not represented. Table 7.5 summarizes specimen counts for generalized functional class by deposit type. The majority of specimens (65.4 percent) are from feature deposits, including 28 pieces from cache pits and an additional 6 pieces from minor pits. Feature 11, a large

Table 7.4. Modified bone organized by tool mark class and generalized functional class.

Generalized Functional Class	Tool Mark Class					Total
	Stone	Metal	Metal?	Stone and Metal	Indeterminate	
Digging Tools		1			6	7
Pressure flakers					2	2
Other Patterned Tools		6	1	1	3	11
Other Expedient Tools	1				3	4
Ornamental and Non-Utilitarian	2	4	2		7	15
Unknown, Utilitarian	2		1		10	13
Total	5	11	4	1	31	52
Percent	*9.6*	*21.2*	*7.7*	*1.9*	*59.6*	*100.0*

Table 7.5. Modified bone organized by generalized functional class and deposit type.

General Deposit Type	Generalized Functional Class						Total	Percent	Density (spec./m^3)[a]
	Digging Tools	Pressure Flakers	Other Patterned Tools	Other Expedient Tools	Ornamental Non-Utilitarian Items	Unknown, Utilitarian Tools			
Surface						1	1	*1.9*	1.0
Midden	4		1		2	3	10	*19.2*	6.3
Midden/Floor				1	1		2	*3.9*	4.0
Floor/Floor Fill			1		2	2	5	*9.6*	8.8
Cache Pit	3	2	8	3	8	4	28	*53.9*	35.9
Pit			1		2	3	6	*11.5*	7.8
Total	7	2	11	4	15	13	52	*100.0*	10.1

[a] Excavated volume by deposit type reported in chapter 3.

cache in Block 5, yielded 14 specimens, 26.9 percent of the 2018 collection (table 7.1). Ten specimens from midden deposits comprise 19.2 percent of the total. Four specimens from deposits taken from the fortification ditch (Feature 12) are included with the midden total. Mixed midden and floor deposits, and floor deposits contribute 3.9 percent and 9.6 percent to the total, respectively. A single specimen from surface deposits (1.9 percent) completes the total. Density values (specimen counts/volume of excavated fill) by deposit type generally mirror percent distributions. The highest density value, 35.9 specimens per cubic meter, is for cache pits, followed by floor and floor fill (8.8 specimens per cubic meter) and minor pits (7.8 specimens per cubic meter). Values for midden, mixed midden and floor, and surface deposits are somewhat lower.

Table 7.6 also organizes specimen distributions by deposit type but emphasizes locational relationships within and outside identified house structures. Twenty-nine specimens, 55.8 percent of the total sample, are from contexts associated with house interiors: cache pit (22 specimens), midden and floor (6 specimens), and floor/fill (1 specimen). Remaining specimens are from contexts lying outside defined structures, primarily midden deposits but also outside cache deposits. Six specimens are from unassigned pit deposits. Table J.5 (appendix J) expands information presented in table 7.6, adding specific functional classes that highlight the variety of tool types (cultivating tool, expedient flaker, abrader, squash knife, flesher, handle, and knife handle), and ornamental items (bead, tube, gaming piece, and incised piece) found in direct association with house structures.

Regional Comparisons

This section compares the modified bone assemblage from Molander Village with those reported from Plains Village occupations within the general area. Table 7.7 presents frequency data for modified bone, organized by seven generalized functional classes, for 27 components distributed among 15 sites. Moving from north to south, sites include Nightwalker's Butte and Rock Village, located in the Garrison region; Big

Table 7.6. Modified bone specimens organized by general deposit type and generalized functional class.

	General Deposit Type							
Generalized Functional Class	Cache Pit/Pit Outside	Cache Pit/Pit Inside	Pit Unass.	Surface Outside	Midden Outside	Midden/ Floor Inside	Floor/Fill Inside	Total
Digging Tools	2	1			4			7
Pressure flakers		2						2
Other Patterned Tools	1	7	1		1		1	11
Other Expedient Tools	1	2				1		4
Ornamental and Non-Utilitarian	2	6	2		2	3		15
Unknown, Utilitarian		4	3	1	3	2		13
Total	6	22	6	1	10	6	1	52
Percent	*11.5*	*42.3*	*11.5*	*1.9*	*19.2*	*11.5*	*1.9*	*99.8*

Hidatsa, Taylor Bluff, Sakakawea, Lower Hidatsa, Amahami, Deapolis, and Molander in the Knife River region; and Larson, Double Ditch, Boley, Chief Looking's Village, Scattered, and On-A-Slant in the Heart River region. Table J.6 (appendix J) provides source citations in support of data presented in table 7.7. Information for the Big Hidatsa, Lower Hidatsa, and Sakakawea collections is taken directly from Weston (1986) following review of work by Ahler and Ryser (1997: 386-387) linking Weston's classification structure with a more explicit functional classification system applied in recent studies. Also, to maintain consistency with recent presentations, unclassified and unknown or utilitarian tools are omitted from table 7.7, and expedient piercing and expedient flaking tools are combined with other expedient tools.

Review of table 7.7 reveals marked variability in sample size between and within archaeological units represented, a circumstance that should be considered in assessing the utility and significance of inter-site comparisons. This disparity is the result of several interconnected factors, including differing research objectives and sampling design, variations in the extent and character of site-specific excavations, and, critically, the design and execution of recovery procedures. Excluding unclassified and unknown pieces, the Molander sample consists of 39 specimens, the smallest sample considered in table 7.7. Comparatively small samples are recorded also for Taylor Bluff (n=48) and Sakakawea (n=54). The low specimen counts reported for these sites contrast spectacularly with specimen counts for Scattered Village (n=871)—with materials recovered during an extensive emergency salvage excavation—and Double Ditch (n=1795) where an extensive and intensive three-year testing program was undertaken. The qualitative and quantitative character of site assemblages is a direct reflection of field recovery technique. Fine-mesh waterscreening procedures were employed at each of these sites, as well as during the Big Hidatsa, Lower, Hidatsa, Larson, Boley, Chief Looking's, and On-A-Slant investigations. Recovery techniques utilized for remaining sites range from intensive surface collection (Deapolis), hand or machine excavation (Deapolis, Nightwalker's Butte, Rock Village), to selective dry screening (Rock Village) and selective waterscreening (Amahami). Analysis of modified remains at Double Ditch (Ahler 2005) showed differences in the percentage representation of some functional groups through time but also revealed meaningful variability in the representation of groups between deposit types (e.g., house roof/floor fill, pit fill, midden, etc.). The following comments, centered primarily on Molander, are offered recognizing the uncertainty inherent in cross-site comparisons.

The sample from Molander includes seven digging (or cultivating) tools, 18.0 percent of the total. One specimen, manufactured with metal tools, is complete. The remaining examples are small, out-of-use fragments. Within the Knife River region, the use of metal tools in the manufacture of bone tools begins in the early to mid-seventeenth century and is well documented in the following century (Weston and Ahler 1993). Digging tools, nearly all fashioned from bison scapulae, are recorded for each of the 26 comparative samples, often representing a relatively large percentage of the total sample. At sites where fine-mesh recovery was employed specimen numbers likely include a high proportion of tool fragments. Digging tools are well represented in pre-contact through historic period occupations but the highest

Table 7.7. Modified bone organized by generalized functional class and select village components in the Knife and Heart River regions. Components are sorted by time period (TP), then by decreasing proportion of digging tools. Rows represent within-site proportions, with a total sample size in the last column.

Village/Component (TP) Time Period	Digging Tools	Patterned Piercing Tools	Patterned Pressure Flakers	Fishhooks	Other Patterned Tools	Other Expedient Tools	Ornamental, Non-Utilitarian	Sample Size
A.D.1800s								
Big Hidatsa TP1-2	*46.4*	*0.0*	*7.2*	*0.0*	*14.4*	*23.7*	*8.2*	97
Amahami	*20.4*	*11.7*	*14.6*	*0.0*	*30.7*	*7.3*	*15.3*	137
Rock Village	*18.1*	*0.7*	*13.4*	*0.0*	*53.0*	*2.7*	*12.1*	149
Taylor Bluff	*12.5*	*2.1*	*0.0*	*0.0*	*29.2*	*25.0*	*31.2*	48
Sakakawea	*9.3*	*5.6*	*1.8*	*0.0*	*31.5*	*25.9*	*25.9*	54
Deapolis	*6.2*	*6.2*	*1.6*	*0.0*	*42.7*	*1.6*	*41.7*	192
A.D. 1700s								
On-A-Slant TP1	*47.7*	*9.0*	*4.5*	*3.0*	*9.0*	*19.4*	*7.5*	67
Big Hidatsa TP3-4	*37.8*	*1.6*	*10.2*	*2.4*	*10.2*	*18.9*	*18.9*	127
Double Ditch TP1	*33.9*	*11.2*	*6.3*	*2.6*	*6.9*	*18.7*	*20.4*	348
Lower Hidatsa TP1-2	*27.1*	*3.4*	*17.0*	*3.4*	*10.2*	*30.5*	*8.5*	59
Boley TP1	*21.2*	*5.5*	*11.0*	*17.8*	*18.5*	*8.9*	*17.1*	146
Double Ditch TP0	*19.6*	*13.4*	*7.1*	*0.9*	*5.4*	*19.6*	*33.9*	112
Molander	*18.0*	*0.0*	*0.0*	*0.0*	*28.2*	*15.4*	*38.5*	39
Nightwalker's Butte	*6.5*	*3.3*	*17.4*	*0.0*	*60.8*	*8.7*	*3.3*	92
A.D. 1600s								
Boley TP2	*52.6*	*10.5*	*5.3*	*0.0*	*10.5*	*10.5*	*10.5*	19
Big Hidatsa TP5-6	*41.5*	*9.4*	*9.4*	*3.8*	*3.8*	*7.6*	*24.5*	53
Double Ditch TP3	*30.6*	*21.1*	*9.7*	*1.7*	*5.7*	*17.4*	*13.7*	648
Double Ditch TP2	*25.7*	*13.2*	*9.4*	*1.4*	*5.9*	*22.9*	*21.5*	288
On-A-Slant TP3	*22.8*	*24.6*	*3.5*	*1.8*	*12.3*	*17.5*	*17.5*	57
On-A-Slant TP2	*21.7*	*13.0*	*5.2*	*4.4*	*7.8*	*24.4*	*23.5*	115
Lower Hidatsa TP3-4	*21.4*	*3.6*	*22.6*	*0.0*	*13.1*	*19.1*	*20.2*	84
Scattered TP1-2	*21.0*	*10.7*	*6.0*	*5.0*	*9.1*	*6.9*	*41.3*	871
A.D. 1500s								
Double Ditch TP4	*34.1*	*16.0*	*8.5*	*1.0*	*4.0*	*19.8*	*16.5*	399
Larson	*27.0*	*16.4*	*5.0*	*1.9*	*12.0*	*25.8*	*11.9*	159
Lower Hidatsa TP5-6	*17.0*	*6.4*	*17.0*	*0.0*	*17.0*	*21.3*	*21.3*	47
Chief Looking's 2008	*15.1*	*37.0*	*11.0*	*0.0*	*1.4*	*15.1*	*20.5*	73
Boley TP3-4	*9.7*	*25.0*	*12.5*	*0.0*	*15.3*	*19.4*	*18.1*	72

percentage values are recorded for late period samples from Big Hidatsa (TP1 and TP2), Boley (TP2), and On-A-Slant (TP1). Reflecting on trends during the early eighteenth century, Weston and Ahler (1993:282) speculate that the "large number of scapula tools may indicate an effort by the Hidatsa to increase output from gardens for use in trade".

Patterned piercing tools (awls, punches, sewing/ weaving/ basketry tools) are absent in the 2018 Molander sample; two specimens are reported from the earlier 1968 investigation (appendix J, table J.2). Molander aside, patterned piercing tools are represented in varying numbers in all assemblages save the latest component at Big Hidatsa where they also are absent. Specimen counts also are low for other eighteenth and nineteenth century Knife River samples including Nightwalker's Butte, Rock Village, Taylor Bluff, Sakakawea, Big Hidatsa, and Lower Hidatsa. Patterned piercing tools are more common in nearly all Heart River site and component samples, both in terms of absolute numbers and relative percentage representation. Considering multi-component sites, piercing tools are most common in earlier periods, diminishing in relative percentage representation in the later periods. This is particularly evident at Big Hidatsa, Boley, and On-A-Slant, but less so at Lower

Hidatsa, and Double Ditch. Decreasing numbers for bone awls were noted by Weston and Ahler (1993:280-281, Table 20.3) who suggested replacement of bone implements by metal equivalents.

Patterned pressure flakers are absent at Molander but present in every sample except for Taylor Bluff where they also are absent. In the Garrison and Knife River samples, the relative percentage representation of patterned pressure flakers is somewhat higher in comparison to Heart River samples, ranging from 7.2 percent to 22.6 percent—omitting Sakakawea with a single specimen (1.8 percent) and Deapolis where three specimens (1.6 percent) are recorded. Heart River components show percentage representation values ranging from 3.5 percent to 12.5 percent, but specimen counts vary widely. The temporal pattern is equivocal for multi-component sites in table 7.7 but review of data presented by Weston and Ahler (1993:281, Table 20.3) shows a decline in the representation of pressure flakers beginning in the late eighteenth century.

Fishhooks are not common in Knife River sites; only seven examples reported. Five specimens are recorded for seventeenth- and eighteenth-century deposits at Big Hidatsa and two are reported from eighteenth-century levels at Lower Hidatsa. Fishhooks are present in many Heart River assemblages but in generally low proportions (0.9 to 4.4 percent). Exceptions are Boley (TP1) where 26 specimens comprise 17.8 percent of the sample and Scattered (TP1-2) with 44 specimens, 5.0 percent of the total. Fish played a minor role in subsistence at Molander (chapter 6). The absence of bone fishhooks at the site may reflect sampling error, or indicate use of metal hooks, or alternate fishing methods such the basket trap or drag (Weitzner 1979:208-209).

The class 'other patterned tools' is a catchall for a variety of well-formed tools fashioned by extensive modification of the original raw material, here a skeletal element. This class includes, but is not limited to, abraders, antler hammers, squash knifes, shaft straighteners, knife handles, scraper handles, and fleshers. Eleven patterned tools are included in the 2018 sample from Molander (abrader, pick, antler hammer or billet, squash knife, flesher, indeterminate handle, and knife handle), comprising 28.2 percent of the sample. An additional specimen (shaft straightener) is included in the materials collected in 1968, along with three knife handles. The general grouping is represented in each of the sites included in table 7.7 indicating that the manufacture of bone tools persisted though the temporal periods considered. To evaluate the occurrence and distribution of tools lumped in this class would require detailed consideration of individual tool types, a task beyond the scope and limitations of this study. However, it is interesting to note the highest percent values for the class are found at Nightwalker's Butte (60.8 percent), Rock Village (53.0 percent), Amahami (30.7 percent), and Deapolis (42.7 percent) where inconsistent or insufficient field recovery procedures may have yielded fewer small tools and ornaments but larger, more recognizable pieces were identified and collected.

In contrast with a patterned tool, an expedient (or unpatterned) bone tool "is one in which an edge, margin, or corner or projection was used expediently or opportunistically for some … task, and the form of the raw material … was not substantially, purposefully altered" (Ahler and Ryser 1997:358). Expedient tools are recorded for each of the 27 site units listed in table 7.7, including Molander where six specimens (two awls/punches, two flaking tools, and two scraping tools) make-up 15.4 percent of the total count. The relative percentage of expedient tools for waterscreened Knife River region samples appears to increase through time at Big Hidatsa and Lower Hidatsa, and remain relatively high at Sakakawea and Taylor Bluff—results consistent with data presented by Weston and Ahler (1993:281, Table 20.3). Comparatively low values are recorded for Nightwalker's Butte and Rock Village in the Garrison region, and for Deapolis and Amahami in the Knife River region, all sites where field recovery techniques were not exacting and expedient tools and tool fragments were less likely to be identified.

Ornamental and other non-utilitarian pieces (gaming pieces, beads, tubes, and at least one antler bracelet) are well represented at Molander where they comprise 38.5 percent to the 2018 sample and over 40 percent of the materials from 1968. The relative proportions of ornamental pieces decline over time at Big Hidatsa, Lower Hidatsa, Boley, and On-A-Slant but appear to increase at Double Ditch. These changes may simply reflect sampling error, or possibly the replacement of bone elements by increasingly available trade material. The highest value for all site units is recorded for Deapolis where intense surface collection and emergency salvage may have biased the sample toward decorative pieces. The low specimen count for Nightwalker's Butte may simply reflect a poor recovery procedure.

Summary and Conclusions

This chapter presents a descriptive account of a small sample of modified bone from Molander Village in 2018. Fifty-two specimens were recovered from 16 test units, distributed between five excavation blocks. Thirteen specimens are from general level deposits in the main village, four from midden deposits within the fortification ditch, one from a surface unit, and the remaining 34 from feature deposits. Specimen density (specimen counts/volume of excavated fill) is comparatively low for midden and mixed midden/floor deposits, as well as for house floor, mixed floor and fill, and strikingly higher for excavated cache pits. All modified bone specimens are from archaeological contexts assigned to the Plains Village occupation of the site.

Twenty-eight broken and discarded pieces (use-phase 4) make-up 53.8 percent of the sample. Twenty specimens (38.5 percent) are judged complete and usable (use-phase 3). Four pieces are unfinished or represent manufacturing discard. For this study specimens are organized into six generalized function classes and 19 specific functional classes. Fifteen ornamental and non-utilitarian pieces (beads, tubes, gaming piece, bracelet, and incised pied), 11 patterned tools (abrader, pick, hammer/billet, squash knifes, flesher, knife handle, and indeterminate handle), seven digging tools/tool fragments, and 13 unknown-utilitarian tool fragment form the bulk of the collection. Six expedient tools, two pressure flakers, two scrapers, and two awls or punches complete the sample. Metal tools were employed at various stages in the manufacture at least seven tools and four ornamental items based on recorded tools marks. Nearly 60 percent of the modified pieces are fashioned from the bones of large artiodactyls. Bison bone dominates the sample but elk is represented by at least two antler sections. Also, deer, large canid, jackrabbit, and bird elements are recorded.

Laboratory notes describing 16 modified specimens recovered in 1968 from a single test unit located outside the fortification ditch were reviewed as part of this study. Two patterned piercing tools, three knife handles slotted for metal blades, a shaft straightener, three expedient awls or punches, five beads and tubes, and two gaming pieces are documented and provide a useful supplement to the available sample. The patterned piercing tools and shaft straightener are modified forms not represented in the 2018 sample.

Broad comparisons with materials from sites distributed through the Garrison, Knife River, and Heart River regions suggest that, taken as a whole, the Molander sample falls well within the range of modified bone assemblages documented for village occupation in the areas considered.

8

Botanical Remains

Robert K. Nickel

The 2018 Molander botanical sample consists of numerous wood fragments and 1,973 identifiable seeds. The collection includes carbonized (charred) and not carboncanized (uncharred) seeds and wood fragments. Initial processing of the 2018 Molander botanical collection occurred at the PCRG lab in Broomfield, Colorado, supervised by Mark Mitchell. This processing included the flotation of the water-screened debris and the size-grading of both the light- and heavy-fractions. Light-fraction samples from G4 and G5 samples were forwarded to the author for sorting and identification. Recognized botanical specimens from G2 and G3 debris were also provided (table 8.1). Ten catalog lots from three Features (7, 9, and 11) were inspected with a microscope at low magnification and all identifiable seeds, fruits, or similar botanical materials were noted and tabulated (table 8.2). Many fine hair-like root segments are present in the samples.

Archaeological specimens were identified either by comparing them with modern seeds and fruits from known plants or by referring to published guides (Hitchcock 1950; Martin and Barkley 1961; Slife *et al*. 1960). Modern comparative material includes specimens collected by the author as well as collections available from universities and departments of agriculture in Nebraska and the Dakotas. Ethnobotanical literature based on Native accounts from the early twentieth century was used when it provided possible indications of species preference, processing, and seasonality. Archaeological data from other Plains Village occupations along the Missouri River near the cities of Bismarck and Mandan were also used.

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The Identified Plants

The four major cultigens, corn (*Zea mays*), squash (*Cucurbita pepo*), beans (*Phaseolus vulgaris*) and sunflowers (*Helianthus annuus*), are present in the Molander collection. All except for beans occur in all three features. Corn and beans occur only as carbonized specimens. Squash and sunflower occur in both carbonized and not carbonized forms. Squash, comprising 57.5 percent of the entire sample, is present in all but one catalog number (CN1057, Feature 7) and exists primarily as fragments of seeds that are not carbonized. A small number of carbonized squash seeds are in the G4 material from a Feature 9 lot (CN1059). Even small fragments of uncarbonized squash seeds are readily identifiable and may be over-represented compared to other taxa that are not regularly preserved as uncarbonized specimens. A small squash stem fragment from where the stem attaches to the fruit is present in a Feature 7 sample (CN1065). The form is like that of a small *Cucurbita pepo*.

Corn kernels and cob fragments are present in all catalog lots except CN1084 (Feature 11). All corn specimens are carbonized and represent 10 percent of the sample. Over 82 percent of the corn specimens come from Feature 9, which had been filled with the dismantled remains of a central hearth. Garden beans (*Phaseolus vulgaris*) are present in CN1059 as carbonized halves and fragments. In other regional archaeological collections, beans are often present only in small numbers and in few proveniences. In general, beans seem under-represented in archaeological collections compared with their documented significance in the historic record.

Several wild fruits are present in the 2018 sample. These include plum (*Prunus americana*), chokecherry (*Prunus virginiana*), buffaloberry (*Shepherdia argentea*), rose (*Rosa* sp.), grape (*Vitis* sp.), and dogwood (*Cornus stolonifera*). Plum, chokecherry, buffaloberry, and dogwood rival corn and squash in abundance and frequency of occurrence in the Molander sample. Unlike most regional archaeological collections, these native fruits are represented primarily by specimens that are not carbonized. A small number of the grape, dogwood, and buffaloberry specimens are carbonized. The uncarbonized specimens do not look modern and are included in a matrix of small fragments of uncarbonized woody material. Only CN1089 (Feature 11) consisted of nearly 50 percent carbonized material. At Chief Looking's Village (32BL3), located approximately 30 kilometers (19 miles) south of Molander, grape, dogwood, and rose also occur as carbonized, partially carbonized, and uncarbonized specimens.

Not listed in the tabular summary is one half of a single uncarbonized seed of a hackberry (*Celtis occidentalis*). According to Stevens (1963:116), hackberry trees are rare in North Dakota except along the Red River in the vicinity of Fargo, North Dakota.

Table 8.1. Summary of charred and uncharred botanical remains by size grade.

	Size Grade						
	G3		G4		G5		
Seed Type	Uncharred	Charred	Uncharred	Charred	Uncharred	Charred	Total
Bean		2		13			15
Buffaloberry			24	12	27		63
Chenopod					7		7
Chokecherry			27		11		38
Corn Cob		3		33		3	39
Corn Kernel		27		120		11	158
Dogwood			43	1	81		125
Grape			15	6	4		25
Grass		1			2	1	4
Plum	28		60		4		92
Rose					10		10
Sedge			2		1		3
Squash	26		477	2	629		1,134
Sunflower			66	14	154	26	260
Total	54	33	714	201	930	41	1,973

Table 8.2. Summary of charred and uncharred botanical remains by feature.

	Feature 7		Feature 9		Feature 11		
Seed Type	Uncharred	Charred	Uncharred	Charred	Uncharred	Charred	Total
Bean				15			15
Buffaloberry			49	1	2	11	63
Chenopod	1		1		5		7
Chokecherry	5		1		32		38
Corn Cob		12		24		3	39
Corn Kernel				138		20	158
Dogwood	85			1	39		125
Grape	11	4	1		7	2	25
Grass				2	2		4
Plum	13				79		92
Rose	9				1		10
Sedge	1				2		3
Squash	504		46	2	582		1,134
Sunflower	154	1	47	39	19		260
Total	783	17	145	222	770	36	1,973

Hackberry trees, however, have been widely planted as street trees in cities and towns in the Dakotas and hackberry seeds are common in botanical collections from Coalescent Tradition villages near Mobridge, South Dakota (Nickel 1988). Hackberry seeds are present in the Scattered Village (32MO31) and Larson Village (32BL9) collections. The Scattered Village site is located within a residential neighborhood in the city of Mandan so it is not clear whether the hackberry seeds at Larson and Scattered Village are archaeological or intrusive modern specimens.

Corn

Corn or maize (*Zea mays*) was the primary food plant of the semi-sedentary villagers in the Dakotas during the historic period. Corn (including kernels and cobs) is the third-most represented food plant in the 2018 Molander sample. Both Euroamerican explorers (summarized in Will and Hyde 1917) and Native American accounts (Wilson 1916, 1917; Gilmore 1919), focus on corn horticulture. Beans, squash and sunflowers were cultivated in and around cornfields, but no historic account ranks them as productive a food plant as corn. George Will's work (Will and Hyde 1917) combined his interest in archaeology with his family's commercial interests in the seed business (Walster 1956). Hugh Cutler, working at the Missouri Botanical Gardens in St. Louis, examined much of the botanical material recovered during the Smithsonian Institution's major salvage excavations along the Missouri River in the Dakotas (Cutler and Blake 1973:6). Will's work with heritage corn varieties and Cutler's work on salvage archaeological collections provide the basis for our current understanding of Native American corn varieties from the Middle Missouri.

The corn specimens from Molander are quite fragmentary. Only a few cob specimens consisted of more than a single cupule. In earlier studies eight-rowed corncob varieties were most common in collections from Middle Missouri sites, with 10-rowed forms the next most common (Cutler and Blake 1973:53-55). Cutler's studies indicate the mean number of rows on corncobs was between 8 and 9. Row numbers could not be measured reliably on the Molander specimens. The presence of 8-10mm wide kernels suggests they are from corncobs typical of 8-10 rowed varieties. The absence of complete cobs or cob sections makes it difficult to compare attributes other than row numbers of the Molander corn specimens to those from archaeological collections at nearby sites.

Squash

Squash is the cultivated plant second to corn in the frequency of recovery from archaeological sites during the salvage era (Nickel 1977:55); however, it is the best represented plant (57.5 percent) in the 2018 Molander sample. In their compendium of identified specimens from the Dakotas, Cutler and Blake (1973) reported finding examples of four species of squash, but *Cucurbita pepo* was by far the most common kind of squash from the Dakota sites.

The 2018 botanical sample from Molander contains primarily small uncarbonized squash fragments. The Molander specimens are consistent with those of *Cucurbita pepo* (Cutler and Whitaker 1961). Complete or nearly complete squash seeds measure 8-10 mm wide by 12-14 mm in length in this collection. The carbonized specimens from CN1059 are 5-6 mm wide and 8-10 mm long. The apparent reduction in size of the carbonized specimens is consistent with the known shrinkage of many carbonized archaeological seeds. Most Molander squash seeds are too fragmentary to be confidently identified to the species level.

Beans

Feature 9 contains the only examples of garden beans (*Phaseolous vulgaris*) in the 2018 Molander sample. Fifteen whole or partial bean halves are in Feature 9 and six are complete enough to make a reasonable measurement of the length and height of the seeds. These six average 9.5 mm in length by 6 mm in height. Modern uncarbonized examples of "Hidatsa Red" beans sold by Seed Savers Exchange and grown by the author range from 9 to 14 mm in length. Unfortunately, the carbonized cotyledons recovered from archaeological sites lack the surface features and color that are major factors used to identify named varieties. The Molander bean seeds are consistent in size with those at Double Ditch (32BL8) and Boley (32MO37) as well as those found in other regional archaeological collections (Nickel 2005).

Buffalo Bird Woman (Maxidiwiac), Gilbert Wilson's principal informant on Hidatsa horticultural activities, discusses six bean varieties grown by the Hidatsas (Wilson 1917:84). Three of these are similar to the modern stock of heritage varieties collected from the Mandans, Hidatsas, and Arikaras at the Fort Berthold Reservation. Three are featured prominently in the Seed Savers collections (seedsavers.org). These varieties include Arikara Yellow, Hidatsa Red, and Hidatsa Shield.

Sunflowers

Sunflowers (*Helianthus annuus*) are the traditional cultivated food plant least frequently represented in archaeological collections from mid- and late-twentieth century excavations in the Great Plains. The small size of sunflower seeds and achenes, even of the domesticated sunflowers, as well as their fragility, explain their absence in the salvage era excavations.

Carbonized sunflower achenes and the seeds or kernels that they contain are both present in the 2018 Molander sample. Sunflower seeds and achenes occur in the large-seeded cultivated form as well as in the small-seeded uncultivated form. Carbonized achenes from Molander specimens ranged from 2.0 mm by 9.0 mm up to 3.0 mm by 13 mm. Heiser (1985:162) estimated that sunflower achenes shrink by 10 to 15 percent when carbonized. Although the genus is one with considerable variation, Heiser's (1954:295) measurements of the length of sunflower achenes collected in the American West suggest that most of the Molander site sunflower specimens are cultivated varieties. The exception is the large number of small-seeded uncarbonized sunflower achenes present in one lot from Feature 7 (CN1065). Since carbonized specimens in the size range of small-seeded wild sunflowers do not occur in the Molander collection, this lot may represent an intrusive rodent or insect horde.

Buffalo Bird Woman, Gilbert Wilson's Hidatsa informant, described both large flower heads (producing large seeds) and small flower heads (producing small seeds) on the sunflower plants that grew from the large seeds the Hidatsa planted in their gardens (Wilson 1917:16-19). The small ancillary flower heads on the cultivated sunflower plants were similar to those of wild sunflowers and the Hidatsa harvested, processed, and stored small seeds of cultivated and wild plants together. According to Buffalo Bird Woman, the small sunflower seeds (wild and cultivated) were kept separate from the large cultivated sunflower seeds. Only the large sunflower seeds were used for planting in the year following a harvest.

The Molander botanical sample contains no specimens of *Iva annua*. Archaeologically recovered cultivars of marshelder (*Iva annua*) are becoming more common in botanical collections from sites in northwestern Iowa (Dunne 2005) and central Nebraska (Adair 2005). Although marshelder specimens were recovered during PCRG research at Chief Looking's Village (32BL3) and several other sites in the vicinity of Bismarck and Mandan, these collections and those from other Middle Missouri sites appear to be well outside the range of modern wild-type weedy populations of *Iva annua* (Asch and Green 1992:20).

Wild Fruits

Buffaloberry (*Shepherdia argentea*), chokecherry (*Prunus virginiana*), plum (*Prunus americana*), grape (*Vitis* sp.), and rose (*cf. Rosa* sp.) are all present in the 2018 Molander botanical collection. Rose achenes and grape seeds are relatively infrequent. Rose specimens occur only in uncarbonized form. Some grape seeds are carbonized but several are not. Both carbonized and uncarbonized grape seeds occur in the same lots. The buffaloberry specimens include complete berries. Both carbonized and uncarbonized buffaloberry seeds are present. The carbonized buffaloberries appear to have been dried before they were carbonized. Both carbonized and uncarbonized buffaloberry seeds occur in Features 9 and 11.

Buffaloberry is the most common wild fruit in many regional archaeobotanical collections. At Molander, the small stones of dogwood are the most common of the local wild fruits. Wilson's Hidatsa informant described collecting berries from dogwood bushes and indicated that they were most palatable when they were collected shortly after a freeze (Wilson 1917:266). Although not mentioned in Wilson's notes, buffaloberries are also more palatable after a hard frost. The uncarbonized specimens of all the wild fruits in the Molander collection have an eroded woody appearance.

Plum and chokecherry pits occur in all three features but are concentrated in Feature 11. The Molander specimens include some that are not carbonized and other plum and chokecherry pits that are only partially carbonized. Specimens of plum and chokecherry pits from Feature 11 show small tooth marks and had holes gnawed in them.

Local Grasses and Weedy Plants

The Molander botanical collection has very few seeds from the weedy plants that are frequently found in regional archaeological collections. These include chenopods (*Chenopodium* spp.), amaranths (*Amaranthus* spp.), nightshades (*Physalis* spp. and *Solanum* spp.), and sedges (*Carex* spp.). In a typical archaeobotanical collection, these weed seeds are uncarbonized and often contain viable embryos revealing their modern origin. Natural seed rain, especially from weedy plants, contributes large numbers of seeds to the ground surface each season. Martin, Zim, and Nelson (1951:389-390) state that chenopods and amaranths can produce well over 100,000 seeds per plant. While many of these seeds are consumed by wildlife, some become incorporated in the archaeological site matrix, either indirectly through burrowing or directly in the form of seed caches created by small animals.

Two carbonized and two uncarbonized grass seeds are in the Molander botanical collection. Seven uncarbonized chenopod seeds are distributed in two catalog lots from Feature 9 and Feature 11. The grass and weed seed specimens are not complete enough to allow specific identification.

Discussion and Conclusions

The 2018 Molander seed collection resembles other village botanical collections in the Bismarck and Mandan vicinity in terms of variety. Traditional cultivated crops (corn, beans, squash, and sunflower) are all present and, with the exception of beans, are ubiquitous across all three features in the sample. In addition to these cultivated plants, all the common wild fruits are present. The Molander collection contains no marshelder (*Iva annua*). Marshelder, including the large-seeded cultivated form, has become a regular, albeit minor, component in archaeological collections from the Heart River region, including Huff Village, Double Ditch Village, Boley Village, and Larson Village. Although it is clear that marshelder was once a cultivated plant used for human consumption, we do not yet know how early it was adopted by villagers in the Dakotas or how recently the large-seeded variety of marshelder was dropped from the suite of cultivated plants.

The 2018 Molander botanical collection differs from most regional archaeobotanical collections in the amount of material that is not carbonized. Overall, only about 14 percent of the collection is carbonized, and in many catalog lots up to 90 percent of the fragments are not carbonized. The collection of wild fruits is comprehensive but only a few of the seeds and pits are carbonized. The bits of wood and bark, like the seeds and pits, do not look modern despite the lack of carbonization. There are not many obviously modern seeds (shiny seed coat and sprouted embryo) in the Molander assemblage. The collection suggests that the storage pits containing these botanical remains were abandoned shortly after use or perhaps still contained grain or wild fruits in storage when they were abandoned.

9

Trade Goods

William T. Billeck and Mark D. Mitchell

Metal and glass artifacts are the primary sources of chronological data for fur-trade era Plains Village settlements. As discussed in chapter 3, the density of trade goods recovered from excavation units provides a semi-quantitative measure of median component age. In addition, the attributes of individual specimens can provide *terminus post quem* or *terminus ante quem* dates that bracket the age of a component and the characteristics of entire assemblages can suggest component date ranges.

This chapter describes the glass beads and trade metal artifacts in the 2018 Molander collection. William Billeck, Repatriation Office Program Manager at the Smithsonian Institution's National Museum of Natural History, analyzed the glass bead assemblage and wrote the section of the chapter describing the results. PCRG Research Director Mark Mitchell analyzed the metal artifacts and wrote the section describing them.

Glass Beads

Beads were described in the Kidd and Kidd (1970) classification system as updated by Karklins (2012). Beads that closely fit the Kidd and Kidd (1970) descriptions for manufacturing and color are fully coded in that system with manufacture and color codes. Beads that exhibit colors that do not fall precisely into the Kidd and Kidd types are described only with their manufacture codes. For instance, a heat-rounded monochrome drawn bead that has a color that does not match the Kidd and Kidd color types would be described only with

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the manufacture code IIa. A bead that matches the manufacture and color code would have the color number appended to the manufacture code. For example, an opaque black, heat-rounded drawn bead would be coded as IIa6. The color of a typical bead of each variety is described using the Munsell color charts.

The 2018 Molander assemblage consists of 41 glass beads and one unidentifiable glass object. All beads are of drawn manufacture: 40 are short barrel-shaped and heat-rounded and one is tubular-shaped and not heat-rounded. Glass beads occur in eight varieties and were recovered from 10 proveniences (figure 9.1 and table 9.1). Four of the proveniences are features and about half of the beads derive from the features. Seven beads are size grade 4 (G4) and 35 are size grade 5 (G5).

Bead Varieties

Variety 1. This variety is Kidd and Kidd code Ia4*, an opaque white tubular-shaped bead with a thin colorless outer layer. Three pieces compose a single complete bead. This bead is similar to translucent white beads assigned to Kidd and Kidd bead type Ia4, but because the glass is opaque the code is marked with an asterisk. In some previous studies by the author these beads have been identified as IIIa, but henceforth the colorless veneer will not be considered in assigning Kidd and Kidd bead codes. The bead is 3.6 mm in diameter and 8.8 mm long.

Variety 2. This variety is Kidd and Kidd code IIa12*, an opaque white (N8.5/) heat-rounded bead. Most have evidence of a thin colorless outer layer that often is degraded. These short barrel shaped beads are similar to translucent white beads assigned to Kidd and Kidd code IIa12, but because the glass is opaque the code is marked with an asterisk. The 12 beads have an average diameter of 2.5 mm and an average length of 1.8 mm.

Variety 3. This variety contains one bead assigned to Kidd and Kidd code IIa that is opaque blue-green

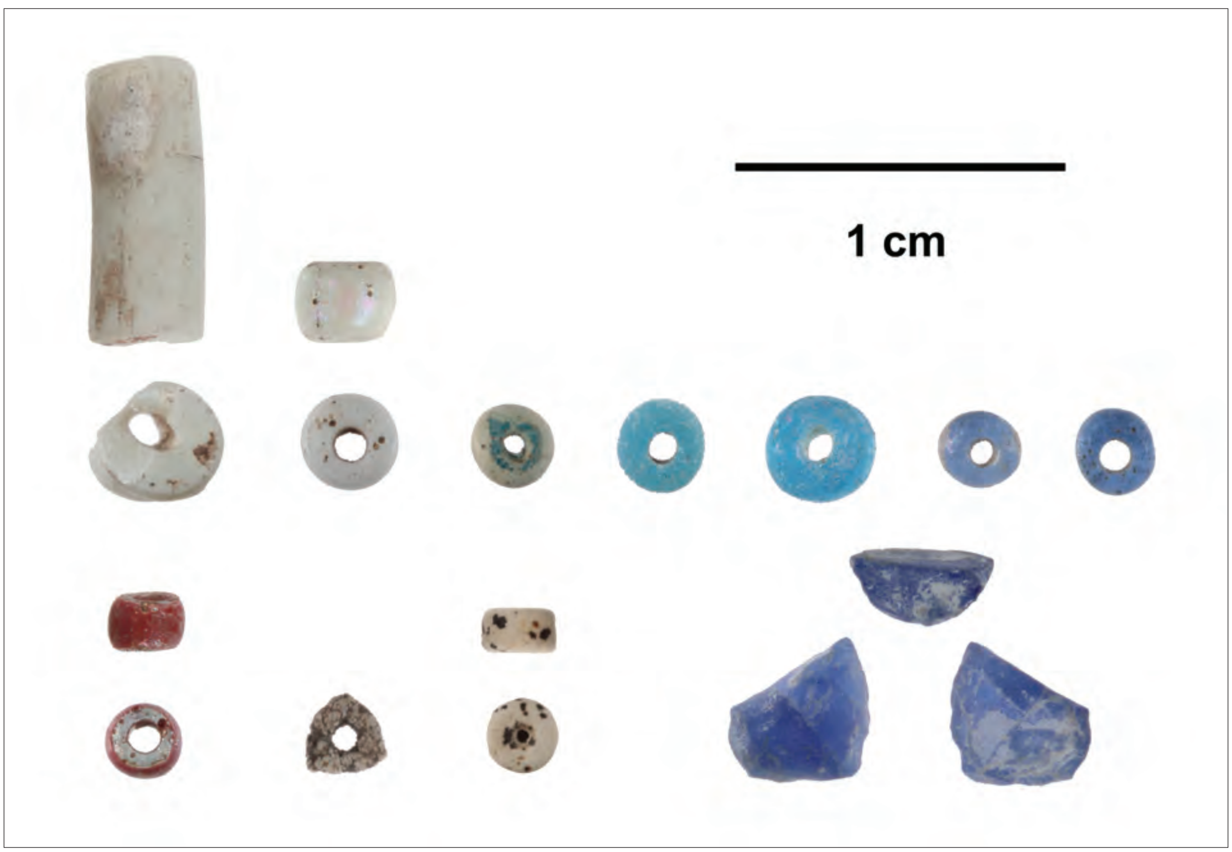

Figure 9.1. Photograph of glass beads and other objects. Top rows: Variety 1 to 7, in order (L-R). Bottom rows: Variety 8; crinoid; disk-shaped crinoid; and three views of an unidentified blue glass fragment. (Photograph courtesy William T. Billeck).

Table 9.1. Distribution of glass beads by excavation block and size class.

		Size Class			
Block	Context	G4 (Small [2-4 mm])	G5 (Very Small [<2mm])	Varieties Present	Total
2	General levels		3	V2 (n=3)	3
	Feature 7	2	2	V2 (n=2); V5 (n=1); V7 (n=1)	4
3	General levels	1	4	V2 (n=2); V6 (n=3)	5
	General levels		5	V5 (n=1); V6 (n=3); V8 (n=1)	5
	Feature 5	1	11	V1 (n=1); V2 (n=1); V4 (n=10)	12
	Feature 9	2	3	V3 (n=1); V4 (n=4)	5
4	General levels	1	1	V2 (n=2)	2
	General levels		1	V8 (n=1)	1
5	General levels		3	V2 (n-1); V7 (n=1); V8 (n=1)	3
	Feature 11		1	V2 (n=1)	1
Total		7	34		41

(10BG4/8) and heat-rounded. The surface color is deteriorated. The bead is 2.6 mm in diameter and 2.0 mm in length.

Variety 4. This variety contains 14 beads assigned to Kidd and Kidd code IIa that are opaque blue (7.5B5/6) and heat rounded. The beads average 2.5 mm in diameter and 1.6 mm in length.

Variety 5. There are two transparent blue (7.5B4/8) heat-rounded beads assigned to Kidd and Kidd code IIa. The beads average 2.9 mm in diameter and 1.9 mm in length.

Variety 6. This variety contains six beads assigned to Kidd and Kidd code IIa that are transparent light purple-blue 5PB4/8) and heat rounded. The beads average 2.4 mm in diameter and 1.4 mm in length.

Variety 7. There are two transparent purple-blue (5PB3/8) heat-rounded beads assigned to Kidd and Kidd code IIa. The color appears darker than the Variety 6 beads, which may be due to the slightly thicker size of the Variety 7 specimens. The beads average 2.7 mm in diameter and 1.5 mm in length.

Variety 8. This variety is Kidd and Kidd code IVa6, an opaque red (5R4/8) heat-rounded bead with a transparent green (10Y7/6) core. One of the beads has evidence of a thin colorless outer layer. The three beads have an average diameter of 2.6 mm and average length of 1.9 mm.

Other Glass Artifacts

The 2018 Molander collection also includes three other glass artifacts that may date to the fur-trade era. One is an opaque blue (7.5B4/6) spherical piece of glass lacking a perforation that is 2.1 mm in diameter from Feature 5 in Block 3 (Units 9 and 10). It is about the size of a glass bead and appears to be the same color glass as Variety 4.

The second is a slightly translucent to transparent purple-blue (5PB4/8) fragment of an unidentified glass object that has a plano-convex cross-section, which was recovered from Block 1 (Unit 16). Very small particles are visible in the object that appear to be fused together, particularly on the flat side. The specimen measures 4.4 mm in maximum length and is 1.7 mm thick. Most edges are acute and exhibit crushing. One edge is more oblique and not crushed. This may be a fragment of a glass bead, but no outside surfaces of the original object could be identified. The presence of what appears to be small fused glass particles may indicate it is a fragment of a Native American-made glass item such as a pendant or bead (Billeck 2016; Ubelaker and Bass 1970). However, positive identification as a bead fragment, another glass object, or a Native-made glass object is inconclusive.

The third specimen of possible fur-trade era glass is a G4 flake from Block 1 (Unit 15). The flake exhibits a single dorsal flake scar and a crushed platform. The glass is brown or amber and exhibits an iridescent surface patina. Thin internal laminae are faintly visible. None of the naturally occurring stone tool raw materials present on Plains Village sites in the northern Middle Missouri exhibit those attributes. The flake was recovered from an excavation level that exposed both ditch fill and intact B horizon sediment. Recent bottle glass and iron artifacts were also recovered from this provenience. Most of the bottle glass is colorless, although some is brown and modestly iridescence. However, no other pieces exhibiting flake morphology were observed.

The collection also includes four segments of crinoid stems or fossil fragments. One each occur in Units 9 and 14 (Blocks 3 and 1) and two occur in Unit 12-13 (Block 5). Three are disk-shaped and are not perforated. One is perforated and is three-sided.

Bead Chronology

The 2018 Molander glass bead assemblage consists of eight varieties. The chronological implications of these varieties are limited. The IIa12* opaque white beads are most common in the eighteenth century and become less common in the early nineteenth century when opaque white beads (IIa14) lacking an outer colorless layer become prevalent. The tubular opaque white Ia4* bead is a type that is also common in the late eighteenth century and into the early nineteenth century and is infrequent in the Plains beyond that time range. In the Plains, the opaque red on green beads in IVa6 are more common in the seventeenth and eighteenth centuries and become rare in the nineteenth century. These few hints most likely date the bead assemblage to the eighteenth century.

Opacifiers in White Glass Beads

The opacifier used in making white beads of drawn manufacture also has a chronological pattern that can be used to approximately place a bead assemblage in time (Billeck and Luze 2019; Billeck and McCabe 2018, Blair 2017; Hancock 2013; Hancock *et al.* 1997; Moreau *et al.* 2002, 2006; Sempowski *et al.* 2000). In the eighteenth century, white drawn beads are made opaque with calcium antimonate, resulting in beads that are high in antimony (Sb). In the first quarter of the nineteenth century, calcium antimonate continued to be used, but beads began to appear that were opacified with lead arsenate, which have high levels of lead (Pb) and arsenic (As). By the mid- to later-nineteenth century, only lead arsenate appears to have been used in the manufacture of white drawn beads found in Plains assemblages.

The Molander assemblage contains 13 white beads (one Variety 1 bead and 12 Variety 2 beads). The opacifiers used in the production of these specimens were identified by X-ray florescence (XRF) using a Bruker Tracer 5i instrument with a 3 mm collimator with an assay time of 30 seconds with the settings kV=50, µA=35, and a Cu 200 µm, Ti 25 µm, Al 300 µm filter. All 13 beads had high levels of antimony and lower peaks for strontium and a few beads have an even lower peak for lead. A spectrum for a Variety 2 bead shows energy peaks at antimony, strontium, and lead (figure 9.2). Only elements potentially related to opacifiers are marked on figure 9.2. This opacifier pattern is consistent with the eighteenth century.

Regional Comparisons

Ahler and Drybred (1993) found some of the colors of small and very small beads (their designations for G4 and G5 beads) from sites in the Knife River and Painted Woods areas along the Missouri River in North Dakota differed in their presence and prevalence through time (table 9.2). Ahler and Drybred's colors are combined into a few states and correlated with the bead varieties identified in this study in table 9.3.

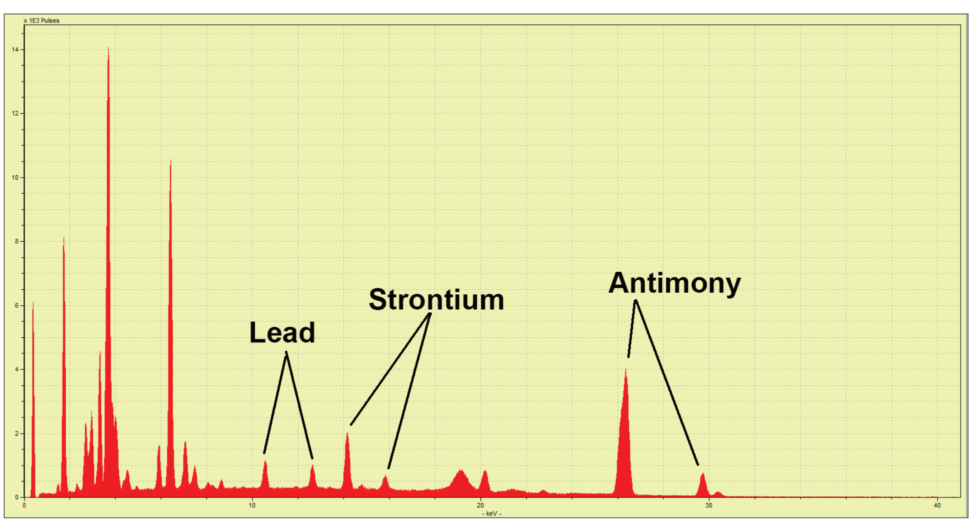

Figure 9.2. pXRF spectra for a Variety 2 white glass bead showing elemental peaks for strontium and antimony. (Image courtesy William Billeck.)

Table 9.2. Color changes through time for small and very small drawn beads from sites in the Knife River and Painted Woods areas of North Dakota (adapted from Ahler and Drybred 1993:Table 21.12). Proportions represent within-period values.

	Ahler and Drybred Color Group																
	Silver/Clear, Gray		White		Brown		Black		Gold/Yellow		Pink/Red		Green		Blue Group		
Period	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	N	Percent	Total
1600-1700	5	15					2	*6*							27	*79*	34
1700-1740/45	25	*52*					3	*6*							20	*42*	48
1740/45-1780	105	*52*	9	*4*			14	*7*					5	*2*	77	*38*	201
1780-1800	49	*33*			3	*2*	20	*13*	3	*2*	12	*8*	5	*3*	57	*38*	149
1780-1845	440	*15*	169	*10*	5		34	*2*	1		25	*1*	16	*1*	1,221	*70*	1,737
1800-1820/30	242	*38*	32	*5*	6	*1*	44	*7*			1		9	*1*	326	*52*	629
1820/30-1886	211	*8*	331	*13*	12		61	*2*	20	*1*	13	*1*	40	*2*	1,810	*70*	2,596

Table 9.3. Ahler and Drybred (1993) glass bead classification system variables correlated with the 2018 Molander bead assemblage.

Ahler and Drybred Variable						
Manufacture	Structure	Shape	Primary Color	Secondary Color	Molander Variety	Molander Count
Drawn	Simple	Tubular	Silver/Clear		1	1
Drawn	Simple	Donut	Silver/Clear		2	12
Drawn	Simple	Donut	Opaque Blue		3, 4	15
Drawn	Simple	Donut	Transparent Blue		5, 6, 7	10
Drawn	Layered	Donut	Opaque red	Transparent green	8	3

Their tables show that silver/clear (correlated here with opaque white beads that have a thin colorless veneer [Varieties 1 and 2]), black, and blue beads are present from the 1600s through 1886, and that white, brown, gold/yellow, and pink/red are present after 1780. Green is present in the assemblages they studied that date to the period after 1740/1745. White beads are listed as present in 1740/1745-1780 contexts, but it is suspected that these beads are either misidentified because small and very small white drawn beads are uncommon in other assemblages in the eighteenth century. The beads may have been misidentified as white because the thin outer colorless veneer can be hard to identified in extensively heat-rounded beads. Brown, gold/yellow, and pink/red bead colors are known to be present before 1780 in other studies and their absence in the Knife River comparisons is likely due to the small sample of beads from before 1780. Blue is the most common color in the assemblages but there is no consistent trend from the seventeenth century to the nineteenth century. Looking at only time periods with a sample of at least 200 beads, the color silver/clear and white varies from 25 to 52 percent of the assemblages, while blue varies from 38 to 70 percent.

There are some broad color patterns that can be compared with the Molander assemblage, which includes 32 percent silver/clear, 7 percent red, and 61 percent blue beads. The small sample of 41 beads from Molander is likely too small to establish a reliable pattern. Molander is most similar to the 1780 to 1800 period based on the presence of silver/clear, red, and blue beads, but lacks black and green beads. The sample sizes of beads from all periods that predate 1800 in table 9.2 are small (34 to 201 beads). The less common colors are likely to be absent due to the low sample sizes, and therefore it cannot be determined how well the Molander bead assemblage matches the 1700-1740/1745 and the 1740/1745-1780 assemblages. The most that can be said is that the colors represented in the Molander bead assemblage are typical for sites dating to the eighteenth century.

Glass Bead Ubiquity

A challenge of using a small assemblage becomes clearer when the presence or absence of bead varieties are examined by provenience. Variety 4 is most numerous by count (n=14), but the beads are concentrated into a small number of provenience lots. Of the ten lots containing glass beads shown in table 9.1, Variety 4 is found in only two (table 9.4). If the proveniences are further combined into the four blocks that have glass beads, Variety 4 occurs in only one. Variety 2 opaque white beads are less common by count (n=12) than Variety 4, but they are found in seven of the ten proveniences containing beads. When the proveniences are further combined, Variety 2 occurs in all four of the block proveniences that have glass beads. Variety 8 consists of just three red on green beads and is a minor component of the assemblage based on count but is common when examined by provenience. Variety 8 occurs in three of the ten proveniences for a ubiquity of 30 percent, and when the proveniences are further reduced to the four blocks Variety 8 occurs in three for a ubiquity of 75 percent. Variety 4 is an example of a bead that appears be an important component of an assemblage based on its high count but has a low ubiquity, while Variety 8, which by count appear to be a minor component of the assemblage has a high ubiquity.

Excavation unit placement also has a great influence of the frequencies of different colors in this assemblage. For instance, Block 3 has 27 beads and 21 of these (78 percent) are blue. Blocks 2, 4, and 5 have a combined total of 14 beads and 21 percent are blue. Beads varieties are not randomly distribution across the site excavations. Why the units differ in the colors represented is difficult to determine. It could be due to the small sample of beads, to the fact that bead use

Table 9.4. Bead ubiquity by provenience. Ssee table 9.1 for overall distribution.

	Assemblage Distribution		Ubiquity Among All Contexts with Glass Beads		Ubiquity within Block 4	
Variety	N	Percent	Present	Percent	Present	Percent
1	1	2.4	1	*10*	1	*25*
2	12	*29.3*	7	*70*	4	*100*
3	1	*2.4*	1	*10*	1	*25*
4	14	*34.1*	2	*20*	1	*25*
5	2	*4.9*	2	*20*	2	*50*
6	6	*14.6*	2	*20*	1	*25*
7	2	*4.9*	2	*20*	2	*50*
8	3	*7.3*	3	*30*	3	*75*

differed by site area, or simply to the random chance of bead loss. A comparison of raw counts of bead varieties and their ubiquity changes the perceptions on the importance of the bead varieties. The small sample size of beads makes variety percentages and ubiquity unreliable fluctuating measures.

Summary

The Molander bead assemblage is difficult to precisely place in time due to the small sample size and low diversity of bead types. White, blue, purple-blue, and red on green are the only colors represented. These are common colors for many years and have limited chronological implications. Small drawn glass beads are the most common glass beads found in eighteenth and nineteenth century glass beads assemblages. All glass beads at Molander are drawn and small sized. In other assemblages, red beads with white cores have been found to date to the 1830s or later, opaque pink beads appear in the nineteenth century, and very small (less than 2 mm in diameter) drawn beads are generally absent in the eighteenth century and are common in the mid-nineteenth century. There are no red-on-white or pink beads, or beads that have a diameter less than 2.0 mm in the Molander assemblage, all suggesting that it does not date to the nineteenth century. Limited evidence points to an eighteenth-century date for the assemblage. Tubular beads tend to be common in the late eighteenth century, and one is present at Molander. The only opacifier used in the white glass beads is calcium antimonate, an opacifier that was used throughout the eighteenth century. In the early nineteenth century either calcium antimonate or lead arsenate was used in white beads. There are no bead types indicative of an assemblage that dates to the first half of the eighteenth century at Molander, but this may not be meaningful because of the small number of beads represented. Overall, the Molander bead assemblage is consistent with an eighteenth-century date.

Trade Metal

All metal artifacts recovered in 2018 were allocated to a single sort class during initial lab processing, including those associated with the site's recent historic component as well as those associated with the Plains Village component. The assemblage was then partitioned into three primary classes, including "recent (post-1880)," "certain trade," and "probable trade." Nominal and metric data collected on each of the three classes are listed in table 9.5.

Several recent Heart region projects have confronted the challenge of separating iron artifacts dating to the American Settlement period from iron artifacts dating to the Plains Village period. The problem was especially acute during the analysis of materials from Scattered Village, where the remains of a Plains Village community had been entirely covered by, and selectively intermixed with, late nineteenth- and twentieth centuries deposits associated with the occupation of the City of Mandan, North Dakota (Ahler 2002b:5.2).

Allocating patterned metal artifacts, such as nails, rings, cartridge cases, food containers, and arrow points, to an age class is generally a straightforward process. More difficult is the allocation of unpatterned artifacts, especially those made from iron. The primary criteria for differentiating between recent iron and trade iron in the Scattered Village assemblage were differences in the thickness and character of an artifact's oxidation rind. Trade iron artifacts commonly exhibit a thick oxidation layer or crust that incorporates bone, sand, charcoal, ash, and other materials. The crust can be several millimeters thick,

Table 9.5. Variables recorded in the analysis of metal artifacts.

Variable		Description
CatNo		**Catalog Number**
Class		**Component Group**
1	Certain trade	
2	Probable trade	
9	Recent (1880-modern)	
Unpat/Pat		**Patternedness**
1	Unpatterned	
2	Patterned	
GenType		**Material and Patternedness**
1	Unpatterned cuprous	
2	Patterned cuprous	
3	Unpatterned ferrous	
4	Patterned ferrous	
5	Lead	
SpecType		**Specific Functional Class**
1	Rolled tube	
2	Pointed rod (probable awl)	
3	Probable knife blade	
4	Rolled cone	
5	Rolled bead	
6	Rolled ring	
7	Arrow point	
8	Rolled hook	
9	Pin or shaft with head	
10	Coil spring	
13	Shaped, function unknown	
14	Wire nail	
15	Cut nail	
16	Other recent	
17	Wire	
Count		**Number of Specimens in Sort Class**
Weight		**Sort Class Weight (to 0.01 g)**
Length		**Patterned Artifact Length (to 0.01 mm)**
Width		**Patterned Artifact Width (to 0.01 mm)**
Thickness		**Patterned Artifact Thickness (to 0.01 mm)**
Comment		**Narrative Description**

effectively obscuring the original shape and surface feature of the artifact. By contrast, comparatively sediment is cemented to recent iron artifacts and portions of the surface may remain intact, even if pitted or friable due to corrosion. Differentiation of unpatterned cuprous (brass or copper) artifacts is generally unproblematic, because traces of the methods used to manipulate the artifact are usually preserved on their surface.

Each of the metal artifacts in the 2018 Molander assemblage were closely examined to assess the extent and character of their oxidation rinds. Encrustations on patterned iron artifacts of known age (including food containers, wire nails, and a projectile point) were used benchmarks. Significant corrosion occurs on some recent patterned artifacts in the collection; however, even those exhibiting adhered sediment nevertheless retain an intact core. By contrast, many pieces of trade iron today consist only of a mass of sediment and other materials held together by an iron oxide matrix (figure 9.3).

Collection Summary

Table 9.6 summaries count and weight data on the 2018 Molander metal assemblage organized by size grade and age class. The assemblage is dominated by artifacts of recent origin: nearly 80 percent by count or weight consist of items associated with the occupation of the homestead. Additional data on these specimens are presented in chapter 10.

The balance of the assemblage includes 42 specimens in the "certain trade" class and 10 specimens in the "probable trade" class. Four are cuprous, while the remainder are ferrous (table 9.7). Four of the trade metal artifacts are classified as patterned and 48 are classified as unpatterned.

Unpatterned Specimens

Examples of unpatterned artifacts in the 2018 Molander assemblage are illustrated in figure 9.3 (artifacts are shown at 1.5X actual size). Unpatterned brass artifacts consist of flat metal of various thicknesses that exhibit chisel-cut or fatigued edges. The specimen illustrated in figure 9.3[A] is 0.40 mm thick and has both fatigued and chisel-cut margins. Two of the three edges are ground, and the surface is irregular and bent. The specimen shown in figure 9.3[B] is flattened, 0.58 to 0.89 mm thick, and exhibits chisel cuts on all five edges. The angle of the cuts suggests that this piece may represent arrow point production scrap.

The ferrous specimens shown in the lower portion of figure 9.3 are representative of the trade iron in the 2018 collection. In some cases, the original shape of the artifact may be partially preserved; figure 9.3[C] shows a roughly rectangular piece that could represent cut scrap. However, most pieces, such as those shown in figure 9.3[D and E] are amorphous and unidentifiable.

Table 9.6. Count and weight data on metal artifacts.

	Count					Weight (g)				
	Size Grade					Size Grade				
Class	G2	G3	G4	G5	Total	G2	G3	G4	G5	Total
Certain Trade		15	24	3	42		8.46	2.59	0.033	11.083
Probable Trade			2	8	10			0.19	0.133	0.323
Recent	3	15	66	101	185	13.19	18.34	5.71	1.136	38.376
Total	3	30	92	112	237	13.19	26.80	8.49	1.302	49.782

Table 9.7. Crosstabulation of general type and size grade for certain and probable trade metal artifacts.

	Size Grade			
General Type	G3	G4	G5	Total
Unpatterned Cuprous	2	1		3
Patterned Cuprous		1		1
Unpatterned Ferrous	12	23	10	45
Patterned Ferrous	1	1	1	3
Total	15	26	11	52

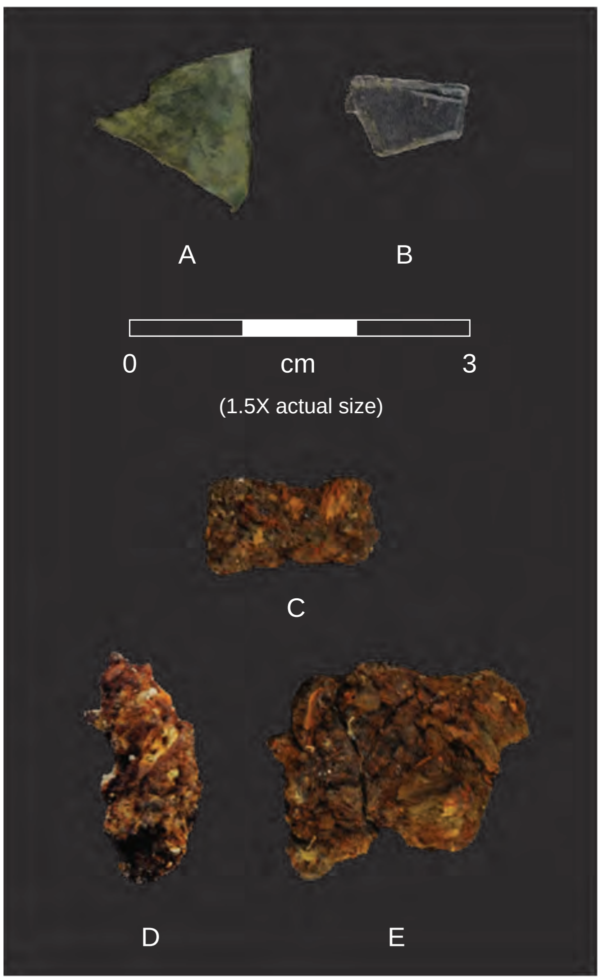

Figure 9.3 Photographs of unpatterned trade metal artifacts.

Patterned Specimens

Four patterned artifacts occur in the 2018 Molander assemblage (table 9.8), including one iron arrow point (figure 9.4[C], one headed pin or nail made from iron (figure 9.4[A]), one thin brass tube or aglet (figure 9.4[B]), and one iron awl tip or pointed rod fragment.

The pointed rod fragment is 6.5 mm long and 1.45 in maximum diameter. Both ends are broken and one end tapers slightly. This specimen is allocated to the probable trade class. Although it exhibits relatively little corrosion or adhering sediment, it was recovered from Block 4 (Unit 9), which yielded only trade metal artifacts and glass beads and lacked other recent historic artifacts such as concrete or bottle glass. However, due to its small size and lack of diagnostic attributes little can be said about the age or function of this specimen.

The iron arrow point is 28.8 mm long and 15.1 mm wide including adhering sediment. The blade is relatively short, and the short stem is straight or slightly contracting; however, the moderately thick oxidation rind makes it difficult to determine whether the proximal end is broken or cut. The Molander specimen is shorter than any of the iron arrow points recovered from Fort Union, and narrower than most (Alhambra 2015:Appendix A).

The headed pin or nail is 17.8 mm long. The shaft is rectangular in cross section and tapers to a point. One face, shown in figure 9.4[A], is wider than the other (3.5 mm compared to 1.5 mm immediately

Table 9.8. Inventory of patterned trade metal artifacts.

Catalog No.	Block	Feature	Level	Metal Type	Artifact Type	Figure Reference
1079	1	F12 (Ditch)	FL1	Brass	Tube (Aglet?)	9.4 [B]
1065	2	F7	FL3	Iron	Nail (?)	9.4 [A]
1031	3	-	GL1 (Unit 9)	Iron	Pointed rod (Awl?)	-
1071	5	-	GL2 (Units 12-13)	Iron	Projectile point	9.4 [C]

Figure 9.4. Photographs of patterned trade metal artifacts. A: iron nail (CN1065); B: brass tube (CN1079); C: iron projectile point (CN1071).

below the head). The oxidation rind obscures facets or other attributes of the head, although it appears to have been roughly circular. Hand-forged nails or brads exhibiting these general characteristics were produced throughout the eighteenth-century (Wells 1998). Machine-cut nails exhibiting similar rectangular shaft cross sections appeared in the late eighteenth-century. Corrosion on the head of the Molander specimen preclude definitive identification of manufacturing technique.

The brass tube or aglet is 14.0 mm long and 1.41 to 1.55 mm in outside diameter. The long edges of the rolled sheet are butted rather than lapped. Both the long and short edges of the sheet were ground before it was rolled. Handmade copper or brass tubes of various lengths and diameters commonly occur in fur trade-era assemblages from Plains Village sites.

Distribution

The 52 pieces of ferrous and cuprous trade metal occur in 21 difference provenience lots spanning all five excavation blocks. A single piece of trade metal occurs in each of 13 lots and the largest number of specimens in a single lot is 14 (CN1065, Feature 7). Twenty-one of the 52 specimens were recovered from general level contexts, while 31 were recovered from feature contexts. However, nearly half of the specimens (n=25) come from Feature 7, a bell-shaped pit located inside House 26 (Block 2). These include the nail shown in figure 9.4[A] and 24 pieces of unpatterned iron, include 11 G3 specimens, 10 G4 specimens, and 3 G5 specimens. Two of the G3 pieces are shown in figure 9.3[C and E].

As is true for the glass bead assemblage, the uneven distribution of trade metal artifacts yields different ubiquity values depending on which context or contexts are examined. However, either glass beads or trade metal artifacts or both occur in 29 of the 90 provenience lots defined in 2018, including at least one lot from each of the five excavation blocks and from eight of the 11 features that were excavated separately. Glass beads or trade metal artifacts were recovered from the earliest Plains Village contexts exposed in 2018 as well as the most recent.

Trade Metal Chronology

The attributes of the small assemblage of patterned metal artifacts recovered in 2018 do not yield bracketing dates for the age of the site's Plains Village component. The brass tube and iron projectile point may date to the eighteenth century, although both could also date to the nineteenth century. Brass tubes of various sizes also occur in late seventeenth-century contexts. If the nail was hand forged, then it likely predates the turn of the nineteenth century. However, corrosion on the nail's head obscures manufacturing traces necessary to identify its method of manufacture.

10

Shell, Leather, and Other Materials

Paul R. Picha, Mark D. Mitchell, and Meagan G. Schoenfelder

This chapter presents data on two broad categories of materials: those that are comparatively rare or unique and those that are widespread and abundant. Detailed data are presented on leather and shell specimens as well as on selected materials assigned to the "Miscellaneous Plains Village" artifact group. Summary or limited data are presented on widely occurring materials and artifacts as well as on naturally occurring materials.

Paul R. Picha, PCRG Research Affiliate and former Chief Archaeologist for the State Historical Society of North Dakota, analyzed the shell remains and wrote the section of the chapter describing them. Leather specimens were analyzed by Meagan Schoenfelder, Archaeology Collections Assistant for the State Historical Society of North Dakota. Other artifact classes were quantified by PCRG's student lab assistants, including Frank Delaney, Kelly Dunlap, Connor Fisher, Karissa Gonzales, Reagan Herdt, Ariana Jones, Maddison King, and Sarah Montoya. PCRG Research Director Mark Mitchell compiled the data and wrote the balance of the chapter.

Shell and Other Fossil Remains

The molluscan and fossil aggregate from the 2018 Molander investigation comprises five classes: (1) freshwater bivalve (unmodified and modified), (2) univalve and bivalve (sub-fossil), (3) fossil pill clam, (4) fossil snail, and (5) other fossil (crinoid stem) remains. Each shell or fossil class is described and analyzed, and a comparative summary discussion of the Molander assemblage

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concludes the section. Analysis and reporting standards follow those found in Picha and others (2014). A comparative molluscan collection housed at the State Historical Society of North Dakota and accompanying identification guides (e.g. Thompson 1982) were consulted.

Freshwater Bivalve Shell

Unmodified freshwater bivalve shell was recovered from 11 proveniences. A total of 18 G2 or G3 fragments weighing 10.1 g is recorded. Most specimens are fragmented. One valve ventral edge and one ligament portion are recognized as present. The lack of diagnostic landmarks (such as beak or umbo portions) precludes further taxonomic identification. Based on relative thicknesses, both common thick- and thin-shelled bivalve taxa (*Lampsilis* and *Pyganodon* spp.) are postulated to occur in the samples (Picha and Falk 2015). Burning was recorded on three specimens from CN1055, a provenience lot representing mixed fill from multiple features in Block 3 (see table 2.8).

A possibly modified bivalve is represented by one G3 piece in Block 1, Unit 1 (CN1001) (figure 10.1). The specimen exhibits a rounded edge margin with the exterior surface being scoured—the periostracum having been removed and the underlying prismatic layer exposed. The piece is 21.3 mm long, 19.6 mm wide, and 1.1 mm thick and weighs 0.6 g. A pendant or decorative item is thought to be represented by the piece. Similar modification is seen on a shell pendant from Taylor Bluff (32ME366) (Picha 1988:Figure 41a). Two additional examples that exhibit this treatment also have been noted in a sample from Awatixa (Sakakawea) Village (32ME11) (Picha In prep.).

Univalve and Bivalve (Sub-fossil) Shell

Univalve (or sub-fossil) snails are represented by six G4 or G5 specimens from five proveniences in Blocks 3 and 4 (CN1025, 1036, 1051, 1064, and 1069). Snails all exhibit a conispiral form. These terrestrial or land snails are natural inclusions and would be attracted to organic matter derived from use of the earthlodge-related features and their contents at the site.

A single G4 pill clam occurs in Feature 7 in Block 2 (CN1057). In contrast to the fossil clams discussed in the next section, this specimen lacks the chalky appearance characteristic of this class of shell. The specimen may have been introduced by fish or avian hosts to the Molander deposits (see chapter 6).

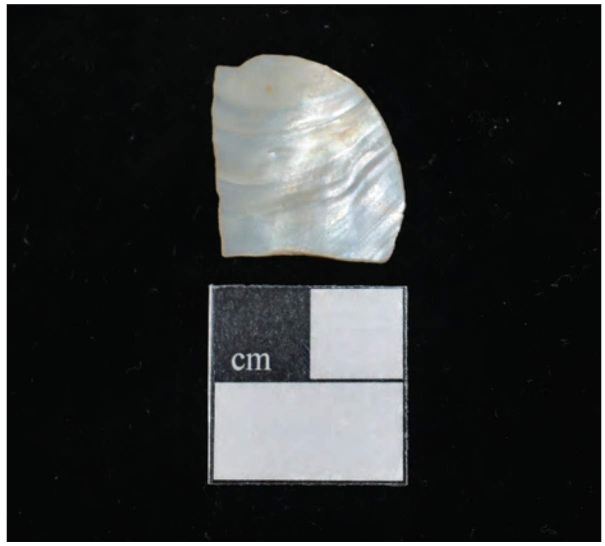

Figure 10.1. Photograph of a possible freshwater bivalve pendant preform (CN1001). (Photograph courtesy the State Historical Society of North Dakota.)

Fossil Pill Clam Shell

Four very small (G4 or G5) fossil pill clams occur in four proveniences in Block 1 and Block 3 (CN1014, 1020, 1059, and 1079). These specimens are thought to be natural inclusions in the site sediments at Molander Village.

Fossil Snail Shell

Fossil snail shell occurs in three proveniences in Block 1 and Block 3 (CN1002, 1015, and 1064). A total of six G3 or G4 pieces of gastropod whorl scrap weighing 0.5 g are present. Viviparid fossil gastropods or snails of *Campeloma*, *Lioplacodes*, and *Viviparus* spp. occur in Plains Village shell aggregates (Picha 1988; Picha *et al.* 2014). Local outcrops of Late Cretaceous strata are the source of fossil gastropods collected by the villagers in some frequency and these were likely intended for ornamental or decorative purposes.

In addition, one very small (G4) fossil gastropod occurs in Block 1, Unit 1 (CN1001). This specimen, along with the previously mentioned fossil pill clams, is thought to be a natural inclusion in the site deposits. Varying frequencies of these shells are reported from Menoken Village (32BL2) and other Knife and Heart region villages where waterscreen recovery has been routinely used (Picha 2003).

Other Fossil

Six G5 crinoid stem segments occur in four proveniences in Block 1 and Block 5 (CN1052, 1060, 1071, and 1090). One specimen from Block 1, Unit 11 (CN1052) appears to be burned. (Crinoid stem fragments also occur along with glass beads in several other provenience lots analyzed by the Smithsonian Institution; two examples are illustrated in figure 9.1. An additional specimen occurs in CN1020.)

These fossil remains are thought to be from the central stem core (Thompson 1982:694-695, Plates 323 and 342). Figure 10.2 illustrates a larger fossil crinoid segment for comparative purposes. These items are conjectured to be natural inclusions derived from local limestone-formation deposits akin to the fossil snail location sources alluded to previously.

Summary

In sum, the Molander aggregate hastens the call for larger samples of invertebrate and vertebrate fauna from controlled excavations at Hidatsa villages in the Knife and Heart regions that will aid in clarifying cultural-tradition specific subsistence strategies of the respective groups (Picha and Falk 2015). Freshwater mussels at Molander are poorly represented in the collections compared with other village samples studied in the Knife and Heart regions. Likewise, fossil gastropods (snail shells or whorl scrap) also are not as well represented in the shell aggregate as reported at some of the downriver villages. It is presently unknown if this finding is the result of sampling vagaries or if it reflects a significant trend in molluscan data through space and time.

Figure 10.2. Photograph of a fossil crinoid stem. (Specimen courtesy of the North Dakota Geological Survey; photograph courtesy of the State Historical Society of North Dakota.)

Leather Artifacts

A G2 sample of thin, pliable, and fibrous organic material recovered from Feature 7 in Block 2 (FL4, CN1067) was sent to Meagan Schoenfelder at the State Historical Society of North Dakota for identification (figure 10.3). Subsequently, a G3 piece of the same material was identified in the same provenience lot.

PCRG lab staff initially judged the specimen to be a fragment of a wool garment due primarily to its fibrous character and pliability. However, Schoenfelder and Jenny Yearous, the Curator of Collections Management for the SHSND Audience Engagement and Museum Division, determined that it is a fragment of leather. Using a high-power metallurgical microscope, the SHSND team observed differences between wool filaments, which are scaly, and the constituent fibers of the Molander specimen, which are smooth and wrinkled (figure 10.4). Schoenfelder also identified other leather artifacts with a similar fibrous appearance (e.g. Explore York 2018). Schoenfelder's research further suggested that the fibrous appearance of the Molander specimen could be due in part to the effects of red rot or a similar deterioration process.

Leather artifacts have been recovered from Plains Village sites in both the Knife and Heart regions. Specimens from Double Ditch Village identified as leather are thin, smooth, and wrinkled, rather than fibrous (figure 10.5). Specimens identified as leather were also recovered from Big Hidatsa Village (Ahler and Swenson 1985a:236) and Taylor Bluff Village (Picha 1988:296). Samples from those two sites are not described in detail or illustrated; however, Paul Picha recalls that some of the Taylor Bluff specimens were also fibrous rather than smooth (Paul Picha, personal communication to Schoenfelder, 2018). The difference between the Double Ditch specimens and the specimens from Molander could be due to the fact that the latter specimens were tanned (leather), while the former were untanned (rawhide).

One face of the Molander specimen bears six or seven parallel dark stripes or lines (figure 10.6). These linear markings are not visible on the reverse face, nor are they present on the G3 specimen from the same context. Schoenfelder regards them as decorative, suggesting that the Molander specimen represents a fragment of a garment or decorated leather object.

Figure 10.3. Photograph of a leather artifact from Feature 7. (Photograph courtesy of the State Historical Society of North Dakota.)

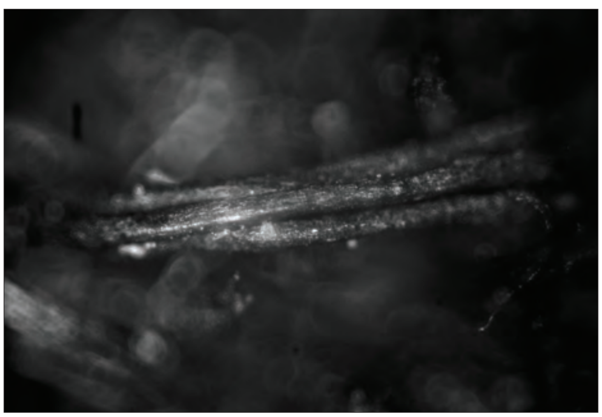

Figure 10.4. Photograph of individual fibers comprising the Molander leather artifact at 200X actual size. (Photograph courtesy the State Historical Society of North Dakota.)

Burned Materials

Each of the four primary classes of burned material—charcoal, ash, fire-cracked rock, and burned earth—occur in each of the five excavation blocks but are unevenly distributed (table 10.1). Within most blocks, these materials are more abundant in feature levels than they are in general levels. They also are unevenly distributed among blocks. For example, 95 percent by weight of the cemented ash derives from feature levels in Block 4. Similarly, feature levels in Block 3 produced 66 percent of the burned earth and 36 percent of the fire-cracked rock.

Differences in the abundance of different burned materials in part reflect differences in feature function. For example, the Feature 4 hearth produced almost

Table 10.1. Weights in grams of widely occurring burned materials, organized by block and level type.

	Material Class							
	Burned Earth		Ash		Charcoal		Fire-Cracked Rock[a]	
Block	GL	FL	GL	FL	GL	FL	GL	FL
1	3.4		4.1	2.8	0.6	2.1	5,057	2,805
2			12.5	12.6	2.1	32.2	1,977	41,388
3		30.8	2.5	55.6	1.3	88.5	299	55,971
4		11.1	14.8	5,068.9	2.4	17.5	699	776
5	1.2		146.1	4.6	3.8	79.0	17,204	30,929
Total	4.6	41.9	180.0	5,144.6	10.2	219.3	25,236	131,869

[a] Excludes samples assigned to the "pre-Plains Village" analytic unit; see discussion in the "Natural Rock" section.

Figure 10.5. Photograph of leather artifacts from Mound G at Double Ditch Village (32BL8). (Photograph courtesy the State Historical Society of North Dakota.)

Figure 10.6. Detail photograph of dark stripes on one face of leather artifact from Molander. (Photograph courtesy the State Historical Society of North Dakota.)

80 percent of the ash, but less than 0.1 percent of the fire-cracked rock. By contrast, the Feature 10 hearth produced 16 percent of the fire-cracked rock, but less than 0.1 percent of the ash. Feature 4 is interpreted as a large outdoor hearth, which likely was used for a variety of purposes. Feature 10 was a shallow basin located inside an earthlodge. Its purpose is unknown, but it could have been used to store or discard heated stones.

In some cases, concentrations of burned materials represent secondary deposits resulting from hearth cleaning. Concentrations of fire-cracked rock occur in Feature 7 in Block 2 and Feature 9 in Block 3, even though both are classified as cache pits. The concentration of fire-cracked rock and ash in Feature 9 represent the partial remains of a single dismantled central hearth. Numerous tabular hearth perimeter stones exhibiting smoothing wear on one edge but not on the opposite edge occur in the fill. The morphology of the perimeter stones indicate that they derive from a slab lined hearth similar in design to those associated with the Sahnish (Arikara) component at Fort Clark State Historic Site (nuuneesawatuuNU) (Mitchell and Wiewel 2014).

Miscellaneous Plains Village Artifacts

This group of artifacts includes notable or unusual items that do not fit into one of the major sorting classes. Specimens in this group were examined closely and assigned to one of about 55 possible subclasses. The most common subclasses are pieces of shaped, fired clay as well as fired and unfired materials related to pottery production, including crushed temper and unfired potting clay or sherds. Other Miscellaneous Plains Village subclasses include wooden artifacts, coprolites, eggshells, plaster, unknown minerals, and other rare materials.

Fired Clay

Three types of unshaped fired clay were identified in the 2018 Molander collection (figure 10.7). One type consists of amorphous masses of fired fine-grained sediment lacking obvious impressions of grass, twigs, bark or other organic materials. This type commonly occurs in all northern Middle Missouri Plains Village collections.

A second type in the Molander collection consists of thin tabular pieces or sheets of fired clay that are relatively featureless on one face and exhibit one or more impressions of branches, grasses, leaves, or other organic materials on the opposite face. In some cases, the smooth face entirely lacks impressions while in other cases striations, fingerprints, or other features indicative of smoothing or compaction are present on the smooth face. Some pieces allocated to this type

Figure 10.7. Photographs of three types of fired clay specimens.

are less than 1 mm thick, while others are 2 or 3 mm thick. The difference in the character of the two faces suggests that the clay was wet or plastic when it was applied to a wooden or organic framework or object. Fragments of clay bearing impressions of sticks, logs, or boards on one face commonly are classified as "daub" or "plaster" (Picha *et al*. 2014). However, those terms imply an architectural application. The relative thinness of the Molander specimens, and the small sizes of impressed sticks, indicate that they were applied to a portable artifact or lightly built non-portable feature. This type of fired clay object has not previously been recognized in the northern Middle Missouri.

The third type of fired clay, which also has not previously been recognized, consists of irregular, and frequently angular, pieces of fired clay that exhibit multiple impressions of grass, bark, or twigs. Specimens in this class generally lack an obvious exterior (smoothed or compacted) surface, in contrast to specimens of the second type. This third type of fired clay may have been packed inside or around a framework or object of some sort, such as a screen or cover made from bent or woven branches.

Table 10.2 tallies counts and weights of fired clay specimens according to excavation block and specimen type. The three types clearly co-occur: together Blocks 3 and 4 produced 93 percent of the amorphous pieces, 86 percent of the tabular pieces, and 83 percent of the irregular pieces. By contrast, relatively few pieces of each type were recovered from Blocks 1, 2, and 5. This suggests that all three types are associated with the same type of object or feature.

Two features produced most of the fired clay pieces, including Feature 4 in Block 4 and Feature 9 in Block 3 (table 10.3). (Fired clay is also abundant in mixed samples from Features 5 and 9; see table 2.8). Feature 4 is interpreted as a large extramural hearth, while Feature 9 is interpreted as a cache pit. However, as noted in the previous section, the fill of Feature 9 included the remains of a dismantled central hearth. This suggests that the fired clay pieces were associated in some way with large hearth features, whether indoor or outdoor. The clay pieces may represent fragments of a covering material applied to a screen, rack, or stand made from small-diameter sticks, grass, and other organic materials that was constructed adjacent to, and likely used in conjunction with, the hearths.

Shaped Fired Clay

Two pieces of shaped fired clay are present in the collection. One is a sphere with several flattened faces that was recovered from beneath the ditch spoil in Unit 4 (Block 1). The other is a smoothed, curved piece with one broken edge that was recovered from the fill of Feature 9 (Block 3). This specimen may have

Table 10.2. Counts and weights in grams of fired clay objects, organized by morphological category and excavation block. Examples of the morphological categories are illustrated in figure 10.7.

	Fired Clay Category							
	Amorphous without Impressions (Type 1)		Thin Sheet with Organic Impressions on One Face (Type 2)		Irregular/Angular with Organic Impressions (Type 3)		Total	
Block	Count	Weight	Count	Weight	Count	Weight	Count	Weight
1	7	1.5	12	2.2	4	2.3	23	6.0
2	7	1.4	1	0.3	5	0.8	13	2.5
3	101	39.9	105	13.5	56	18.2	262	71.6
4	73	28.6	71	14.6	50	16.3	194	59.5
5	12	2.1	10	2.1	10	3.9	32	8.0
Total	200	73.5	199	32.7	125	41.5	524	147.7

Table 10.3. Weights in grams of fired clay objects organized by context and morphological class. Contexts are sorted by block.

		Fired Clay Categories		
Context	Block	Amorphous without Impressions	Thin Sheet with Organic Impressions on One Face	Irregular/Angular with Organic Impressions
All General Levels	All	8.9	6.5	10.5
Feature 12 (Ditch)	1	0.5	0.7	-
Feature 7 (Cache Pit	2	0.6	-	0.3
Feature 5 (Cache Pit)	3	13.7	2.6	9.0
Feature 9 (Cache Pit)	3	25.1	10.5	8.3
Feature 3 (Basin Pit)	4	6.0	0.7	1.6
Feature 4 (Hearth)	4	12.0	6.8	8.7
Feature 6 (Cache Pit)	4	5.7	4.3	2.9
Feature 11 (Cache Pit)	5	1.0	0.7	0.2
Total		73.5	32.7	41.5

been part of a larger clay object such as an animal figurine.

Bark and Wood

Numerous uncharred fragments of cottonwood bark were recovered from Feature 7 in Block 2 and Feature 11 in Block 5 (table 10.4). Abundant bark fragments were also observed during the analysis of botanical specimens from those contexts, as were numerous uncharred seeds and other plant parts (see chapter 8). All G1 and G2 bark specimens were carefully examined for modifications but none were observed. The bark pieces from both pits likely represent the remains of an organic lining installed to protect the pits' contents from moisture.

The collection also includes a small number of branches. One from Feature 7 is about 1.5 cm in diameter and consists of five pieces that together measure about 33 cm long. A single chop mark, possibly made with a metal tool, is present on one of the five pieces.

Table 10.4. Weights in grams of unburned cottonwood bark and wood specimens, organized by excavation context and sorted by block.

Context	Block	Weight
General Level Samples	All	4.1
Feature 12 (Ditch)	1	0.6
Feature 7 (Cache Pit)	2	324.3
Feature 5 (Pit)	3	0.6
Feature 9 (Cache Pit)	3	3.9
Feature 10 (Basin)	5	0.2
Feature 11 (Cache Pit)	5	227.3
Total		561.0

Other Miscellaneous Plains Village Specimens

The 2018 Molander collection includes a single G3 eggshell fragment (from Block 1, Unit 7), a G1 mass of folded or knotted unidentified vegetal material or bark (from Feature 7 in Block 2), and multiple G4 and G5 pieces of unidentified material (from Feature 11 in Block 5). Conspicuously absent from the collection are specimens related to pottery production. No samples of crushed temper, potter's clay, or unfired sherds were recovered. Also absent are wooden artifact fragments, despite generally good preservation of uncharred organic materials; unmodified pieces of cottonwood bark are discussed in the previous section.

Ochre and Pigment

Provenience lots assigned to the Plains Village analytic unit contained a total of 85 grams of ochre or pigment pieces (table 10.5). Nearly two-thirds of that total was recovered from Block 1. Pieces of hematite, or red ochre, comprise about one-fifth of the total by weight, while limonite or yellow ochre pieces comprise about one-third (table 10.6). The balance, amounting to half of the collection, is comprise of other mineral pigments ranging in color from white to buff to pink.

Provenience lots assigned to the pre-Plains Village analytic unit contained an additional 27.6 g of ochre and pigment, 98 percent of which was recovered from the ditch spoil in Units 1 and 4 (GL2 and GL3). These specimens likely represent naturally-occurring clay minerals entrained in Coleharbor Formation deposits, rather than archaeological materials.

Table 10.5. Weight in grams of ochre specimens from contexts assigned to the Plains Village analytic unit, organized by excavation block and size grade.

	Size Grade			
Block	G2	G3	G4	Total
1	10.4	35.8	8.9	55.1
2		2.5	1.5	4.0
3	9.6	2.3	4.5	16.4
4		0.5	1.1	1.6
5	2.7	3.2	2.1	8.0
Total	22.7	44.4	18.0	85.0

Table 10.6. Proportional weight distributions of ochre specimens from contexts assigned to the Plains Village analytic unit among three color classes, organized by size grade.

	Size Grade			
Color	G2	G3	G4	Total
Red	*21.1*	*10.6*	*31.9*	*18.6*
Yellow	*10.2*	*54.7*	*22.1*	*31.3*
Other	*68.6*	*34.7*	*46.0*	*50.0*
Total	*100.0*	*100.0*	*100.0*	*100.0*

Unmodified Clinker

Thirty-seven pieces of unmodified clinker weighing just over 40 grams occur in the 2018 Molander collection (table 10.7). Although most abundant in Block 1, unmodified clinker specimens occur in all five excavation blocks. While grooves, ground facets, or other modifications were not observed on these objects, it is likely that most represent fragments of clinker tools rather than naturally occurring nodules.

Recent Historic Artifacts

Table 10.8 tallies the recent historic artifacts in the 2018 Molander collection. Included are metal artifacts assigned to the "Recent (post-1880)" class (see table 9.6). Recent historic artifacts are highly unevenly distributed among the five excavation blocks. Specimens allocated to all twelve of the identified material types occur in Block 1. Block 2 produced specimens allocated to six types. Just three types occurred in Block 5 and two types occurred in Block 4. No recent historic artifacts were recovered from Block 3. Excluding pieces of concrete, which together comprise 75 percent of the assemblage by weight, almost 90 percent of the assemblage was recovered from Block 1.

Many of the bottle specimens were recovered from a single provenience lot (CN1060; Unit 14, GL2) and appear to represent a single colorless glass bottle likely dating to the early twentieth century (Horn 2005). Other bottle glass specimens likely represent fragments of a brown glass patent medicine bottle. The surfaces of the fragments have partially desilicified and exhibit an iridescent patina. However, no fragments bearing temporally diagnostic attributes occur in the collection.

Patterned recent metal artifacts include both wire and machine-cut nails, a fence staple, pieces of baling wire, fragments of sanitary cans, a possible fragment of a hole-in-cap or hole-in-top can, and a paper and brass shotgun cartridge fragment. Other recent metal artifacts include small brads or shoe nails, a possible steel shotgun pellet, and unidentified iron scrap. By count, sanitary can fragments and pieces of wire are the most abundant.

Table 10.7. Counts and weights of unmodified clinker specimens, organized by excavation block and size grade.

	Counts				Weights (g)			
	Size Grade				Size Grade			
Block	G1	G2	G3	Total	G1	G2	G3	Total
1		3	8	11		8.2	4.2	12.4
2		2	7	9		6.7	2.3	9.0
3		1	4	5		3.2	0.8	4.0
4	1		7	8	10.9		2.6	13.5
5			4	4			1.5	1.5
Total	1	6	30	37	10.9	18.1	11.4	40.4

Table 10.8. Weights in grams of recent historic artifacts, organized by artifact material class and excavation block.

	Excavation Block					
Material Class	1	2	3	4	5	Total
Bottle Glass	227.2	1.6				228.8
Window Glass	0.9	0.2				1.1
Unidentified Glass	15.2	31.7		<0.1		46.9
Ceramic	0.7					0.7
Plaster (?)	<0.1					<0.1
Coal	0.7					0.7
Slag	0.3					0.3
Rubberized Fabric	6.2				1.6	7.8
Concrete	132.8	804.6				937.4
Patterned Cuprous Metal	7.6					7.6
Unpatterned Ferrous Metal	6.1	1.5		1.1	0.7	9.4
Patterned Ferrous Metal	15.5	0.9			5.0	21.4
Total	413.2	840.5	-	1.1	7.3	1,262.1

Architectural elements include fragments of window glass and pieces of concrete. The concrete is mostly amorphous and relatively friable. The incorporated aggregate consists of coarse sand and sparse subrounded pebbles. Few pieces preserve form impressions.

Other recent historic artifacts include pieces of coal and slag, fragments of rubber-coated fabric, and a fragment of a glazed whiteware cup or bowl.

The density of recent historic artifacts observed within and around the homestead features (especially Feature 2 and adjacent to Feature 1 [see figure 2.13]) was higher than the density of artifacts recovered from Block 1 during the 2018 field investigation. The assemblage directly associated with the homestead features was also more varied than the excavated assemblage. These observations suggest that the materials observed during 2018 reflect a general scatter of artifacts, rather than focused dumping. Feature 7, a likely homestead-era dump or possibly a privy pit, is located approximately 20 m east-southeast of Block 1.

The 2018 assemblage comprises specimens that either certainly or probably date to the period between the early 1880s and the late 1930s. Most appear to post-date 1900. The collection does not include artifacts that definitely post-date SHSND acquisition of the property.

Natural Rock

Owing to the shallow depth of till (Coleharbor Formation) deposits at Molander, the 2018 collection included a large amount of natural rock (table 10.9). Natural rock was a major component sorted of all coarse fraction (G1-G3) samples and constitutes

Table 10.9. Weights in grams of natural rock and unsorted residue samples, organized by excavation block and size grade.

		Size Grade					
Material Class	Block	G1	G2	G3	G4	G5	Total
Natural Rock	1	188,023	57,278	64,505			309,806
	2	10,601	3,432	3,830			17,863
	3	2,044	1,225	1,314			4,583
	4	2,177	2,047	3,045			7,269
	5	1,689	1,916	3,845			7,450
Subtotal		204,534	65,898	76,539			346,971
Unsorted Residue	1				49,354	26,956	76,310
	2				6,814	6,124	12,938
	3				5,330	7,003	12,333
	4				4,439	3,538	7,977
	5				10,727	10,128	20,855
Subtotal					76,664	53,749	130,413

a majority by weight of fine fraction (G4 and G5) unsorted residue samples. A wide variety of lithologies and clast sizes are present, reflecting the glacial origin of the material. Clasts of locally occurring rock (derived from the Cannonball, Slope, and Bullion Creek formations) are present, but constitute only a fraction of the total natural rock aggregate.

Natural rock is far more abundant at Molander than at any other Heart or Knife region Plains Village site. A total of approximately 140 kg of natural rock was sorted from coarse fraction samples assigned to the Plains Village analytic unit, yielding a weight density of 27 g/liter. (If pre-Plains Village provenience lots are included, the overall density is 67 g/liter.). By comparison, the density of natural rock at Chief Looking's Village is 0.17 g/liter. Values for other Knife or Heart region Plains Village sites range from 0.2 g/liter at Larson Village to 0.57 g/liter at Boley Village to 5 g/liter at Fort Clark. Thus, the density at Molander is between 5.4 and 158.8 times greater than the density at other recently investigate sites.

About 30 percent of the natural rock encountered during the excavation was quantified in the field and reburied when the excavation units were backfilled. All of that material was recovered from the ditch spoil deposits in Units 1 and 4 (Block 1). The remainder of the coarse fraction natural rock was returned to PCRG's Broomfield, Colorado lab for processing. The largest specimens (G1 and G2) returned to the lab were individually inspected to confirm that they were not modified. All coarse fraction natural rock samples were subsequently discarded.

Approximately 2.6 percent by weight of the specimens allocated to the fire-cracked rock sort class (4.2 kg) was recovered from Block 1 contexts assigned to the pre-Plains Village analytic unit. It is likely that those specimens, which came primarily from ditch spoil levels in Units 1 and 4, represent decomposing natural rock rather than fire cracked rock. Those specimens are retained in the collection but are not reported in table 10.1.

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Summary

Mark D. Mitchell

The Molander site (32OL7) consists of two Plains Village settlements and an American Settlement-era homestead. The site is located on the right bank of the Missouri River, near the southern end of the Knife River archaeological region, a section of the Missouri that runs from the mouth of the Knife River downstream to Square Buttes. The larger of Molander's two Plains Village settlements is a fortified earthlodge community covering about 2.1 ha (5.2 acres) of the river's T3 terrace, roughly 20 m above the modern channel of the Missouri. The recent historic homestead is superimposed on the eastern third of the fortified village. Both the fortified community and the homestead, which are the focus of this report, were purchased by the state of North Dakota in 1935 and are managed by the State Historical Society of North Dakota (SHSND) as Molander Indian Village State Historic Site. The property is listed on the North Dakota State Historical Site Registry and is eligible for inclusion on the National Register of Historic Places.

The smaller of the two Plains Village settlements comprising the site is an apparently unfortified community located on the T2 terrace. Apart from its approximate extent, nothing is known about the age or layout of the lower settlement, which is privately owned.

Over the course of 12 days in August 2018, Paleocultural Research Group (PCRG) in cooperation with Oklahoma State University and the SHSND conducted an archaeological and geophysical field investigation at Molander Indian Village State Historic Site. The work built directly on the results of geophysical surveys, photogrammetric mapping, and hand coring

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undertaken in 2017 by the University of Arkansas's Archeo-Imaging Lab, PCRG, and the SHSND. The primary goals of the project were to achieve a better understanding of Molander's place in the regional cultural landscape and to answer specific questions about the settlement's age and occupation history, its architectural features and overall layout, and its current condition.

The 2018 project's 31 participants opened 16 1 x 1-m excavation squares grouped into five blocks, in the process screening 6.2 m^2 of sediment and exposing 15 cultural features. The crew also extracted 78 soil cores and conducted geophysical surveys covering 0.56 ha (1.4 acres). The project investigated the site's encircling fortification ditch, sampled storage pits and other features inside two earthlodge depressions, and exposed two sets of superimposed hearths and pits located between earthlodges. The resulting collection consisting of 89 provenience lots includes roughly 2,700 flakes, 150 stone tools, 7,300 pottery sherds, and 30 kg of vertebrate faunal remains, along with a wide variety of other artifacts and materials.

Post-Occupation Impacts and Current Condition

The construction of the American Settlement-era homestead on the eastern third of the fortified Plains Village settlement, coupled with the subsequent activities of the homestead's residents, have had the most significant impacts on Molander's archaeological deposits. T.H. Lewis's 1883 map shows the locations of two structures within the fortification ditch, including a "modern house" and a stable. At least two additional structures had been put up prior to 1924, either by Albert Hanson, the original homesteader, or by Gustav Molander, who acquired the property in 1898 (Will 1924:Figure 4).

Archaeological inventory data collected in 2017 identified six features associated with the homestead, including three structure foundations and three trash-filled pits. The homestead's primary residence (Historical Feature 1) appears to have incorporated a root cellar or subfloor storage space. The floor of a barn or stable complex documented in 2017 (Historical Features 4 and 5) was created by slope leveling. Construction of these structures and associated pits undoubtedly disturbed village-age archaeological deposits. In addition, a scatter of metal and glass artifacts associated with the homestead blankets about one-third of the fortified settlement. Dipolar magnetic anomalies created by recent metal artifacts significantly affect the interpretation of geophysical survey data in that area.

Although the effects of the homestead were most severe on the eastern end of the fortified site, the more extensive—and arguably more important—effects were caused by plowing. George Will noted in 1924 that the lower settlement (located on the T2 terrace east of the railroad right-of-way) had been extensively plowed (Will 1924:317). The map he produced at the time indicates that about one-third of the fortified upper settlement had been plowed, although he nevertheless regarded the site's overall condition as "excellent" (Will 1924:Figure 4, 317). Will did not quantify the extent of plowing during his 1944 visit to the site, roughly a decade after the state of North Dakota purchased the upper settlement. However, he did note that at least a portion still consisted of "unbroken ground" (Will and Hecker 1944:107).

Topographic and magnetic data acquired in 2017 suggest that somewhat more than half of the fortified village was under cultivation at one time or another. However, those datasets also confirm that plowing was confined to the interior of the fortification ditch, perhaps because the ditch was too deep to be traversed by the horse-drawn moldboard plows commonly in use during the late nineteenth and twentieth centuries.

Subsurface data provided by excavation and hand coring offer additional insights on the effects of plowing at Molander. Coring data on six hearths or probable hearths indicates that 18 to 30 cm of sediment accumulated on the features after they were no longer in use. Moldboard plows generally produced a plowzone up to about 30 cm thick. Thus, the depth of the plowzone is roughly comparable to the current depths of earthlodge floors or exterior work surfaces, suggesting that the effects of plowing on the tops of features or floor surfaces is likely to be spotty. In some places plowing likely damaged buried occupation surfaces but in others did not. The greatest impacts likely occurred in areas where aeolian erosion removed surface sediment after plowing initially broke the sod.

A homogeneous near-surface stratum was observed in all five excavation blocks. However, only Blocks 4 and 5 were located within the plowed area as defined by magnetic and microtopographic features and only in Block 4 was an obvious plowzone (Ap horizon) observed. In that case, the plowzone was 20 to 25 cm thick and the contact between that layer and the underlying cultural deposits was abrupt. Block 4 exposed an extramural work area. A thin but intact surface burn occurred immediately below the plowzone, suggesting that deposits contemporaneous with the village were largely intact in Block 4. Block 5 also exposed a homogenous near-surface stratum. However, that layer was just 10 to 12 cm thick and the characteristics of its upper and lower boundaries suggested that it was not produced by plowing.

The test excavations also provided data on the effects of animal burrowing on the site's deposits. Although a plowzone was not observed in Blocks 1 and 2, a variety of recent historical (post-1880) artifacts were recovered from general level contexts in both. The activities of northern pocket gophers, the most common burrowing mammal species in the region, are likely responsible for the burial of recent historical artifacts. Numerous gopher-sized krotovina were observed in all general level deposits in all blocks. The site's modern surface exhibits a nearly continuous distribution of pocket gopher backdirt piles. However, very little evidence of active burrowing was observed in 2017 or 2018. This suggests that the size of the gopher population has varied over time. The period of maximum animal population likely predates the late 1990s, based on a brief assessment of aerial imagery available on Google Earth.

The effects of rodent burrowing are complex and not fully understood but one common result of prolonged rodent activity is the formation of a homogenized layer of sediment known as a "biomantle" that extends to the depth of the animal's feeding tunnels, which generally occur between 10 and 30 cm below the surface (Mitchell and Sturdevant In Press). In Block 2 and in Block 5, the depths of the upper earthlodge floors observed in 2018 (which are described later in this chapter) were by chance nearly coincident with the lower limit of the biomantle. As a result, only limited patches of the upper floors were preserved. The lower floors, which were 8 to 10 cm deeper than the upper floors, were also impacted by burrowing but to a lesser extent.

The preservation of animal bones and uncharred botanical remains is notably good at Molander. This is due in part to the site's relatively young age, but perhaps also to the absence of near surface groundwater. The fact that spring channels are deeply incised into the upper surface of the T3 terrace means that the local water table is well below the site, a circumstance that has prevented ponding of water within the site boundary.

The most significant factors that have damaged or destroyed many archaeological sites in the Knife region, including road and railroad construction, gravel mining, and riverbank erosion, have had little or no effect on Molander. Apart from limited aeolian erosion due to plowing, surface erosion at Molander is limited. As a result—and notwithstanding the effects of plowing and burrowing animals—Molander remains among the best-preserved Plains Village settlements in the region. Preservation of the settlement's defensive system is especially good; in fact, along with fortifications at the Huff site in Morton County and at Menoken Village in Burleigh County, Molander's fortification ditch is probably the most complete and well preserved in the northern Middle Missouri.

Lehmer and others (1978:434) cast some doubt on the topographic integrity of Molander's defensive ditch. Pointing to the striking contrast between the "muted" character of the site's earthlodge depressions and the comparative clarity and prominence of the ditch, they suggest that that contrast reflects modifications made to the ditch by workers who fenced the site when it was purchased by the SHSND in 1935. As noted previously, that contrast is due largely to the fact that plowing did not occur within (or outside) the ditch but did occur inside. Direct evidence that the ditch was not modified in the twentieth century is provided by T.H. Lewis's (1883) observation that the ditch was "4 to 5 ½ ft deep" at the time of his visit. Today the ditch is essentially the same depth; if it had been modified in some way it would be deeper now than it was 140 years ago. Excavation data obtained in 2018 further confirms the integrity of the ditch's fill deposits, as well as the antiquity of the spoil bank thrown outside the ditch.

Site Age and Occupation History

At least three archaeological components are present on the T3 terrace at the Molander site. The homestead, which is represented by the remains of at least three structures along with associated pits, roads, and plowed fields, dates to the period between 1882 and 1935. Surface artifacts associated with that component are widely scattered across the eastern third of the fortified settlement and occur in 37 percent of the provenience lots recovered in 2018. Virtually all of the datable specimens in the collection were manufactured between the late 1880s and the early 1920s.

The oldest component on the T3 terrace consists of at least one, and likely several, Archaic or Woodland occupations. A maximum age for the pre-ceramic occupations at Molander is provided by a 6300 cal B.P. radiocarbon age obtained on a bulk sample taken from the A horizon of a well-developed paleosol that was exposed in the wall of Feature 7 in Block 2. That soil formed in Oahe Formation deposits directly overlying ground till (Coleharbor Formation). The age of the soil suggests that it may represent the Thompson paleosol, which occurs near the base of the Oahe Formation's Riverdale member. The stratigraphic position of the paleosol suggests that intact archaeological deposits older than that soil are not likely to be present at Molander.

A possible minimum age for the pre-ceramic occupations at Molander is suggested by patination intensity data on flakes made from Knife River flint (KRF) and related chalcedonies. Four-fifths of the patinated coarse fraction (size grades 1 through 3 [G1-3]) flakes exhibit moderate to pronounced patination, as do three-fifths of the size grade 4 (G4) flakes. Assemblages exhibiting that degree of patination commonly are thought to be at least 1,500 years old. Woodland pottery is not present in the Molander assemblage, suggesting that the pre-Plains Village occupations at Molander may be Archaic in age.

Although the number of pre-ceramic occupations is not known, circumstantial evidence suggests that at least two are present. A concentration of patinated flaking debris was recovered from the pre-settlement surface preserved beneath the fortification ditch spoil bank in Block 1. In addition, a prominent but undated paleosol was observed in a coring transect on the west edge of the fortified settlement. The stratigraphic position of that soil suggests that it may not be correlated with the dated soil exposed in Block 2. Although no artifacts were recovered from the dated paleosol or from the paleosol identified in the coring transect, patinated flakes or tools occur in 74 percent of the provenience lots recovered in 2018. That wide distribution suggests that artifacts associated with pre-Plains Village occupations are widespread on the T3 terrace, a pattern which likely indicates the multiple occupations are represented.

Data from historical documents and maps along with archaeological data provide a relatively precise *terminus ante quem* for Molander's fortified earthlodge village. Information provided to William Clark by Too Né, the Sahnish leader and diplomat, in October 1804 indicates that a settlement in the approximate location of Molander was abandoned by the Awaxawis about 1764. In March of 1805, the headman Tetuckopinreha confirmed to Clark that the Awaxawis formerly lived in a settlement in a location nearly identical to the one identified by Too Né. Both men were knowledgeable about the region's history and politics, and neither had cause to deceive Clark, at least on this topic.

No other appropriately aged site is known to occur in the section of the river valley between Square Buttes and Painted Woods Lake (Clark's "Mandan Island"), which the Corps of Discovery traversed on the day that Too Né told them about the site. Given these data, there can be little doubt that Molander is the site to which Too Né and Tetuckopinreha were referring.

Stratigraphic data on earthlodge remodeling and feature superimposition suggest that the duration of the Late Plains Village occupation at Molander was at least 20 years. Two prepared floor surfaces were present in each of the two earthlodges investigated (H26 in Block 2 and H6 in Block 5). In both cases, the floors were separated by a layer of intentionally emplaced fill and at least three of the four documented floors exhibited evidence of repeated re-surfacing or renewal. No evidence of catastrophic fires was observed in either Block 2 or Block 5, which if present could have indicated that the structures were abandoned prematurely. Taken together, these observations suggest that at least two maximum earthlodge use-lives are represented.

The maximum use-life of an earthlodge is not known. Wilson (1934:372) offers a range of seven to ten years as an "ordinary" use-life. A typical maximum use-life for Molander's circular four-post earthlodges—which likely were constructed primarily from cottonwood posts and rafters—was probably less than the 15- to 20-year use-life commonly estimated for earth-banked long-rectangular lodges (Toom 1992). Assuming a mean maximum 10-year use-life, the occupation duration at Molander was at least 20 years.

However, sediment rip-up clasts present in the fill above the upper floor or H26 (Block 2) suggests that the occupation may have continued after the reconstructed earthlodge was no longer in use. In fact, nothing is known about the relationships between the site's overall occupation period and the ages of the two investigated earthlodges. It is possible, for example, that one or both were built sometime after the settlement was established or that occupation continued after both were no longer in use. Given this uncertainty, a duration of about 30 years may be a more realistic estimate. In any case, the extent of feature superimpositioning observed in Blocks 3 and 4 is entirely consistent with an occupation span of 20 to 30 years, as is the absence of thick or mounded midden deposits that, if present, could indicate that the period of occupation was longer.

Assemblage data support the occupation period derived from the documentary and stratigraphic data. Data on the 2018 pottery assemblage support Ahler and Swenson's (1993) conclusion that a single Plains Village component is present at the site. Data on the density of glass beads and fur trade-era metal artifacts recovered in 2018 indicate that the median date of the occupation almost certainly falls between 1663 and 1761, the bracketing dates defined by the 95 percent confidence interval of the regional trade goods density regression. Data on glass bead type and size, on pottery types, and on chipped stone raw material usage all point to a mid-eighteenth-century occupation. Although specimens exhibiting precisely dated attributes—such as clay pipes or certain varieties of glass beads—are not present in the collection, all of the available data on chronologically sensitive artifact types are internally coherent and support the inference that the fortified settlement was occupied in the mid-1700s. The estimated date range for the settlement based on a 30-year occupation duration and Too Né's *terminus ante quem* is 1735 to 1765.

Settlement Layout and Architectural Features

Excavation data obtained during 2018 offer insights into aspects of eighteenth-century earthlodge design, extramural features, and the construction history of the settlements fortification system. Geophysical data provide additional information about earthlodge size and layout.

Earthlodge Design and Extramural Features

One of the more striking findings of the project is evidence for the presence of prepared earthlodge floors. Both structures investigated in 2018 exhibited two distinct floor surfaces, separated by a layer of intentionally placed fill. Three different types of floor were observed. The upper floors of both earthlodges (H6 exposed in Block 5 and H26 exposed in Block 2) consisted of compact, laminated sediment made up of alternating layers of gray and white clay. The white clay layers were generally 1 to 2 mm thick. The gray clay layers that occurred between the white layers were generally somewhat thicker. Each pair of gray and white microstrata is believed to represent a single floor-surfacing event, with the gray stratum laid down first as a base coat and filler and the white stratum laid down as a topcoat. A new layer pair was added after the prior floor surface had been worn away or damaged by foot traffic, sweeping, and other activities. Owing to damage by burrowing rodents, it was not possible to precisely count the number of floor-surface pairs present within the upper floors, although more pairs appeared to occur in H6 (Block 5) than in H26 (Block 2). However, at least two were present in H26 and two or three were present in H6, suggesting that the resurfacing interval was approximately three to five years.

The lower floors of both earthlodges differed from the upper floors, as well as from each other. The lower floor of H26 consisted of platy gray clay laid directly on a truncated B horizon surface. A white topcoat was lacking; it may never have been applied or may have be removed by foot traffic and not replaced before the earthlodge was remodeled or rebuilt. The platy character of the floor material may indicate that it was applied in a saturated or puddled state. The lower floor of H6 was unprepared and instead consisted simply of truncated B horizon terrace sediment.

The fill layers between the floors consisted of packed sediment containing relatively few artifacts, likely indicating that the fill material was gathered from the surface or from shallow borrow basins within the settlement. The apparent extent and consistent thickness of these layers in both earthlodges suggests that they were laid down during major remodeling or rebuilding events, which may have included a partial or complete dismantlement of the original earthlodges.

Prepared earthlodge floors have not previously been identified in the Heart or Knife regions. However, the conclusion that they were not present may not be warranted. The activities of burrowing animals may have obscured or destroyed evidence of floor preparation at many sites; at Molander, for example, if the fill above the upper floors had been thinner, burrowing might well have entirely obliterated evidence of their presence. Structure remodeling and rebuilding, as well as large-scale sediment borrowing and transport, may also have obliterated or obscured evidence of floor preparation (Crawford 2003).

Prepared floors may also been present at some sites but not recognized. For example, floor surfaces were exposed in several excavation blocks at Scattered

Village (32MO31), where they were easily identified by the presence of overlying burned roof material (Ahler, *ed*. 2002). However, the characteristics of those floors were not investigated in detail and in most cases after they were exposed the focus of the fieldwork shifted either to feature excavation or to stratigraphic excavation of natural and cultural strata predating the site's Plains Village component. A similar approach was taken during the investigation of House 28 at Awatixa (Sakakawea) Village (32ME11) in the Knife River Indian Villages National Historic Site (KNRI) (Ahler *et al.* 1980). Smith (1972) reports the "thickness" of floors in several excavated earthlodges at Like-A-Fishhook Village but does not describe their characteristics. However, he does note that House 19 at the site had been rebuilt and that "clean earth had been spread and compacted over the older floor, to fill depressions and soft places and to provide a fresh surface" for the later earthlodge (Smith 1972:51). A similar emplaced layer was observed between two structure floors at Fort Clark Village (32ME2) (Mitchell and Wiewel 2014).

However, the most important factor affecting the recognition of prepared floors may be the fact that most projects in the Knife and Heart regions have focused on pit and midden excavations designed to build a culture-historical and chronological framework, rather than horizontal excavations designed to investigate architectural spaces. Even projects that have yielded data on architecture mostly have focused on overall structure layout and the design of the buildings' superstructures (Lehmer *et al*. 1973; Lehmer *et al*. 1978).

Wilson (1934) provides detailed data on the dimensions, construction methods, and furnishings of several Hidatsa earthlodges but is silent on the attributes of their floors. The sole ethnographic description of Plains earthlodge floor construction methods is Alice Fletcher and Francis La Flesche's account of Omaha practice. They report that

> much labor is expended on the floor of the lodge. The loose earth was carefully removed and the ground then tamped. It was next flooded with water, after which dried grass was spread over it and set on fire. Then the ground was tamped once again. This wetting and heating was repeated two or three times until the floor became hard and level and could be easily swept and kept clean [Fletcher and La Flesche 1911; quoted in Bushnell 1922:79].

No mention is made of added clay filler or a colored topcoat, although a process like the one they describe could have been used to create the lower floor of H26 (Block 2).

Excavation data from Block 5 also provide limited evidence on several interior features apart from cache pits. Feature 10 was a shallow basin filled with burned rock that was used in conjunction with the lower or original floor of the earthlodge. Although the function of Feature 10 is not known, the presence of abundant burned rock suggests that it may have been used in conjunction with an interior sweat feature. A probable pot-rest (Feature 16) was also documented in association with the second or upper floor of H6. Interestingly, the distance between the structure's probable central hearth and Feature 16 was nearly 4 m, a distance suggesting that a secondary hearth may have been located nearer at hand. The presence of several discrete surface burns associated with the later earthlodge (Feature 14 and a smaller unnumbered surface burn) suggests that heated stones or burning hearth materials were placed on the floor temporarily. The reason for manipulating heated materials in that way is unknown. However, the position and attributes of Features 10, 14, and 16 suggest that the types of activities carried out inside H6 may have been more varied than current models admit.

Excavation data from Molander also provide some evidence for pre-construction excavation of earthlodge floors. Stratigraphic data show clearly that the pre-settlement surface was stripped away before the H26 earthlodge was built. Based on a comparison of the thicknesses of undisturbed soil horizons present under the fortification ditch spoil bank in Block 1 with the thicknesses of soil horizons visible in the wall of Feature 7 in Block 2, it appears that all of the A horizon and about 20 cm of the B horizon were removed prior to construction. The floor of the H6 earthlodge exposed in Block 5 was also built on truncated B horizon sediment, although the precise depth of surface stripping was not calculated for that structure. For both earthlodges, the depth of sediment removal can be compared to that observed in Block 3, which was located outside an earthlodge. In that block, the lower portion of the pre-settlement A horizon appeared to have been preserved. In addition, coring data indicate that sampled hearth features are buried by 18 to 30 cm of sediment. That depth brackets the upper and lower floors of the H6 and H26 lodges. By contrast, the Feature 13 exterior hearth in Block 3 was buried under just 12 cm of sediment.

These data suggest that both H6 and H26 were built over pits up to 25 or 30 cm deep. However, data from Block 1 suggest that widespread surface stripping occurred in at least some portions of the site, possibly to obtain fine-grained sediment for earthlodge roof construction. The presence of rip-up clasts in the fill above intact B horizon sediment inside the ditch may indicate that some surface stripping occurred prior to or during the construction of the fortification, which took place when the settlement was first established. In general, the elevation of the modern surface is lower inside the ditch than it is outside, which may indicate that surface stripping occurred across most or all of the site. Of course, much of that stripping may have occurred routinely throughout the period of occupation, as the residents excavated borrow basins to obtain sediment for earthlodge repair or reconstruction. Given this evidence for extensive planar borrowing, the value of 25 or 30 cm for the depth of pre-construction excavation should be regarded as a maximum.

Wilson (1934:357) reports that Hidatsa earthlodge floors were not excavated prior to construction but instead were built directly on the existing ground surface. He does note that because new earthlodges commonly were replacements built on the locations of prior earthlodges, the floors usually were lower than the surrounding surface owing to sweeping and wear and to the continual deposition of roof sediment around the perimeters. However, Wilson's editor Bella Weitzner provides historical evidence from several eighteenth and nineteenth century sources indicating that at least some earthlodges were built over excavated floors (Wilson 1934:357[Note 2], 358[Note1]). In addition, both surface data and excavation data from Awatixa (Sakakawea) and Big Hidatsa villages located at the mouth of the Knife indicate that floor excavation was common in the early nineteenth century and perhaps earlier (Ahler and Swenson 1985a; Ahler *et al*. 1980).

Overall, the evidence from Molander suggests that earthlodges there were built over shallowly excavated floors. That practice may have waned after the abandonment of the Knife River settlements. Evidence for pre-construction excavation at Like-A-Fishhook Village, occupied between 1845 and the mid-1880s, is equivocal, although Smith (1972:35) was inclined to believe that lodges there were built on the existing surface. Apparently, excavation was no longer practiced when Wilson conducted his fieldwork between 1906 and 1918.

The extent of the 2018 testing effort was too limited to provide data on the sizes of Molander's earthlodges. However, the 2018 GPR survey did provide important data on H11, located in the site's northeast quadrant. The GPR data reveal the lodge perimeter, the central hearth, and the southeast-facing entryway. Interior pits along the earthlodge walls may be represented by four distinct GPR anomalies. Significantly, the interior floor of H11 is approximately 18 m in diameter, some 50 percent larger in diameter and 225 percent larger in area than the corresponding H11 surface depression. The entryway of H11 is approximately 5 m in length.

Extramural features have received relatively little attention during most Knife and Heart region projects, which justifiably have focused on the excavation of large undercut pit features, fortification ditches, and stratified midden deposits. However, data on the Feature 4 hearth exposed in Block 4 at Molander provide insights on the potential scope of outdoor activities within villages. Feature 4 was larger than 140 cm in diameter, unlined, and filled primarily with ash. The feature's size suggests that cooking or some type of intensive resource processing occurred in the spaces between lodges. Pieces of fired clay exhibiting impressions of twigs, grass, leaves, and other organic material recovered from Block 4 suggest that a screen, rack, or stand made from a framework of organic materials may have been used in conjunction with the Feature 4 hearth. Similar pieces of fired clay were also recovered from features in Block 3, which contained the remains of a dismantled earthlodge central hearth. That finding suggests that similar clay-covered screens or stands were also used indoors.

Fortification Design and Construction

Molander's fortification system is among the best-preserved in the northern Middle Missouri, a circumstance that makes possible a relatively precise estimate of the labor and materiel required to build it. The fortification consists of two surface-visible components: a ditch excavated into the upper surface of the T3 terrace and a bench or shelf cut into the top of the coulee slope (figure 11.1). The fortification incorporates eight constructed bastions. Several apparent projections in the cut terrace coincide with natural ridges in the coulee slope that the builders integrated into their design. Although not apparent on the modern surface, the fortification would also have incorporated an interior log palisade. By combining topographic, coring, and excavation data it is possible

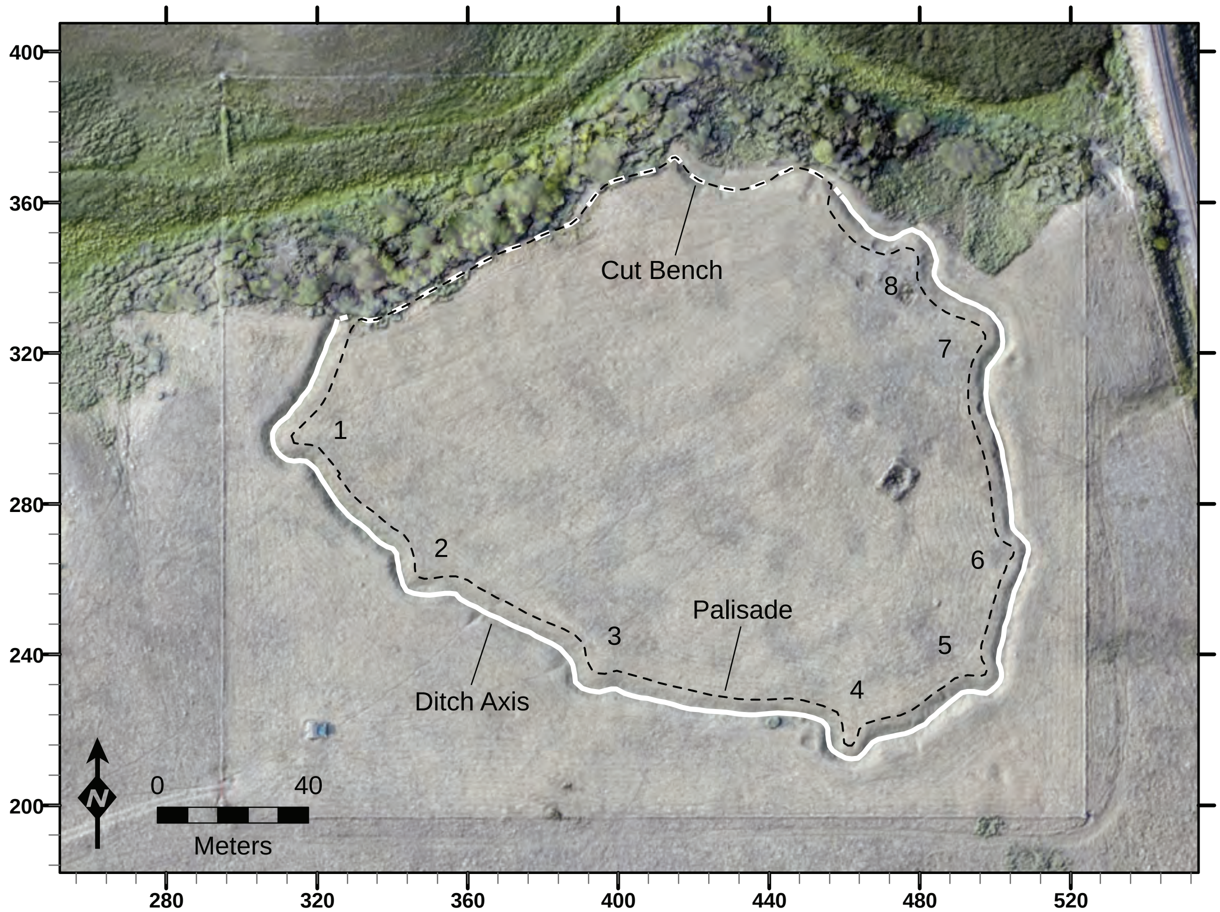


Figure 11.1. Map showing the principal features of Molander's fortification system. The dashed black line illustrates the estimated position of the palisade line; see text. The eight constructed bastions are numbered.

to estimate the total volume of sediment excavated during the construction of the ditch and cut bench. Using data from excavations at several other fortified sites, it is also possible to estimate the number of logs that would have been needed to construct the palisade.

Excavation data from Block 1 indicate that the ditch at that point was approximately 1.38 m deep, 0.90 m wide at the bottom, and 3.55 m wide at the top (figure 11.2). Data from 23 cores taken from the ditch centerline and spaced at roughly 20 m intervals along its length—combined with topographic data from the site-wide digital terrain model (DTM)—suggest that the depth and widths measured in Block 1 represent reasonable estimates for the ditch as a whole. The overall length of the ditch is 440 m. Using the formula for a trapezoidal prism, the estimated original excavated volume of the ditch is 1,350,000 liters.

The cut bench is 152 m long. Estimates derived from the DTM indicate that the bench cut is about 4 m wide and the 0.3 m deep (figure 11.3). The volume of sediment excavated to create the bench is estimated at 270,000 liters.

To estimate the number of posts required to construct the palisade, excavation data on mean post spacing and mean palisade setback were compiled from four sites (table 11.1). Post spacing values appear to have been quite consistent over time, from the 1300s into the 1500s. The mean value for these sites is about 3.1 post/m. Setback values—the distance between the line of palisade posts and the axis of the ditch—are somewhat more variable. The mean setback is 4.53 m. Based on this mean value, the length of the Molander palisade would have been about 574 m. Given the regional post spacing value, approximately 1,780 posts would have been required to construct the palisade.

Productivity rates are needed to convert estimated volume and post-count data into work-effort estimates. Many factors would have affected productivity. The

Figure 11.2. Photograph of the west profile of Units 1 and 4 showing the fortification ditch spoil bank superimposed on the pre-settlement ground surface.

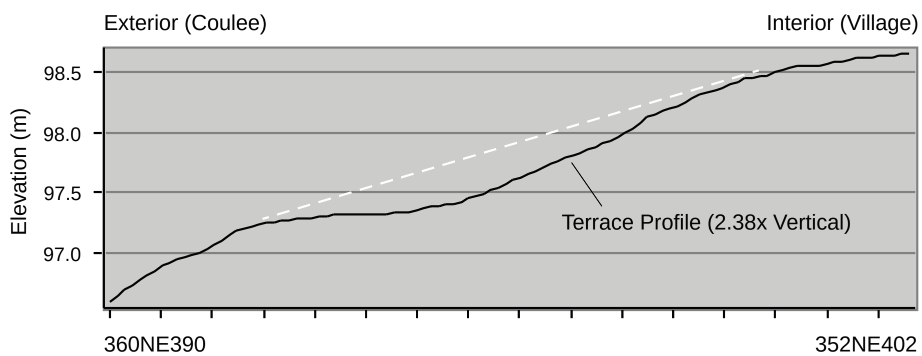


Figure 11.3. Surface profile showing the width and depth of the cut bench at the top of the coulee slope.

Table 11.1. Palisade post spacing and setback data from four excavated sites. Setback is the distance between the ditch centerline (axis) and the line of palisade posts. All measurements made from published scaled drawings.

Site	Post Spacing (posts/m)	Post Setback (m)	Source
Shermer (32EM10)	3.56	4.95	Sperry 1968:Figure 11
Shermer (32EM10)	3.25	-	Sperry 1968:Figure 12
Huff (32MO11)	3.19	5.76	Wood 1967:Map 7
Huff (32MO11)	2.79	4.66	Wood 1967:Map 13
Double Ditch (32BL8)	2.58	2.75	Crawford and Ahler 2003:Figure 78
Means	3.07	4.53	

Molander estimate assumes maximum continuous production and so may be regarded as a minimum value. The assumed value for excavation productivity is 500 liters/day for each person, which represents 25 excavated loads of 20 liters each, or about one large basket load every 20 minutes for eight hours. Digging efficiency would have varied significantly; removal of Oahe Formation deposits would have been relatively easy but removal of the underlying Coleharbor Formation till would have been quite difficult.

The sizes of the palisade posts are not known; however, it seems likely that the finished height of the palisade was at least 3 m. Two people likely would have been needed to install each one, a task which would have included excavation of the posthole and emplacement and stabilization of the post. Such a two-person team might have been able to install 10 posts/day, or one post every 45 minutes.

Using these productivity values, a total of 3,240 person-days would have been required to excavate the ditch and bench. Another 356 person-days would have been needed to install the palisade posts. This does not include harvesting the posts and transporting them to the site, nor does it include installation of a framework and rawhide covering that likely was an integral part of the palisade (Smith 1980:59). The estimate also does not include support for the construction crew, including meal preparation. If the fortification was installed in a single continuous operation, it would have taken a 45-person crew approximately 80 days to complete the work. Earthlodge construction would of course have required additional timbers and additional labor.

This work-effort estimate has significant implications for interpretations of eighteenth-century community leadership and mobility. Stratigraphic data from Block 1 demonstrate that that the fortification was built early in the occupation of the site. The pre-settlement soil beneath the ditch spoil bank is essentially intact and most of the artifacts recovered from that soil predate the Plains Village period. Few village-age features occur outside the settlement's fortified perimeter. These data indicate either that the fortification was constructed first or perhaps that fortification and earthlodge construction were begun concurrently.

The fact that the construction of the fortification mostly or entirely predates the primary occupation of the village has several significant implications. The location of the site and the design of the fortification must have been determined in advance. Logs needed for the palisade, as well as for earthlodge construction, may have been cut and stockpiled prior to construction. Because the site was likely not immediately available for occupancy—and because the potential for armed conflict must have been foremost in the minds of Molander's residents, given the size and specialized features of the site's fortifications—the Awaxawis must have remained at their prior village during construction. Based on Molander's size it probably contained about 48 earthlodges, which could house roughly 528 people (Mitchell 2013a:69). If 45 people—presumably mostly able-bodied adults—were tasked with construction, then about 8 percent of the community's population would have been unable to engage in other productive activities for roughly 80 days—the better part of an entire growing season.

Regardless of the precise number of individuals engaged in construction, or the precise amount of time required, the estimated amount of labor need to build the fortification strongly suggests that significant advance planning and resource stockpiling would have been needed. Surpluses would have been needed to support the construction crew but also to feed the community while a significant proportion of the labor force was otherwise engaged. In addition, the total harvest made during the construction year may have been significantly lower than the mean. In that event, surpluses would have been needed to carry the community through the winter following construction.

The need for stockpiling, advance planning, site pre-selection, and management of a large and complex construction project implies the existence of well-developed community decision-making processes and strong leadership. Those factors also imply that a decision to relocate the community was not taken lightly, but instead required several years of preparation as well as participation by all of the community's constituent households.

Regional Comparison

Lehmer and others (1978:434) describe Molander's fortification as "unusual" and an "anomaly." Highly engineered, bastioned fortifications were, in their view, primarily a feature of what they termed Terminal Middle Missouri settlements, which at the time were dated to the period between 1550 and 1675 (Lehmer 1971:124). (Johnson [2007] and Mitchell [2011a] discuss revisions to the age and definition of the Terminal Middle Missouri variant.) Bowers (1948) also regarded Molander as a so-called Huff Focus site, in part owing to the site's bastioned fortification. Bowers was wrong about Molander's cultural affiliation—and Lehmer was essentially right—but the question remains: should Molander's fortification be considered an anomaly?

Table 11.2 lists width and depth measurements for eight fortification ditches at five sites, along with data for Molander. Mean values excluding Molander are 1.04 m in depth and 2.87 m in width at the top. Molander's ditch is large compared to others in the Heart region, but not outside the documented range of variation (figure 11.4).

The best-known bastioned fortification may be the carefully engineered defensive system surrounding the fifteenth-century Huff site (Wood 1967), but bastions are present in northern Middle Missouri fortifications dating from the late 1100s into the 1800s. Two early examples are the Terminal Late Woodland Menoken

Table 11.2. Regional fortification ditch depth and width data.

Site and Feature	Depth (m)	Width (m)
Boley (32MO37)		
Ditch 2[a]	1.02	3.00
Ditch 3[a]	1.19	3.97
Double Ditch (32BL8)		
Ditch 3	0.82	2.82
Ditch 4, 2004[b]	1.03	2.30
Ditch 4, F105	1.33	2.08
Ditch 4, F205	1.18	2.50
Huff (32MO11)		
Exc. 5	0.76	2.59
Map 16	1.37	4.57
Larson (32BL9)		
Ditch 3[c]	1.31	3.17
Ditch 4[c]	0.82	2.72
Shermer (32EM10)		
Profile A	0.84	2.58
Profile B	0.93	2.92
Profile C	0.91	2.14
Regional Means	1.04	2.87
Molander	1.38	3.55

[a] Depth minimum values.
[b] Depth and width minimum values.
[c] Estimated values.

site (32BL2), which dates to the early 1200s (Ahler *ed*. 2003), and the Charred Body complex Flaming Arrow site (32ML4), which may be a century older than Menoken (Ahler 1993) (figure 11.5). Like-A-Fishhook Village, which was dismantled in the mid-1880s, is the most recent example (Smith 1972:53). Bastions also occur in fortifications at the Shermer site (which dates to the 1300s), at Double Ditch, Chief Looking's, and Larson villages (early to middle 1500s), and at Boley Village (late 1600s or early 1700s) (figures 11.6 and 11.7) (Ahler *ed*. 2005, 2006; Mitchell *ed*. 2007, 2013; Sperry 1968).

This unsystematic inventory suggests that at least some bastioned fortifications were present during most periods, even if they were more common in some. The regular occurrence but fluctuating frequency of bastioned fortifications is an indication that they represent decisions taken by communities in response to specific sets of social and economic relationships that foreshadow the need for stout defenses (Mitchell 2018). In this sense, fortification attributes reflect functional design requirements rather than stylistic choices.

Bastion spacing is one aspect of a defensive system's functional design (Keeley *et al.* 2007).

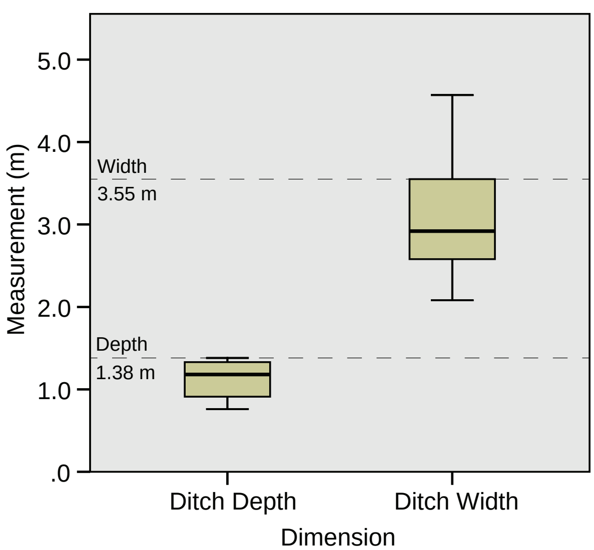


Figure 11.4. Box-and-whisker plot illustrating regional fortification ditch width and depth data. Values for Molander are indicated by dashed lines.

Figure 11.5. Aerial photograph of the Flaming Arrow site. (Photograph courtesy of Adam Wiewel.)

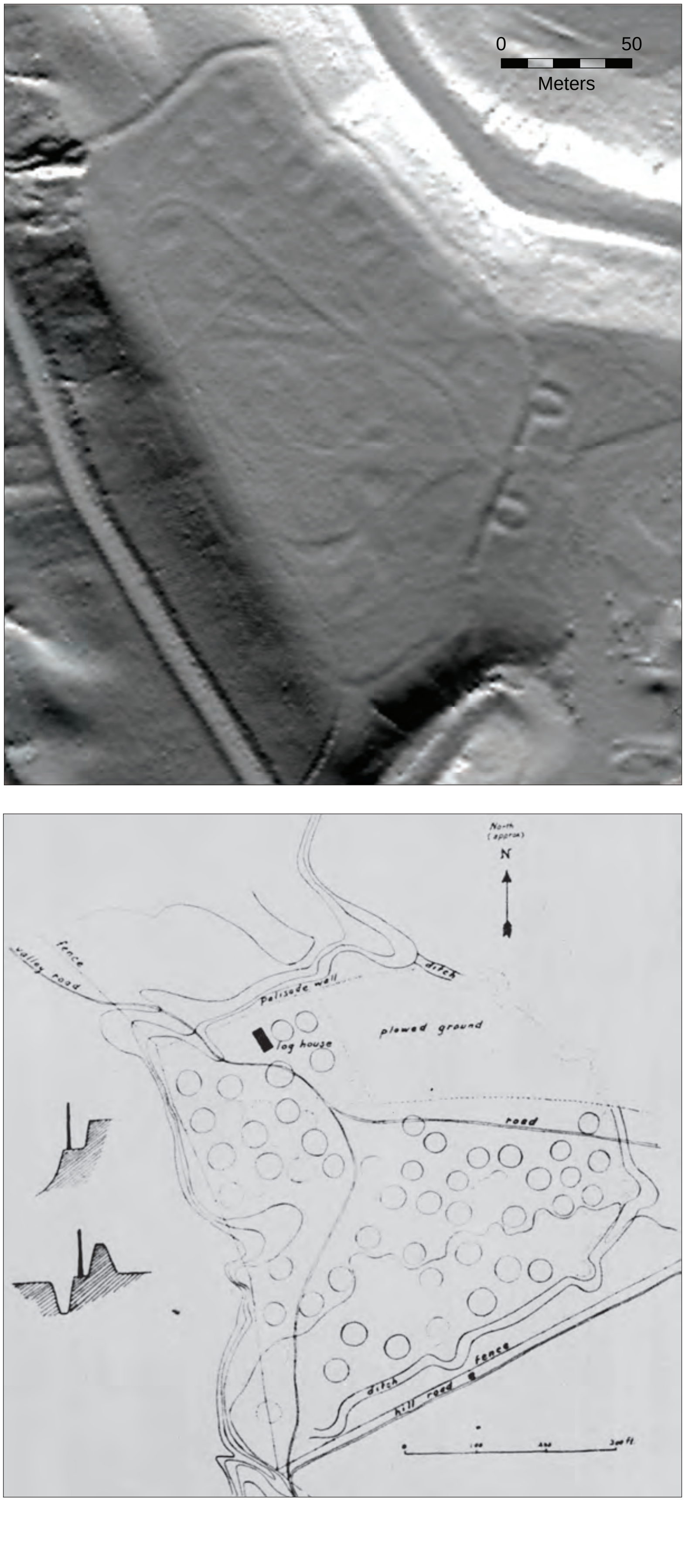
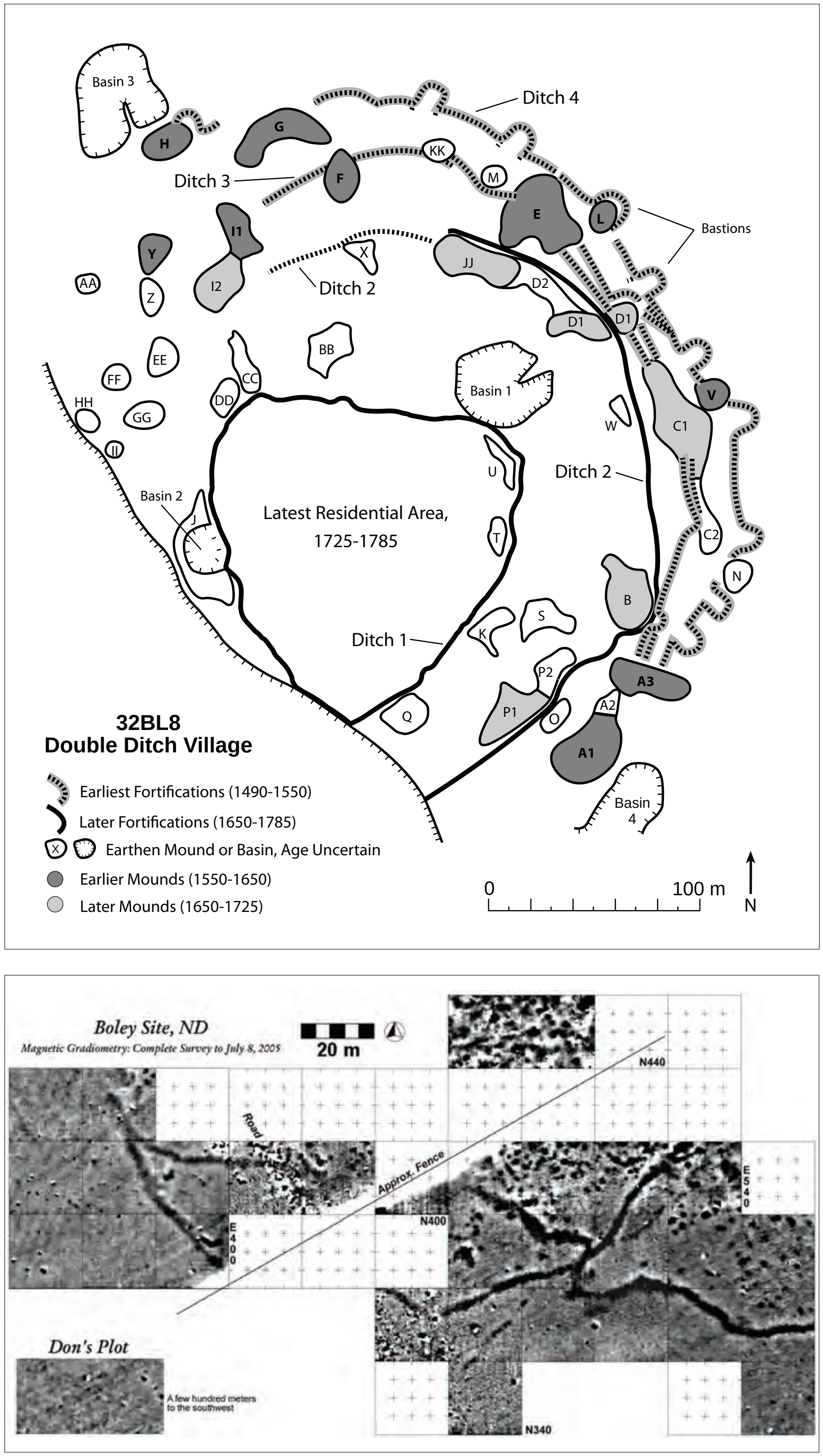


Figure 11.6. Examples of bastioned fortifications. ***Upper panel****: Digital terrain model of Chief Looking's Village. Two bastions are present on the southeastern side of the settlement and a cut bench similar to the cut bench at Molander is present on the northeastern and southwestern sides. (Image courtesy of Kenneth L. Kvamme.)* ***Lower panel****: sketch map of the Shermer site drawn by George Will in 1919 (Sperry 1968:Figure 4).*

Figure 11.7. Examples of bastioned fortifications. ***Upper panel****: schematic map of Double Ditch Village (Mitchell 2013a:Figure 5.4 [adapted from Ahler ed. 2005]);* ***Lower panel****: Magnetic map of Boley Village. (Image courtesy of Kenneth L. Kvamme.)*



Because bastions are positioned to defend the base of the fortification's palisade, the ideal spacing between them is a bit less than twice the accurate range of commonly used projectile weapons. The distances between them therefore is a reflection of the prevailing weaponry technology: if the spaces are too great the goal of defense is not met, but if the space is too small the efficiency of defense is diminished. Bastion spacing may also reflect the overall shape of a fortification; curving curtain walls may require slightly closer spacing for effective coverage of the base of the wall.

Table 11.3 provides data on bastion spacing for four sites with bastioned fortifications that range in age from the mid-1300s to the mid-1700s. The spacing of Molander's bastions conforms in general to regional means (figure 11.8). Although the sample is small, values for the earlier two sites is above the four-site mean, while values for the later sites are below the mean. This may indicate that aspects of weaponry technology shifted in the late 1400s.

Taken together, these data indicate that Molander's fortification is not unusual when compared to those of other Heart region sites. Its prominence mainly reflects its excellent preservation, rather than its design or size. The absence of other bastioned fortifications in the regional sample—apart from Boley Village—likely reflects preservation issues, especially in the Knife region where occupation at several eighteenth-century sites continued into the nineteenth century.

Regional Cultural Landscape

Comparisons of Molander's material culture with that of contemporaneous communities in the Knife and Heart regions help to place the archaeological history of the Awaxawis into regional context. The sample of comparative sites primarily consists of two contemporaneous Heart region communities and four contemporaneous Knife region communities (table 3.2). Some comparisons also incorporate data from TP1 (1675-1725) at Double Ditch Village.

Lithic Raw Material Use and Technology

The makeup of Molander's flaking debris assemblage reflects the community's unique geographical location and cultural position within the northern Middle Missouri. Molander's inventory of near-local raw materials is nearly identical to that of the Heart region batches dated to between 1500 and 1780. The Molander assemblage is dominated by KRF, but smooth gray TRSS is also well represented as are a variety of other materials. The same is true of Heart region assemblages. By contrast, Knife region assemblages consist almost entirely of KRF. Smooth gray TRSS is all but absent and other near-local materials are uncommon.

A different pattern is evident in the inventory of imported or exotic raw materials. The most common imported materials at Molander are those from western sources, especially porcellanite. The same pattern is true of Knife region assemblages. By contrast, stone from western sources is relatively uncommon in the Heart region.

This contrastive pattern suggests that although Molander's flintknappers primarily exploited a direct procurement zone nearly identical to that of their Heart region counterparts, Molander's long-distance trade connections were aligned with those of the Knife region settlements. This suggests that both geography and cultural identity shaped Molander's lithic raw material procurement. The stone tool raw material data suggest cooperative economic relationships with Heart region communities but also political ties to Knife region communities.

Imported raw materials at Molander are represented by flakes, cores, and unpatterned tools—in addition to arrow points (small patterned bifaces). This pattern indicates that imported stone arrived

Table 11.3. Regional bastion spacing data.

Site	Period	Number of Bastions	Number of Measurements	Bastion Spacing Measurement (m) Minimum	Maximum	Mean	Std. Deviation
Double Ditch (32BL8)	1500s	9	8	25.5	63.6	44.6	12.35
Molander (32OL7)	1700s	8	7	35.3	73.7	51.6	13.17
Huff (32MO11)	1400s	10	9	58.8	83.8	65.9	9.44
Shermer (32EM10)	1300s	7	6	47.2	91.4	67.9	16.19
Total		34	30	25.5	91.4	57.3	15.53

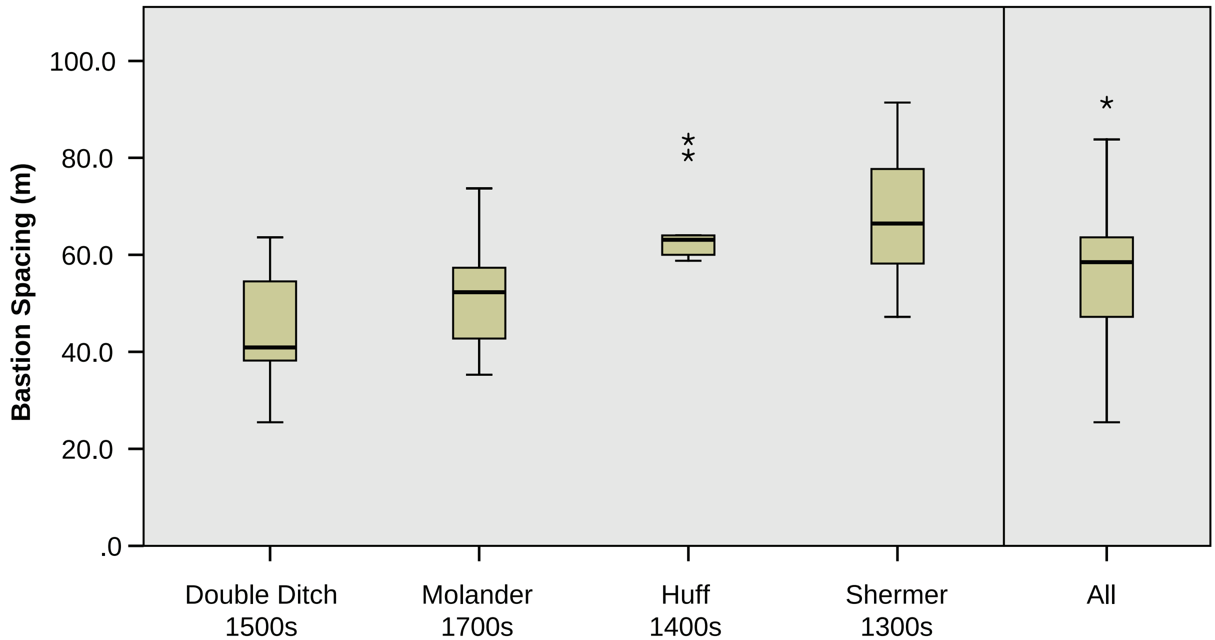


Figure 11.8. Box-and-whisker plots illustrating bastion spacing data for four fortified Heart region settlements.

in the village primarily in nodule form, rather than as finished tools or semi-finished bifaces. Whether the villagers obtained stone from visiting traders or whether they obtained stone at rendezvous away from the Missouri is unclear. Under either scenario the haul capacity on regional trade routes must have been substantial.

The technological characteristics of the Molander tool assemblage appear to reflect aspects of both Knife and Heart region assemblages. The Molander analysis reveals significant interregional differences in stone tool technology. These regional differences were both widespread and persistent. Virtually all Heart region batches contain more patterned bifaces (small and large) than do batches from Knife region sites. Conversely, virtually all Knife region assemblages contain more unpatterned bifaces and unpatterned flake tools. Although no Heart region sites were occupied during the 1800s, the Knife region proportions for that period continued the pattern established during earlier periods. Overall, this pattern reflects a greater emphasis by Heart region flintknappers on patterned tools. Knife region chipped stone technology was by contrast more expedient.

In the Molander assemblage, the proportions of small patterned bifaces and unpatterned flake tools are similar to those of Heart region assemblages, while the proportions of large patterned bifaces and unpatterned bifaces are similar to those of Knife region assemblages. Thus, Molander's stone technology primarily represents expedient production, with the important exception of small patterned bifaces.

However, it is unclear whether these similarities and differences primarily reflect Molander's geographical and cultural position or whether they reflect fur trade-induced temporal patterns. On the one hand, the relatively high proportion of small patterned bifaces seems to reflect long-standing differences between the Heart and Knife regions. However, the attributes of the Molander assemblage also conform to many of Ahler and Toom's (1993) expectations for the effects of the fur trade on stone tool production. Expedient technological practices are well represented. Unpatterned bifaces are relatively common, particularly compared to Heart region batches. Aimlessly flaked or irregularly battered nodules make up a significant share of the non-bipolar core class. Unpatterned flake tools primarily reflect expedient, one-time use. Large patterned bifaces are uncommon.

Tool re-purposing data also suggest that the shift toward expediency encouraged by the introduction of metal tools may be reflected in the Molander assemblage. The re-purposing rate at Molander is higher than that of earlier Heart or Knife region assemblages and comparable to that of nineteenth-century assemblages. Re-purposing at Molander also includes re-manufacturing of scavenged ancient stone pieces, a practice that was virtually unknown before the 1700s.

However, the Molander tool assemblage also demonstrates that skilled production of small patterned bifaces continued into the eighteenth century. By most measures the Molander arrow point assemblage is comparable to earlier Heart region assemblages, apart from the fact that notable proportions of the Molander assemblage were made from both imported and local raw materials. The limited changes in arrow production reflected in the Molander assemblage indicate that the introduction of metal tools during the fur trade effected different aspects of chipped stone tool production in different ways.

Several other aspects of fur trade-era stone tool technology are also reflected in the Molander assemblage. Ahler and Swenson (1985a:167-169) identify a stone tool generalized functional class, which they call the "Post-Contact Group," that they argue is diagnostic of the fur-trade era. The group includes gunflints, striker flakes, and aimlessly flaked practice pieces. The latter occur in the Molander assemblage, but the former two types are absent. However, whetstones used to sharpen edged metal tools could be included in the post-contact group and one specimen of that type is present in the Molander collection. The relatively high proportion of unpatterned ground stone tools present in most batches dating to the late 1700s and especially the 1800s also appears to be reflected in the Molander assemblage. Prior to 1800, ground stone tools are moderately more common in Heart region batches than Knife region batches. However, after 1800, the proportion of ground stone tools increases dramatically. The proportion of the Molander assemblage made up of ground stone tools is somewhat higher than the proportions for most Heart region assemblages and much higher than those for Knife region assemblages pre-dating the nineteenth century. This proportion, coupled with the presence of a specialized whetstone, supports the conclusion that the Molander assemblage dates to the middle decades of the eighteenth century, when metal tools were becoming more widely available.

Pottery Style and Technology

An important byproduct of the Molander pottery analysis has been the identification of clear differences between Knife and Heart region pottery batches across a range of measures. Although assemblages from both regions exhibit intra-regional variation, unmistakable differences exist in the distributions of body sherd surface treatment types; rim form classes; dominant decorative types; appendage types and orifice modifications; brace and vessel sizes; and cordage attributes. Inter-regional comparisons of pottery ware and variety distributions are complicated by changes in the coding system over the last 20 years; however, differences between Knife and Heart region pottery are also evident in pottery style.

As measured by those variables, the 2018 Molander pottery assemblage has far more in common with Knife region pottery than it does with Heart region pottery. In each case, the Molander pottery fits within the range of attribute variation present in Knife region pottery batches but not within the range of variation present in Heart region batches.

Pottery production skill is one measure for which inter-regional comparisons are currently not possible, owing to the lack of skill data for Knife region batches. However, the available data indicate that clear skill differences exist between the Molander assemblage and Heart region assemblages: the overall production skill reflected in Heart region pottery is higher than the production skill reflected in Molander pottery.

It may be the case that the lower skill expressed in the Molander assemblage primarily reflects change over time, in keeping with the expectations of models of fur trade-era technological change. However, it is clear that high quality pottery was produced throughout the eighteenth century at one and perhaps more Heart region sites, and so it is possible than the overall skill of Heart region pottery production was higher than that of Knife region pottery production, even prior to the advent of the fur trade. Multiple lines of evidence point to the economic importance of specialized craft production in the Heart region (Mitchell 2013a). Insufficient data are available to determine whether specialization was also an important feature of Knife region production. However, if the production skill of Knife region pottery was generally lower than that of Heart region pottery, then the difference between the Molander assemblage—which exhibits most characteristics of pottery made in the Knife region—and contemporaneous Heart region samples may primarily reflect different economic practices rather than technological change prompted by epidemic disease outbreaks or the fur trade.

Although clear similarities exist between the characteristics of the Molander vessel assemblage and Knife region potting practices, the presence of Sperry ware pots at Molander indicates that the community's residents maintained economic—and perhaps social—connections to contemporaneous Heart region settlements. Those connections may have included participation in the local Heart region trade network. Other characteristics of the Molander assemblage, such as relatively small braces on Knife River ware pots or the presence of vessels with faint S-rims and paddle-stamped decoration, may also point to economic or social connections with Heart region communities.

Subsistence Practices

As is the case for other northern Middle Missouri samples, Molander's botanical and faunal samples reflect a complex multi-focal subsistence economy. Although dominated by bison, the 2018 vertebrate sample includes a wide variety of fish, bird, and mammal species. Comparisons between Knife and Heart region assemblages are complicated by analytic differences, as well as by sampling issues. However, the proportions of fish, bird, and small-to-medium mammal bones in the Molander assemblage may be more comparable to Heart region samples than to Knife region samples. Mitchell (2013a) suggests that diet breadth may have been greater in the Heart region that the Knife region after 1500. That pattern may also be reflected at Molander. However, harvest practices may also reflect the effects of the fur trade. The fact that Knife region archaeofauna postdating the middle of the eighteenth century are dominated by bison may reflect the growth of the bison robe trade

Harvest of freshwater mussels was common at some Heart region communities but is not reflected in the 2018 Molander sample. Whether that reflects a dietary preference or the distribution of suitable mussel habitat is not known. Also rare in the suite of subsistence remains in the Molander collection are the seeds of weedy annuals, including both domesticated and wild varieties. Sunflower seeds (representing cultivated and wild varieties) are present, along with smaller numbers of chenopod and sedge seeds. However, marshelder seeds—small numbers of which occur in many Heart region assemblages—are absent. It is not known whether this reflects a simplification of the agricultural system during the fur trade or Hidatsa dietary preferences or cultivation practices.

Summary

These comparisons show that the Awaxawi community at Molander cultivated different kinds of relationships with their neighbors to the north and south. Their ties to the Mandan communities of the Heart River region appear to have been primarily economic. Molander's residents exploited a lithic territory similar to that of contemporaneous Heart river villagers. That resource zone, which extended west of the mouth of the Heart and northward from the headwaters of the Grand River to the headwaters of the Knife River, had been used by Heart River communities for centuries. Molander's residents may also have participated in the local Heart region market system that developed after 1500.

By contrast, Molander's ties to Hidatsa communities of the Knife River region appear to have been primarily cultural. Molander's potters produced vessels similar in style to those of their upstream contemporaries. Aspects of earthlodge and feature design documented at Molander—including white-surfaced floors and large extramural hearths—also occur at Awatixa Village on the lower Knife river (Mitchell In prep.)

Recommendations for Future Research

Both collections research and additional field research could be conducted to further evaluate the interpretations presented in this report and to provide additional data bearing on regional archaeological history.

Productive collections research could focus on reanalysis of selected pottery samples previously studied by Ahler and Swenson (1993). Reexamination of the Molander KNRI sample (Batch 4) would resolve lingering questions about the differences between that sample and the 2018 sample. A surprising lack of congruity—in the distributions of body sherd surface treatment classes, rim form classes, and pottery wares—exists between these two Molander samples. Investigating those differences could contribute to a more complete understanding of the site's occupational history or two contemporaneous material variation across the site. The differences may also be a product of changes to the ceramic coding system. Reanalysis of the Molander KNRI sample, as well as KNRI samples from Big Hidatsa, Lower Hidatsa, and Awatixa villages, would increase the comparability of Knife and Heart region pottery samples. Technological analysis of Knife region pottery samples, including evaluations of producer skill, would also contribute to regional comparisons.

Additional analysis of the Mahhaha sample (Batch 29), as well as the late sample from Amahami Village (Batch 41), would help clarify the cultural relationships among the sites. If the Awaxawis occupied Mahhaha immediately after Molander, and immediately prior to Amahami, then clear trends in pottery form and design should be apparent among them.

Analysis of the large, but mostly unstudied, TP0 assemblage from Double Ditch Village (1725-1785) would also contribute greatly to an understanding of differences between the Heart region and the Knife region during the eighteenth century. Analysis of stone tools from TP0 contexts, for which no data are currently available, would also contribute important data.

Additional limited excavation at Molander would add greatly to the interpretations presented in this report on the site's occupation history and on eighteenth-century earthlodge architecture. An investigation focused on H11, for which detailed ground-penetrating radar data are available and which appears to be especially well-preserved, likely would prove especially fruitful.

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Appendix A:

Photogrammetric Control Points

Table A.1. Photogrammetric control point data.

	Local Grid Coordinates			UTM Coordinates (NAD83)		
Point	Northing	Easting	Z	Northing	Easting	Height
CP1	319.896	299.941	99.746	5220870.053	350694.573	523.027
CP2	259.978	299.897	99.788	5220810.170	350693.389	523.045
CP3	201.311	299.414	100.097	5220751.523	350691.824	523.381
CP4	199.803	379.980	99.196	5220748.557	350772.314	522.465
CP5	199.841	440.060	98.828	5220747.445	350832.352	522.113
CP6	198.353	522.270	96.148	5220744.426	350914.527	519.432
CP7	260.796	522.379	95.751	5220806.891	350915.743	519.026
CP8	355.439	521.981	94.370	5220901.481	350917.110	517.632
CP9	438.498	349.121	97.407	5220990.604	350907.501	517.099
CP10	424.837	287.497	99.295	5220987.701	350745.863	520.712
CP11	383.609	285.248	89.665	5220975.126	350683.994	522.561
CP12	nd	nd	nd	5220933.991	350681.019	512.956
CP13	314.196	461.682	97.577	5220861.334	350856.071	520.868
CP14	279.792	380.021	99.300	5220828.528	350773.777	522.578

Appendix B:
Magnetic Map

Kenneth L. Kvamme

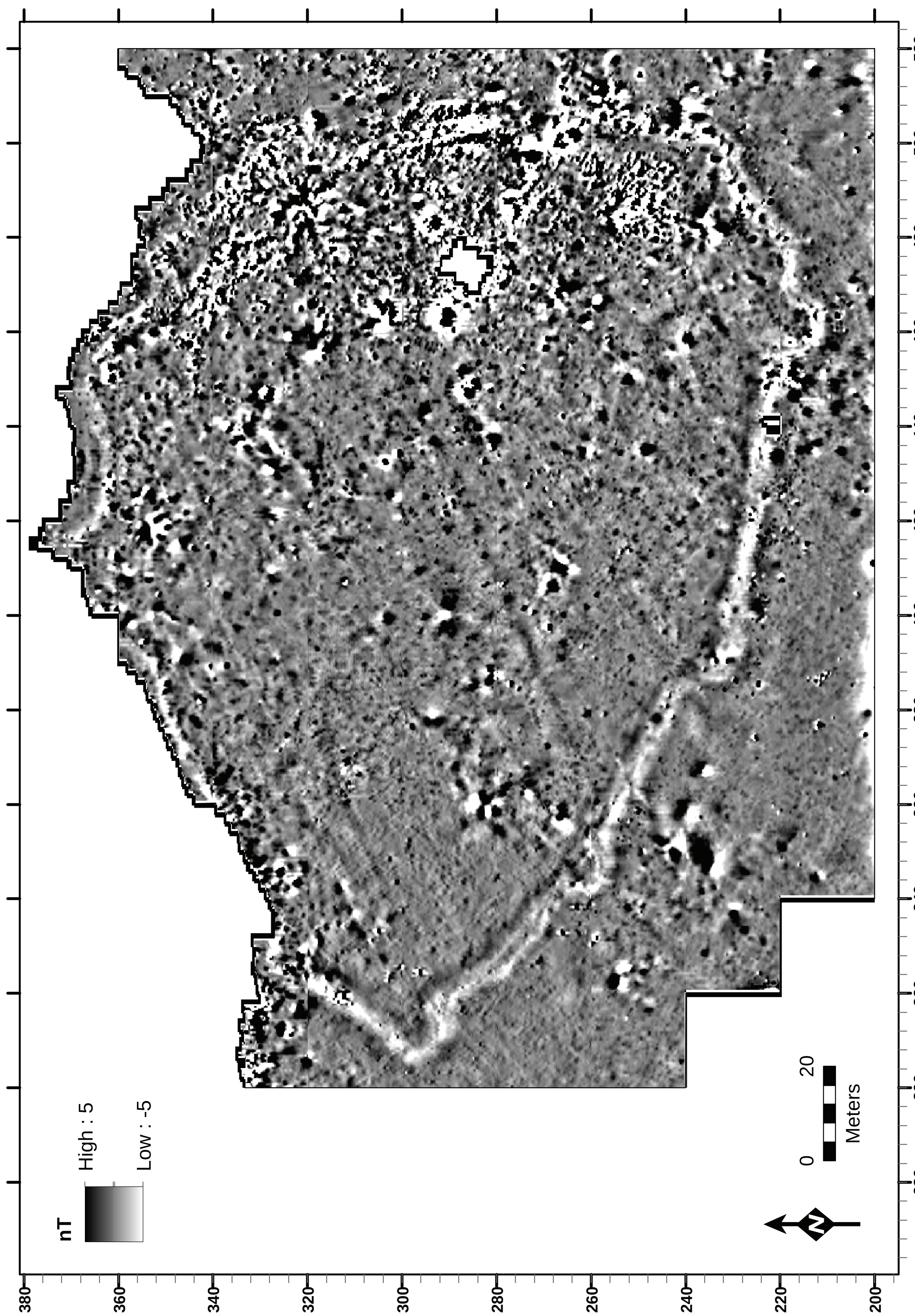

Figure B.1. Complete magnetic gradiometer map of the Molander site.

Appendix C:
Hand Coring Data

Table C.1. Hand coring data. Cores within or adjacent to excavated features are indicated by shading.

				Local Grid Coordinates					
Field Year	Date	Anomaly No.	Core No.	Northing	Easting	Maximum Depth (cm)	Reason for Termination	Magnetic Intensity (nT)	Interpretation
2017	8/3/2017	2017-1	1	236.00	349.00	57	Compact	28.8	No feature; boulder?
2017	8/3/2017	2017-1	2	237.00	349.00	57	Compact		
2017	8/3/2017	2017-2	3	236.25	341.75	83	Sterile	13.8	No feature
2017	8/3/2017	2017-3	4	236.00	329.00	72	Rock?	17.3	No feature
2017	8/3/2017	2017-4	5	230.00	337.00	67	Sterile	24.5	No feature; boulder?
2017	8/3/2017	2017-5	6	287.00	356.00	81	Sterile	6.0	No feature
2017	8/3/2017	2017-6	7	289.00	368.00	74	Compact	9.2	Probable pit
2017	8/3/2017	none	8	292.00	379.00	73	Sterile	-1.4	[no anomaly]
2017	8/3/2017	2017-7	9	279.00	355.00	73	Sterile	15.3	No feature
2017	8/3/2017	2017-8	10	269.00	372.50	78	Compact	20.9	Possible pit
2017	8/3/2017	2017-9	11	260.35	379.65	80	Sterile	22.5	No feature
2017	8/3/2017	2017-5	12	287.00	356.00	82	Sterile		
2017	8/3/2017	2017-10	13	276.25	359.00	58	Base of feature	6.0	Hearth
2017	8/3/2017	2017-10	14	275.75	359.00	60	Base of feature		
2017	8/3/2017	2017-10	15	276.75	359.00	69	Base of feature		
2017	8/3/2017	2017-10	16	276.25	358.50	78	Base of feature		
2017	8/3/2017	2017-10	17	276.25	359.50	64	Base of feature		
2017	8/3/2017	2017-11	18	273.00	364.50	60	Sterile	20.6	No feature
2017	8/3/2017	2017-12	19	277.00	364.50	67	Sterile	15.8	No feature
2017	8/3/2017	2017-12	20	278.00	363.50	70	Sterile		
2017	8/3/2017	2017-13	21	269.50	355.00	70	Compact	14.4	Probable pit
2017	8/3/2017	2017-14	22	271.00	353.00	52	Compact	5.0	No feature
2017	8/3/2017	2017-15	23	288.00	365.00	48	Compact	8.9	No feature
2017	8/3/2017	2017-16	24	292.00	377.00	50	Compact	10.0	No feature
2017	8/3/2017	2017-17	25	294.50	377.00	50	Compact	11.7	No feature
2017	8/3/2017	none	26	223.50	334.00	53	Sterile	-0.2	[no anomaly]
2017	8/3/2017	none	27	227.00	332.00	57	Sterile	-0.9	[no anomaly]
2017	8/3/2017	2017-18	28	227.00	333.00	36	n/d	23.4	Possible pit; boulder?
2017	8/3/2017	2017-19	29	223.50	331.00	70	Sterile	7.1	No feature
2017	8/4/2017	2017-20	51	217.00	451.00	43	Wood	84.9	Historic pit
2017	8/4/2017	2017-21	52	318.50	505.00	57	Wood	101.3	Historic pit
2017	8/4/2017	2017-22	53	246.00	378.50	65	Compact	17.7	Pit or ditch fill

Table C.1. Hand coring data (*continued*).

Field Year	Date	Anomaly No.	Core No.	Local Grid Coordinates: Northing	Local Grid Coordinates: Easting	Maximum Depth (cm)	Reason for Termination	Magnetic Intensity (nT)	Interpretation
2017	8/4/2017	2017-23	54	244.50	443.50	102	Compact	18.2	Hearth; possibly over pit
2017	8/4/2017	2017-24	55	245.00	451.00	112	Loose sediment	8.0	Possible pit
2017	8/4/2017	2017-25	56	243.00	457.00	50	Rock?	15.3	Pit (Block 2 Anomaly)
2017	8/4/2017	2017-25	57	243.20	457.00	101	End of probe		
2017	8/4/2017	2017-26	58	251.00	455.50	90	Compact	17.7	Pit
2017	8/4/2017	2017-27	59	253.00	455.00	68	Compact	16.8	Possible pit
2017	8/4/2017	2017-28	60	261.00	402.00	73	Bone	15.9	Hearth
2017	8/4/2017	2017-29	61	265.50	400.00	70	Compact	18.2	Pit
2017	8/4/2017	2017-30	62	274.50	401.50	62	Compact	24.3	Hearth?
2017	8/4/2017	2017-31	63	266.00	394.50	69	Bone	8.4	Possible pit
2017	8/4/2017	2017-32	64	266.50	391.00	90	Sterile	10.7	Hearth
2017	8/4/2017	2017-33	65	275.50	388.50	62	Sterile	5.6	No feature
2017	8/4/2017	none	66	281.00	387.00	60	Sterile	0.8	[no anomaly]
2017	8/4/2017	2017-34	67	281.00	389.00	53	Sterile	19.7	No feature
2017	8/4/2017	2017-35	68	280.50	391.50	15	Rock	6.8	No feature
2017	8/4/2017	2017-35	69	280.30	391.50	57	Sterile		
2017	8/4/2017	2017-36	70	285.00	395.50	64	Sterile	10.3	No feature
2017	8/4/2017	2017-37	71	295.00	400.00	45	Compact	14.2	No feature
2017	8/4/2017	2017-38	72	296.50	409.20	62	Compact	12.1	No feature
2017	8/4/2017	2017-39	73	291.00	418.50	10	Rock	6.3	Rock
2017	8/4/2017	2017-40	74	282.50	412.50	113	Rock	13.0	Pit (Block 4 Anomaly)
2017	8/2/2017	Transect	T1	280.00	300.50	50			
2017	8/4/2017	Transect	T10	280.00	317.50	40			
2017	8/4/2017	Transect	T11	280.00	320.50	21			
2017	8/4/2017	Transect	T12	280.00	323.50	92			
2017	8/4/2017	Transect	T13	280.00	325.00	58			
2017	8/4/2017	Transect	T14	280.00	328.00	65			
2017	8/4/2017	Transect	T15	280.00	330.50	33			
2017	8/4/2017	Transect	T16	280.00	333.50	10			
2017	8/4/2017	Transect	T17	280.00	334.00	67			
2017	8/2/2017	Transect	T2	280.00	302.50	57			
2017	8/2/2017	Transect	T3	280.00	304.50	130			

Table C.1. Hand coring data (*continued*).

Field Year	Date	Anomaly No.	Core No.	Local Grid Coordinates: Northing	Easting	Maximum Depth (cm)	Reason for Termination	Magnetic Intensity (nT)	Interpretation
2017	8/2/2017	Transect	T4	280.00	306.50	22			
2017	8/2/2017	Transect	T5	280.00	307.50	90			
2017	8/2/2017	Transect	T6	280.00	309.50	87			
2017	8/2/2017	Transect	T7	280.00	311.50	95			
2017	8/4/2017	Transect	T8	280.00	314.50	13			
2017	8/4/2017	Transect	T9	280.00	314.75	92			
2018	8/4/2018	2018-1	1	304.00	327.50	42	Compact	7.3	No feature
2018	8/4/2018	2018-4	4	307.00	326.50	76	Rock	6.3	Pit
2018	8/4/2018	2018-4	4.1	307.00	326.65	88	Sterile		
2018	8/4/2018	none	5	296.50	327.50	108	Sterile	0.7	[no anomaly]
2018	8/4/2018	none	5.1	296.80	327.50	79	Compact		
2018	8/4/2018	2018-6	6	282.50	412.50	107	Compact	13.0	Pit (Block 4 Anomaly)
2018	8/4/2018	2018-6	6.2	283.00	412.50	77	Compact		
2018	8/5/2018	2018-7	7	292.50	411.50	34	Rock	9.8	Boulder?
2018	8/5/2018	2018-7	7.1	292.50	411.75	22	Rock		
2018	8/5/2018	2018-7	7.2	292.50	411.25	21	Rock		
2018	8/4/2018	2018-8	8	295.00	399.50	50	Rock	14.2	No feature
2018	8/4/2018	2018-8	8.1	295.00	399.75	79	Rock		
2018	8/5/2018	2018-9	9	295.00	425.00	85	Sterile	9.1	No feature
2018	8/5/2018	2018-10	10	243.00	457.00	111	Rock	15.3	Pit (Block 2 Anomaly)
2018	8/5/2018	2018-10	10.1	243.00	457.25	29	Compact		
2018	8/5/2018	2018-10	10.2	243.00	456.75	46	Compact		
2018	8/5/2018	2018-10	10.3	242.75	457.00	30	Compact		
2018	8/5/2018	2018-11	11	242.00	442.50	80	Compact	21.4	No feature; boulder?
2018	8/5/2018	2018-12	12	236.50	433.50	83	Compact	22.1	Possible pit
2018	8/5/2018	2018-13	13	232.00	434.50	72	Rock	11.5	No feature
2018	8/5/2018	2018-14	14	240.50	404.50	100	Sterile	18.2	Pit
2018	8/5/2018	none	15	243.50	413.00	122	Sterile	-0.7	[no anomaly]
2018	8/6/2019	2018-16	16	232.50	430.00	66	Sterile	15.7	Possible pit
2018	8/6/2018	none	17	239.00	428.50	33	Rock	2.8	[no anomaly]
2018	8/6/2018	none	17.1	239.25	428.50	53	Sterile		
2018	8/7/2018	2018-18	18	259.00	404.50	20	Rock	21.1	Pit (Block 3 Anomaly)
2018	8/7/2018	2018-18	18.1	258.75	404.50	25	Rock		

Table C.1. Hand coring data (*continued*).

Field Year	Date	Anomaly No.	Core No.	Local Grid Coordinates Northing	Local Grid Coordinates Easting	Maximum Depth (cm)	Reason for Termination	Magnetic Intensity (nT)	Interpretation
2018	8/7/2018	2018-18	18.2	258.75	404.25	7	Rock		
2018	8/7/2018	2018-18	18.3	259.25	404.50	7	Rock		
2018	8/7/2018	2018-18	18.4	259.00	404.75	52	Rock		
2018	8/7/2018	2018-18	18.5	258.50	404.50	33	Rock		
2018	8/7/2018	2018-18	18.6	259.00	404.00	127	Sterile		
2018	8/6/2018	2018-19	19	254.75	417.50	3	Rock	7.7	Pit
2018	8/6/2018	2018-19	19.1	254.85	417.50	11	Rock		
2018	8/6/2018	2018-19	19.2	254.75	417.40	145	End of probe		
2018	8/6/2018	2018-20	20	236.00	393.75	131	Rock	8.5	Pit
2018	8/7/2018	2018-21	21	219.50	351.00	55	Rock	7.9	Possible pit
2018	8/7/2018	2018-21	21.1	220.00	351.00	70	Rock		
2018	8/15/2018	2018-22	22	227.50	345.50	112	Rock	9.9	No feature; boulder?
2018	8/7/2018	2018-26	26	334.00	378.50	110	Rock	9.9	Hearth
2018	8/9/2018	2018-26	26.1	334.50	378.50	85	Sterile		
2018	8/9/2018	2018-29	29	335.50	381.75	38	Rock	7.0	Pit (Block 5 Anomaly)
2018	8/9/2018	2018-29	29.1	336.00	381.75	102	Sterile		
2018	8/9/2018	2018-29	29.2	335.25	381.75	44	Rock		
2018	8/9/2018	2018-29	29.3	335.50	381.50	72	Sterile		
2018	8/9/2018	2018-29	29.4	335.50	382.00	44	Rock		
2018	8/9/2018	2018-30	30	329.00	376.50	112	Sterile	5.7	Pit
2018	8/9/2018	2018-30	30.1	329.25	376.50	80	Sterile		
2018	8/9/2018	2018-31	31	337.00	375.25	79	Sterile	7.2	Pit
2018	8/9/2018	2018-33	33	334.00	385.50	26	Bone	GPR	Pit
2018	8/9/2018	2018-33	33.1	333.75	385.50	107	Sterile		
2018	8/9/2018	2018-34	34	326.00	383.00	117	Rock	GPR	Possible pit
2018	8/9/2018	2018-34	34.1	325.75	383.00	20	Compact		
2018	8/9/2018	2018-34	34.2	325.65	383.00	20	Compact		
2018	8/9/2018	2018-34	34.3	326.00	382.75	105	Sterile		
2018	8/4/2018	Ditch	D0	224.92	432.18	95	Sterile		Max depth of fill
2018	8/15/2018	Ditch	D1	212.47	460.46	51			
2018	8/15/2018	Ditch	D10	349.77	482.23	73			
2018	8/15/2018	Ditch	D11	354.88	464.72	47			
2018	8/15/2018	Ditch	D12	320.40	322.02	65			

Table C.1. Hand coring data (*continued*).

				Local Grid Coordinates					
Field Year	Date	Anomaly No.	Core No.	Northing	Easting	Maximum Depth (cm)	Reason for Termination	Magnetic Intensity (nT)	Interpretation
2018	8/15/2018	Ditch	D13	303.24	312.17	119			
2018	8/15/2018	Ditch	D14	289.13	319.73	87			
2018	8/15/2018	Ditch	D15	272.96	333.31	72			
2018	8/15/2018	Ditch	D16	260.43	342.38	75			
2018	8/15/2018	Ditch	D17	256.67	356.80	48			
2018	8/15/2018	Ditch	D18	245.83	376.52	67			
2018	8/15/2018	Ditch	D19	234.32	388.61	90			
2018	8/15/2018	Ditch	D2	218.92	476.12	102			
2018	8/15/2018	Ditch	D20	228.19	409.83	53			
2018	8/5/2018	Ditch	D21	225.45	426.55	98	Rock		Max depth of fill
2018	8/5/2018	Ditch	D22	224.39	438.07	109	Gravel		Max depth of fill
2018	8/15/2018	Ditch	D3	229.79	491.10	66			
2018	8/15/2018	Ditch	D4	245.97	502.40	107			
2018	8/15/2018	Ditch	D5	269.37	508.56	70			
2018	8/15/2018	Ditch	D6	286.60	503.21	70			
2018	8/15/2018	Ditch	D7	303.92	498.36	60			
2018	8/15/2018	Ditch	D8	321.44	501.78	70			
2018	8/15/2018	Ditch	D9	335.21	489.60	52			

Appendix D: Comparative Batch Data

Comparative data used in this report derive from multiple sources. Original project datasets for sites located within the Knife River Indian Villages National Historic Site (KNRI) were generously provided by the National Park Service Midwest Archeological Center. Coding formats for these data are described in Ahler (1987). These datasets, which Ahler (1987:1) describes as "excavated artifact inventories," primarily comprise count and weight data on artifact batches. These data were supplemented with detailed artifact coding data presented in individual project reports for each site as well as summaries of coded data presented in Ahler and Swenson (1993). Data on Knife River region sites located outside the KNRI are presented in Ahler and Swenson (1993), Lehmer and others (1978), and Wood (1986). Data on Heart River region sites are stored in relational databases compiled and maintained by PCRG. Coding formats for these databases are described in reports prepared for each project.

Analytic Batches

An "analytic batch" or "analytic unit" is a collection of artifacts and other materials drawn from a defined archaeological context or contexts that are thought to represent "a chronologically and/or culture-historically distinct context" (Ahler and Swenson 1993:5). Researchers use multiple attributes to allocate specific catalog numbers to an analytic unit, including site stratigraphy, chronometric data, artifact seriation, and other factors. The procedures used to define analytic units vary according to the characteristics of the archaeological deposits investigated, the excavation methods used, the scope of the collected assemblages, and the specific research questions posed. Methods of analytic unit definition are described in Ahler and Swenson (1993) and in site-specific project reports.

The analytic batches initially identified as potential comparative samples for the Molander analysis are listed in tables D.1 and D.2. Table D.1 organizes batches by Smithsonian site number and median date. In table D.2 the same batches are organized by regional period and median date.

Apart from On-A-Slant Village, the analytic units defined by Ahler and Swenson (1993) were used without modification for sites included in their regional pottery study and their unique batch numbers are retained. For On-A-Slant, data presented in Ahler (ed. 1997) are used instead of Ahler and Swenson's (1993) Batches 0/1 and 2/3. For other sites, the analytic batches defined by the original investigators are used and new unique numbers are assigned.

In the current study, two batches from Lower Hidatsa Village that are allocated to a common time period were combined. Time Periods 3 and 4 from Scattered Village were similarly combine. All batches from controlled contexts from Sakakawea Village were combined into a single batch.

Table D.1. Regional comparative batches organized by site number and date range.

Name	Number	Regional Period	Batch	Region[a]	KNRI Batch	Analytic Unit/ Site Period	Date Range	Median Date	Volume (m^3)	Reference
Chief Looking's	32BL3	1500-1600	116	2		TP4	1550-1600	1575	3.379	Mitchell, ed. 2013
Double Ditch	32BL8	1700-1800	108	2		TP0	1725-1785	1755	6.744	Ahler, ed. 2005
Double Ditch	32BL8	1700-1800	107	2		TP1	1675-1725	1700	12.602	Ahler, ed. 2003a, 2004, 2005
Double Ditch	32BL8	1600-1700	106	2		TP2	1650-1700	1675	5.269	Ahler, ed. 2003a, 2004, 2005
Double Ditch	32BL8	1600-1700	105	2		TP3	1600-1650	1625	23.297	Ahler, ed. 2003a, 2004, 2005
Double Ditch	32BL8	1500-1600	104	2		TP4	1500-1600	1550	22.218	Ahler, ed. 2003a, 2004, 2005
Larson	32BL9	1500-1600	115	2		TP3/4	1500-1650	1575	11.971	Mitchell, ed. 2007, 2008
Lower Hidatsa	32ME10	1700-1800	44	1	44	TP1	1740-1780	1760	1.262	Ahler and Weston 1981
Lower Hidatsa	32ME10	1700-1800	45	1	45	TP2	1700-1740	1720	2.163	Ahler and Weston 1981
Lower Hidatsa	32ME10	1600-1700	46	1	46	TP3	1650-1700	1675	4.473	Ahler and Weston 1981
Lower Hidatsa	32ME10	1600-1700	47	1	47	TP4	1600-1650	1625	2.486	Ahler and Weston 1981
Lower Hidatsa	32ME10	1500-1600	48	1	48-49	TP5 and TP6	1525-1600	1563	3.736	Ahler and Weston 1981
Sakakawea	32ME11	1800-1900	59	1	59-62	AC3-12	1797-1834	1815	18.462	Ahler *et al.* 1980
Big Hidatsa	32ME12	1800-1900	64	1	64	TP1	1830-1845	1838	2.100	Ahler and Swenson 1985
Big Hidatsa	32ME12	1800-1900	65	1	65	TP2	1790-1830	1810	6.259	Ahler and Swenson 1985
Big Hidatsa	32ME12	1700-1800	66	1	66	TP3	1745-1790	1775	8.819	Ahler and Swenson 1985
Big Hidatsa	32ME12	1700-1800	67	1	67	TP4	1700-1745	1725	5.153	Ahler and Swenson 1985
Big Hidatsa	32ME12	1600-1700	68	1	68	TP5	1650-1700	1675	3.614	Ahler and Swenson 1985
Big Hidatsa	32ME12	1600-1700	69	1	69	TP6	1600-1650	1625	1.632	Ahler and Swenson 1985
Rock	32ME15	1800-1900	82	1	82	RBS	1780-1840	1810	nd	Ahler and Swenson 1993
Star	32ME16	1800-1900	83	1	83	RBS	1861-1862	1862	nd	Ahler and Swenson 1993
Fort Clark 2012	32ME2	1800-1900	119	1		Cabin	1850-1861	1855	0.820	Mitchell, ed. 2014
Fort Clark 2012	32ME2	1800-1900	120	1		Pre-Cabin	1839-1850	1844	0.665	Mitchell, ed. 2014
Fort Clark 2000	32ME2	1800-1900	118	1		Village	1822-1860	1841	1.415	Ahler, ed. 2003b
Taylor Bluff	32ME366	1800-1900	94	1	94	AC3	1834-1845	1840	7.467	Ahler ed. 1988
Deapolis	32ME5	1800-1900	38	1	38	Thompson	1820-1855	1838	nd	Ahler and Swenson 1993
Amahami	32ME8	1800-1900	41	1	41	Late	1780-1845	1813	nd	Ahler and Swenson 1993
Like-A-Fishhook	32ML2	1800-1900	85	1	85	RBS	1845-1886	1866	nd	Ahler and Swenson 1993
Nightwalker's Butte	32ML39	1700-1800	86	1	86	RBS	1700-1780	1740	nd	Ahler and Swenson 1993
Slant	32MO26	1700-1800	103	2		TP1	1725-1785	1755	2.599	Ahler, ed. 1997
Slant	32MO26	1600-1700	102	2		TP2	1625-1725	1675	4.878	Ahler, ed. 1997
Slant	32MO26	1600-1700	101	2		TP3	1575-1625	1600	4.813	Ahler, ed. 1997
Scattered	32MO31	1600-1700	111	2		TP1	1650-1700	1675	9.961	Ahler, ed. 2002
Scattered	32MO31	1600-1700	110	2		TP2	1600-1650	1625	19.236	Ahler, ed. 2002

Table D.1. Regional comparative batches organized by site number and date range (*continued*).

Name	Number	Regional Period	Batch	Region[a]	KNRI Batch	Analytic Unit/ Site Period	Date Range	Median Date	Volume (m^3)	Reference
Scattered	32MO31	1500-1600	109	2		TP3 and TP4	1550-1600	1575	10.233	Ahler, ed. 2002
Boley	32MO37	1700-1800	112	2		TP1	1675-1725	1700	3.319	Ahler, ed. 2006
Boley	32MO37	1600-1700	113	2		TP2	1650-1700	1675	0.861	Ahler, ed. 2006
Boley	32MO37	1500-1600	114	2		TP3/4	1500-1650	1575	2.868	Ahler, ed. 2006
Greenshield	32OL17	1700-1800	19	1	19	Lehmer/Wood-Lehmer	1780-1800	1790	nd	Ahler and Swenson 1993; Wood 1986
Mahhaha	32OL22	1700-1800	29	1	29	TP1	1700-1780	1740	nd	Ahler and Swenson 1993; Wood 1986
Mahhaha	32OL22	1600-1700	30	1	30	TP2	1600-1700	1650	nd	Ahler and Swenson 1993; Wood 1986
Molander 2018	32OL7	1700-1800	117	1		PV	1735-1765	1750	5.162	This report
Molander KNRI	32OL7	1700-1800	4	1	4	SHSND/Wood-Lehmer	1700-1780	1740	nd	Ahler and Swenson 1993; Wood 1986

[a] 1-Knife region; 2=Heart region.

Table D.2. Regional comparative batches organized by regional period and median date.

Name	Number	Regional Period	Batch	Region[a]	KNRI Batch	Analytic Unit/ Site Period	Date Range	Median Date	Volume (m^3)	Reference
Double Ditch	32BL8	1500-1600	104	2		TP4	1500-1600	1550	22.218	Ahler, ed. 2003a, 2004, 2005
Lower Hidatsa	32ME10	1500-1600	48	1	48-49	TP5 and TP6	1525-1600	1563	3.736	Ahler and Weston 1981
Chief Looking's	32BL3	1500-1600	116	2		TP4	1550-1600	1575	3.379	Mitchell, ed. 2013
Larson	32BL9	1500-1600	115	2		TP3/4	1500-1650	1575	11.971	Mitchell, ed. 2007, 2008
Scattered	32MO31	1500-1600	109	2		TP3 and TP4	1550-1600	1575	10.233	Ahler, ed. 2002
Boley	32MO37	1500-1600	114	2		TP3/4	1500-1650	1575	2.868	Ahler, ed. 2006
Slant	32MO26	1600-1700	101	2		TP3	1575-1625	1600	4.813	Ahler, ed. 1997
Double Ditch	32BL8	1600-1700	105	2		TP3	1600-1650	1625	23.297	Ahler, ed. 2003a, 2004, 2005
Scattered	32MO31	1600-1700	110	2		TP2	1600-1650	1625	19.236	Ahler, ed. 2002
Big Hidatsa	32ME12	1600-1700	69	1	69	TP6	1600-1650	1625	1.632	Ahler and Swenson 1985
Lower Hidatsa	32ME10	1600-1700	47	1	47	TP4	1600-1650	1625	2.486	Ahler and Weston 1981;
Mahhaha	32OL22	1600-1700	30	1	30	TP2	1600-1700	1650	nd	Ahler and Swenson 1993; Wood 1986a
Double Ditch	32BL8	1600-1700	106	2		TP2	1650-1700	1675	5.269	Ahler, ed. 2003a, 2004, 2005
Scattered	32MO31	1600-1700	111	2		TP1	1650-1700	1675	9.961	Ahler, ed. 2002
Slant	32MO26	1600-1700	102	2		TP2	1625-1725	1675	4.878	Ahler, ed. 1997
Boley	32MO37	1600-1700	113	2		TP2	1650-1700	1675	0.861	Ahler, ed. 2006
Big Hidatsa	32ME12	1600-1700	68	1	68	TP5	1650-1700	1675	3.614	Ahler and Swenson 1985
Lower Hidatsa	32ME10	1600-1700	46	1	46	TP3	1650-1700	1675	4.473	Ahler and Weston 1981
Double Ditch	32BL8	1700-1800	107	2		TP1	1675-1725	1700	12.602	Ahler, ed. 2003a, 2004, 2005
Boley	32MO37	1700-1800	112	2		TP1	1675-1725	1700	3.319	Ahler, ed. 2006
Lower Hidatsa	32ME10	1700-1800	45	1	45	TP2	1700-1740	1720	2.163	Ahler and Weston 1981
Big Hidatsa	32ME12	1700-1800	67	1	67	TP4	1700-1745	1725	5.153	Ahler and Swenson 1985
Mahhaha	32OL22	1700-1800	29	1	29	TP1	1700-1780	1740	nd	Ahler and Swenson 1993; Wood 1986a
Molander KNRI	32OL7	1700-1800	4	1	4	SHSND/Wood-Lehmer	1700-1780	1740	nd	Ahler and Swenson 1993; Wood 1986a
Nightwalker's Butte	32ML39	1700-1800	86	1	86	RBS	1700-1780	1740	nd	Ahler and Swenson 1993
Molander 2018	32OL7	1700-1800	117	1		PV	1735-1765	1750	5.162	This report
Double Ditch	32BL8	1700-1800	108	2		TP0	1725-1785	1755	6.744	Ahler, ed. 2005
Slant	32MO26	1700-1800	103	2		TP1	1725-1785	1755	2.599	Ahler, ed. 1997
Lower Hidatsa	32ME10	1700-1800	44	1	44	TP1	1740-1780	1760	1.262	Ahler and Weston 1981;
Big Hidatsa	32ME12	1700-1800	66	1	66	TP3	1745-1790	1775	8.819	Ahler and Swenson 1985
Greenshield	32OL17	1700-1800	19	1	19	Lehmer/Wood-Lehmer	1780-1800	1790	nd	Ahler and Swenson 1993; Wood 1986a
Rock	32ME15	1800-1900	82	1	82	RBS	1780-1840	1810	nd	Ahler and Swenson 1993
Big Hidatsa	32ME12	1800-1900	65	1	65	TP2	1790-1830	1810	6.259	Ahler and Swenson 1985
Amahami	32ME8	1800-1900	41	1	41	Late	1780-1845	1813	nd	Ahler and Swenson 1993

Table D.2. Regional comparative batches organized by regional period and median date (*continued*).

Name	Number	Regional Period	Batch	Region[a]	KNRI Batch	Analytic Unit/ Site Period	Date Range	Median Date	Volume (m^3)	Reference
Sakakawea	32ME11	1800-1900	59	1	59-62	AC3-12	1797-1834	1815	18.462	Ahler *et al.* 1980
Deapolis	32ME5	1800-1900	38	1	38	Thompson	1820-1855	1838	nd	Ahler and Swenson 1993
Big Hidatsa	32ME12	1800-1900	64	1	64	TP1	1830-1845	1838	2.100	Ahler and Swenson 1985
Taylor Bluff	32ME366	1800-1900	94	1	94	AC3	1834-1845	1840	7.467	Ahler ed. 1988
Fort Clark 2000	32ME2	1800-1900	118	1		Village	1822-1860	1841	1.415	Ahler, ed. 2003b
Fort Clark 2012	32ME2	1800-1900	120	1		Pre-Cabin	1839-1850	1844	0.665	Mitchell, ed. 2014
Fort Clark 2012	32ME2	1800-1900	119	1		Cabin	1850-1861	1855	0.820	Mitchell, ed. 2014
Star	32ME16	1800-1900	83	1	83	RBS	1861-1862	1862	nd	Ahler and Swenson 1993
Like-A-Fishhook	32ML2	1800-1900	85	1	85	RBS	1845-1886	1866	nd	Ahler and Swenson 1993

[a] 1-Knife region; 2=Heart region.

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Appendix E:
Analytic Units, Coding Formats, and Data

Five variables were used to analyze each of the 2018 provenience lots (table E.1). Stratigraphic data were used to assign lots to a general temporal period. The primary purpose of this assignment was to ensure that the trade goods density calculation—the primary chronological method available for eighteenth-century sites—excluded the volume of excavated sediment that pre-dated the founding of the site's Plains Village occupation. Pre-Village deposits included both intact Oahe Formation deposits and displaced till (Coleharbor Formation) deposits exposed in Blocks 1 and 2. However, because a majority of 2018 artifact lots contained specimens associated with more than one of Molander's primary occupations, for most analyses artifact attributes rather that stratigraphic data were used to partition the collected materials into analytic units. Details on the specific procedures applied to different material classes are provided in each of this report's analytic chapters.

Provenience units were also allocated to both specific and general depositional classes and classified according to whether they occurred inside or outside an earthlodge. Three general deposit types are recognized in the 2018 analysis: contained deposits, uncontained deposits, and mixed or unassigned deposits. Contained deposits occur within discrete features, such as storage pits or small basins. Most contained deposits consist of discrete, basket-sized loads of domestic debris that accumulated rapidly. Artifacts recovered from contained deposits generally are larger than those recovered from other deposit types and are mixed with ash, charcoal, faunal remains, and feces. Provenience lots from all of the numbered features investigated in 2018, apart from the fortification ditch (Feature 12), fall into the contained deposit class.

Uncontained deposits accumulated on surfaces or in large borrow basins or trenches, including fortification ditches. The rate at which these deposits accumulated varied significantly. Many defensive features filled slowly with sediment deposited by wind and water, but domestic debris sometimes accumulated rapidly in large basins or in catastrophically burned semi-subterranean lodges. Artifacts from uncontained contexts often are more fragmented and occur in lower densities than artifacts from contained deposits. The matrix of uncontained deposits generally consists of a mixture of sediment, ash, and charcoal, sometimes interspersed with discrete basket loads of primary domestic debris. Disconformities—representing temporal gaps of unknown duration—occur more frequently in uncontained deposits than contained deposits due to erosion and intentional sediment borrowing and transport. In the 2018 Molander collection, provenience lots from earthlodge floor deposits and exterior sheet midden deposits are allocated to the uncontained deposit class.

Mixed or unassigned deposits incorporate artifacts and sediment from two or more primary or secondary depositional contexts. Deposits derived from unknown, and possibly mixed, contexts also are included in this class, as are culturally sterile deposits. Provenience lots from Molander allocated to the unassigned deposit class include natural terrace deposits as well as the single lot allocated to the unassigned temporal unit.

Analytic unit data for each of the 89 catalog numbers assigned in 2018 are presented in table E.2.

Table E.1. Analytic unit variables and attributes.

Variable	Description
TP	**General Time Period**
PV	Plains Village (1700s)
Pre-Village	Pre-Plains Village occupation(s)
Unassigned	Time period not determined
Deposit Type	**Depositional Group**
Surface	General level 1
Midden	Surface midden, including Ap horizon
Midden and Floor	Surface midden and earthlodge floor
Pit	Pit feature, including basins and posts
Cache Pit	Storage pit
Floor/Floor Fill	Earthlodge floor or fill between floors
Terrace	Terrace deposits, intact or displaced
Unassigned	Type not determined
General Type	**Depositional Class**
Contained	Closed features, excluding fortifications
Uncontained	Open strata
Unassigned	Class not determined
Inside House	**Relationship to Earthlodge**
O	Outside house
I	Inside house
U	Relationship not determined
Density Exclude[a]	**Trade Goods Density Exclusion**
N	Included in density calculation
Y	Excluded from density calculation

[a] Data not reported in table E.2.

Table E.2. Analytic unit data organized by catalog number.

CN	Block	Unit	GL	Fea.	FL	Sample Type	Description	TP	Deposit Type	Deposit General Type	Inside House	Volume (Liters)
1001	1	1	1			GL	Surface GL1; contains PV-age materials	PV	Surface	Uncontained	O	84.0
1002	1	4	1			GL	Surface GL1; contains PV-age materials	PV	Surface	Uncontained	O	68.0
1003	2	5	1			GL	Surface GL1; recent soil, not plowed	PV	Surface	Uncontained	I	68.0
1004	2	6	1			GL	Surface GL1; recent soil, midden	PV	Surface	Uncontained	I	48.0
1005	4	2	1			GL	Surface GL1; plow zone	PV	Surface	Uncontained	U	120.0
1006	4	3	1			GL	Surface GL1; plow zone	PV	Surface	Uncontained	U	104.0
1007	1	7	1			GL	Surface GL1	PV	Surface	Uncontained	O	48.0
1008	1	4	2			GL	Displaced till	pre-Village	Terrace	Unassigned	O	116.0
1009	1	1	2			GL	Displaced till	pre-Village	Terrace	Unassigned	O	92.0
1010	1	7	2			GL	Ditch spoil and surface midden	PV	Midden	Uncontained	O	100.0
1011	2	5	2			GL	Upper fill and upper floor	PV	Midden and Floor	Uncontained	I	100.0
1012	2	6	2			GL	Upper fill and upper floor	PV	Midden and Floor	Uncontained	I	100.0
1013	4	2		1	1	FL	Historic post mold filled with Village-age deposit	PV	Pit	Contained	U	5.0
1014	1	4	3			GL	Displaced till	pre-Village	Terrace	Unassigned	O	106.0
1015	1	1	3			GL	Displaced till	pre-Village	Terrace	Unassigned	O	112.0
1016	4	3	2			GL	Mottled cultural	PV	Midden	Uncontained	U	104.0
1017	2	5-6	3			GL	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	200.0
1019	1	1	4			GL	Till and A horizon beneath till	PV	Midden	Uncontained	O	56.0
1020	1	4	4			GL	Till and A horizon beneath till	PV	Midden	Uncontained	O	80.0
1021	1	7		2	1	FL	Post mold	PV	Pit	Contained	O	4.3
1022	1	4	5			GL	Intact terrace beneath till	pre-Village	Terrace	Unassigned	O	114.0
1023	1	1	5			GL	Intact terrace beneath till	pre-Village	Terrace	Unassigned	O	140.0
1024	1	7	3			GL	Ditch spoil and surface midden	PV	Midden	Uncontained	O	100.0
1025	4	3	3			GL	Mottled cultural	PV	Midden	Uncontained	U	20.0
1026	4	2	2			GL	Mottled cultural	PV	Midden	Uncontained	U	86.0
1027	2	8	1			GL	Surface GL1; recent soil, midden	PV	Surface	Uncontained	I	62.0
1028	1	4	6			GL	Intact terrace beneath till	pre-Village	Terrace	Unassigned	O	104.0
1029	1	1	6			GL	Intact terrace beneath till	pre-Village	Terrace	Unassigned	O	100.0
1030	1	7	4			GL	Ditch spoil and surface midden	PV	Midden	Uncontained	O	96.7
1031	3	9	1			GL	Surface GL1; midden	PV	Surface	Uncontained	O	66.0
1032	3	10	1			GL	Surface GL1; midden	PV	Surface	Uncontained	O	64.0
1033	2	8	2			GL	Upper fill and upper floor	PV	Midden and Floor	Uncontained	I	92.0
1034	4	2-3		3	1	FL	Shallow basin; pre-dates F4	PV	Pit	Contained	U	94.1
1035	3	9	2			GL	Mixing zone (cultural and A horizon); upper features	PV	Midden	Uncontained	O	48.0

Table E.2. Analytic unit data organized by catalog number (*continued*).

CN	Block	Unit	GL	Fea.	FL	Sample Type	Description	TP	Deposit Type	Deposit General Type	Inside House	Volume (Liters)
1036	3	10	2			GL	Mixing zone (cultural and A horizon); upper features	PV	Midden	Uncontained	O	50.0
1037	2	8	3			GL	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	70.0
1038	2	8	2			PP	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	0.0
1039	2	8	3			PP	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	0.0
1040	1	11	1			GL	Surface GL1	PV	Surface	Uncontained	O	48.0
1041	4	2-3		3	2	FL	Shallow basin; pre-dates F4	PV	Pit	Contained	U	78.1
1042	2	8	3			PP	Lower floor?	PV	Floor/Floor Fill	Uncontained	I	0.0
1043	2	8	3			PP	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	0.0
1044	2	8	3			PP	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	0.0
1045	2	8	3			PP	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	0.0
1046	2	8	3			PP	Between-floor fill	PV	Floor/Floor Fill	Uncontained	I	0.0
1047	3	9-10		5	1	FL	F5, F9, F13 mixed	PV	Cache Pit	Contained	O	43.4
1048	1	11	2			GL	Ditch spoil and surface midden	PV	Midden	Uncontained	O	98.0
1049	1	14	1	12		GL	Surface GL1	PV	Surface	Uncontained	O	56.8
1050	1	15		12	1	FL	Surface GL1, ditch spoil, ditch fill	PV	Surface	Uncontained	O	14.4
1051	4	2-3		4	1	FL	Hearth; postdates F6 and F3	PV	Pit	Contained	U	187.0
1052	1	11	3			GL	Ditch spoil, surface midden, and basin fill	PV	Midden	Uncontained	O	104.0
1053	4	2-3		4	1	PP	Hearth; block of ash	PV	Pit	Contained	U	0.0
1054	4	2-3		6	1	FL	Pit; predates F4; CN may include some F4	PV	Pit	Contained	U	130.4
1055	3	9-10		5	2	FL	F5, F9, F13 mixed	PV	Cache Pit	Contained	O	86.7
1056	4	2-3		6	1	PP	Could be in F4 or F6	PV	Pit	Contained	U	0.0
1057	2	5-8		7	1	FL	F7 pit	PV	Cache Pit	Contained	I	47.1
1059	3	9-10		9	1	FL	F9 only (younger than F5)	PV	Cache Pit	Contained	O	102.8
1060	1	14	2	12		GL	Ditch fill	PV	Midden	Uncontained	O	105.8
1061	5	12-13	1			GL	Surface GL1; modern soil and top of upper floor	PV	Midden and Floor	Uncontained	I	212.0
1062	1	16	1			GL	Surface GL1; Ditch spoil and surface midden	PV	Surface	Uncontained	O	98.0
1063	2	5-8		7	2	FL	F7 pit	PV	Cache Pit	Contained	I	44.5
1064	3	9-10		5	3	FL	F5 only (older than F9)	PV	Cache Pit	Contained	O	22.4
1065	2	5-8		7	3	FL	F7 pit	PV	Cache Pit	Contained	I	99.0
1066	2	5-8		7	3	PP	F7 pit	PV	Cache Pit	Contained	I	0.0
1067	2	5-8		7	4	FL	F7 pit	PV	Cache Pit	Contained	I	127.1
1068	1	14	3	12		GL	Ditch fill	PV	Midden	Uncontained	O	98.0
1069	3	9-10		9	1	BS	F9 only (younger than F5)	PV	Cache Pit	Contained	O	10.0
1070	2	5-8		7	4	PP	F7 pit	PV	Cache Pit	Contained	I	0.0

Table E.2. Analytic unit data organized by catalog number (*continued*).

CN	Block	Unit	GL	Fea.	FL	Sample Type	Description	TP	Deposit Type	Deposit General Type	Inside House	Volume (Liters)
1071	5	12-13	2			GL	Bottom of upper floor; between-floor fill; top of F10	PV	Floor/Floor Fill	Uncontained	I	200.0
1072	1	16	2			GL	Ditch spoil and surface midden	PV	Midden	Uncontained	O	100.0
1073	2	5-8		7	4	FL	F7 pit	PV	Cache Pit	Contained	I	0.0
1074	2	5-8		7	4	FL	F7 pit	PV	Cache Pit	Contained	I	0.0
1075	1	11	4			GL	Basin fill and B horizon	PV	Pit	Contained	O	100.0
1076	3	9-10			1	FL	Unnumbered feature or stratum pre-dating F5	Unassigned	Unassigned	Unassigned	O	13.1
1077	1	14	4	12		GL	Ditch fill	PV	Midden	Uncontained	O	86.0
1078	5	12-13	3			GL	Between-floor fill and lower floor; top of F10, F11	PV	Floor/Floor Fill	Uncontained	I	100.0
1079	1	14		12	1	FL	Ditch fill	PV	Midden	Uncontained	O	77.8
1080	5	12		10	1	FL	Basin assoc. w/ upper floor	PV	Pit	Contained	I	35.0
1081	5	12		10	2	FL	Basin assoc. w/ upper floor	PV	Pit	Contained	I	36.2
1082	1	16	3			GL	Basin fill and B horizon	PV	Pit	Contained	O	100.0
1083	5	13		11	1	FL	Pit assoc. w/ lower floor	PV	Cache Pit	Contained	I	43.7
1084	5	13		11	2	FL	Pit assoc. w/ lower floor	PV	Cache Pit	Contained	I	49.6
1085	1	14		12	2	FL	Ditch fill	PV	Midden	Uncontained	O	89.2
1086	1	15		12	2	FL	Ditch fill and B horizon	PV	Midden	Uncontained	O	28.8
1087	1	7	5			GL	B horizon	pre-Village	Terrace	Unassigned	O	100.0
1088	5	13		11	3	FL	Pit assoc. w/ lower floor	PV	Cache Pit	Contained	I	60.9
1089	5	13		11	4	FL	Pit assoc. w/ lower floor	PV	Cache Pit	Contained	I	42.0
1090	1	14		12	3	FL	Ditch fill	PV	Midden	Uncontained	O	61.3
1091	2	5				BS	pre-Village terrace sediment	pre-Village	Terrace	Unassigned	I	0.5

Appendix F:
Collection Processing and Quantification

The laboratory procedures used to process and quantify the 2018 Molander collection duplicated those that PCRG previously applied to other Plains Village collections from the Heart and Knife regions, including those from Double Ditch, Larson, Boley, Chief Looking's, and Fort Clark villages (e.g. Ahler 2004, 2006; Ahler and Mitchell 2007; Mitchell 2013, 2014). Those methods in turn largely duplicated approaches and processes developed for the study of collections recovered from sites in the Knife River Indian Villages National Historic Site (e.g. Ahler and Swenson 1985:69-85).

Because the 2018 excavation effort at Molander was closely guided by the results of the 2017 magnetic gradiometer survey (Kvamme 2018), none of the sampled contexts were assigned to a second-tier processing group. Second-tier samples commonly receive abbreviated study or even no processing at all. All samples recovered during 2018 were considered useful for study, and all waterscreen lots and plotted specimens were processed in the lab using a single, standardized routine. In addition, a sampling protocol was not used to estimate the content of size grade 4 (G4) waterscreen samples.

Collection Processing

All waterscreen samples were subjected to three basic processing steps: size-grading over nested screens, water flotation, and sorting into artifact and material classes. Artifacts or specimens recovered by piece-plotting were individually size-graded and assigned to a sort class. Together, these procedures portioned the recovered lots and specimens into standardized, size-matched sets of artifacts and other materials. Several discrete record-keeping steps designed to track the history of each sample occurred during the size-grading, floating, and sorting processes, as described in the processing guide that lab workers used (figure F.1).

During size-grading, samples were manipulated or shaken over nested screens with five graduated square mesh opening sizes (U.S. Standard Sieve Cloth): grade 1=1.000 in; grade 2=0.500 in; grade 3=0.223 in; grade 4=0.100 in; and grade 5=0.046 in. To minimize damage, artifacts were manipulated by hand through G1 and G2 screens. Samples were shaken for a standard 30-second interval over nested G3, G4, and G5 screens. Size-grading assists in the efficiency of the sorting process that follows, allowing the sorter to examine batches of specimens that are all approximately the same size. Size-grading also allows use of objective, size-determined cut-off points for sorting different types of artifacts. For example, pottery sorting can effectively cease at G3 samples, because smaller pottery fragments do not contain useful information about pottery style or manufacture. By contrast, glass trade beads and fragments of trade metal from G4 and G5 samples can provide important information about site chronology. In addition, size distribution data for certain artifact classes are in themselves useful for study of site formation processes as well as the technological processes performed at the site. Artifacts with different depositional histories can exhibit differing size distributions (Behm 1983; Sherwood *et al*. 1995). Distinct processing histories, such as different stone knapping technologies (Ahler 1989a, 1989b), can be identified through careful attention to data controlled by size grade.

Lab Procedures Specific to the 2018 Molander Collection

The 2018 collection includes 74 waterscreen lots (26 feature-level lots and 48 general-level lots); 11 plotted artifact lots, several of which comprise multiple items; two lots consisting of separately collected but unplotted artifacts; and two bulk lots, one of which was collected for radiocarbon dating. Artifact and material sort classes applied to the collection are listed

PROCESSING GUIDE – STEPS IN PROCESSING WATERSCREENED FIELD SAMPLES
2018 MOLANDER EXCAVATIONS

1. Use the field catalog or an external list and **check the number of field bags** expected for a given catalog number. Do not process a catalog number until all field bags have been brought together. Log in the number of bags expected and the number found when size grading is started.
2. **Size-grade** by hand, manipulating G1 and G2, then vigorously shaking G3, G4, and G5 for 30 seconds.
3. **Record** catalog number and check off size grading in the **Processing Log**.
4. Set G1, G2, and G3 samples aside and **float and separate G4 and G5** samples into heavy and light fractions; label appropriately for drying.
5. **Record** that floating has been done for that catalog number in **Processing Log**.
6. When dry, bag in plastic the heavy and light fractions of G4 and G5 remains, **place light fraction in appropriate box**, and set all heavy fraction size-graded samples aside for sorting. See section 11 below for bag labeling instructions.
7. **Record** that bagging has been done for this catalog number in the **Processing Log.**
8. **Conduct the sorting process using the Sorting Guide**. Have your sort decisions and categories checked by a supervisor unless you have been cleared to sort without checking.
9. After sorting G4 and G5, **weigh the unsorted residue** to the nearest 1 gram on the electronic scale, and write down weights.
10. **Bag appropriately**, using cover bags for multiple size grades.
11. **BAG LABELING PROTOCOL:** Place the SHSND **Accession Number** for the collection [**2019A.27**] in upper right corner of every plastic bag**.** Place **Catalog Number** over a line over the **Site Number** in the upper left corner. Put the **Unit Coordinates** below the site number and the **Unit Number** below that. On the next line write the **General Level Number** or the **Feature Number**. If applicable, write the **Feature Level Number** below that. Place **size grade** (G1, G2, G3 etc.) and **material class** information below. **Examples**:

1001	2019A.27	1034	2019A.27	1075	2019A.27
32OL7		32OL7		32OL7	
219NE431		281.5NE412.5		228NE431	
Unit 1		Unit 2/3		Unit 11	
GL1 (20-30 cm DD)		Feat. 3		GL4 (50-60 cm DD)	
G2		FL1 (39-50 cm DD)		G3	
Nat Rock		G4		Bone	
		Mod Stone			

12. **Enter data** on counts of bags and weights of G4 and G5 residue in the **Sort Completion Check List**.
13. **Cut out** and save the labeled area from one of the paper field bags.
14. **Place all bags** of sorted material and bag labels in appropriate boxes for accumulation.

Figure F.1. Molander sample processing guide.

in table F.1, along with the size grades to which each class was applied. All of the objects in G1-3 (which together constitute the "coarse fraction" sample) were assigned into a distinct artifact or material class. Only selected objects were sorted from the G4 and G5 portions of each lot (the "fine fraction"), thereby creating an unsorted residue class for those samples.

Although the processing and quantification methods applied to the Molander collection corresponded to those applied to other Plains Village collections from the northern Middle Missouri, several minor procedural and classificatory variations were implemented. Two subclasses of fired clay were encountered in the Molander collection that previously had not been observed in regional Plains Village collections. Those new subclasses are described and illustrated in chapter 10. Pieces of fired clay ordinarily are sorted into the "Miscellaneous Plains Village" category; however, because the newly identified subtypes were abundant in the Molander collection, they were sorted into a separate "Fired Clay" category. Shaped fired clay artifacts were allocated to the Miscellaneous Plains Village category, as has been done previously.

Sorting classes for metal, glass, and porcelain artifacts were modified slightly from prior practice. A principal challenge for projects investigating seventeenth- and eighteenth-century sites in the Middle Missouri is to differentiate between fragments of metal trade goods used by the settlement's inhabitants and metal items introduced later during the American Settlement period. That problem is acute at Molander, owing to the presence of a homestead component. To ensure that fur-trade era metal was properly isolated from recent metal, all metal artifacts were sorted into a single category, regardless of age. A secondary sorting process was implemented to separate eighteenth-century metal from metal artifacts dating to the late nineteenth and twentieth centuries.

Non-metallic historical artifacts were sorted into three categories: glass beads, other historic artifacts (dating to the fur-trade era), and recent historic artifacts (dating to the American Settlement period).

Table F.1. Sorting guide for the Molander 2018 collection.

	Size Grade				
Artifact or Material Class	G1	G2	G3	G4	G5
Earthenware Pottery (including rim sherds and body sherds)	✓	✓	✓		
Modified Stone (including stone tools and flaking debris)	✓	✓	✓	✓	
Clinker (including modified and unmodified)	✓	✓	✓		
Botanicals (including charred and uncharred seeds and maize)	✓	✓	✓	✓	
Fired Clay	✓	✓	✓		
Burned Earth	✓	✓	✓		
Ash	✓	✓	✓		
Charcoal	✓	✓	✓		
Fire-Cracked Rock	✓	✓	✓		
Wood and Bark (uncharred)	✓	✓	✓		
Ochre/Pigment	✓	✓	✓	✓	
Gypsum/Minerals	✓	✓	✓	✓	
Fossils	✓	✓	✓	✓	
Faunal Remains (including modified)	✓	✓	✓	ID and modified only	Modified only
Shell (including fossil, identifiable, and modified)	✓	✓	✓	ID and modified only	Modified only
Metal (including fur-trade era and recent)	✓	✓	✓	✓	✓
Glass Beads	✓	✓	✓	✓	✓
Recent Historic Artifacts (other than metal)	✓	✓	✓	✓	
Other Historic Artifacts (other than metal and glass beads)	✓	✓	✓	✓	✓
Miscellaneous Plains Village Artifacts	✓	✓	✓	✓	✓
Natural Rock	✓	✓	✓		
Unsorted Residue				✓	✓

In all cases, recent historical artifacts were easily distinguished from glass beads and fur trade-era non-metallic specimens. (No examples of the latter were identified, apart from a possible flake of historic glass.)

Unmodified wood and charcoal pieces previously have been sorted into a single category. However, a significant amount of uncharred bark occurred in the Molander collection. That material was isolated from charcoal into a separate category. Several pieces of uncharred wood (branches) were also sorted into the "Bark and wood, uncharred" category.

The State Historical Society of North Dakota assigned accession number 2019A.27 to the materials recovered in 2018. Unique object identification numbers were assigned to artifact lots according to the procedures described in SHSND (2016:7-8). Owing to the sorting and analysis procedures applied to the collection, and to its extent, unique numbers were applied to size-graded object lots rather than to individual items. In some cases, object class definitions were simplified during the accessioning process. For example, all unmodified faunal remains were assigned to a single class that included both identifiable and unidentified specimens. Most recovered specimens were bagged by material class, excavation block, catalog number, and size grade and boxed by material class.

Quantification and Analysis

Table F.2 summarizes the quantitative and analytic information collected for various kinds of artifacts. Detailed methods of analysis for the more complex and data-rich artifact classes are discussed in the chapters devoted to each material class, as indicated in the table. Quantitative and analytic data are stored in a single Microsoft Access (Office 2016) database. Table F.3 lists the data tables containing coded or quantified information for each artifact or material class. Some form of quantitative information was collected for all material classes, regardless of type or context.

Provenience data are stored in the "Catalog FINAL" table, along with data on sample type and recovery method, and excavation volume. Additional framework data are stored in the "Analytic Units" table. Queries linking these provenience and sample type data with other analytic data were built as needed to derive the data tables necessary for subsequent interpretation. In some cases, data queries developed in Access were compiled in PASW Statistics 17 or Microsoft Excel (Office 2016) for purposes of further analysis and data summation.

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Table F.2. Summary of analysis intensity and data tables for recovered artifact and material classes.

General Class	Specific Class	How Studied [Chapter No.]	Microsoft Access Database Table(s)
Pottery	rim sherds	detailed [4]	Pottery; Pottery Vessel p1; Pottery Vessel p2; Pottery G3 Rims; Pottery Vessel Metric
	body sherds	detailed [4]	Pottery
Modified Stone	stone tools	detailed [5]	Stone Tool Complete
	flaking debris	detailed [5]	CSFD
Faunal Remains	unmodified	detailed [6]	Bone; Bone ID
	modified	detailed [7]	Bone; Bone Modified
Clinker	modified	detailed [5]	Stone Tool Complete
	unmodified	count and weight [10]	General Quantification
Botanical Remains	selected contexts	detailed [8]	Botanicals
	unselected	[not studied]	-
Shell	all	detailed [10]	Shell
Glass Beads	all	detailed [9]	Glass Beads
Metal	all	detailed [9]	Metal
Other Historical Artifacts	all	[none identified]	-
Recent Historical Artifacts	all	count and weight [10]	General Quantification
Fired Clay	all	count and weight by type [10]	General Quantification
Miscellaneous Plains Village	all	varied [10]	Miscellaneous PV
Ochre/Pigment	all	count and weight by color [10]	General Quantification
Burned Earth	all	weight [10]	General Quantification
Ash	all	weight [10]	General Quantification
Charcoal	all	weight [10]	General Quantification
Wood/Bark	all	weight [10]	General Quantification
Fire Cracked Rock	all	weight and G1 count [10]	General Quantification
Natural Rock	all	weight and G1 count [10]	General Quantification
Unsorted Residue	all	weight [10]	General Quantification

Table F.3. Data tables comprising the final Microsoft Access database. Each table also includes an autonumbered ID field.

Table Name	Content	Fields	Records
Analytic Units	Analytic units	6	89
Bone	Faunal remains quantification	5	307
Bone ID	Faunal remains quantification and identification		
Bone Modified	Modified bone and antler identification		
Botanicals	Macrobotanical quantification and identification	5	105
Catalog FINAL	Provenience	23	89
CSFD	Flaking debris	12	757
General Quantification	Miscellaneous sort classes	6	1,284
Glass Beads	Glass beads	13	47
Metal	Metal artifacts (recent and fur-trade era)	12	97
Miscellaneous PV	Miscellaneous Plains Village sort classes	6	9
Pottery	Pottery quantification	10	504
Pottery G3 Rim	Pottery size grade 3 rims	8	63
Pottery Vessel Metric	Pottery vessel measurements	6	75
Pottery Vessel p1	Pottery vessel ware and variety	11	75
Pottery Vessel p2	Pottery vessel zones and technology	12	75
Shell	Shell quantification		
Stone Tools Complete	Stone tools	30	151

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Appendix G:

Pottery Wares and Coding Formats

Mark D. Mitchell

Northern Middle Missouri Pottery Types

Northern Middle Missouri ceramics are classified according to a typological system first developed by Donald J. Lehmer (1954) and later modified and expanded by Stanley A. Ahler and Anthony Swenson (1985). The highest-order unit in Lehmer's system is the pottery "ware," which he defines as a set of types that share technological attributes, including clay body or paste, vessel shape, rim form, and surface treatment. Many but not all of the currently defined wares include one or more types (usually called "varieties" or "subwares"), which are distinguished by aesthetic or decorative differences, including vessel zone proportions and shapes, decorative techniques, and decorative patterns or motifs.

In the Middle Missouri, all analysts now distinguish between two basic classes of wares: straight-rim wares, in which the upper rim of the vessel is vertical or flares outward, and S-rim wares, in which the upper rim curves inward. Apart from some nineteenth-century assemblages, all northern Middle Missouri pottery assemblages include both straight-rim and S-rim forms. Paired sets of straight-rim and S-rim wares are generally characteristic of different time periods. For example, Stanton ware (a straight-rim ware) and Sanger ware (an S-rim ware) comprise the paired set characteristic of northern Middle Missouri assemblages dating to the fifteenth century. Similarly, Knife River ware (straight-rim) and Le Beau ware (S-rim), make up the paired set characteristic of assemblages dating the sixteenth and seventeenth centuries.

This pattern of paired wares, each defined by typical and recurring rim forms and, to a lesser degree, characteristic decorative techniques and patterns, began to change in the eighteenth century. One aspect of the change was a gradual reduction in the production of S-rim forms. Concurrent with that decrease in the production of S-rim vessels was an increase in the morphological and decorative variation of straight-rim vessels. The result was an increase in the proportions of "unassigned" wares, which are catch-all groups rather than ware classes. The factors prompting these shifts are not entirely understood, but likely reflect a combination of social and economic processes including the arrival on the Missouri of the Awaxawis and the Hidatsas proper; the effects of Old World crowd diseases; and the breakdown of specialized craft production systems (e.g. Ahler and Swenson 1993; Hollenback 2012; Mitchell 2013).

This appendix describes the primary pottery wares and varieties that occur in seventeenth and eighteenth-century northern Middle Missouri assemblages. Several of these varieties do not occur in the 2018 Molander assemblage but do occur in contemporaneous assemblages. Wares that were not produced after about 1525 are excluded from the discussion. Additional data on northern Middle Missouri pottery wares and varieties are presented in Ahler (2001), Ahler and Stanford (2004), Ahler and others (2002), Mitchell (2011, 2013), and Mitchell and others (2007).

S-Rim Wares and Varieties

Le Beau Classic Ware (Variety 4). Chronologically, Le Beau ware first appeared in the northern Middle Missouri about 1500 or perhaps a little earlier. In Le Beau ware vessels, the height of zone 3 is markedly less than the height of zone 2 and the juncture between zone 3 and zone 2 is smoothly curved. Cord impressing remains the dominant decorative technique, but impression spacing is narrow and cord sizes are small compared to earlier wares. Decorative patterns commonly consist of many closely spaced horizontal cord impressions (up to 18), broken by four curvilinear "rainbow" motifs arranged symmetrically around the vessel. These curved motifs frequently are centered on a small node. Another common zone 3 decorative pattern consists of a bounded zone filled with diagonal or zoned triangle cord lines. A variety of lip forms occur. Interior braces are common.

Le Beau Classic Fine Ware (Variety 4.1). Le Beau Fine vessels are morphologically similar to Le Beau Classic vessels but are much smaller. Such vessels are often highly decorated and well made.

Le Beau T-Lip (Variety 4.2). Le Beau T-lip vessels are decoratively and morphologically like Le Beau Classic vessels but exhibit a pronounced T-shaped lip. Le Beau T-lip vessels are rare and are absent from many assemblages.

Le Beau Recurved (Variety 5). This variety is decoratively similar to Le Beau Classic but includes zone 4, or an outwardly curved addition, above zone 3. Some Le Beau recurved vessels also feature an exterior brace, which complicates their identification. However, vessels only are assigned to the recurved variety of Le Beau ware if zone 4 is expressed on the interior vessel wall. In the Heart region, recurved S-rim vessels appear to have been most popular during the later 1500s.

Le Beau High Rim (Variety 7). Le Beau High Rim variety is distinguished by a vertically asymmetrical upper zone 3, with the inward curvature of the vessel wall tightening progressively toward the lip. Le Beau High Rim was common during the late 1600s at Scattered Village, where it was first identified.

Le Beau Classic/Le Beau Recurved/Le Beau T-Lip/Le Beau High Rim (Variety 10). This category includes zone 3 or zone 2 and 3 fragments that lack features that would permit a more specific identification but that exhibit decorative features present in one of those four varieties.

Le Beau Paddle-Stamped (Variety 8). Although morphologically similar to Le Beau Classic vessels, Le Beau Paddle-Stamped vessels are decorated with carefully placed, vertical simple stamping on zone 2 and zone 3, extending continuously from the body to the lip. (Paddle-stamping or simple-stamping on zone 3 is regarded as a decorative technique, rather than a surface treatment; simple-stamping on zones 1 and 2 are regarded as a surface treatment.)

Le Beau Plain (Variety 9). This variety lacks decoration but retains the basic rim form characteristic of Le Beau ware. At Scattered and On-a-Slant villages, Le Beau Plain became more abundant during the latter part of the 1600s.

Sperry Ware (Variety 6). Owing to its S-rim form, Sperry ware was once considered a variety of Le Beau ware. However, more recent analyses demonstrate that there are significant technological, morphological, and decorative differences between Sperry ware and Le Beau ware (Mitchell 2011). Sperry variety vessels are distinguished by a subtle but distinctive subangular lower zone 3, expressed most clearly on the exterior rather than the interior wall. Decoratively, Sperry vessels are both distinct and notably uniform. Among previously studied Heart region assemblages, cord impression is the only known decorative technique. The decorative pattern consists exclusively of horizontal cord impressions on zone 3. However, Sperry ware vessels in the Molander assemblage are undecorated. Nodes, handles and other appendages have not been recorded on Sperry vessels, but interior bracing is common, as is a "wavy" vessel orifice created by repeated deformation of the lip and upper rim. Commonly, both interior and exterior vessel surfaces are burnished or polished. The name "Sperry" comes from the fact that this variety is a prominent part of the assemblage at Sperry Village (32BL4). At Double Ditch Village, Sperry vessels appear abruptly in deposits postdating 1650.

Sperry Recurved (Variety 6.1). This variety is similar to Sperry but includes zone 4.

Sperry/Sperry Recurved (Variety 11). This category includes zone 3 or zone 2 and 3 fragments that exhibit the distinctive subangular lower zone 3 but lack the upper portion of zone 3.

Transitional Ware (Variety 19). Transitional ware combines the S-rim form of Le Beau ware with the bold exterior brace and decorative pattern of Knife River ware (see discussion in following section). The brace is generally so large that it entirely covers the exterior face of zone 3. Decoration generally consists of diagonal cord impressions on the brace, with a row of finger or tool impressions at the juncture between the brace and the exterior vessel wall. First identified in studies of Hidatsa sites in the Knife region, Transitional ware has been considered a companion to Knife River ware (Ahler and Swenson 1993). Transitional ware was produced over a long period of time and can be found at many sites in both the Knife and Heart regions, although nowhere can it be considered abundant. At Double Ditch, Transitional ware becomes much more common after 1650.

Unclassified Late S-Rim (Variety 12). This is a catch-all category that includes unique or unusual vessels that do not exhibit the defined attributes of a named type, either because of an unusual rim form, decorative technique, or decorative pattern.

Zone 3 or Zone 2-3 Fragments (Variety 31). This category includes parts of S-rim vessels that are too fragmentary to assign to a specific variety.

Straight-Rim Wares and Varieties

Knife River Ware (Varieties 21.0, 21.1, 22.0, and 22.1). Knife River ware is distinguished by a high, gently and evenly curving rim to which an exterior brace was added. Braces generally are prominent and well-defined but can sometimes be short and relatively thin. Lips usually are narrow and rounded and the brace shape is curved or, less commonly, wedge-shaped. The dominant decorative technique is cord impression, although other techniques also were used. Decorative pattern commonly consists of diagonal impressions on the brace and lip. In some cases, parallel horizontal cord impressions occur in zone 2. Later Knife River ware frequently includes spouts, handles, castellations, and other appendages. Knife River ware was first defined by Lehmer and others (1978) based on collections from Hidatsa sites in the Knife region. Their definition emphasizes Knife River ware's lower technical quality and its dominant occurrence in later Hidatsa assemblages.

Ahler (2001) argues that the technological characteristics of Knife River ware, especially its bold exterior bracing and its apparent lower technical quality, set it apart from earlier straight rim wares. However, Heart region research has demonstrated that Knife River ware occurs in sixteenth-century contexts and that many Knife River ware vessels exhibit average or high technical quality relative to contemporaneous wares.

The analysis of ceramic collections from the Knife River Indian Villages National Historic Site recognizes two distinct sizes of Knife River ware. The term "Knife River ware" was retained for larger vessels, but smaller pots were classified as "Knife River Fine ware," which is described later. In the Heart region, by contrast, a continuous gradation of braced straight rim vessels, from quite small to very large, has been recognized (Ahler *et al*. 2002). Accordingly, prior Heart region analyses have subdivided Knife River ware into two varieties, Knife River Large (Variety 21) and Knife River Indeterminate (Variety 22). Minor decorative and morphological differences have been noted between the two varieties. Two sub-varieties of each are recognized, one with interior horizontal cord impressions and one without.

The Knife River Indeterminate group was created to isolate vessels that exhibited greater technical quality and decorative elaboration than Knife River Classic vessels, but lower technical quality and decorative elaboration than Knife River Fine vessels. However, the metric and morphological distinctions between the two Knife River ware varieties (Large and Indeterminate) have never been specified and so the Molander analysis recognizes only the Knife River Large type (Varieties 22.0 and 22.1).

Knife River Fine Ware (Varieties 23.0 and 23.1). This category comprises relatively small pots that typically are decorated on the brace, on the interior surface near the lip, on the exterior neck, and on the shoulder. Shoulder decorations are generally incised while decoration elsewhere consists of cord impressions. These vessels have the rim morphology of Knife River ware but are set apart by their small size and high degree of decoration. Many are very well made and may have been special function pots. They are widely distributed but generally rare in both the Knife and Heart regions. As with Knife River ware, vessels with interior cord impressions (Variety 23.1) are distinguished from those without (Variety 23.0).

Unclassified Late Straight Rim without Brace (Variety 16). This is a catch-all category that includes unbraced rims bearing unusual decoration or other features precluding their assignment to a better-defined ware or variety.

Crosshatched (Variety 16.1). The distinctive decorative pattern of these vessels was first recognized at Double Ditch Village. Crosshatched variety vessels are decorated with widely spaced cord impressions made with large, loosely twisted cords. The impressions are arranged in a crisscross pattern bounded above and below by single horizontal cord impressions. At Double Ditch, this distinctive decorative pattern occurs mostly on vertical straight rim vessels, but occasionally also on rims having a faint S-rim form. Cross-hatched variety vessels were not recognized in the Molander collection.

Unclassified Late Straight Rim with Brace (Variety 17). This variety is a catch-all that includes braced straight rim vessels bearing unusual decoration or other features that preclude their allocation to Knife River ware.

Bowl Form without Flange (Variety 27). This category includes open-mouthed containers lacking inflection points in vertical section and lacking a rim as a separate vessel element. In the Heart region, vessels of this type were first identified during the analysis of the 2003 Double Ditch collection.

Deapolis Collared Ware (Variety 34). Deapolis ware has a nearly vertical rim orientation and a broad, distinctly flattened exterior brace. The lip is rounded to pointed. The exterior brace is generally undecorated but may feature paddle-stamped decoration. Deapolis ware mimics the exterior appearance of an S-rim vessel. Transitional ware vessels with small zone 3 inflections could be misclassified as Deapolis ware, although the common decorative patterns of the two wares are generally distinct. Lehmer and others (1978) first defined Deapolis ware and it is generally regarded as an eighteenth- and nineteenth-century companion to Knife River ware.

Unclassifiable Lips and Other Fragments (Variety 99). This group includes rim pieces that cannot be assigned to any of the other categories discussed above.

Pottery Coding Formats

The pottery variables and attributes used to study the 2018 Molander collection were first systematized by Ahler and Swenson (1985). Selected aspects of their system subsequently have been modified or extended as new projects have revealed new pottery types and new pottery production practices. In particular, the Scattered Village pottery analysis incorporates many alterations and additions (Ahler *et al*. 2002). Mitchell and others (2007) and Mitchell (2011) also add or redefine several variables and attributes.

Tables G.1 and G.2 present the attribute values for the specific variables coded in the Molander analysis. Vessel zones and rim form classes are illustrated in figures G.1 and G.2.

Table G.1. Variables and attribute codes recorded in the initial inventory of ceramic remains and the study of exterior surface treatment for body sherds.

CAT NO	**catalog number**	
SIZE	**size grade (1, 2, 3)**	
CLASS	**ceramic category**	
1-body sherd (zone 1 only)		4-miniature vessel or vessel part
2-rim sherd (zone 2 or higher is present)		5-worked sherd
3-slipped		6-unknown tempered object
PART	**part of vessel present**	
1.1-zone 1 only (body sherd) lacking angular shoulder		3-zone 3 only (nothing above or below zone 3)
1.2-zone 1 only (body sherds) with angular shoulder part		7-zone 7 only (lip sherd only with no lower zones)
2.1-zone 2 only or zone 2 and 1 (neck or neck and body) lacking angular shoulder		8-multiple adjoining zones (2+3; 2+7; 2+3+7, etc.)
2.2-zone 2 only or zone 2 and 1 (neck or neck and body) with angular shoulder part		
OCHRE	**ochre residue**	
0-none		4-yellow exterior
1-red, interior		6-yellow slip/wash exterior
2-yellow, interior		7-orange interior
3-red, exterior		8-purple stain interior
SURF	**body & neck sherd (zone 1 & 2) exterior surface treatment and decoration – size G1 and G2 only; for bodies, record only surface treatment in zone 1; for necks record only surface treatment in zone 2 and ignore zone 1; if decoration occurs, it takes precedence over surface treatment**	
Surface Treatment		*Decoration*
1-plain / smoothed		6-incised (takes precedence over surface treat.)
2-simple-stamped		7-trailed (takes precedence over surface treat.)
3-check-stamped		8-cord-impressed (takes precedence over surface treat.)
4-brushed		10-tool-marked (takes precedence over surface treat.)
5-cord-roughened		
9-other / not determined (used for G3 body and neck sherds)		blank = vessel part in zone 3 or higher
11-micro-grooved simple-stamped		0-indeterminate (eroded away or obscured)
COUNT	**count of sherds having a common code on all preceding variables**	
WEIGHT	**combined weight of sherds for this data case, to 0.1 gram**	
COMMENT	**comments about matching, etc.**	

Table G.2. Variables and attributes used to code pottery vessel fragments.

CN1,2,3	**catalog number(s)**
Vess	**vessel number**
Size	**size grade of largest sherd**
Rim	**rim form class based on zones present and their placement**
1-lip sherd (zone 7 only)	19-lip frag. w/ exterior brace (zone 5,7) or brace frag. only (z5)
2-bowl or jar (zone 1+7 only)	20-zone 3 fragment (zone 3 only)
3-straight or outflared rim (zone 1,2,7)	21-appendage only (no zone designation)
4-straight rim w/ brace (zone 1,2,5,7)	23-straight rim w/ interior brace (zone 1,2,5,7)
5-straight rim w/ fillet (zone 1,2,6,7)	24-S-rim w/ interior brace (zone 1,2,3,5,7)
7-S-rim (zone 1,2,3,7)	25-recurved S-rim w/ interior brace (zone 1,2,3,4,5,7)
8-S-rim w/ exterior brace (zone 1,2,3,5,7)	26-zone 2-3 fragment w interior brace (zone 2,3,5)
9-S-rim w/ fillet (on interior) (zone 1,2,3,6,7)	27-lip fragment w/ interior brace (zone 5,7)
11-recurved S-rim (zone 1,2,3,4,7)	28-S-rim w/ interior and exterior brace (zone 1,2,3,5,7)
12-recurved S-rim w/ exterior brace (zone1,2,3,4,5,7)	29-Straight rim with ext. brace and fillet (zone 1,2,5,6)
15-zone 2-3 fragment (zone 2,3 only)	
16-zone 3 fragment w/ exterior brace (zone 3,5 only)	
Append	**appendages or rim/lip modifications**
1-node	8-pinched or wavy rim
2-tab	9-vestigial lug or tab
3-lop handle	10-appendage scar visible
4-strap handle	11-flange
5-boss	12-multiple, see note 5/29/07
6-spout	13-asymmetrical orifice
7-castellation	99-absent or not observed
Ware	**ware classification**
0.0-unnamed straight rim, late or indeterminate ware	7-Deapolis Collared ware
0.1-Stanton ware	8-Knife River Fine ware
1.0-unnamed S-rim, late or indeterminate ware	9-Transitional ware
1.1-Sanger ware	10-Unclassifiable S-rim ware (Le Beau or Sanger)
5-Le Beau ware	11-Sperry ware
6-Knife River ware	32-Le Beau Fine ware
	99-fragment, unclassifiable
Variety	**ware-variety classification**
1-Ft. Yates	16-Unnamed Late Straight Rim without Brace
2-Sanger	16.1-Cross-Hatched Straight or S-Rim
3-Unnamed Early S-Rim	17-Unnamed Late Straight Rim with Brace
4-Le Beau Classic	19-Transitional
4.1-Le Beau Fine	21.0-Knife River Large, lacking interior cord dec
4.2-Le Beau Classic T-Lip	21.1-Knife River Large, with interior cord dec
5-Le Beau Recurved	22.0-Knife River Intermediate, lacking interior cord dec
6-Le Beau Sperry	22.1-Knife River Intermediate, with interior cord dec
6.1-Le Beau Sperry Recurved	23.0-Knife River Fine, lacking interior cord dec
7-Le Beau High Rim	23.1-Knife River Fine, with interior cord dec
8-Le Beau Paddle Stamped	26-Rolled Rim Jar
9-Le Beau Plain	27.0-Bowl without Flange 27.1 Bowl with Flange
10-Le Beau Classic 4 or 5 (zone 3 fragments)	31-Unclassifiable Zone 2/3 Fragments (indeterminate Le Beau Classic or Sperry)
11-Le Beau Sperry 6 or 6.1 (zone 3 fragments)	33-Unclassifiable S-rim (indeterminate Le Beau or Sanger)
12-Unnamed Late S-Rim	34-Deapolis Collared
13-	99-fragment, unclassifiable
14-Riggs	
15-Stanton	

Table G.2. Variables and attributes used to code pottery vessel fragments (*continued*).

Type	**new type based on decoration only**
0-plain	8-cord-wrapped-tool-impressed
1-cord impressed	9-finger impressed
2-tool impressed	10-simple stamped (paddle stamped)
3-incised (includes trailed)	11-brushed
4-pinched	12-
5-filleted	13-multiple
6-punctate	99-unclassifiable fragment
Z3shape	**condition and shape of zone 3**
1.0-prsnt, shape unknown	3.0-angular
2.0-smoothly curved	4-present, composite, angular shape
2.3-slight uneven curve	5-present, faintly S-shaped
2.6-uneven curve	9-unobservable, broken away
Z5shape	**condition and shape of zone 5**
0.0-zone not used	3.5-ext & int wedged
1.0-exterior curved	4.0-ext collared
2.0-prsnt interior	5-present on exterior, wedge-shaped
2.1-interior curved	6-present exterior, inverted wedge
2.5-interior wedged	7-present, interior, flat collared
3.0-int & ext curved	8-present on exterior, shape unknown
3.1-ext & int curved	9-unobservable, broken away
Z7shape	**condition and shape of zone 7**
1-rounded	8-beaded, round
2-flattened	10-round beaded on exterior
3-in-slanted	11-round beaded on interior
4-out-slanted	12-inslanted, beaded interior and exterior
5-L-shaped	13-irregular 7/20/06
6-T-shaped	14-
7-pointed	99-unobservable, broken away
TWIST	**cord twist direction**
0-present but indeterminate	2-Z-twist
1-S-twist	9-not applicable (not cord-impressed)
Z2,3,5surf	**zone exterior surface treatment**
0- Zone not used on vessel (NA for Zone 1 only)	8.1- Smoothed over brushed
1- Plain/rough, temper usually visible	8.2- Burnished over brushed
2.1- Smoothed, no temper visible	8.3- Polished over brushed
2.2- Burnished, discontinuous or discrete marks	9.1- Smoothed over simple stamped
2.3- Polished, marks continuous and blended	9.2- Burnished over simple stamped
3- Brushed	9.3- Polished over simple stamped
4- Simple stamped	10.1- Smoothed over check stamped
5- Check stamped	10.2- Burnished over check stamped
6- Cord roughened	10.3- Polished over check stamped
	99- Unobservable or broken away
SurfColor	**surface color (exterior- first digit; interior- second digit)**
1- Buff or brighter	5- Firing clouds (two color)
2- Brown	6-
3- Gray	8- Post-firing alteration (refired)
4- Black	9- Not observable or too small for accuracy
CoreColor	**interior color**
1- Red or buff throughout, no core	5- Gray exterior, black interior (dark interior)
2- Red or buff (or light gray) both surfaces, dark core w/ diffuse margin	6- Black exterior, gray interior (light interior)
	7- Gray throughout, no core
3- Red or buff (or light gray) both surfaces, dark core w/ sharp margin	8- Black throughout, no core
	9- Contrastive core expression from place to place
4- Black both surfaces, red or buff (or light gray) core	99- Indeterminate (too small to assess)

Table G.2. Variables and attributes used to code pottery vessel fragments (*continued*).

Qual	**quality of fabrication (based on clay selection, compaction, uniformity of temper, structural symmetry, decorative symmetry, firing flays, fabric flaws, etc.)**	
1- non-functional		4- well made
2- poorly made		5- exceptional
3- serviceable		9- indeterminate/too small
Dia	**vessel orifice diameter (to 1 cm)**	
MeanCord	mean cord diameter (based on three measurements; to 0.1 mm)	
MeanZ5wide	mean zone 5 width (height) (based on two measurements; to 0.1 mm)	
MeanZ5thick	mean zone 5 thickness (based on two measurements; to 0.1 mm)	
Comment	additional description	

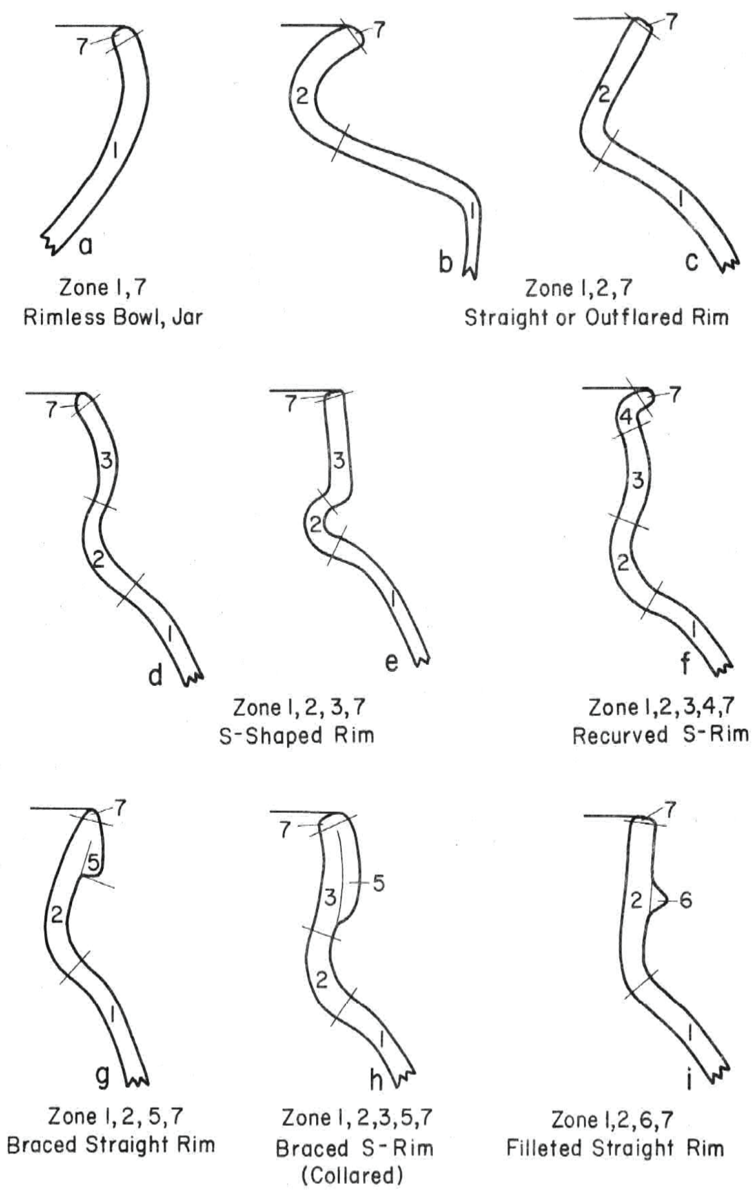

Figure G.1. Examples of northern Middle Missouri rim profiles, showing vessel zones and inflection points; vessel exterior to the right (Ahler and Swenson 1985:Figure 1).

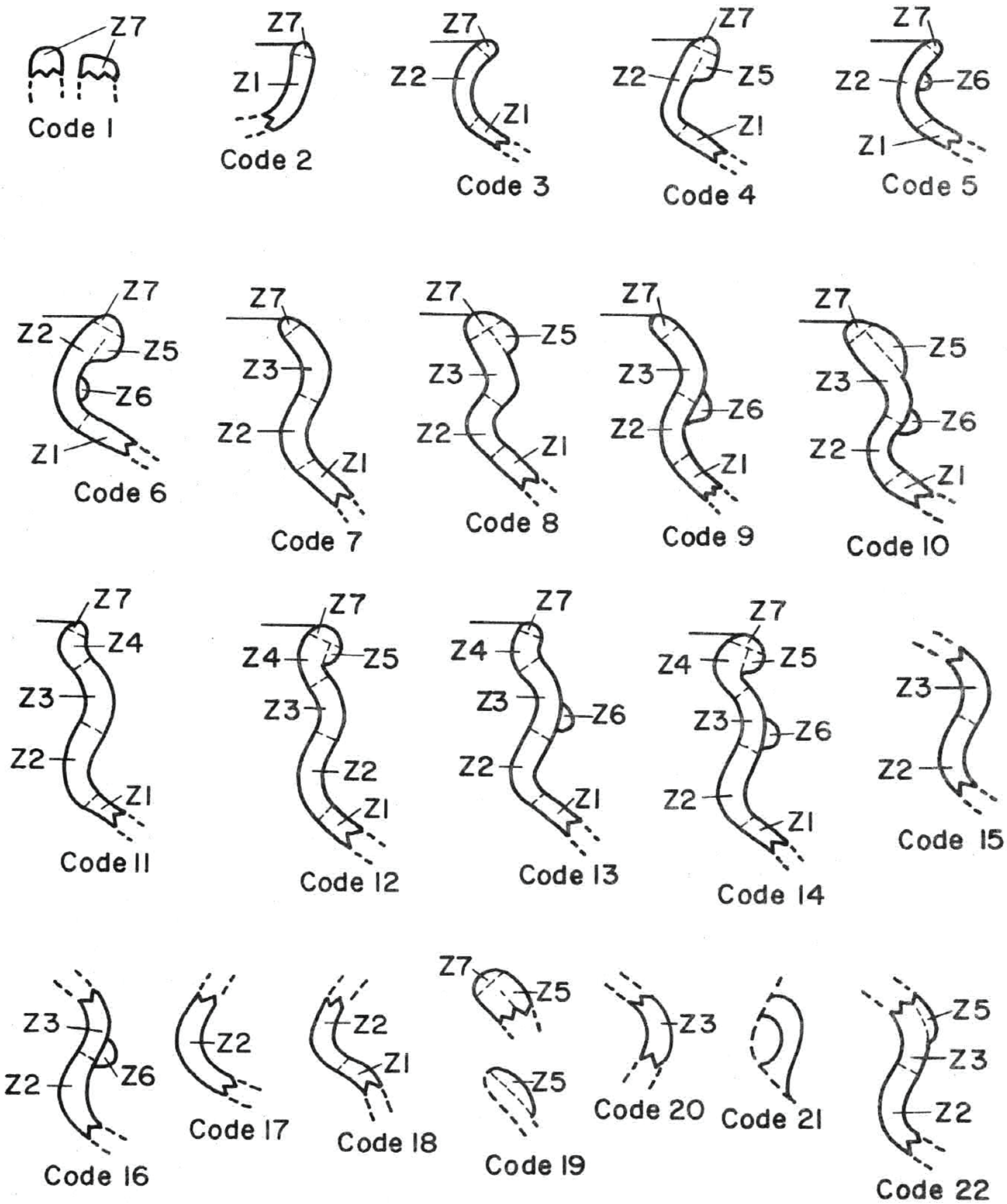

Figure G.2. Drawings of rim sherd cross-sections for each rim form class, showing the zones present in each; vessel exterior to the right (Ahler and Swenson 1985:Figure 2).

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Appendix H:
Modified Stone Coding Formats

Table H.1. Chipped stone flaking debris coding format.

CATNO	**catalog number**	
SIZE	**size grade**	
1- size grade 1 (> 1 inch) 2- size grade 2 (1 inch>1/2 inch)		3- size grade 3 (1/2 inch>1/4 inch) 4-(1/4 inch>1/8 inch)
RAWM	**raw material type**	
1- smooth gray Tongue River silicified sediment		28- Knife River flint
2- coarse yellow Tongue River silicified sediment		29- Rainy Buttes silicified wood
3- coarse red Tongue River silicified sediment		30- tough gray-green chert
4- solid quartzite (fine-grained orthoquartzite)		31- blonde French flint
5- Swan River chert (porous quartzite)		32- Thames River (Dover) flint
6.0- miscellaneous jasper/chert		33- light yellow pigment stone
6.5- dendritic yellow (no longer used)		34- historic period glass
6.6- dendritic red (no longer used)		35- metaquartzite (not class 4)
6.7- dendritic chert (all colors)		36- scoria
7- White River Group silicates		37- siltstone/limestone/mudstone
8- clear/gray chalcedony (not obvious silicified wood)		38- steatite
9- yellow/light brown chalcedony (not obvious silicified wood)		39-
10- dark brown chalcedony (non-KRF, non-silicified wood)		40- non-volcanic natural glass
11- plate chalcedony		41- opal
12- burned chalcedony, not identifiable (no longer used)		42- felspar
13- basaltic material		43-
14- other unclassifiable		50- Charlie Creek chert
15- Bijou Hills silicified sediment		51- Miocene flint (Sentinel Butte flint)
16- milk or vein quartz		52- obvious silicified wood
17.1- porcellanite (gray)		53- moss agate
17.2- porcellanite (red or purple)		54- Antelope chert
18- obsidian (any source)		55- gray silcrete (non-Tongue River types)
19- granitic material		56- Scenic chalcedony
20- coarse porous sandstone		57- Hartville Uplift chert (no longer used)
21- compact sandstone		58- Yellowstone agate (no longer used)
22- fossil or concretion		59- Turtle Valley orthoquartzite (not used w/ Slant)
23- clinker		60-68-
24- catlinite		69- Schmidtt chert (not used w/Slant)
25- hematite (red ochre)		70- shist
26- limonite (yellow ochre)		71- Hixton silicified sandstone
27- gypsum		72-
BURN	**burning (G1-3 only)**	
0- absent 1- present	9- indeterminate due to raw material	
HEAT	**heat treatment (G1-3 only)**	
0- absent 1- possibly present	2-definitely present 9-indeterminate due to raw material or burning	

Table H.1. Chipped stone flaking debris coding format (*continued*).

CORT	**cortex**
0-absent	1-present
PATN	**patination intensity (G1-3 coded separately for each side; G4 is maximum patination on either face)**
0- absent	2- moderate
1- light	3- pronounced
COUNT	**count of flakes having a common code on all preceding variables**
WEIGHT	**combined weight (g) of flakes for this data case; if weight = 0.0, recorded as 0.03 g**
COMMENT	**comment text noted in database**

Table H.2. Stone tool coding format.

CATNO	**catalog number**	
SIZE	**size grade**	
1- size grade 1 (> 1 inch)		3- size grade 3 (1/2 inch>1/4 inch)
2- size grade 2 (1 inch>1/2 inch)		4-(1/4 inch>1/8 inch)
SEQ	**artifact identifier within catalog number and size grade**	
CASE	**case number, for multiple records for a single artifact**	
1-first record and case for the artifact		2-second record and case for the artifact (implies different technological class)
WEIGH	**weight to 0.1 gram**	
RAWM	**raw material type**	
1- smooth gray Tongue River silicified sediment		28- Knife River flint
2- coarse yellow Tongue River silicified sediment		29- Rainy Buttes silicified wood
3- coarse red Tongue River silicified sediment		30- tough gray-green chert
4- solid quartzite (fine-grained orthoquartzite)		31- blonde French flint
5- Swan River chert (porous quartzite)		32- Thames River (Dover) flint
6.0- miscellaneous jasper/chert		33- light yellow pigment stone
6.5- dendritic yellow (no longer used)		34- historic period glass
6.6- dendritic red (no longer used)		35- metaquartzite (not class 4)
6.7- dendritic chert (all colors)		36- scoria
7- White River Group silicates		37- siltstone/limestone/mudstone
8- clear/gray chalcedony (not obvious silicified wood)		38- steatite
9- yellow/light brown chalcedony (not obvious silicified wood)		39-
10- dark brown chalcedony (non-KRF, non-silicified wood)		40- non-volcanic natural glass
11- plate chalcedony		41- opal
12- burned chalcedony, not identifiable (no longer used)		42- felspar
13- basaltic material		43-
14- other unclassifiable		50- Charlie Creek chert
15- Bijou Hills silicified sediment		51- Miocene flint (Sentinel Butte flint)
16- milk or vein quartz		52- obvious silicified wood
17.1- porcellanite (gray)		53- moss agate
17.2- porcellanite (red or purple)		54- Antelope chert
18- obsidian (any source)		55- gray silcrete (non-Tongue River types)
19- granitic material		56- Scenic chalcedony
20- coarse porous sandstone		57- Hartville Uplift chert (no longer used)
21- compact sandstone		58- Yellowstone agate (no longer used)
22- fossil or concretion		59- Turtle Valley orthoquartzite (not used w/ Slant)
23- clinker		60-68-
24- catlinite		69- Schmidtt chert (not used w/Slant)
25- hematite (red ochre)		70- shist
26- limonite (yellow ochre)		71- Hixton silicified sandstone
27- gypsum		72-
TECH	**technological class**	
1- patterned small thin biface		7- nonbipolar core and core-tool
2- patterned large thin biface		8- bipolar core and core-tool
3- unpatterned small to medium biface		9- unpatterned pecked or ground tool
4- patterned steeply beveled flake tool		10- patterned pecked or ground tool
5- unpatterned other flake tool, retouched or use-modified		11- radial break tool
6- large, thick bifacial core-tool		12- retouched tabular piece or plate
SUBTECH	**subtechnological class**	
5.1- use modified		7.1- core
5.2- retouch		7.2- tested cobble
		7.3- random flaking
		7.4- unoriented fragment
		7.5- unflaked raw material

Table H.2. Stone tool coding format (*continued*).

MCII	revised morphological class
	1-bipointed biface
	2-triangular, symmetrical biface
	3-triangular, asymmetrical biface
	4-ovoid biface
	5-ovoid, pointed biface
	6-rectangular biface
	7-crescent-shaped biface
	8-notched crescent
	9-asymmetrical biface with notched haft element
	10-hafted drill form
	11-ovoid biface fragment
	12-triangular or rectangular biface fragment
	13-pointed biface fragment
	14-drill tip fragment
	15-indeterminate biface fragment
	16-side-hafted knife
	21-generalized end scraper form (unspurred)
	21.1-unspurred end scraper, lacking dorsal flaking from lateral margins
	21.2-unspurred end scraper, with partial dorsal flaking from lateral margins
	21.3-unspurred end scraper, with complete dorsal flaking from lateral margins
	22-spurred or angled end scraper
	22.1-spurred end scraper, lacking dorsal flaking from lateral margins
	22.2-spurred end scraper, with partial dorsal flaking from lateral margins
	22.3-spurred end scraper, with complete dorsal flaking from lateral margins
	23-double ended end scraper form
	24-bilaterally symmetrical, side-notched end scraper form
	25-hafted beak form
	26-
	31-unpatterned retouched flake with one working edge
	32-unpatterned retouched flake with two isolated working edges
	33-unpatterned retouched flake with three isolated working edges
	34-unpatterned retouched flake with two connecting working edges
	35-unpatterned retouched flake with three connecting working edges
	36-
	41--unpatterned utilized flake with one working edge
	42-unpatterned utilized flake with two isolated working edges
	43-unpatterned utilized flake with three isolated working edges
	44-unpatterned utilized flake with two connecting working edges
	45-unpatterned utilized flake with three connecting working edges
	46-
	51-transverse snap break without crack
	52-transverse snap break with crack
	53-obtuse snap break without crack
	54-obtuse snap break with crack
	55-acute snap break without crack
	56-acute snap break with crack
	57-transverse hinge
	58-transverse lip
	59-
	61-irregular
	62-
	71-complex patterned ground stone tool
	72-complex core-tool form
	73-bead
	74-grooved maul form
	75-celt form
	76-sphere
	77-paired grooved abrader form; shaft smoother
	78-unpaired grooved abrader form
	79-pipe
	80-grooved ax form
	101-159-various Paleoindian and Archaic point forms
	144-misc. Late Plains Archaic
	161-small, tanged, eared side-notched point
	162-small, shallow side-notched point
	163-Avonlea point
	164-
	171-Prairie Side-Notched arrow point
	172-Plains Side-Notched arrow point
	173-isosceles triangular arrow point
	174-tri-notched arrow point
	175-other miscellaneous arrow point forms
	176-oversized Plains side-notched arrowpoint form
	179-arrow point fragments

USEPH	use-phase class
	1-unfinished, usable (unbroken)
	2-unfinished, unusable (broken or rejected)
	3-finished, usable (unbroken; includes usable cores)
	4-finished, unusable (broken, burnt, exhausted, rejected; includes exhausted cores)

Table H.2. Stone tool coding format (*continued*).

BLANK	**original input blank form**
1-tabular cobble/pebble (>10 mm thick; w/th ratio >2.5)	12-other nonbipolar flake from prepared core; platform ground and/or dorsally reduced
2-thin plate (thickness < 10 mm)	13-finished patterned biface used as blank
3-subrounded, rounded, spherical cobble or pebble	14-unfinished patterned biface used as blank
4-blocky/angular cobble or pebble (thickness >10 mm; w/th ratio < 2.5)	15-unpatterned flake tool or ret. tabular piece used as blank
5-split cobble	16-patterned flake tool used as blank
6-other nonbipolar flake, with no platform present or with unprepared platform present	17-simple flake (code 24 used with Scattered Village)
7-bifacial thinning flake	18-complex flake (code 25 used with Scattered Village)
8-bipolar flake	19-non-bipolar core or core fragment
9-blade or bladelet	20-bipolar core
10-shatter	21-fire-cracked rock
11-indeterminate	22-unpatterned biface
	23-complex/patterned ground stone tool
RJCT	**reason for rejection, failure, or disuse**
1-has potential for further work or use	10-heat or thermal fracture
2-bending fracture or end shock	11-lateral break
3-perverse fracture	12-broken by radial fracture
4-material flaw or poor quality stone	13-crescentic chunk from tool margin
5-outré-passé fracture	14-channel flake or fragment
6-compound hinge/step occurrence	15-recycled into another form or use, by bipolar process
7-impact fracture	16-burination spall
8-small size or exhaustion	17-resharpening flake coded as a tool; no further use possible
9-indeterminate	18-recycled into another form or use, by non-bipolar process
COMP	**completeness**
1-complete	6-indeterminate end
2-nearly complete, primary part of core or tested raw material	7-margin fragment
3-distal end	8-channel flake or channel flake fragment
4-proximal end	9-other fragment
5-medial fragment or segment	
PATN	**patination intensity (coded separately for each side)**
0-absent	2-moderate
1-light	3-pronounced
BURN	**burning**
0-absent	9-indeterminate due to raw material
1-present	
HEAT	**heat treatment**
0-absent	2-definitely present
1-possibly present	9-indeterminate due to raw material or burning
CORT	**Cortex**
0-absent	1-present
LENG	**maximum length, perpendicular to width (0.1 mm)**
WIDE	**maximum width, perpendicular to length (0.1 mm)**
THICK	**maximum thickness (0.1 mm)**
GRIND	**basal grinding**
0-none	3-base and lateral
1-basal	9-broken
2-lateral	

Table H.2. Stone tool coding format (*continued*).

PHW	**proximal haft width (0.1 mm)**	
DHW	**distal haft width (0.1 mm)**	
DHL	**distal haft length (0.1 mm)**	
BBW	**blade base width (0.1 mm)**	
BL	**blade length (0.1 mm)**	
ND	**notch depth (0.1 mm)**	
NW	**notch width (0.1 mm)**	
COMMENT	**1- comment exists, recorded outside dataset on note sheets**	
RMGRP	**raw material group**	
1-near-local southwest	4-exotic southwest	
2-near-local west	5-exotic west	
3-near-local northwest	6-coarse local	

Appendix I:
Vertebrate Remains

Carl R. Falk

Table I.1. Specimen counts (NISP) for identified fish remains organized by taxon and size grade.

	Size Grade					
Identified Taxon (common name)	1	2	3	4	Total	Percent Burned
Osteichthyes (bony fish)				15	15	-
Cyprinidae (cyprinids)			31	21	52	*1.9*
Catostomidae (suckers)			1	1	2	-
Ictaluridae (North American catfish)			2	24	26	-
Ictalurus cf. *I. punctatus* (channel catfish)			5	1	6	16.7
Noturus flavus (stonecat)			1	3	4	-
Sander sp. (sauger, walleye)			1	0	1	*100.0*
Total			41	65	106	*2.8*
Percent Total			*38.7*	*61.3*	*100.0*	

Table I.2. Distribution of identified fish (NISP) organized by archaeological context.

	Feature				Non-Feature			
Identified Taxon (common name)	4	5	7	11	Ditch/ Midden	Midden	Floor/ fill	Total
Osteichthyes			13				2	15
Cyprinidae		2	40	4	1		5	52
Catostomidae							2	2
Ictaluridae		4	20	1		1		26
Ictalurus cf. *I. punctatus*	1	1	2	1		1		6
Noturus flavus			3			1		4
Sander sp.			1					1
Total	1	7	79	6	1	3	9	106
Percent Total	*0.9*	*6.6*	*74.5*	*5.7*	*0.9*	*2.8*	*8.5*	*99.9*

Table I.3. Specimen counts (NISP) for identified bird remains organized by taxon and size grade.

	Size Grade					
Identified Taxon (common name)	1	2	3	4	Total	Percent Burned
Aves (undetermined)			3	7	10	*10.0*
Anatidae (waterfowl)			3		3	-
Accipitridae (Accipitrids)				3	3	-
Circus hudsonius (marsh hawk)	1		8		9	-
Buteo sp. (broad-winged hawk)	1	2	11		14	-
Tetraoninae (grouse)			1	2	3	*33.3*
Rallidae (rails, gallinules, and coots)				2	2	*50.0*
Charadriiformes (charadriiform)			1	1	2	-
Ectopistes migratorius (passenger pigeon)			3		3	*33.3*
Bubo sp. (horned owls)			1		1	-
Picidae (woodpeckers)			9	2	11	*27.2*
Passeriformes (passerines)			2	48	50	*18.0*
Pica hudsonia (black-billed magpie)			13	7	20	-
Corvus brachyrhynchos (American crow)			2		2	-
Corvus corax (common raven)			9	2	11	-
Total	2	2	66	74	144	*11.1*
Percent Total	*1.4*	*1.4*	*45.8*	*51.4*	*100.0*	

Table I.4. Distribution of identified bird remains (NISP) organized by archaeological context.

	Feature							Non-Feature			
Identified Taxon	3	4	5	7	9	10	11	Ditch/ Midden	Surface Midden	Floor/Fill	Total
Aves		1	1	1	2		1	2		2	10
Anatidae			1				2				3
Accipitridae			1			1				1	3
Circus hudsonius				2			6		1		9
Buteo sp.				6			8				14
Tetraoninae	1				1					1	3
Rallidae									2		2
Charadriiformes			1	1							2
Ectopistes migratorius		1		1						1	3
Bubo sp.								1			1
Picidae				11							11
Passeriformes	1	1	16	14	5		3	1	8	1	50
Pica hudsonia				1			17			2	20
Corvus brachyrhynchos								2			2
Corvus corax				10					1		11
Total	2	3	20	47	8	1	37	6	12	8	144
Percent Total	*1.4*	*2.1*	*13.9*	*32.6*	*5.6*	*0.7*	*25.7*	*4.2*	*8.3*	*5.6*	*100.1*

Table I.5. Specimen counts (NISP) for identified mammal remains organized by taxon and size grade.

	Size Grade					
Identified Taxon (common name)	1	2	3	4	Total	Percent Burned
Soricidae (shrews)				2	2	-
Leporidae (leporids)				9	9	*11.1*
Sylvilagus sp. (cottontail)				4	4	-
Lepus cf. *L. townsendii* (white-tailed jackrabbit)			9		9	*11.1*
Sciuridae (squirrels)			2	10	12	-
Neotamias minimus (least chipmunk)			1	5	6	-
Urocitellus richardsonii or *Poliocitellus franklinii* (Richardson's or Franklin's ground squirrel)			17	2	19	-
Ictidomys tridecemlineatus (13-lined ground squirrel)			4	11	15	-
Thomomys talpoides (northern pocket gopher)			4	17	21	*4.8*
Cricetidae (New World mice, voles, etc.)			5	205	210	-
Rattus sp. (Old World rats)				1	1	-
Canis sp. (coyote, wolf, domestic dog)			5	1	6	*16.7*
Vulpes velox (swift fox)		3	15	4	22	*22.7*
Lontra canadensis (North American river otter)			1		1	-
Mustela nivalis (least weasel)				1	1	-
Mephitis mephitis (striped skunk)		1			1	*100.0*
Cervus canadensis (elk)	1				1	*100.0*
Odocoileus sp. (deer)			1		1	-
Antilocapra americana? (pronghorn)	4	9	11		24	*4.2*
Odocoileus sp./*Antilocapra americana*		1	1		2	-
Bison bison (bison)	201	145	19		365	*5.2*
B. bison/*Cervus canadensis*	52	93	10		155	*2.6*
Total	258	252	105	272	887	*3.8*
Percent Total	*29.1*	*28.4*	*11.8*	*30.7*	*100.0*	

Table I.6. Distribution of identified mammal remains (NISP) organized by archaeological context.

	Feature									Non-Feature			
Identified Taxon	1	3	4	5	6	7	9	10	11	Ditch/Midden	Surface Midden	Floor/Fill	Total
Soricidae							2						2
Leporidae									1	1	3	4	9
Sylvilagus sp.		1		1							2		4
Lepus cf. *L. townsendii*									4		3	2	9
Sciuridae				2		3	1		3	1	1	1	12
Neotamias minimus						3					3		6
Urocitellus richardsonii/Poliocitellus franklinii						18					1		19
Ictidomys tridecemlineatus			2	1		4			5		1	2	15
Thomomys talpoides	1	7	6		1	2					4		21
Cricetidae	0	4	5	7	0	84	38	1	34	0	23	14	210
Rattus sp.										1			1
Canis sp.						2		1		3			6
Vulpes velox				1	3		8	4	1		2	3	22
Lontra canadensis												1	1
Mustela nivalis		1											1
Mephitis mephitis		1											1
Cervus canadensis						1							1
Odocoileus sp.											1		1
Antilocapra americana						22					2		24
Odocoileus sp./*A. americana*				1							1		2
Bison bison (bison)				12	1	67	1	11	213	17	23	20	365
B. bison/Cervus canadensis			1	6	2	61	1	5		13	26	40	155
Total	1	14	14	31	7	267	51	22	261	36	96	87	887
Percent Total	*0.1*	*1.6*	*1.6*	*3.5*	*0.8*	*30.1*	*5.7*	*2.5*	*29.4*	*4.1*	*10.8*	*9.8*	*100.0*

Table I.7. Specimen counts (NISP) for identified bison organized by excavation block. MNI, MNI, and MAU values are for the combined sample.

	Excavation Block								
Identified Specimens	1	2	3	4	5	Total	MNI	MNE	MAU
incisive	1	1			6	8	4	8	4.0
nasal	1	1			1	3	3	3	1.5
maxilla		2			3	5	4	4	2.0
frontal		3	1		7	11	5	8	4.0
zygomatic					1	1	1	1	0.5
lacrimal					1	1	1	1	0.5
occipital		1			1	2	2	2	2.0
temporal petrous					2	2	2	2	1.0
basisphenoid					1	1	1	1	0.5
mandible	3	10	2		14	29	9	10	5.0
hyoid					2	2	1	2	1.0
atlas		3			1	4	2	2	2.0
axis		1				1	1	1	1.0
cervical vertebra – 3-7	2	3			5	10	2	3	0.6
vertebra thoracic	5	15	5	1	18	44	3	9	0.6
vertebra lumbar	4	6	2	1	8	21	3	13	2.6
vertebra caudal	1				2	3	2	3	-
vertebra – mixed	1	27				28	-	-	-
sacrum		1	1			2	1	1	1.0
rib	4	20	4	4	37	69	3	27	1.0
costal cartilage		1			1	2	1	2	-
scapula	1	1			3	5	3	5	2.5
humerus – proximal					2	2	1	2	1.0
humerus – diaphysis		2	1		5	8	3	5	2.5
humerus – distal	1	1			4	6	4	5	2.5
ulna – proximal					3	3	2	3	1.5
ulna – diaphysis					3	3	2	3	1.5
ulna – distal					4	4	3	4	2.0
radius – proximal		1			2	3	2	2	1.0
radius – diaphysis	2	2	1		3	8	3	5	2.5
radius – distal	3	3			4	10	5	7	3.5
radial carpal	2	1			2	5	2	4	2.0
intermediate carpal		1			1	2	2	2	1.0
ulnar carpal		1			1	2	2	2	1.0
2nd + 3rd carpal		1		1	1	3	2	3	1.5
4th carpal		1				1	1	1	0.5
accessory carpal		1			1	2	2	2	1.0
metacarpal – proximal		1	1		1	3	2	3	1.5
metacarpal – diaphysis			1			1	1	1	0.5
metacarpal – distal					3	3	2	3	1.5
5th metacarpal		1				1	1	1	0.5
innominate		2	1	2	2	7	3	5	2.5
femur – proximal	1				4	5	2	2	1.0
femur – diaphysis	1	3	1		1	6	3	4	2.0
femur – distal	1	1			1	3	3	3	1.5
patella		2			1	3	2	3	1.5
tibia – proximal		1			1	2	1	2	1.0

Table I.7. Specimen counts for identified bison (*continued*).

	Excavation Block								
Identified Specimens	1	2	3	4	5	Total	MNI	MNE	MAU
tibia – diaphysis	2	6	2		6	16	6	7	3.5
tibia – distal		2	4		4	10	4	8	4.0
lateral malleolus			2		2	4	3	4	2.0
astragalus					5	5	3	5	2.5
calcaneum			1		5	6	4	5	2.5
central + 4th tarsal					4	4	3	4	2.0
2nd + 3rd tarsal		1			3	4	2	4	2.0
1st tarsal					2	2	1	2	1.0
metatarsal – proximal					3	3	2	3	1.5
metatarsal – diaphysis					2	2	1	2	1.0
metatarsal – distal		1			1	2	1	2	1.0
phalange 1	3	12	1	2	22	40	4	27	3.4
phalange 2	1	7		1	10	19	2	17	2.1
phalange 3	1	3	1	2	6	13	2	10	1.2
proximal sesamoid	3	7	3	2	9	24	2	24	1.5
distal sesamoid	2	2	1		3	8	1	8	1.0
metapodial – distal				1	7	8	-	-	-
Totals	46	163	36	17	258	520			

Table I.8. Bison mandible and maxilla age range estimates based on tooth eruption and wear patterns. Facet labels follow Frison and others (1976:Figure 8).

Specimen	Catalog Number	Context	Specimen Description	Estimated Age Range (years)
Right mandible	1027	General Level	Body fragment with P_3 in regular wear. Age difficult to assess.	2.0–unknown
Left mandible	1074	Feature 7	Body fragment with fully erupted DP_2, DP_3, and DP_4 (fragmented) in wear; molars missing. Deciduous premolar wear is consistent with, or slightly advanced in comparison to specimens CN1083 and CN1088.	1.0–2.0
Left mandible	1074	Feature 7	Body with fully erupted DP_3, DP_4, M_1, and M_2; DP_2 missing (pushed out?) and P_2 visible above alveolus but unworn; DP_3 and DP_4 well worn; erupting P_3 visible below DP_3; M_1 and M_2 in full wear. M_1 exostylid in wear with loop; M_2 visible but unworn. M_3 erupting with unworn 1st and 2nd cusps just visible above alveolus.	2.0–3.0
Left maxilla	1057	Feature 7	Rostral fragment with DP^3 visible above alveolar border, unworn. Compares well with late or near-term fetal specimen.	fetal
Left mandible	1083	Feature 11	Body fragment with fully erupted DP_4 in wear.	0.5–1.0?
Right mandible	1083	Feature 11	Fragmented body/partial ascending ramus, M_1 erupted with slight wear on facets I, III, and Va. M_2 not erupted but likely visible above alveolus; no wear. Pairing with left mandible CN1088.	0.5–1.0
Left mandible	1088	Feature 11	Fragmented body/ascending ramus with fully erupted DP_2, DP_3, DP_4, all in wear. M_1 erupted with slight wear on facets I, II, IV, and VI. M_2 and M_3 missing. Pairing with right mandible CN1083.	0.5–1.0
Left mandible	1088	Feature 11	Body fragment with fully erupted M_2 and M_3 in regular wear; M_3 hypoconulid enamel fractured but wear is evident. M_2 exostylid with very light wear but dentine not exposed. M_3 exostylid visible but unworn. Uncertain pairing with right mandible CN1083.	1
Right mandible	1083	Feature 11	Body fragment with fully erupted P_2, P_3, P_4, M_1, and M_3; M_2 missing. All teeth in regular wear; P_2 misaligned. M_1 exostylid worn with loop. M_3 exostylid visible with very slight polish but unworn and dentine not exposed. Uncertain pairing with left mandible CN1088.	4.0–7. 0
Left mandible	1089	Feature 11	Body fragment with fully erupted M_2 and M_3 in regular wear. M_2 and M_3 extostylids worn with loops. Age difficult to assess. Likely younger than right mandible CN1077	8.0–unknown
Right maxilla	1089	Feature 11	Rostral portion with fully erupted DP^2, DP^3, and DP^4 in regular wear.	1.0–2.0?
Right maxilla	1084	Feature 11	Alveolar border with full erupted P^2, P^3, P^4, M^1, M^2, and M^3 in regular wear. M^1 endostyle worn with irregular loop. M^2 endostyle visible with light polish. M^3 endostyle visible but unworn and dentine not exposed.	4.0–7. 0?
Right mandible	1077	Feature 12	Body fragment with fully erupted P_3, P_4, M1, and M_2; M_3 missing. All teeth in regular wear but some fragmentation of enamel; M_1 prefossette worn away. M_2 exostylid worn with loop. Age difficult to assess.	10.0–unknown

Table I.9. Specimen counts for fetal and postnatal bison remains.

Skeletal Element	Catalog Number	Context	Fetal	Fetal/Postnatal	Postnatal
incisive	1063	Feature 7		1	
nasal	1065	Feature 7	1		
maxilla (DP^2)	1057	Feature 7	1		
frontal	1084, 1088	Feature 11		2	
temporal	1071	Floor/Fill Deposits		1	
thoracic vertebra	1065	Feature 7	1		
lumbar vertebra	1088	Feature 11	2		
rib	1089	Feature 11		1	
rib	1057, 1063	Feature 7		2	
humerus - diaphysis	1089	Feature 11	1		
humerus - distal	1089	Feature 11			1
radius - distal	1065	Feature 7	1		
metacarpal	1055	Feature 5		1	
tibia - diaphysis	1084	Feature 11	1		
phalange 1	1062	General Level Surface Deposits			1
Total			8	8	2

Table I.10. Comparison of relative proportions of identified fish, bird, and mammal remains from village sites organized by component and vertebrate group, Knife River Region and Heart River Region. On-A-Slant and Chief Looking's samples include G5 specimens.

Village/Component (TP) Time Period	Fish	Bird	Small to Medium Mammal	Large Canid	Small Artiodactyl	Large Artiodactyl	Total NISP
A.D.1800s							
Taylor Bluff	*10.4*	*2.1*	*2.9*	*3.3*	*1.1*	*80.2*	994
Big Hidatsa TP1	*1.5*	*1.1*	*1.1*	*7.0*	*5.1*	*84.3*	470
Sakakawea	*11.8*	*1.2*	*1.7*	*15.8*	*1.7*	*67.8*	2,762
Big Hidatsa TP2	*3.6*	*1.4*	*1.0*	*9.6*	*2.6*	*81.9*	1,100
A.D. 1700s							
Molander	*11.7*	*15.9*	*11.0*	*0.7*	*3.0*	*57.7*	903
Double Ditch TP0	*19.1*	*44.4*	*8.9*	*3.4*	*7.3*	*16.9*	1,569
On-A-Slant TP1	*65.9*	*9.5*	*5.0*	*1.6*	*4.7*	*13.3*	959
Big Hidatsa TP3-4	*5.8*	*2.5*	*2.0*	*11.6*	*3.1*	*75.0*	1,920
Lower Hidatsa TP1-2	2.9	2.6	*0.6*	*4.4*	*7.6*	*81.8*	1,409
Double Ditch TP1	*21.7*	*13.2*	*16.4*	*10.6*	*4.3*	*33.8*	3,960
Boley TP1	*16.5*	*19.9*	*13.0*	*3.2*	*3.8*	*43.6*	956
A.D. 1600s							
Double Ditch TP2	*11.5*	*20.5*	*9.5*	*7.6*	*9.7*	*41.2*	1,589
On-A-Slant TP2	*68.7*	*15.0*	*1.3*	*1.2*	*2.2*	*11.6*	2,306
Double Ditch TP3	*16.6*	*17.2*	*12.8*	*8.1*	*5.1*	*40.3*	4,697
Boley TP2	*6.9*	*25.9*	*5.2*	*8.6*	*0.0*	*53.4*	58
Big Hidatsa TP5-6	*5.6*	*3.2*	*2.8*	*18.8*	*4.2*	*65.4*	500
Lower Hidatsa TP3-4	*2.7*	*1.9*	*0.8*	*11.4*	*10.0*	*73.2*	1,551
Scattered TP1-2	*33.5*	*15.8*	*10.8*	*4.1*	*12.6*	*23.3*	12,533
On-A-Slant TP3	*62.9*	*7.2*	*1.1*	*1.1*	*3.3*	*24.4*	1,002
A.D. 1500s							
Larson	*10.5*	*13.2*	*15.4*	*18.0*	*4.0*	*38.9*	2,052
Boley TP3/4	*61.7*	*4.8*	*1.6*	*3.8*	*0.1*	*28.0*	1,343
Scattered TP3-4	*31.7*	*11.8*	*9.5*	*6.0*	*5.9*	*35.0*	4,190
Lower Hidatsa TP5-6	*1.3*	*0.5*	*0.9*	*3.1*	*1.1*	*93.1*	1,003
Chief Looking's	*33.6*	*5.8*	*50.0*	*1.9*	*1.4*	*7.3*	4,281
Double Ditch TP4	*20.2*	*15.5*	*9.9*	*12.1*	*2.8*	*39.5*	3,534

References Cited

Frison, George C., Michael Wilson, and Diane J. Wilson.
1976 Fossil Bison and Artifacts from an Early Altithermal Period Arroyo Trap in Wyoming. *American Antiquity* 41(1):28-57.

Appendix J:
Modified Bone and Antler

Carl R. Falk

Table J.1. Variables and attribute codes applied to modified bone remains.

Variable	Description
SPECNO	**Individual Specimen Number (001 – 052)**
CATNO	**Catalog Number (1001 – 1091)**
SIZE	**Size Grade (G1-G5)**
GENFUN	**Grouped Functional Class**
1	digging tools (hoes, expedient tools)
2	patterned piercing tools
3	pressure flakers (patterned and unpatterned)
4	fishhooks
5	other patterned tools
6	other expedient tools
7	ornamental and nonutilitarian
8	unknown, utilitarian?
FUNC	**Functional Class**
0	unknown, utilitarian
1	bead
2	bracelet (strip)
3	tube
4	gaming piece
5	whistle
6	incised piece
7	rattler
8	unknown, nonutilitarian
9	effigy (bird)
10	cultivating tool
11	chopper
12	expedient cutting tool
13	abrader
14	patterned pick
15	hammer/percussion (billet)
16	bipolar wedge
17	squash knife
18	bipolar anvil
20	patterned awl or punch
22	patterned pressure flaker
25	basketry/weaving/sewing tool
26	shaft straightener
30	fishhook

Table J.1. Variables and attribute codes (*continued*).

Variable	Description
31	projectile point
32	antler wrist guard/bracelet
39	broad exped. pressure flaker
40	scraper handle
41	scraper - soft material
42	scraper - resist material
43	narrow exped. pressure flaker
44	surface burnishing tool
45	expedient awl or punch
46	expedient digging tool
47	beaver tooth adz
48	expedient adz
49	used on pliable material
50	expedient pick – non-digging
51	flesher
52	antler bow
53	elk tooth pendant
54	unspecified rib tool
56	handle portion of unspecified tool
57	knife handle
58	unspecified antler tool/artifact
59	antler choker
60	unspecified expedient tool (replaces classes 41, 42, 44, 48, 49, and 50)
62	bone projectile/bow-lance tip
UPH	**Use-Phase Class**
1	unfinished, usable
2	unfinished, not usable
3	finished, usable
4	finished, not usable
5	debris from manufacture
6	debris from resharpening
MULT	**Multi-Function**
1	Single
2	Dual

Table J.1. Variables and attribute codes (*continued*).

Variable	Description
CERT	**Certainty That Specimen Is A Tool Or Culturally Modified Piece**
1	Certain
2	Uncertain
PART	**Portion Of Tool Present**
1	complete
2	near complete
3	proximal end
4	distal end
5	medial segment
6	lateral fragment
8	manufacturing debris
9	indeterminate part
PCT	**Percent Of Tool Present (To Nearest 5%)**
999	Manufacturing debris

Table J.1. Variables and attribute codes (*continued*).

Variable	Description
BURN	**Burning**
0	Absent
1	Present
WEIGHT	**Specimen Weight (0.1 g)**
LENGTH	**Specimen Length (0.1 mm)**
WIDTH	**Specimen Width (0.1 mm)**
THICK	**Specimen Thickness (0.1 mm)**
TAXON	**Taxonomic Identification (Species, Genus, Family, Class, Etc.)**
ELEMENT	**Skeletal Element Identification (Scapula, Ulna, Etc.)**
SIDE	Side (Left, Right, Axial, Unsided)
PORTION	Element Portion (Complete, Proximal, Distal, Indeterminate, Etc.)

Table J.2. Counts of modified bone specimens from the 1968 test investigation at Molander, organized by generalized and specific functional class (Falk 1969).

General and Specific Functional Class	Count	Comment
Patterned Piercing Tools		
patterned awl or punch	2	One specimen (length 108 mm) manufactured from split rib; large artiodactyl (*Bison bison*?). A second specimen (length 64 mm) manufactured from vestigial metapodial; small artiodactyl.
Other Patterned Tools		
shaft straightener	1	Manufactured from a large artiodactyl rib; incomplete specimen, two perforations.
knife handle	3	Two knife handle fragments manufactured from large artiodactyl ribs. Slots cut on both specimens to accommodate thin metal blades. One specimen with two slots cut on opposing margins. A third complete specimen (length 270 mm) is manufactured from the dorsal spine of a thoracic vertebra; large artiodactyl. The specimen is slotted along the caudal border to accept a metal knife blade.
Other Expedient Tools		
expedient awl or punch	3	Two complete specimens (lengths 201 mm and 96 mm) fashioned from scapular spines; large artiodactyl. A third specimen is distal end of tool; large artiodactyl long bone splinter.
Ornamental and Non-Utilitarian		
bead	2	Described as small and large tubular beads.
tube	3	Described as large tube, possibly whistle fragments.
gaming piece	2	Circular pieces (diameter 12 mm for both pieces) manufactured from split rib sections; large artiodactyl. Specimens well-worn and undecorated.
Total	16	

Table J.3. Modified bone organized by specimen completeness and generalized functional class.

		Portion Present							
Generalized Functional Class		Whole	Near Whole	Proximal End	Distal End	Lateral Fragment	Manufac. Debris	Indeterminate	Total
Digging Tools	n	1		1	5				7
	%	*14.3*		*14.3*	*71.4*				*100.0*
Pressure flakers	n				2				2
	%				*100.0*				*100.0*
Other Patterned Tools	n	3	4	2	1	1			11
	%	*27.3*	*36.4*	*18.2*	*9.1*	*9.1*			*100.1*
Other Expedient Tools	n	2	1		1				4
	%	*50.0*	*25.0*		*25.0*				*100.0*
Ornamental and Non-utilit.	n	6	2			3	1	3	15
	%	*40.0*	*13.3*			*20.0*	*6.7*	*20.0*	*100.0*
Unknown, Utilitarian	n			2	1	1	1	8	13
	%			*15.4*	*7.7*	*7.7*	*7.7*	*61.5*	*100.0*
	n	12	7	5	10	5	2	11	52
Total	%	*23.1*	*13.5*	*9.6*	*19.2*	*9.6*	*3.8*	*21.2*	*100.0*

Table J.4. Modified bone organized by skeletal element for select vertebrate groupings.

Skeletal Element	Vertebrate Group: *Bison bison*/ *Bison bison*?	*Cervus canadensis*/ Cervidae	*Odocoileus* sp.	Large Artiodactyl	Small Artiodactyl	*Canis* sp.	*Lepus* sp.	Small/Medium Mammal	Large Bird	Other/ Indeterminate	Total
antler		3	2								5
mandible	1										1
rib				6							6
rib/vert. spine				1						1	2
thoracic vert.				1							1
scapula	7			7							14
humerus	1			1			1				3
ulna									1		1
metatarsal	1			1	1						3
metapodial					1	2		2			5
indeterminate		1		2					2	6	11
Total	10	4	2	19	2	2	1	2	3	9	52

Table J.5. Modified bone specimens organized by deposit type and generalized and specific functional class.

	Deposit Type							
Generalized and Specific Functional Class	Cache Pit/Pit Outside	Cache Pit/ Pit Inside	Pit Unass.	Surface Outside	Midden Outside	Midden/Floor Inside	Floor Fill Inside	Total
Digging Tools								
cultivating tool	2	1			4			7
Pressure flakers								
narrow expedient flaker		2						2
Other Patterned Tools								
abrader		2						2
pick					1			
hammer/billet			1					
squash knife	1	2					1	4
flesher		1						1
handle		1						1
knife handle		1						1
Other Expedient Tools								
scraper-soft mat.	1					1		2
expedient awl/punch		2						2
Ornamental and Non-utili.								
bead	1	1				1		3
bracelet (strip)		1						1
tube					2	1		3
gaming piece		1	1					2
incised piece		1						1
unknown, nonutilitarian	1	2	1			1		5
Unknown, Utilitarian								
unknown, utilitarian		4	2	1	3	2		12
unspecified antler tool			1					1
Total	6	22	6	1	10	6	1	52
Percent Total	*11.5*	*42.3*	*11.5*	*1.9*	*19.2*	*11.5*	*1.9*	*99.8*

Table J.6. List of sites, site numbers, and references for data presented in table 7.7.

Site Name	Site Number	Region	Reference(s)
Nightwalker's Butte	32ML39	Garrison	Lehmer *et al.* (1978:258-302)
Rock Village	32ME15	Garrison	Lehmer *et al.* (1978:258-302)
Big Hidatsa Village	32ME12	Knife	Ahler and Ryser (1997:387, Table 142); Weston (1986:263-265, Table 27),
Taylor Bluff Village	32ME366	Knife	Snyder (1988:205-218, Table 54)
Sakakawea Village	32ME11	Knife	Ahler and Ryser (1997: 387, Table 142); Weston (1986:260-263, Table 26)
Lower Hidatsa Village	32ME10	Knife	Ahler and Ryser (1997: 387, Table 142); Weston (1986:257-260, Table 25)
Amahami	32ME8	Knife	Lehmer *et al.* (1978:258-302)
Deapolis	32ME5	Knife	Lehmer *et al.* (1978:258-302)
Molander Village	32MO7	Knife	This report
Larson Village	32BL9	Heart	Falk (2007:191, Table 10.11)
Double Ditch Village	32BL8	Heart	Ahler (2005:276, Table 55)
Boley Village	32MO37	Heart	Ahler and Falk (2006:193, Table 64)
Chief Looking's Village	32BL3	Heart	Falk (2013:124, Table 8.2)
Scattered Village	32MO31	Heart	Ahler and Falk (2002:278, Table 57)
On-A-Slant Village	32MO26	Heart	Ahler And Ryser (1997:384, Table 141)

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Appendix K:
Inventory of Botanical Remains

Robert K. Nickel

Table K.1. Inventory of botanical specimens by feature number.

CN	Size	Seed Type	Count	Burn	Feature
1057	4	Chokecherry	1	No	7
1057	4	Corn Cob	2	Yes	7
1057	5	Dogwood	1	No	7
1057	4	Plum	1	No	7
1057	4	Sedge	1	No	7
1063	4	Corn Cob	1	Yes	7
1063	4	Dogwood	2	No	7
1063	4	Grape	4	Yes	7
1063	3	Plum	2	No	7
1063	3	Squash	1	No	7
1063	4	Squash	4	No	7
1063	5	Squash	5	No	7
1063	5	Sunflower	3	No	7
1063	5	Sunflower	1	Yes	7
1065	5	Chenopod	1	No	7
1065	4	Chokecherry	4	No	7
1065	4	Corn Cob	6	Yes	7
1065	4	Dogwood	24	No	7
1065	5	Dogwood	51	No	7
1065	4	Plum	7	No	7
1065	5	Rose	9	No	7
1065	4	Squash	25	No	7
1065	5	Sunflower	150	No	7
1067	4	Corn Cob	3	Yes	7
1067	4	Dogwood	7	No	7
1067	4	Grape	8	No	7
1067	5	Grape	3	No	7
1067	4	Plum	3	No	7
1067	4	Squash	69	No	7
1067	5	Squash	400	No	7
1067	4	Sunflower	1	No	7
1059	3	Bean	2	Yes	9
1059	4	Bean	13	Yes	9
1059	4	Buffaloberry	23	No	9
1059	5	Buffaloberry	15	No	9
1059	5	Chenopod	1	No	9
1059	3	Corn Cob	3	Yes	9

Table K.1. Inventory of botanical specimens by feature number *continued*.

CN	Size	Seed Type	Count	Burn	Feature
1059	4	Corn Cob	21	Yes	9
1059	3	Corn Kernel	11	Yes	9
1059	4	Corn Kernel	73	Yes	9
1059	5	Grape	1	No	9
1059	5	Grass	1	Yes	9
1059	4	Squash	2	Yes	9
1059	4	Sunflower	37	No	9
1059	4	Sunflower	14	Yes	9
1059	5	Sunflower	1	No	9
1059	5	Sunflower	24	Yes	9
1069	4	Buffaloberry	1	Yes	9
1069	5	Buffaloberry	11	No	9
1069	4	Chokecherry	1	No	9
1069	3	Corn Kernel	10	Yes	9
1069	4	Corn Kernel	33	Yes	9
1069	5	Corn Kernel	11	Yes	9
1069	4	Dogwood	1	Yes	9
1069	3	Grass	1	Yes	9
1069	3	Squash	1	No	9
1069	5	Squash	45	No	9
1069	4	Sunflower	9	No	9
1069	5	Sunflower	1	Yes	9
1083	4	Corn Kernel	3	Yes	11
1083	5	Dogwood	5	No	11
1083	4	Plum	3	No	11
1083	5	Rose	1	No	11
1083	4	Sedge	1	No	11
1083	4	Squash	104	No	11
1084	4	Buffaloberry	1	No	11
1084	5	Buffaloberry	1	No	11
1084	4	Chokecherry	8	No	11
1084	5	Chokecherry	1	No	11
1084	4	Dogwood	4	No	11
1084	5	Dogwood	2	No	11
1084	3	Plum	7	No	11
1084	4	Plum	26	No	11
1084	5	Sedge	1	No	11

Table K.1. Inventory of botanical specimens by feature number *continued*.

CN	Size	Seed Type	Count	Burn	Feature
1084	3	Squash	3	No	11
1084	4	Squash	37	No	11
1088	5	Chenopod	5	No	11
1088	4	Chokecherry	13	No	11
1088	5	Chokecherry	6	No	11
1088	5	Corn Cob	1	Yes	11
1088	3	Corn Kernel	4	Yes	11
1088	4	Corn Kernel	2	Yes	11
1088	4	Dogwood	6	No	11
1088	5	Dogwood	21	No	11
1088	4	Grape	4	No	11
1088	5	Grass	1	No	11
1088	3	Plum	16	No	11
1088	4	Plum	20	No	11
1088	5	Plum	4	No	11
1088	3	Squash	18	No	11
1088	4	Squash	189	No	11
1089	4	Buffaloberry	11	Yes	11
1089	5	Chokecherry	4	No	11
1089	5	Corn Cob	2	Yes	11
1089	3	Corn Kernel	2	Yes	11
1089	4	Corn Kernel	9	Yes	11
1089	5	Dogwood	1	No	11
1089	4	Grape	3	No	11
1089	4	Grape	2	Yes	11
1089	5	Grass	1	No	11
1089	3	Plum	3	No	11
1089	3	Squash	3	No	11
1089	4	Squash	49	No	11
1089	5	Squash	179	No	11
1089	4	Sunflower	19	No	11

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