Revisiting the Ancients:
A Natural and Cultural History of the MacHaffie Archaeological Site (24JF4)

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ABSTRACT

The MacHaffie site (24JF4) in southwest Montana is not, for the most part, a campsite. It is neither a bison killsite, nor a deer hunting site. These associations are incorrectly made in the archaeological literature. It is best characterized as a stopping point between residential base and local chert quarries. Beginning with Folsom groups and extending into either the latter portion of the Middle Precontact or even the Late Precontact, Native American occupants generally conducted the same kinds of activities while at MacHaffie. Those typically being translocation of tool quality stone from nearby chert sources and reducing those cores and spalls into flake and bifacial blanks. Subsequently, the desired mid-reduction stage pieces were then transported elsewhere for later use or further refinement. Secondary activities consisted of pressure flaking of formal tools, removal and rehafting of projectile points, and limited domestic enterprises. These latter activities, however, appear to have been superfluous to the production of flake blanks, flake production from unprepared cores, and mid-reduction stage percussion refinement of bifacial pieces.

In addition to the repeated use by past Native American occupants of the region, the MacHaffie site also provides one of the few examples, in a Montana archaeological context, of what is probably an early 20th century cultural feature associated with protective magic. Presumably, the phenomenon was created by a local homesteader of European ancestry.

PREFACE AND ACKNOWLEDGEMENTS

The MacHaffie site (24JF4) in southwest Montana may be the most name-recognized yet poorly understood archaeological resource in the northern plains. This seems strange considering it gained national recognition by 1951 as the subject of several articles in scientific journals and newspapers. It was also the focus of two doctoral dissertations. Even today the MacHaffie site is repeatedly, albeit vaguely, referenced in cultural resource management reports, regional culture history models, and academic books, theses, and manuscripts. The MacHaffie site advanced archaeological understanding of projectile point type sequences and demonstrated a long, continued presence of humans in the northern plains. Both issues were topics of uncertainty in 1951 when formal excavation work commenced. Although intermittent research spans approximately 70 years, detailed and defensible documentation has been limited because site data was never thoroughly analyzed.

Committing to a volunteer research project involving additional excavation, analysis of cultural remains, review and analysis of past documentation, and artifact consolidation and cataloguing requires a tremendous amount of time. The senior author can personally account for approximately 2,100 hours of evening and weekend work over a span of five years. Obstacles encountered along the way include lost, misplaced, unclear, contradictory, and non-existent records pertaining to work conducted and artifact and sediment unit proveniences. Additionally, some documented cultural materials have been lost, misplaced, or discarded. Further, some vaguely referenced cultural remains were never catalogued and cannot be located. Regardless of missing data and an element of collection bias, information has been gleaned in conjunction with specialized chronometric, environmental, geological, and geomorhoplogical studies. It is Dr. Leslie Davis who must be recognized for coordinating studies that we have organized into a manuscript. Our intention with this document is to present future researchers with credible, defensible explanations of our interpretations of human activities at 24JF4. In doing so we dedicate the effort to the lives and careers of Dr. Richard G. Forbis and Dr. Leslie B. Davis.

Credit must begin with James Bompart, the property owner at the time the site was discovered. Mr. Bompart graciously allowed and supported archaeological investigations and academic fieldtrips from the late 1940s through the 1960s. Equally significant is Edmund MacHaffie for whom the site is named. Mr. MacHaffie recognized the archaeological property as something extraordinary and brought it to the attention of Wesley Bliss and Jack Hughes of the River Basin Surveys. Funds, supplies and sponsorship for the 1951 investigation are credited to William Duncan Strong, Harry L. Shapiro, W. P. Clark, Paul C. Phillips and Carling I. Malouf. Their efforts made it possible for Richard G. Forbis to conduct the first systematic, documented excavations at 24JF4. Forbis' crew consisted of John D. Sperry, Paul Tolstoy and Robert Fischer. Their fieldnotes were critical to our research.

Crew members who assisted Leslie B. Davis from 1989 through 2010 include Steve Aaberg, Steve Armstrong, David Austin, Lon Banderob, Ted Birne, Shengquian Chen, Tim Cowan, Buck Damone, Jocelynn DeHass, Jennifer Easton, Jack Fisher, Jr., Tom Flanigan, Martha Foster, Becky Gilluly, David Grant, Troy Helmick, Eoughan (Hillary) Hiers, Sarah Jenkins, Marilyn Kananen, Matt Landt, Ann Lockie, Ed Mohler, Phil, Adam, and Willy Pallister,

Peter Pratt, Patrick Rennie, Roy Reynolds, Sara Scott, Wendy Stokes, John Stoner, Jr., Helen Strickland, Ralph Van Daele, Bruce Waller, Barbi White, Terri Wolfgram, Jenny Younger. Funding for the 1989-2010 excavations was made possible through grants and donations of Bompart Cleaning Service LLC (Helena), Virginia B. Bompart (Helena), Ed Casne and Associates (Helena), Earthtalk Studios (Bozeman), Elkhorn Mountain Inn (Joe and Marianne Calnan, Montana City), Richard G. Forbis Fund for Paleo-Indian Research (Museum of the Rockies, Bozeman), Patrick H. Grimes (New York), Paul F. and Nancy Heymann (Toledo/Big Sky), Stanley and Paula Holland (Great Falls,), Dr. Cel and Dr. Ron Johnson (Bozeman), Kokopelli Archaeological Research Fund, Lifeways of Canada Ltd. (Dr. Brian O.K. Reeves, Calgary), John and Nina Lipkowitz (New York City), R. Thomas and Ann M. Lockie (Los Angeles/Bozeman), Dr. Carling I. Malouf (Missoula), The National Science Foundation, John L. Stoner, Jr. (Townsend), Helen C. Strickland (Bozeman), Dr. Phillip and Willa Pallister (Boulder) and Jenny B. Younger (Bozeman).

Those who volunteered their time, skills and other resources to the 2017 and 2018 MacHaffie field project are cornerstone to both this document and continued public education and support of Montana archaeology. To that end we give a warm and heartfelt thank you to: John Andrews, Steve Armstrong, John and Nina Baucus, Melvin Beattie, Ken and Carol Brady, DeeAnna Brady-Leader, Richard Buswell, Scott Buswell, Mike Davis, Bob and Brian Haseman, Russell W. Graham, T. Weber Greiser, Gretchen Hibbard, Mary Hibbard, Barry Hood, Mary Langenderfer, Sean McQueen, Dennis and Debbie Milburn, Ed Mohler, Phillip and Adam Pallister, Rich Pettersen, Gayle Reid, Patrick Rennie, Dawn Rennie, Jack Reynolds, Jeff Sherlock, Dan Smith, Sally Thompson, Jim Varney and Kate, Hannah, Elijah and David Weiss.

Completion of the MacHaffie archaeological study may not have occurred but for the vigilance, sound judgment, and generosity of former property-owner, Pamela Bompart. Ms. Bompart funded much of the specialized analysis. She subsequently transferred the cultural material recovered from 1989 through 2018 to the University of Montana Anthropological Curation Facility. The intent is to keep all materials (excluding seven pieces accessioned at the Smithsonian) we have a record for as a single, useable collection in a single repository. She has also donated the MacHaffie site to the Archaeological Conservancy for protective measures. In turn, James Walker and the Archaeological Conservancy permitted completion of Dr. Leslie B. Davis' work initiated in 1989.

Steve Aaberg, Ray Alt, Steve Armstrong, Melvin Beattie, John Byrd, Carl Davis, David Eck, David Ferguson, Dale Fisher, Jack Fisher, Jr., Mavis Greer, Eugene Gryba, Jim Keyser, Edward Knell, Ruthann Knudson, Marcel Kornfeld, Jason LaBelle, Larry Lahren, Craig Lee, Julie Morrow, Doug Melton, Trevor Peck, Stephanie Garcia Richard, Barney Reeves, Tom Roll, Sally Thompson, Michael C. Wilson and Terri Wolfgram unfailingly directed us to critical contacts and sometimes obscure literary references, engaged in discussions of lithic material sources, lithic reduction patterns, or heat treatment of lithic raw materials. They also helped locate various materials previously collected from the MacHaffie site or helped piece together information lacking, vague or ambiguous in the 1989 through 2010 field records.

John Byrd donated his collection of MacHaffie artifacts to this study, and Dr. David Meltzer permitted us to use a photo of the first two projectile point fragments known to have

been recovered from the Folsom type-site. In addition to the authors, Larry Lahren reviewed a draft of the manuscript and provided valuable editorial comments and suggestions.

James Krakker of the National Museum of Natural History (Smithsonian Institution) photographed the seven MacHaffie site artifacts accessioned there, and he provided metric and nonmetric data for those pieces. Henry Abbott (Beta Analytic), Alexander Cherkinsky (University of Georgia, Center for Applied Sciences), Linda Scott Cummings (Paleo Research Institute), and Jonathan Jarvis (The University of Texas Archaeological Research Lab) kindly provided data missing from field notes and office records regarding a suite of organic samples intermittently submitted for C-14 assay by Leslie B. Davis from 1989 through 2013.

Barney Reeves directed us to the Richard G. Forbis Fonds at the University of Calgary where some additional MacHaffie documentation was located. Sally Thompson receives full credit for locating Richard G. Forbis' MacHaffie site artifacts and associated documents at the University of Montana, and coordinating initial meetings with Cynthia-Riley Augé, University of Montana Anthropological Curation Facility Curator and Adjunct Instructor. Dr. Augé, allowed us to analyze, catalogue, and photograph these materials and to combine those with the MacHaffie materials recovered by Leslie B. Davis and our work from 2017 through 2018. We are grateful for her professionalism and guidance concerning acquisition of the entire MacHaffie collection, now stored at the UM Anthropological Curation Facility (UM Curation #2010.09.33). Further, were it not for Dr. Augé's expertise in protective magic, the horse skull feature from MacHaffie would have gone under-reported and unrecognized for what it likely is.

Lance Vossler donated his time and use of a trackhoe to remove spoil dirt from areas investigated in 2017 through 2018 and subsequently to infill the excavation pit opened in 2010 by Dr. Davis. Jeff Wiest of Ash Grove Cement Company guided the senior author to chert quarries 24JF226 and 24JF879 so comparative material collections could be made.

Although only a few names are credited on the title page as authors, the contributors to this effort are numerous. Were it not for a collaborative goal of producing a useful and meaningful study of the early human presence of what is now Montana, the resulting product would be an overgeneralization lacking in substance and comparative value. Even more detrimental, the perpetuation of misinformation regarding MacHaffie would continue.

Thank you, to all who contributed to this multi-disciplinary exercise. We hope you feel a sense of pride and ownership in this manuscript and that your passion for studying the past never fades. We also hope that this effort inspires archaeologists to see academic value in analyzing or re-analyzing older artifact collections. Much information can be gleaned from these resources. So too, the MacHaffie collection will continue to reveal information as analytical methods and technologies advance. To aid in future studies it is our intention to leave subsequent MacHaffie researchers a thoroughly organized and documented collection.

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1.0 FILLING AN ARCHAEOLOGICAL VOID

On an August day in 1908, George McJunkin rode along Wild Horse Arroyo in northeast New Mexico. He was looking for missing cattle and repairing fence damaged by a destructive storm (Folsom 1992; Meltzer et al. 2002:5). What he found would posthumously put the ranch-hand at the center of a decades-long controversy and, eventually, at the apex of archaeological celebrity.

McJunkin had perhaps four years of formal education, but he had become literate with the help of local cowboys. He was a voracious reader with abiding curiosity and a consuming interest in natural history. So, when he observed large bones protruding from the arroyo-face he was prompted to investigate. McJunkin recognized the bones to be bovine, but he also realized they were of neither domestic cattle nor modern bison. Although unclear if McJunkin found stone tools with the bison remains (Meltzer et al. 2002:7), he knew the find was significant. He attempted multiple times to engage experts of extinct fauna but generated no interest before his death in 1922 (Hillerman 1973; Peeples 2015).

In 1926, paleontologists Jesse Figgins and Harold Cook of the Colorado Museum of Natural History learned of McJunkin's find and traveled to Folsom, New Mexico, to confirm the discovery and possibly recover a mountable skeleton of an extinct bison. They had previously identified the bones as those of a poorly known species now designated *Bison antiquus occidentalis*. In 1928, Kirk Bryan of the United States Geological Service concluded that the Folsom site was late Pleistocene or early Holocene in age. The find appears to have been initially viewed as strictly paleontological since there is no written suggestion prior to 1926 of an associated human aspect. As excavations proceeded, the recovery work became archaeological. Fluted projectile point fragments were exposed among the fossil bison skeletal remains (Folsom 1992; Meltzer et al. 2002:8: See Figure 1). Currently, the Folsom site (29CX1) is interpreted as a bison kill where Folsom hunters impounded and dispatched approximately 32 adult, sub-adult and calf bison-- mostly female. The kill occurred in the fall of the year approximately 10,500 radiocarbon years before present (BP) (Meltzer et al. 2002:5,15,17).

With the presence of associated artifacts, McJunkin's find proved to be exceptionally important in the understanding of human chronology in the New World. Perhaps, it seemed, the controversial late 19th Century speculations of Thomas Wilson (1888) held merit. It was Wilson, who opined, without substantive evidence, that man had occupied the continent for much longer than most academics would accept. For the next two decades, however, a better understanding of culture history in the New World and representative diagnostic artifacts was elusive.

Word of the 1926 discovery soon reached Aleš Hrdlička, curator of physical anthropology at the Smithsonian Institution and one of the day's most respected and influential scientists. Some accounts state Dr. Hrdlička instructed Figgins to direct Carl Schwachheim, the individual conducting excavations, to leave all artifacts in place when discovered (Jackson 1997:42-43; Meltzer et al. 2002:8). Other sources claim Hrdlička dismissed the presence of artifacts at the Folsom site as a hoax (Folsom 1992; Hillerman 1973; Jackson 1997:43). Dr. Hrdlička had built a parallel career disproving spurious claims of "scientific" discoveries. From this point of view an account of extinct fauna and human interaction was no more than a yarn foisted onto--

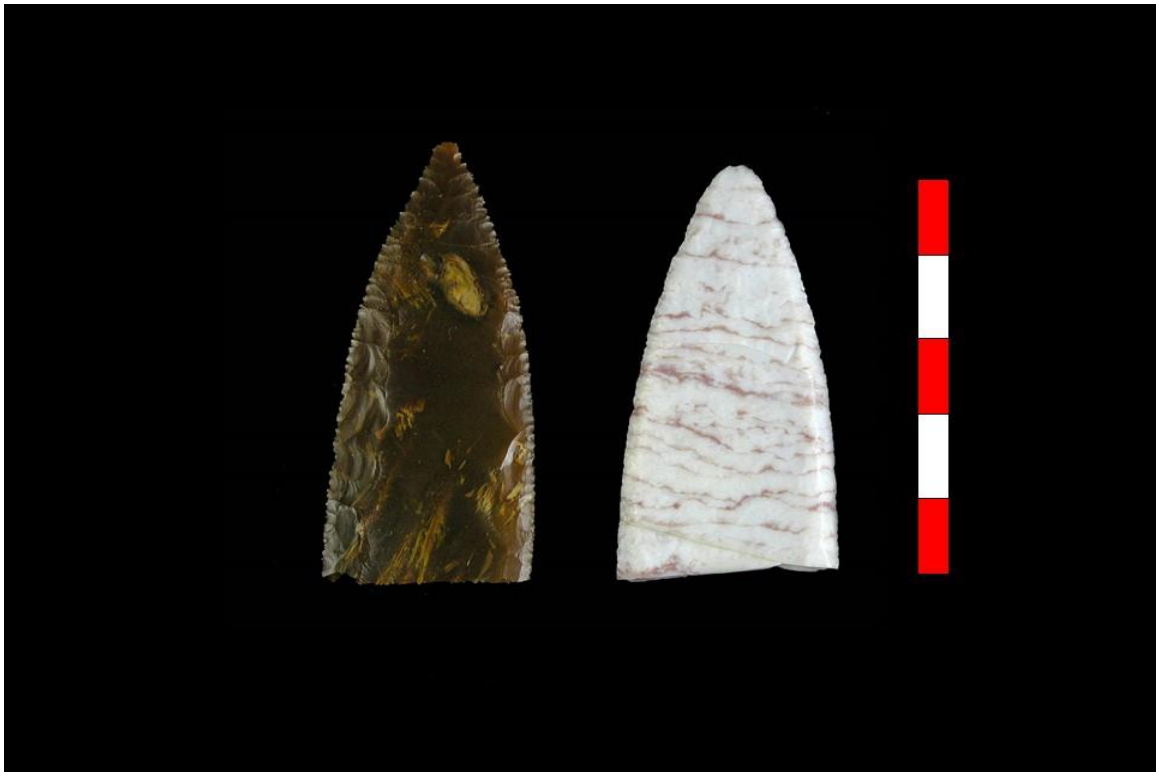


Figure 1. The First Two Folsom Projectile Point Fragments Recovered from the Folsom Type-site (29CX1) in 1926 (*Photograph by David J. Meltzer, Department of Anthropology, Southern Methodist University: scale in centimeters)*.

or manufactured by-- gullible, if not unethical, back-country incompetents. And who was one to believe? A respected and world-famous scientist who was also a physician with university training and degrees earned in Europe and the Americas? Or the advocates of a self-educated black cowboy from the deserts of New Mexico?

Hrdlička had a plausible argument for his assertions. He championed the hypothesis of an Asian origin of the American Indian (e.g., Ives 1956). He also cited geological evidence that northern reaches of Asia and America had been covered by sheets of ice until some six or eight thousand years ago. Only after that, he surmised, would an ice-free land corridor permit human migration across the arctic. If glaciers blocked passage from Asia to North America, then humans could not have inhabited the steppes of New Mexico prior to approximately 6,000 years ago (Hrdlička 1926; 1942). Hrdlička persisted in his beliefs, dismissing numerous claims of antiquity, including those of human remains found in 1914 at Rancho La Brea, California, along a canal near Vero Beach, Florida, in 1915, and the 1929 discovery of fluted points near Clovis, New Mexico (Folsom 1992; Hillerman 1973; Johnson 2017; Preston 1997)—all of which were later authenticated.

Before the 1951 excavation at the MacHaffie site, understanding the human temporal-cultural sequence in the American West was limited by a paucity of documented archaeological finds. Investigated sites appeared to be manifestations of isolated populations or localized

events. They also lacked clear temporal relationships to other similar sites. Dating techniques were unreliable, and conclusions drawn from data collected in other research was often in conflict. The absence of stratified sites where chronologic cultural sequences are identifiable hindered credible interpretations of pre-contact societies. Additionally, inadequately researched personal assumptions and the accounts of sixteenth century Spanish entradas suggested the American West was sparsely populated (Cabeza de Vaca 1961; Castañeda and Coronado 1933; Cortés 1971). Many anthropologists from at least 1900 through the 1940s concluded that the resource base of the Great Plains was too unreliable to support a permanent population of pedestrian nomads. Prior to introduction of the horse and the increased mobility the animal provided, it was believed the region was visited only infrequently by small, itinerant bands of people who subsisted by hunting, scavenging, and collecting fruits, roots and vegetables in season (Kroeber 1939: 76; Wissler 1906: 39-52).

The Great Depression and World War II put dampers on field research, but scientific opinion increasingly questioned Hrdlička's dogma. Evidence mounted to suggest that Paleo-Indians inhabited portions of the southern and central United States prior to Hrdlička's accepted temporal threshold. A renewed interest in the past came with the end of the war, but the archaeology of Montana, as with most of the northern plains, remained poorly understood. In fact, Montana was generally believed to contain a dearth of archaeological resources (Forbis 1955:10-11; Johnson 1961; Strong 1940:356).

The 1937 through 1942 excavations at Pictograph Cave near Billings eventually allowed for the establishment of an archaeological history of the northwestern plains by "…permitting archaeologists to place in sequence certain otherwise temporally floating archeological complexes (Forbis 1955:11)". However, this data would not be published for at least another decade (Mulloy 1952, 1958), and neither Clovis nor Folsom points were recovered from Pictograph Cave. As late as 1950 there remained an ignorance of the kind and quantity of archaeological resources in Montana.

During 1946 through 1948, Wesley L. Bliss led the Smithsonian Institution's River Basin Surveys through portions of Wyoming and Montana with emphasis on the North Platte and Missouri River drainages. The reconnaissance located some 242 precontact archaeological sites in the two states. While these discoveries did not establish a chronologic cultural sequence, Bliss concluded: "It is now possible to state that not only were the western plains occupied in prehistoric times but that they were occupied ...over a long period of time (Bliss 1949a:7)".

In either 1938 (Forbis and Sperry 1952:127) or 1946 [mistyped in manuscript as 1956] (Malouf 1965:12), while on a mineral and artifact seeking excursion east of Montana City, Mr. A. J. Harstad observed chipped stone items and animal bones exposed in a cutbank profile of an unnamed drainage. According to his account, Harstad showed the eroding materials to Edmund and June MacHaffie, who accompanied him on this fieldtrip (Malouf 1965:12). Edmund MacHaffie, a well-established amateur archaeologist from Helena, collected a "Yuma Point" from the surface "near" Mr. Harstad's find-spot, but it was not in direct association with the exposed bone. MacHaffie noted that he later "did a little digging" where cultural materials were exposed in the cutbank profile, but he recovered only "…knives and more chips". Two months later, Mrs. MacHaffie collected a "Clovis fluted point" from the stream bed approximately 25 meters downslope of Mr. Harstad's original find (Forbis n.d.:1; Forbis and Sperry 1952:127;

Malouf 1965:12; UMMC 2020). In discussing this artifact, Forbis stated that it "…may eventually prove to have originated at the site; but under the present circumstances, there is more reason for believing its place of origin was elsewhere, because typologically there is little justification for including this Clovis Fluted point with the Folsom Fluted points found during the course of [1951] excavation (Forbis n.d.1)". June MacHaffie's find is reclassified here as a Folsom Point preform that broke during manufacture (Projectile Point Catalogue #18 [this study]; Forbis artifact #1004).

From 1946 through 1948, a River Basin Surveys party conducted cultural resources inventory of the portion of the Missouri River valley to be inundated by reservoir waters of the proposed Canyon Ferry Dam. Recognizing that the Montana City site held great antiquity, Edmund MacHaffie convinced the head of that crew, Wesley L. Bliss, to assess his "Yuma" site. Bliss reported that during the party's two hour visit in 1947 they recovered, *in situ*, two partial projectile points (a blade portion and most of a stemmed point), an endscraper, and a retouched flake-- all from an area of less than 0.6 square meters and all from the exposure of cultural material in the cutbank profile (Bliss 1949b:127). These pieces are not part of the University of Montana (UM) MacHaffie site collection.

Rick Torben (pers. comm. 2019) informed that the pieces described by Bliss plus five additional pieces are accessioned (Accession #206347 (1955) at the Smtihsonian Institution, National Museum of Natural History (NMNH), under catalogue numbers A406712 through A406716. Because these are accessioned, they can not be transferred to the UM and will remain at the Smithsonian Institution. James Krakker (pers. comm. 2019) graciously provided high resolution, scaled, color photographs, and metric and descriptive data on these pieces (that information is included in Sections 7.0 and 9.0 of this report).

Wesley L. Bliss, Jack T. Hughes, and J. Mett Shippe of the River Basin Surveys prepared a site form on August 24, 1947, and the MacHaffie site was subsequently assigned Smithsonian Trinomial 24JF4 (Appendix 1). A supplement to the original site form dated August, 1947, provides a list of 62 pieces of cultural material collected by Bliss and Hughes (Bliss et al. 1947). These items were out-of-context surface finds and pieces recovered from the exposed Cody (Yuma) component 1.3 feet (39 cm) below present ground surface (BS) along the cutbank profile. Surface finds consist of four blade fragments, 16 pieces of worked stone, two modified flakes, one large flake, three small cores, one modified core, six cores, two obsidian flakes, one anvil stone, one stone fragment and one bone fragment (Bliss et al. 1947). These items were documented by Bliss and Hughes under Lot 18, items 1 through 38. A remark in the supplement reads "Not cataloged but stored with Nos. 1-38 are two points loaned by E.D. MacHaffie, Helena, Mont., and coming from surface of 24JF4. One point is Yuma-like, one is Folsom-like (Points returned by Bliss)". The two pieces loaned by, and returned to, Edmund MacHaffie are catalogued for this study as projectile points #29 and #17. An additional notation in the supplement states that unspecified amounts of surface-collected worked stone, stone samples and bone were donated by Edmund MacHaffie in May 1948 and documented by Bliss and Hughes under lot/item #s 63 through 65. Three "blade" fragments (Bliss and Hughes item #s 1, 2, and 16) are reclassified here as unhafted biface fragments (MacHaffie Biface Catalogue #s 49-51; NMNH accession #206347/catalogue #406716). One "worked stone" piece (Bliss and Hughes item #25) is reclassified here as unmodified chipped stone debitage (MacHaffie Debitage Catalogue #17493; NMNH accession #206347/catalogue #406716).

The pieces collected from 1.3 ft (39 cm) below ground surface consist of one Yuma [Cody] point, one blade, one scraper, one flake, one knife, one large scraper, one core, 11 stone fragments, one identifiable bone and five bone fragments (Bliss et al. 1947). These items were documented by Bliss and Hughes under lot 18, item #s 39 through 62. The "Yuma Point" (Bliss and Hughes item #39) is reclassified here as a Cody knife (MacHaffie Projectile Point Catalogue #49; NMNH accession #206347/catalogue #406712), the "blade" (Bliss and Hughes item #40) is reclassified here as a probable Folsom point preform (MacHaffie Projectile Point Catalogue #50; NMNH accession #206347/catalogue #406713), the "large scraper" (Bliss and Hughes item #44) is reclassified here as a retouched flake (MacHaffie DEF/M Catalogue #47, NMNH accession #206347/catalogue #406714) and the "scraper" (Bliss and Hughes item #41) is reclassified here as an endscraper (MacHaffie endscraper catalogue #19; NMNH accession #206347/catalogue #406715).

The remaining items catalogued by Bliss and Hughes are believed to have been discarded shortly after they were collected (James Krakker pers. comm. 2019). There is no clear mention of them in Forbis' (1955) dissertation. Two documents in Forbis' field notes (UMMC 2020) indicate that some portion of "Identified, unworked animal bone" was transferred to the University of Nebraska State Museum on May 12, 1952, and "All specimens in the site" were transferred to the U.S. National Museum on November 5, 1954 (Bliss et al. 1947). Forbis et al. (n.d.:145) later note that "Material remains from the MacHaffie site were shipped to Columbia University for study in 1951 and in 1960 were permanently deposited at Montana State University [now the University of Montana] in Missoula".

Dominique Alhambra (pers. comm. 2019), Anthropology Collections Manager, Denver Museum of Nature and Science, informed that no records or artifacts attributable to the MacHaffie site exist there. Multiple unsuccessful attempts were made to contact David Scott and Terence D'Altroy (Anthropology Department) and Brian Boyd (Director of Museum Anthropology), Columbia University, and Alan Osborn (Anthropology Curator) and Trisha Patton (Anthropology Collections/NAGPRA Assistant), University of Nebraska State Museum, so it remains uncertain if MacHaffie site artifacts are present at those institutions.

Two Montana State University, Missoula, field crews headed by Carling Malouf, absorbed inventory duties for the River Basin Surveys (Forbis n.d.:1; Forbis and Sperry 1952:127; Malouf 1965:12). One of the students with Malouf's field crews was Richard G. Forbis. It was Forbis who, as a graduate student at Columbia University, would direct the first controlled and well-documented excavations at the MacHaffie site.

Guided by Edmund MacHaffie, Malouf and Forbis visited 24JF4 in September of 1949 (Forbis et al. nd), but accounts are inconsistent. One states that no excavating or collecting was conducted at that time, but Malouf revisited the site in 1950 and identified a cultural layer stratigraphically below the Yuma [Cody] level (Forbis and Sperry 1952:127)". How Malouf made this observation is unknown. Forbis (1955:52) would later contradict this statement by noting that the excavation methods implemented in 1951, "…served to indicate… the presence of a Folsom layer, the existence of which had not been suspected previously". Davis (2000:1) credits Malouf with being the first to formally test the site, and Table 2 in the original MacHaffie site report (Forbis 1955:54) credits three out-of-context "Scottsbluff artifacts" to Malouf. All

three pieces are unhafted bifaces (Forbis artifact #s 10005, 10007, 10009 [Forbis 1955: 54, 90-93]). Items 10005 and 10009 are missing from the University of Montana (UM) Collection.

Another account contends that in September 1949 Forbis and Malouf conducted limited excavation during a snowstorm at the location Bliss presumably recovered the two Cody projectile point pieces. Again, there is neither indication of the extent of this work, nor if any artifacts were collected. What was concluded was that they, "…turned up nothing except chips and bones. Only with excavation did it become clear that Mr. Bliss had uncovered the only point within five feet of that place along the edge of the bank, practically the only artifact in that area (Forbis n.d.:1)".

Through a relationship built with the landowner, James Bompart, Malouf obtained permission for Forbis to excavate the site (Forbis et al. n.d., Appendix 1). Funds, supplies and sponsorship for the project were obtained through Columbia University (William Duncan Strong), the American Museum of Natural History (Harry L. Shapiro), and Montana State University, Missoula (W. P. Clark, Paul C. Phillips, and Carling I. Malouf). Plans for fieldwork were developed in consultations among Dick Forbis, William Duncan Strong, and Jack T. Hughes. Forbis' crew consisted of John D. Sperry, Paul Tolstoy (graduate students at Columbia University), and Robert Fischer (Montana State University, Missoula). Based on 1951 excavation photos, it appears that the wives of John Sperry and Paul Tolstoy should also be listed as crew members (Forbis 1955:31; Forbis and Sperry 1952:127; Malouf 1965:12-13; MacHaffie site-Richard Forbis photographic file at the MT SHPO; UMMC 2020).

Although Malouf was instrumental in setting the stage for Forbis' work at MacHaffie, and although post-1950 correspondence between Malouf and Forbis is quite friendly (UMMC 2020), Malouf felt marginalized. In an undated letter to Les Davis, presumably written in the late 1980s, Malouf noted, "Lately, it seems I had nothing to do with the MacHaffie site. I did the first digging there and Forbis was my student. I let him use the site for his PhD dissertation at his request (UMMC 2020)". In a subsequent letter to Les Davis (dated December 19, 2000), Malouf reiterates much of his previous sentiment with:

> …I did some excavating there, particularly doing a stratigraphic excavation near the stream bed. The stream had uncovered some of the specimens which Ed [MacHaffie] found in the stream bed. No one seems to be aware that I was the first to work at the site. When Dick left here, after receiving his M.A. degree, he went to Columbia University, at my encouragement, and like me, worked considerably under the guidance of William Duncan Strong. I encouraged Dick to use the site for his dissertation, but since that time he has been the great authority on the site. The fact we found some ancient bison bones has been neglected a bit, but they were in such small pieces I haven't worked out whether they are Bison taylorii, Bison occidentalis, etc.. I took a class over to the site a year or two later, but I wanted to concentrate also on materials higher up in the stratigraphy, including surface finds (UMMC 2020).

It appears Carling Malouf did conduct archaeological investigations at MacHaffie. Questions that may never be answered include: When did Malouf's work occur? How much excavation did he conduct? Where were his excavation units situated in relation to Forbis' 1951 work? What cultural materials did he recover? What conclusions did he draw about the site?

The Columbia University party, headed by Dick Forbis, arrived at the MacHaffie site in mid-June, 1951. Its objectives were to collect data that would lend to an examination of the

poorly understood Yuma (now known as Cody) archaeological culture and to establish a relationship among Yuma and the succeeding "Neo-Indian complexes of the Great Plains and adjacent regions". Forbis' excavations were concentrated in the area where Bliss and MacHaffie had recovered *in situ* projectile point fragments and other artifacts from the cutbank face (Forbis 1955:9). We believe it was during the 1951 excavations that the Folsom component was revealed, and it was slightly deeper in the soil profile than the Cody materials. Forbis and Sperry (1952:132) concluded that the stratigraphically discrete point styles from the MacHaffie site substantiate the recently established Paleo-Indian point chronology of the western United States with reference to the works of Mulloy (1952) and Strong (1940).

Forbis' findings were hailed in *The New York Times* as one of the most significant scientific inquiries into the prehistory of North America (*New York Times* 1951). The MacHaffie site, Forbis concluded, provided two notable contributions to the understanding of Paleo-Indians. First, it extended the "known range of Folsom and Scottsbluff cultures....well to the west in the northern section of the Great Plains (Forbis 1955:9)". Second, the succession and separation of cultural layers validated speculation that Folsom preceded Cody (Montana State University News Bulletin 1951). An additional notable fact is that the MacHaffie site produced the first C-14 date for a Montana archaeological resource (Davis 1982:1). The date of 8,100 ±300 (L-578A) is assigned to the Cody component (Forbis et al. n.d., Forbis 1962). By default, Forbis' findings helped restore credibility to George McJunkin by validating the Folsom type-site (29CX1) some 1,287 kilometers to the southeast. It is worth mentioning that today site 29CX1 is listed in the National Register of Historic Places for its significance in North American archaeology. It is also a National Historic Landmark and a New Mexico State Monument (Meltzer et al. 2002:5; Stephanie Garcia Richard pers. comm. 2019).

Perhaps the most compelling aspect of MacHaffie is that it was billed to be a rare, ideally stratified archaeological site (Montana State University News Bulletin 1951; *New York Times* 1951). Isolated, temporally distinct components provide snapshots in time. Such isolated events can allow comparisons of temporally distinct activities, material culture, and preferences for flora, fauna, and toolstone. Studying unmixed, stratified cultural components can credibly shape our understanding of environmental adaptations among the highly mobile hunter-gatherer groups that inhabited North America for millennia.

Regarding the Yuma [Cody] component, Bliss observed that, "The overlying [sediment] deposit averages some two feet (61 cm) thick and there is evidence of a later occupation in the soil cap (Bliss 1949b:125-126)". Another pre-1951 excavation report describes the depth of the "Yuma level" as "…18 inches to 30 inches (46-76 cm) BS (Smithsonian Institution 1948:7). Forbis' (1955:55-59) post-excavation analysis concluded that the upper 40 cm (15 inches) of sediment contained what Forbis dubbed the "Helena Component"—an inseparable mixture of Late and Middle precontact materials. The Helena Component and the more deeply buried Yuma layer were separated by up to two feet (30-61 cm) of culturally sterile sediment. Following Forbis (1955:55-59), the Cody level is situated at approximately 4 to 5 feet (1.2 to 1.5 m) below datum (53 to 82 cm BS), and the Folsom layer at approximately 5.5 to 6.5 feet (1.68 to 2 m) below datum (101 to 133 cm BS). A soil profile prepared by Forbis (n.d.) shows the "Helena Component" present from ground surface to 38 cm BS, followed by a culturally sterile "red soil" unit extending from 38-62 cm BS, followed by the Cody component from 62-114 cm BS, followed by a culturally sterile unit (114-129 cm BS) which separates Cody from Folsom.

Forbis appears convinced that the Folsom component marked the earliest human occupation in the MacHaffie site. Below the Folsom materials (~150 cm BS), Forbis identified nothing but culturally sterile "basal sands" to a depth of at least two meters BS. Groundwater was encountered at about the two-meter depth BS. This halted deeper exploration work (Forbis 1955:52; Forbis and Sperry 1952:127). Puzzlingly, a reference to the MacHaffie site in a later University of Montana survey report states "The lowest level of the site, that below the Folsom material, contains bison remains and is suggestive of a very early human occupation, possibly even a Clovis horizon (Munday 1978:1)". As is typical for the history of MacHaffie, it may never be understood why Fred Munday made this statement, if he collected any of the observed bison remains, or where the sub-Folsom bison remains are today. Davis (2009:47) also contended that there are "…traces of Paleo-Indian deposits buried beneath the Folsom level". However, the 2017 and 2018 work in MacHaffie identified the Folsom component as the oldest cultural materials confirmed.

In 1970, Ruthann Knudson studied selected Cody component materials from 24JF4 as part of her Ph.D. research. Throughout her dissertation she used the term "MacHaffie II" which is a reference to Forbis' designation of "Level II"— an arbitrary stratigraphic section of the MacHaffie site he believed contained the Yuma (Cody) component. Knudson (1982) described in detail some of the chipped stone detritus and formal stone tools associated with the Cody component. She produced several quality line drawings of artifacts, and she refit a few of the biface thinning flakes. She also assigned catalogue numbers 6000 through 6031 to several pieces (mostly debitage) she examined (Knudson 1982:128-129; Ruthann Knudson pers. comm. 2017). Some of the pieces were previously assigned different catalogue numbers by Richard Forbis.

Knudson must have reached out to Edmund MacHaffie at this time because in a letter dated August 8, 1970, to Ruthann Knudson, MacHaffie noted that he retained "…no chips or artifacts from the site, except two artifacts that enabled me to discover the site and notify the University at Missoula of what I had found." In Knudson's preface to her dissertation (Knudson 1982:iii) she noted that "In 1975 I gained access to a scraper and the "bi-shouldered point" from MacHaffie Level II that had been in the possession of Edmund MacHaffie (it is now accessioned at the University of Montana)".

In a letter to Dick Forbis dated January 15, 1996, Ruthann Knudson mentioned the "…drawings and measurements of four Folsom bases and one channel flake from MacHaffie… The largest piece [projectile point preform #18] was acquired by the University of Montana when Mr. MacHaffie died and I used that drawing for a 1973 Christmas card and one of my Paleo-Designs notecards (UMMC 2020)".

According to Joyce Young (Edmund and June MacHaffie's daughter), all of Edmund MacHaffie's pieces from 24JF4 were transferred to the University of Montana (Joyce Young pers. comm. 2022). One box of artifacts in the UM collection was labeled "MacHaffie", but these items all have associated UM catalogue cards exhibiting a two-part number with a "73" prefix. A note found in this box, presumably drafted by Carling Malouf because of the initials "C.M.", indicates that the artifacts catalogued with a binomial "73-xxxx" are from Edmund MacHaffie's personal collection. They are not from the MacHaffie site. This supposition is confirmed by Joyce Young (pers. comm. 2022) and a 1973 *Great Falls Tribune* newspaper article

(Winslow 1973). These items have been returned to the UM for separate cataloguing and storage. Joyce Young (pers. comm. 2022) believes that several of these pieces were collected in the area of Hauser Dam prior to dam construction. At that time a large iron bridge crossed the Missouri River.

Forbis catalogued most of the formal tools and a limited number of sundry items from the 1951 work, but the chipped stone debitage was never described. Some of the artifacts catalogued by Forbis are no longer in the UM collection, and their whereabouts are unknown. Similarly, a few of Knudson's catalogued pieces used in her dissertation are also missing from the UM collection. These include three Cody points (Forbis artifact #s 1201, 1212, 1202). Presumably these three artifacts were in the UM collection in the early 1970s because someone made poor quality plaster casts of two of the now-missing points (Forbis artifact #s 1201, 1212) and Knudson (1982:123) made quality line drawings of all three pieces.

Area resident, John Byrd, visited MacHaffie in 1952 and observed many flakes and a few stone tools scattered on the surface of Forbis' excavated sediments. He recalls seeing a small pile of bone fragments left on the ground surface to deteriorate (John Byrd pers. comm. 2021). Mr. Byrd collected three bifaces, four DEF/M and a single piece of chipped stone debitage from the myriad visible pieces. He recently donated them to be part of the MacHaffie collection. The pieces are assigned biface catalogue #s 152 through 154, DEF/M catalogue #s 48 through 51, and chipped stone debitage catalogue # 20969. A brief description and illustrations can be found in Appendix 2 of this report.

The publicity of the MacHaffie site attracted looters who disturbed the Middle and possibly Late-Precontact (upper 1 m) deposits but usually did not reach the depths of the Paleo-Indian components (Davis 2009:46; Malouf pers. comm. with Leslie Davis: UMMC 2020, Munday 1978). Even before the MacHaffie site was recognized as an archaeological property, topsoil was intermittently removed in some localities for local gardens (UMMC 2020). A handwritten note by Ruthann Knudson in 1970 (UMMC 2020) indicates that Carling Malouf had enlisted local artifact collector, Mauck Brammer, to excavate a series of five-foot squares in 24JF4. Whether Mr. Brammer followed through with this request is unknown.

Although the MacHaffie site was widely known, its location was not. Several first-hand accounts tell of family and group outings to dig for "arrowheads" in the 1960s and 1970s. The destination is consistently identified as a terrace along the north side of Prickly Pear Creek between the Montana City School and the concrete plant, approximately one-half mile northwest of the actual MacHaffie site (Nina Baucus pers. comm. 2018; Ed Weber pers. comm. 1997). While visiting 24JF4 excavations in September of 2017, Ruthann Knudson explained that she too had been misinformed of the correct location of 24JF4. In 1971 she collected soil monoliths from the terrace adjoining Prickly Pear Creek southeast of the Montana City School "where all the digging was taking place"-- presuming this to be 24JF4. During her 2017 visit, she showed Rennie and Mohler the location she previously believed to be the MacHaffie site. We do not know when incorrect information regarding the MacHaffie site location began to circulate. Undoubtedly it provided 24JF4 some protection.

From 1952 until 1980, academic research in 24JF4 consisted of a few University of Montana field trips and limited excavations. Les Davis, Charles Zeier and John Darroch briefly

visited the "MacHaffie quarry" in September 1970. The exact location of the quarry is uncertain because it is described as "about three miles southwest of East Helena…" and identified by numerous quarry pits "… up to two feet deep at present, and from six to fifteen feet in diameter". The lithic material is described as "…chert and jasper, ranging from black and brown through yellow and red, with brown and yellow colors predominating (Darroch 1971:33-34)". This general location and the description of the toolstone and presence of shallow quarry pits applies to several documented chert quarries in the Montana City area. A notation of interest in Darroch's account is that "An investigation of a cut bank between the stream bed and the site revealed chipping debris to a depth of as much as five feet (Darroch 1971:34)". In 1985, Carling Malouf and other Montana Archaeological Society members visited 24JF4 for the annual meeting field trip, but this was only a site visit. No data recovery was carried out (Michael C. Wilson pers. comm. 2019). David Schwab prepared and submitted a National Register nomination form for 24JF4 on January 3, 1986. The MacHaffie site was listed in the National Register of Historic Places on April 3 of that same year (Appendix 1).

Dick Forbis was Leslie B. Davis' Ph.D supervisor at the University of Calgary (1969 to 1972). When Dr. Davis resumed investigations at MacHaffie from 1989 through 2010, his intent was to expand on Forbis' work. As was the case in 1951, the water table seeped into excavation units at approximately two meters below present ground surface (BS) and hindered efforts to confirm maximum depth and oldest age of occupational sequences at MacHaffie. Numerous specialized studies were conducted at the site during those years, and radiocarbon and thermoluminescence sequences showed increasing age with depth below the current ground surface.

In 2009, the landowner, Pamela Bompart, donated the MacHaffie site to the Archaeological Conservancy with hopes of protecting the remaining resource from destruction by future housing development. She also hoped the conveyance would help guard against unmonitored and unauthorized artifact collecting that has plagued the site for decades (P. Bompart pers. comm. 2017; Davis 2009).

In September 2017 and 2018, with permission from the Archaeological Conservancy (Appendix 1), at the request of former site owner Pamela Bompart, and as an attempt to fulfill the wishes of Dr. Leslie B. Davis, a volunteer crew convened at the MacHaffie site to attempt to reach the maximum depth of cultural deposits. Increasingly arid conditions in the state, coupled with the demands of numerous domestic water wells now surrounding MacHaffie, lowered the water table and allowed exploration of sediment layers previously saturated by ground water. Other goals of the 2017 and 2018 work were: 1) to reconcile the apparent stratigraphic discrepancies between Forbis and Davis work; 2) to determine what type of archaeological site MacHaffie is; and 3) to catalogue the Dick Forbis and the Les Davis collections, consolidate the materials into a single collection at one secure repository, and produce a detailed technical report. Herein we provide a comprehensive look at the MacHaffie site through both factual data and speculation based on our experiences, observations, existing documentation, and the oral reports of others who worked there. The following discussion of site setting, present and past environments, geomorphology, cultural materials and interpreted cultural activities is intended to secure the MacHaffie site in the context of North American archaeology.

2.0 PRESENT AND PAST ENVIRONMENTS AT THE MACHAFFIE SITE

2.1 Geographic, Geologic, and Topographic Setting

In the most general terms, the MacHaffie site is at the west margin of the Great Plains along the Rocky Mountain interface in southwest Montana (Figure 2). At an elevation of 4,199 ft (1,280 m) above mean sea level (ASL), the site is in the foothills along the northwest flank of the Elkhorn Mountains (Figures 2 and 3). The Elkhorn Mountains constitute a 132 square mile (212 square km) southwest to northeast-trending mountain range east of the Rocky Mountain Front. Maximum elevation of this range is 9,414 ft (2,869 m) ASL on Crow Peak approximately 17 miles (27 km) south of the MacHaffie site. Geologically, the Elkhorn Mountains are a series of folded and faulted sedimentary and volcanic rocks variously bisected by intrusive igneous rocks. These consist of ashes, tuffs, basalts, andesites, and ryodacites of the Elkhorn Mountain Volcanics series; intrusive plutonic granites of the Boulder Batholith; limestones; both marine and nonmarine mudstones, shales and sandstones; and Flathead quartzites (Smedes 1966). Particularly important to past Native American occupants is the occurrence of tool quality cryptocrystalline and microcrystalline silicates throughout much of the west-half of Montana. These lithic materials are generically referred to hereafter as "chert" (Figure 3). Chert deposits are abundant throughout the Montana City area. Here it was collected from surface exposures of the chert-bearing limestone bedrock and quarried from subsurface contexts by Pre-Contact human occupants of the region. These toolstone deposits were heavily exploited throughout Pre-contact human occupation of the area (Herbort 1987). The plethora of tool quality lithic material made the Montana City area a destination for transient, non-industrialized peoples.

Primary drainages of the general site area consist of Prickly Pear Creek and the Missouri River. Prickly Pear Creek is located 0.5 miles (0.75 km) northwest of MacHaffie at an elevation of 4,030 ft (1,228 m). It is a major tributary of the Missouri River, located 10.6 miles (17 km) northeast of MacHaffie at an elevation of 3,659 ft (1,115 m). The MacHaffie site proper is the portion of the site explored through formal excavation. It is a combination of channel marginal and slope deposits. The portion of the MacHaffie site where most excavation has occurred is described here as an "island" that formed in a drainage channel (Figures 3-8), however, that description may be misleading. It seems more probable that during the extent of Pre-Contact human occupation the landform declined uninterrupted toward the north drainage channel. Probably a result of intensive livestock grazing and concomitant impacts on riparian zone vegetation during the early 20th century, the channel split and downcut at the toe of the slope. This downcutting through soft sediments probably formed the southern channel quite quickly. The result was formation of an "island". Establishment and downcutting of the southern channel exposed once buried cultural materials in the newly formed cutbank profile. Forbis et al. (n.d.:149) reached the same conclusion.

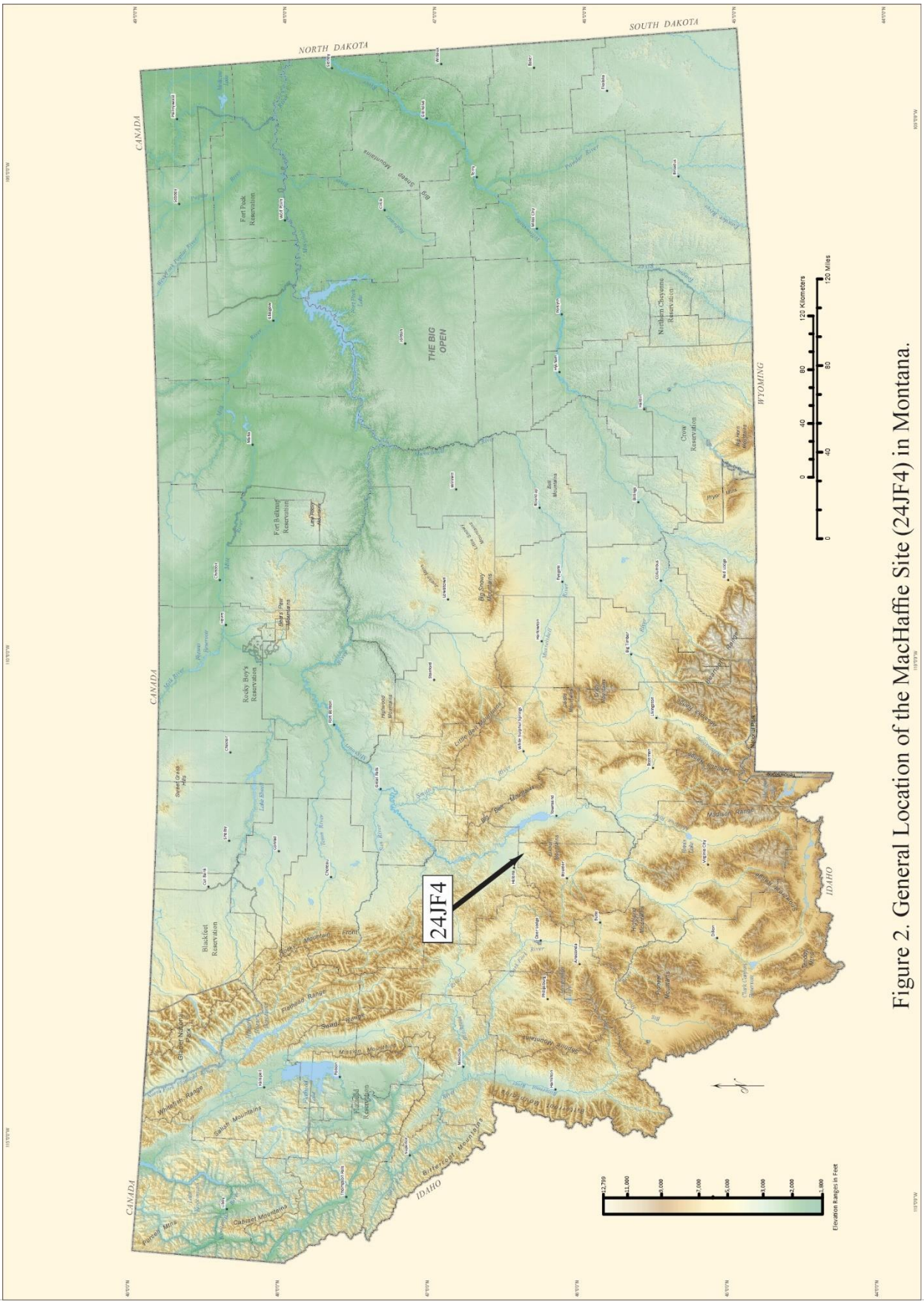


Figure 2. General Location of the MacHaffie Site (24JF4) in Montana.

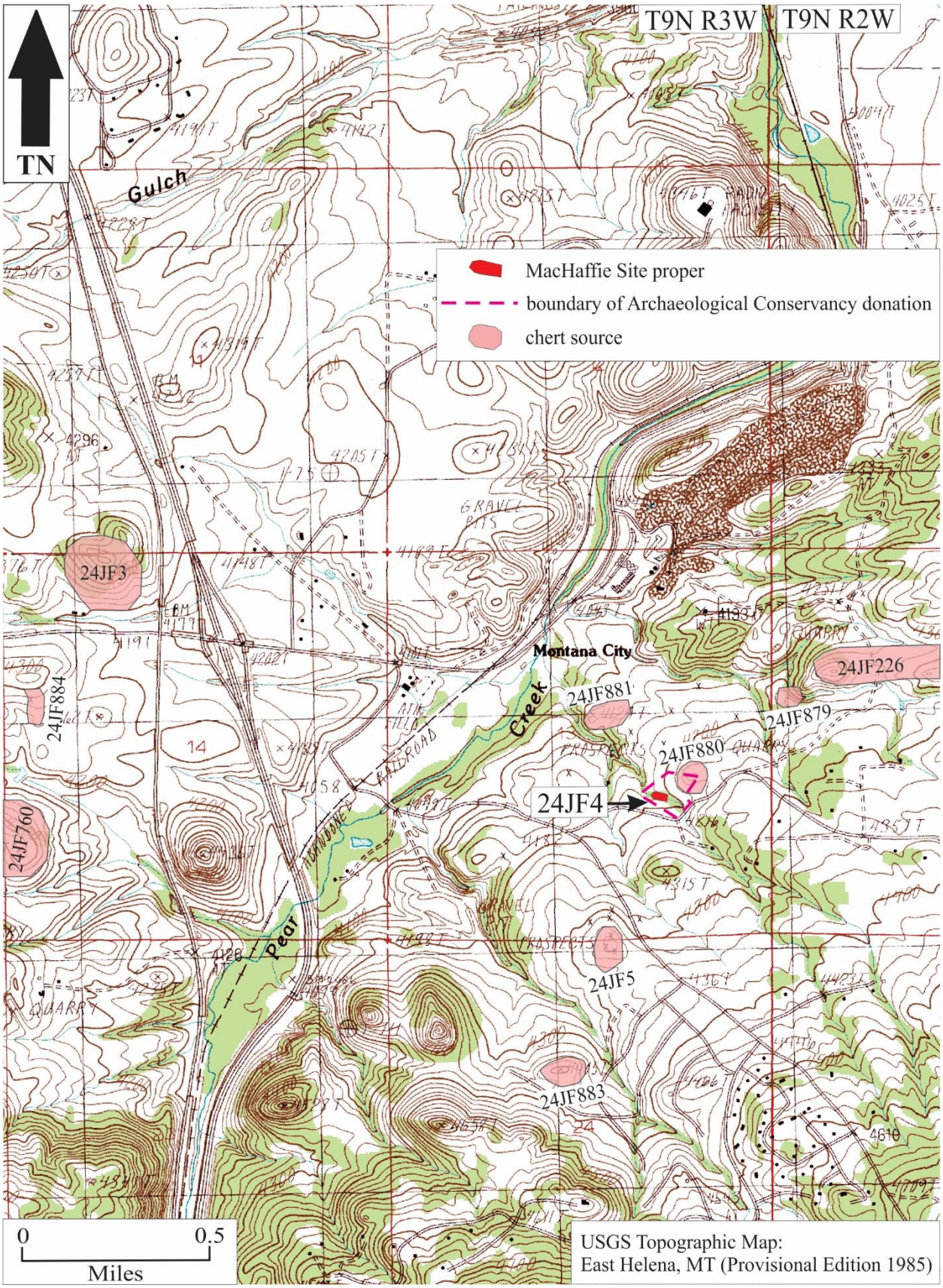


Figure 3. Topographic Map Showing Documented Chert Sources in Relation to 24JF4.

Figure 4. View Southeast at the MacHaffie site Setting (arrow) in 1989.

Figure 5. View Northeast at MacHaffie site in 1951 Prior to Excavations. Groove in Cutbank Profile (arrow) is Reportedly that of Wesley Bliss in 1947.

Figure 6. Commencement of 1951 Excavations in the MacHaffie site. View North.

Figure 7. Cutbank Face at Beginning of 1951 Excavations. View North.

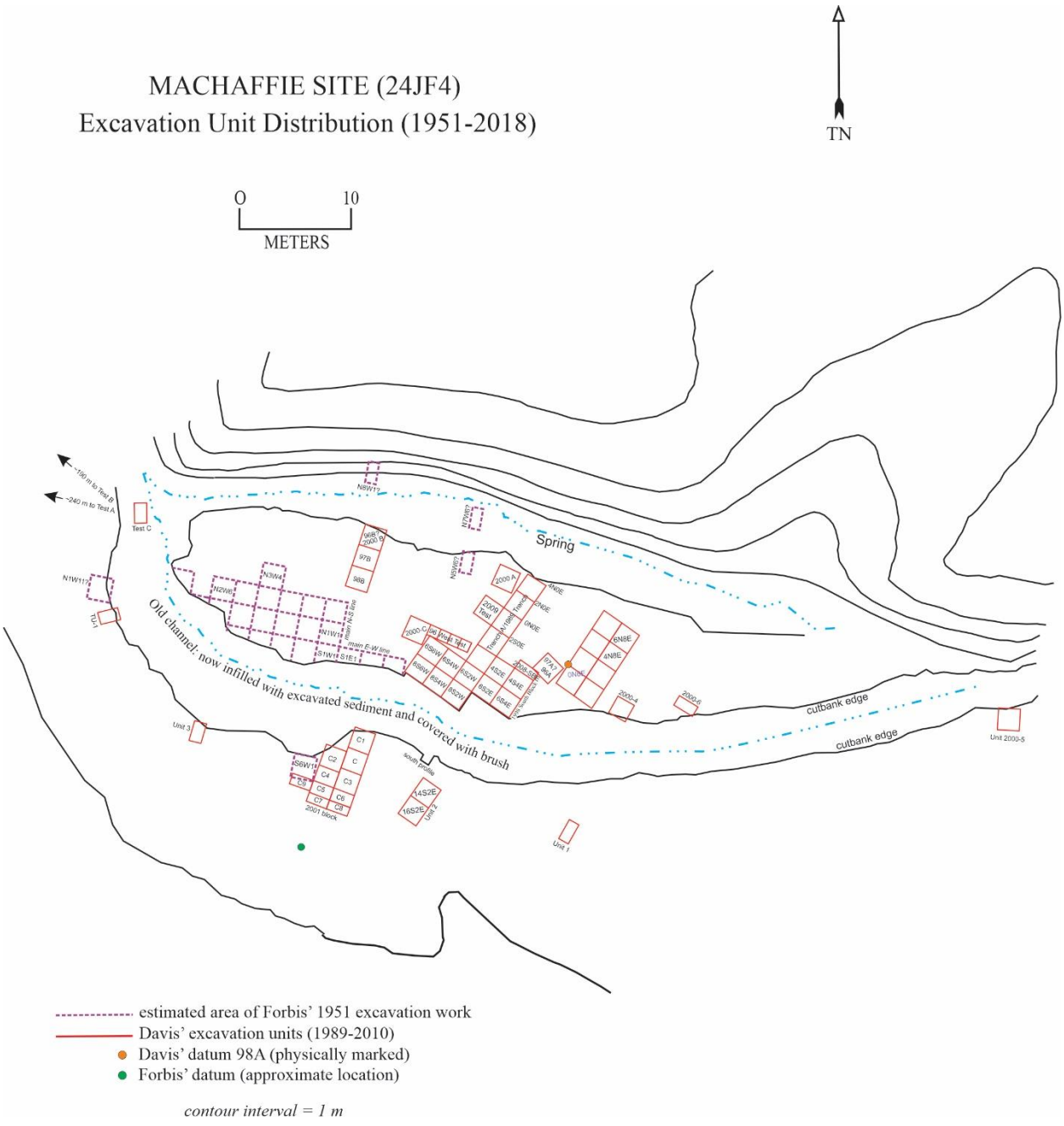


Figure 8. MacHaffie site Excavation Unit Distribution Plan Map.

During Forbis' 1951 investigations the channel at the south side of the island contained a low-volume perennial spring. The channel at the north side was more ephemeral and more deeply entrenched. Archaeological deposits are also found along the south margin of the southern channel, but sediments there are largely or wholly colluvium. Formation of the "island" sediments is explained as:

> The gradient of the small stream on which the site is located… has a rather steep upper section, a short, relatively gently intermediate section including the site, and a much steeper lower section draining on down into the main [Prickly Pear] creek....The relatively gentle gradient in the intermediate section is apparently responsible for the development of the [MacHaffie site]. The… flattening of the gradient in that section… is a result of the increased resistance to weathering and erosion of a dike-like… mass… just west and downstream from the site (Forbis 1955:37).

The Prickly Pear (Helena) Valley is an intermontane, alluvium covered basin that measures 13 miles (21 km) in diameter. It has an average elevation of 3,772 ft (1,150 m) ASL. The valley meets the foothills of the Elkhorn Mountains 2.6 miles (4.17 km) north of MacHaffie. The Missouri River flows north along the east margin of the valley passing through the Gates of the Mountains, the moniker given by Lewis and Clark who believed the canyon marked the Corps of Discovery's entry into the Rocky Mountains. While the west and south sides of Prickly Pear Valley are largely bounded by the Rocky Mountains (including the Elkhorns), the east and north sides are demarcated by the Big Belt Mountains (Figures 2 and 4).

A partially documented Indian trail (24BW1138) follows along the west flank of the Elkhorn Mountains. The north end of a 3.22 km long segment of trail is approximately 14 miles southeast of the MacHaffie site. The trail is indicated by a narrow and entrenched trail tread with cairns of various size situated at either side. Another visible segment of the trail is 36 km southeast of the MacHaffie site in the Limestone Hills. This more southerly segment of trail is poorly documented (Davis et al. 1980) but photos are available. The trail shows intensive use, presumably over a long span of time. It is possible that these segments are associated with the fabled "Old North Trail" (Louter 1986; McClintock 1909; Reeves 1991). The trail is ideal to have brought people to the Montana City area and then either north or south along the Rocky Mountain Front.

2.2 Past and Present Climates

Late Quaternary geology of the Elkhorn Mountains has been described in several publications (Alden 1953; Freeman et al. 1958; Klepper et al. 1971; Knopf 1963; Lorenz and McMurtrey 1956; Smedes 1966). Two episodes of alpine glaciation (Wisconsin and possibly Illinoisan) are believed to have occurred in the Elkhorn Mountains. The climatic conditions necessary for development and maintenance of such glaciers is not well understood and appears to be a matter of opinion from one source to the next.

Evidence of past montane glaciation includes cirques and glacial moraines in the high-altitude portions of the range. The nearest morainal deposits to MacHaffie lie 10 km to the southeast (Smedes 1966). Glacial outwash gravel underlies high terraces along portions of major drainages downslope from the mountain crest. Knopf (1963) mapped these Pleistocene gravels beneath high terraces adjacent to Prickly Pear Creek. Extensive, inter-fingering alluvial fan,

mudflow, and bouldery rock veneer deposits of both early and late Pleistocene age are present along the periphery of the Elkhorn Mountains downslope from the igneous rock core. A broad northwest-trending belt of these sediments is 2 km northeast of MacHaffie (Smedes 1966). No chronometric date is available for glacial-related Pleistocene sediments located within the Elkhorn Mountains.

During the Wisconsin glacial maximum ca. 40,000 to 20,000 BP, extensive alpine glaciers are believed to have been present in the Yellowstone Plateau and the area of Glacier National Park (Porter et al. 1983). The Cordilleran and Laurentide continental ice sheets extended perhaps 90 miles (145 km) into Montana (Colton et al. 1961). A series of large proglacial lakes formed where northwest-draining rivers abutted and were dammed by the continental ice sheets. The westernmost lake (Lake Missoula) adjoined the Cordilleran ice sheet. A series of other lakes formed to the east, adjacent to the Laurentide ice sheet. From west to east, these latter proglacial lakes were named Cut Bank, Great Falls, Musselshell, Jordan, and Glendive (Colton et al. 1961). Lake Great Falls, the nearest to Montana City, was formed by glacial damming of the northeast-flowing Missouri River. Colton et al. (1961) contend that Lake Great Falls extended as far south as 25 miles (40 km) north of the MacHaffie site locale. Montagne (1972) contradicts this opinion and holds that the lake once extended as far southeast as Townsend, Montana. If Montagne is correct, Lake Great Falls once extended 24 miles (39 km) to the southeast of the MacHaffie site.

Geologic literature is limited regarding Pleistocene deglaciation as reflected in the alluvial record. Albanese (1986) conducted a geologic study of the Indian Creek archaeological site (24BW626) on the southeast flank of the Elkhorn Mountains 22 miles (35 km) southeast of MacHaffie. Three stratigraphic units were recognized within the exposed Quaternary section of the excavation block. The lowest exposed unit is a fluvial accumulation of cobbles and boulders (Unit A) that was probably deposited by glacial melt waters during late Wisconsin time. Unit A is overlain by a two-meter-thick deposit (Unit B) composed mainly of braided-stream sediments. The Glacier Peak "G" ash occurs within the lower third of Unit B. Davis (1984) reported a radiocarbon date of 11,125 $\pm$ 130 BP secured from plant remains contained within the Glacier Peak "G" ash layer at Indian Creek. Unit B is composed of thin lenses of silty-clay, sand, and gravel which were intermittently deposited under low to moderate stream-flow regimes. The difference in overall sediment grain-size between Units A and B reflects change in stream-flow regimes from glacial melting (Unit A) to non-glacial conditions (Unit B). The presence of the Glacier Peak "G" ash in the lower third of Unit B indicates that glacial melting in the Elkhorn Mountains took place prior to 11,200 BP. Excavations in MacHaffie have not reached sufficient depth to determine if the stratigraphic equivalent of Indian Creek's Unit A is present (Davis and Root n.d.).

Deglaciation is surmised to have occurred between 14,500 and 11,000 BP. By 11,500 BP, alpine glaciers in high mountain areas had disappeared or diminished to sizes typical of the later Neoglacial (Porter et al. 1983:97). By 11,000 BP, the Cordilleran ice had retreated to the Canadian border (Baker 1983:126). By 11,300 BP, the southern margin of the Laurentide continental ice sheet had retreated to 109-373 miles (175-600 km) north of the Montana border (Teller 1987:55). Lemke et al. (1975) document the presence of the Glacier Peak "G" ash (originating in the Cascade Range of Washington) near the very top of lacustrine beds deposited in Lake Choteau, a northwestern arm of Lake Great Falls. The Glacier Peak "G" ash has been

dated at 11,200 BP by Mehringer et al. (1984). It is interesting that a remnant of Lake Great Falls may have persisted as recently as 11,000 BP, even though the Laurentide ice sheet had withdrawn far into Canada by that time. Whether a remnant of the lake was still present southeast of the MacHaffie site during the time of Glacier Peak "G" ash deposition is unknown.

Dr. A. Bryan Leonard (University of Kansas) identified a fossil snail species (*Vallonia gracilicostata*) throughout the early Holocene/late Pleistocene sediments at MacHaffie. This snail is common to "the Pleistocene sediments of the Great Plains from the Nebraskan to the first half of the Wisconsin glaciation, whence it migrated to the Rocky Mountains, particularly along the front range". Dr. Leonard surmised that because *Vallonia gracilicostata* "…is not one which thrives on or near glaciers… it [is] possible to conclude that not only was the area not glaciated, but that it was probably somewhat remote from large masses of ice at the time when the snails were living at the site (Forbis et al. n.d.:149)".

The climate today is typical of similar topographic settings throughout southwestern Montana. It can be characterized as semi-arid with temperatures and precipitation levels exhibiting a great deal of annual variability and storm systems that are intense, short-lived, and localized (Cunningham 1982). Cunningham (1982) estimated local average temperatures range from 38° F to 44° F (3.3° C to 6.7° C) with means of five days when temperatures exceed 90° F (32° C), and 180 days when temperatures can be expected to be less than 32° F (0° C). During winter months intermittent spells of intense cold often are ameliorated by Chinook winds-- warm Pacific air masses that sweep over the Rocky Mountains. Such meteorologic phenomena are generally recognized along the east slope of the Rocky Mountains and can extend east and south as far as Billings, Montana, and east and north as far as central Alberta.

Dightman (1956:10) identifies average annual precipitation to be approximately 11.5 inches (29 cm) for the Prickly Pear Valley, while the areas exceeding 5,000 ft (1,524 m) ASL receive an average of approximately 14.5 inches (35 cm) of annual precipitation (Ross and Hunter 1976). The months of May and June normally receive most of the annual precipitation, and August is typically the driest month. Southwestern Montana's precipitation patterns and temperature fluctuations are largely the result of Pacific, Gulf Coast, and Arctic air masses that influence local weather. Although moist Pacific air masses tend to have the most climatic influence over southwestern Montana throughout the year, the spring and summer weather systems are occasionally influenced by Gulf Coast fronts that sweep across the Great Plains. During winter months, dry-cold air from the arctic occasionally retards the eastward movement of warm-moist Pacific air masses causing short periods of bitter cold and little precipitation.

2.3 Plant Resources (Present)

The Plains biotic province is defined as "Those cold-temperate [plant] communities lying west of the Northeastern Deciduous Forest, east of the Rocky Mountain cordillera, and south of the Canadian Taiga… (Brown et al. 1998:29)". The unnamed drainage containing the MacHaffie site and the nearby Prickly Pear Creek are lined with willow, alder, juniper, ponderosa pine, quaking aspen, chokecherry, snowberry, wild rose, and serviceberry. Additionally, cottonwood is found along Prickly Pear Creek. Adjoining the riparian zones are short prairie grasses, prickly pear cactus, sagebrush and sporadic groves and isolated ponderosa pine, Douglas fir, and juniper

trees. Today, a moderate percentage of xeric native grasses and forbs in and surrounding MacHaffie has been replaced by a plethora of noxious weeds imported from Eurasia by human settlers over the past century.

Because the MacHaffie site is near the margin of three ecotones (prairie, conifer, and riparian) along the east slope of the Rocky Mountain Front, it is characterized by an exceptionally wide variety of native plant and animal species. Table 1 summarizes the plants identified within a 0.5 mile (0.8 km) radius of 24JF4. It also indicates which of those plants have a known human use and which plant species are native to the region. The 0.5 mile (0.8 km) radius study area was selected because of time and budgetary constraints. It does not imply a maximum area of exploitation by hunter-gatherers that occupied the MacHaffie site. Plant resources are numerous in the general site area with approximately 42 species that could be utilized for human consumption, 53 having human medicinal properties, 13 potentially used for ceremonial purposes, 28 that could serve for tools or crafts and at least six that provide materials for fuel and shelter.

2.4 Plant Resources (Past): Pollen and Phytolith Analysis

A single stratigraphic column emplaced in sediments exposed in the north face of excavation unit 6S/1W, the east-half of excavation unit 6S/2W (Figures 8 and 9), yielded both identifiable pollen and phytoliths. Pollen and phytolith analyses were conducted for each collected sediment sample to identify elements of the local vegetation to describe both local vegetation and paleoenvironmental conditions over the past 9,700 years BP (Cummings 1990).

A chemical extraction technique based on flotation is the standard method used to remove pollen from the large volume of sand, silt, and clay with which they are mixed. This particular process was developed to extract pollen from soils where preservation has been less than ideal and pollen density is low.

Hydrochloric acid (10%) was used to dissolve calcium carbonates, after which the samples were screened through 150 μm mesh. Zinc bromide (density 2.0) was used for the flotation process. The samples were mixed with zinc bromide while still moist, immediately after centrifugation to remove the dilute hydrochloric acid and water. All samples received a short (one minute) treatment in hot hydrofluoric acid to remove remaining inorganic particles. The samples were then acetolated for three minutes to remove extraneous organic matter.

A light microscope was used to count the pollen to a total of 50 to 200 pollen grains at a magnification of 430x. Pollen preservation in these samples varied from good to poor. Comparative reference material collected at the Intermountain Herbarium at Utah State University and the University of Colorado Herbarium was used to identify the MacHaffie pollens to family, genus and species. Clumps of a single type of pollen are referred to here as pollen aggregates. Aggregates may be interpreted to represent pollen dispersal over short distances or the actual introduction of portions of the plant into an archaeological setting. Aggregates were included in the pollen counts as single grains, as is customary. The presence of aggregates is

Table 1: Plant Resource Potential in the MacHaffie site Study Area.

GRASSES AND GRASS-LIKE PLANTS			
Binomial	**Common name**	**Vegetative zone**	**Use**
Agropyron smithii	western wheatgrass	G, R	F, X
Agropyron spicatum	blue-bunch wheatgrass	G	--
Bouteloua gracilis	blue gramma	G	--
Juncus balticus	wire rush	R	F, T
Koeleria pyramidata (cristata)	prairie junegrass	G	--
**Poa pratensis*	Kentucky bluegrass	G, R	--
Poa Sandbergii (secunda)	Sandberg's bluegrass	G	--
Stipa comata	needle and thread	G	--
FORBS			
Binomial	**Common name**	**Vegetative zone**	**Use**
Achillea millefolium	common yarrow	F, G, R	F, T, X, Y
Allium cernuum	nodding onion	F, G	F, T, X, Y
Antennaria microphylla	rose pussytoes	F, G	X
Arnica cordifolia	heartleaf arnica	F	X
Astragalus spp.	locoweed (milkvetch)	G	--
Campanula rotundifolia	round-leaf harebell	G	F, T
Cardimine pensylvanica	Pennsylvania bittercress	R	F
**Centaurea stoebe*	spotted knapweed	G, R, F	
**Centaurea diffusa*	diffuse knapweed	G, R, F	
Chenopodium sp.	goosefoot	R	F
Clematis columbiana	Columbia clematis	F	C, X, Y
	coral-root species	F, R	X
Crepis sp.	hawksbeard	G	F
**cynoglossum officinale*	houndstongue	G, F, R	--
Dodecatheon sp.	shooting star	G	X
Equisetum arvense	common horsetail	R	F, T, X,
Erigeron sp.	daisy (fleabane)	G	X
Fragaria virginiana	Virginia strawberry	F, G	F, X
Galium boreale	northern bedstraw	F, G, R	F, X
Geum triflorum	prairiesmoke	F, G	X, Y
Glycyrrhiza lepidata	wild licorice	R	F, X
Grindelia squarrosa	curlycup gumweed	G	C, F, X, Y
Heracleum sphondylium	cow parsnip	R	F, T, X
Heterotheca villosa	hairy golden aster	F, G	T
Heuchera sp.	alumroot	F, G	X, Y
Iris missouriensis	Rocky Mountain iris	G, R	F, X
Lewisia rediviva	bitterroot	G	F, X
Liatrus punctata	dotted gayfeather	G	F, X
**Linaria dalmatica*	dalmatian toadflax	F, G, R	--
Linum lewisii	blue flax	G	F, T, X
Lomatium triternatum	nineleaf lomatium	G	F, X

Table 1: Plant Resource Potential in the MacHaffie site Study Area (continued).

FORBS (continued)			
Binomial	**Common name**	**Vegetative zone**	**Use**
Lupinus sp.	lupine	G	C, X, Y
Mertensia oblongifolia	bluebells	G	X
Mammillaria crinata	Pincushion cactus	G	F, T, X
Microseris sp.	microseris	G	--
Opuntia polyacantha	plains pricklypear	G	F, T, X
Phlox hoodii	Hood's phlox	G	T, X
Polygonum sp.	buckwheat	G	F, T, X
Senecio integerrimus	lamb's tounge groundsel	F, G	F
Smilacina stellata	starry false Solomon's seal	F, R	F, X
Sphaeralcea coccinea	scarlet globemallow	G	F, X
**Taraxicum officianale*	common dandelion	R, G	F, X
Thalictrum occidentale	meadowrue	R	F, T, X
Thermopsis Montana	mountain thermopsis	R	T, X
**Tragapogon dubius*	salsify	G	--
**Trifolium repens*	meadow clover	R	--
**Urtica dioica*	stinging nettle	R	F, T, X
**Verbascum thapsus*	wolly mullein	G, F, R	--
Vicia americana	American vetch	F, G	F, X
Viola adunca	western violet	F, R	F, T, X
SUBSHRUBS			
Binomial	**Common name**	**Vegetative zone**	**Use**
Artemisia frigida	fringed sagewort	G	C, F, T, X, Y
Artemesia ludoviciana	cudweed sagewort	G, R	C, F, X, Y
Gutierrezia sarothrae	broom snakeweed	G	X
Linnaea borealis	twinflower	F, R	X
SHRUBS			
Binomial	**Common name**	**Vegetative zone**	**Use**
Artemisia cana	silver sagebrush	G, R	C, S, X
Artemisia tridentata	big sagebrush	G	C, F, S, X, Y
Chrysothamnus nauseosus	rubber rabbitbrush	F	T, X
Cornus stolonifera	red osier dogwood	R	C, F, T, X
Juniperus communis	common juniper	F	F, X
Juniperus scopulorum	Rocky Mountain juniper	F, R	C, F, T, X, Y
Prunus virginiana	chokecherry	F, R	F, T, X
Ribes cereum	squaw currant	G, F, R	F, T
Ribes misouriiensis	Missouri gooseberry	F, R	F, T
Rosa woodsii	Wood's rose	R	F, T, X
Rubus idaeus	red raspberry	F	F, X

Table 1: Plant Resource Potential in the MacHaffie site Study Area (continued).

TREES			
Binomial	**Common name**	**Vegetative zone**	**Use**
Alnus incana	thin-leaf alder	R	T, X
Pinus ponderosa	ponderosa pine	F	F, S, T, X
Populus tremuloides	quaking aspen	R	C, F, S, X, Y
Pseudotsuga menziesii	Douglas fir	F	C, S, T, X
Salix sp.	willow species	R	C, S, T, X, Y

Number of plant species identified in the study area which have a documented human use.

Potential Use	**Riparian**	**Grassland**	**Forest**
Food	23	24	14
Human medicine	24	28	22
Horse medicine	6	9	8
Ceremonial	7	6	4
Tools/crafts	17	10	12
Shelter	2	2	2

Some plant species occur in more than one ecotone and have multiple human uses.

** Invasive, noxious weed species introduced from Eurasia*

Vegetative Zone Codes: F- forest (conifer); G- grassland and shrubland; R- riparian

Human Use Codes: C-ceremonial; F-food; S-shelter; T-tools and crafts; X-human medicine; Y- horse medicine; -- no known human use

Sources:

Aaberg and Tallbull (1993); Berglund and Bolsby (1977); Black (1980); Blankenship (1905); Castetter (1935); Chamberlin (1909); Coon (1974); Deaver and Tallbull (1988); Densmore (1928); Dorn (1984); Ewers (1955); Flannery (1953); Fowler (1986); Gilmore (1933, 1977); Grinell (1905,1923); Gunther (1973); Hall (1976); Hamel and Chiltoskey (1975); Harrington (1967); Hart (1974, 1976, 1981); Hart and Moore (1976); Harvard (1895); Heath (1986); Hellison and Gadd (1974); Herrick (1977); Hitchcock and Cronquist (1973); Holmes (1884); Johnston (1969, 1970, 1987); Kari (1985); Kindscher (1987); Kirk (1970); Kraft (1990); Kroeber (1908); Leithton (1985); Lowie (1935); Mandelbaum (1940); McClintock (1940); McPherson and McPherson (1979); Moerman (2000); Moore (1979); Nickerson (1966); Niethammer (1974); Olsen (1981); Opler (1936); Palmer (1881); Perry (1952); Ray (1932); Reagan (1928, 1929, 1934, 1936); Reed (1967); Robbins et al. (1916); Rogers (1980); Shay (1980); Scully (1970); Smith (1933); Speck (1917); Spinden (1908); Steedman (1928); Steward (1933); Stout (1914); Stubbs (1965); Sweet (1976); Tallbull (1993); Teit (1928); Thwaites (1959); Toineeta-Yellowtail (1970); Train et al. (1941); Turner (1978); Turner et al. (1980); Turner et al. (1990); Turney-High (1937, 1941); Van Allen-Murphy (1959); Vogel (1970); Whiting (1939); Williams (1984); Williams-Dean (1978); Wyman and Harris (1951)

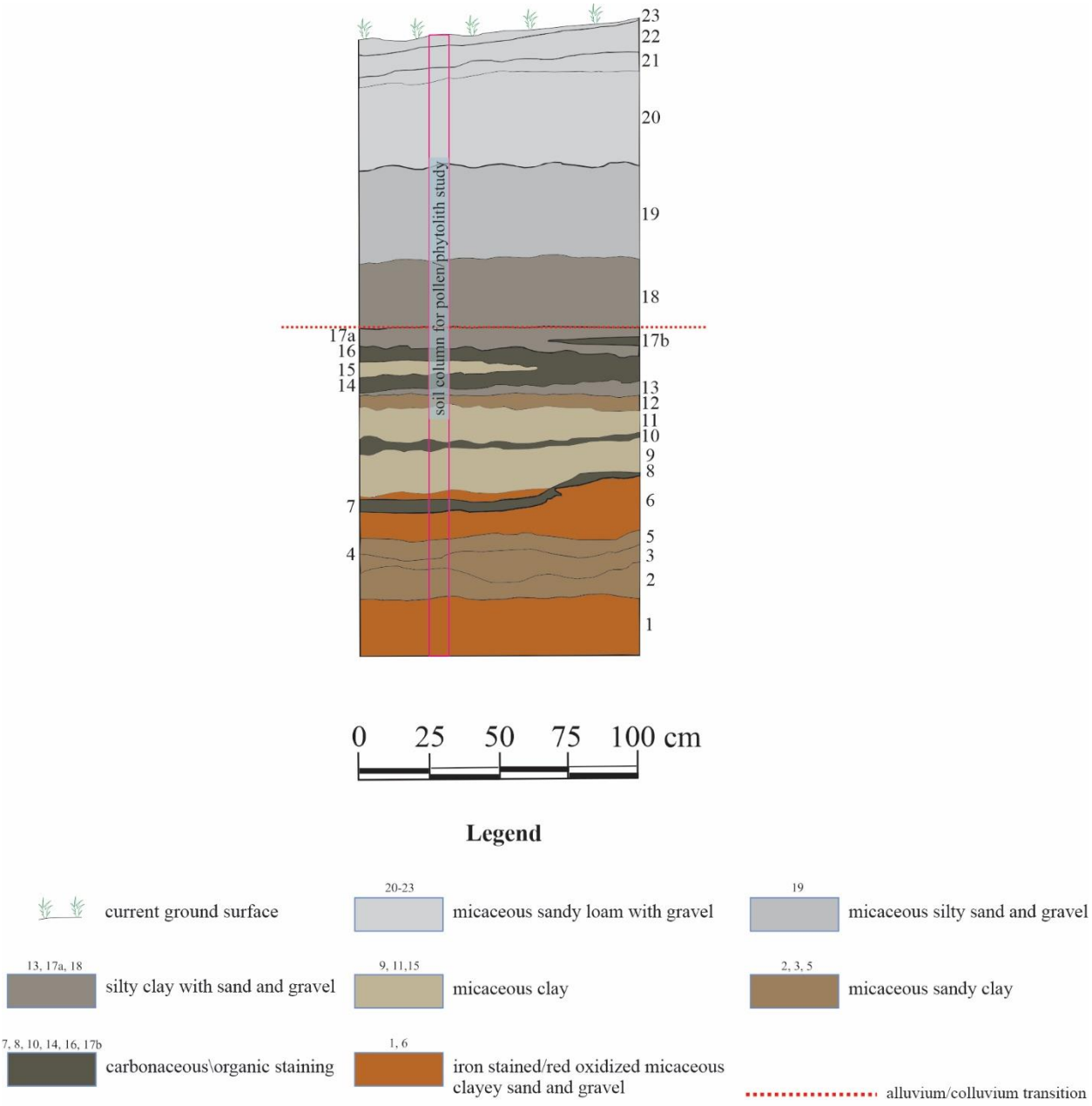


Figure 9. North Wall Profile, Excavation Unit 6S/1W Showing Defined Sediment Units and Soil Column used for Pollen and Phytolith studies.

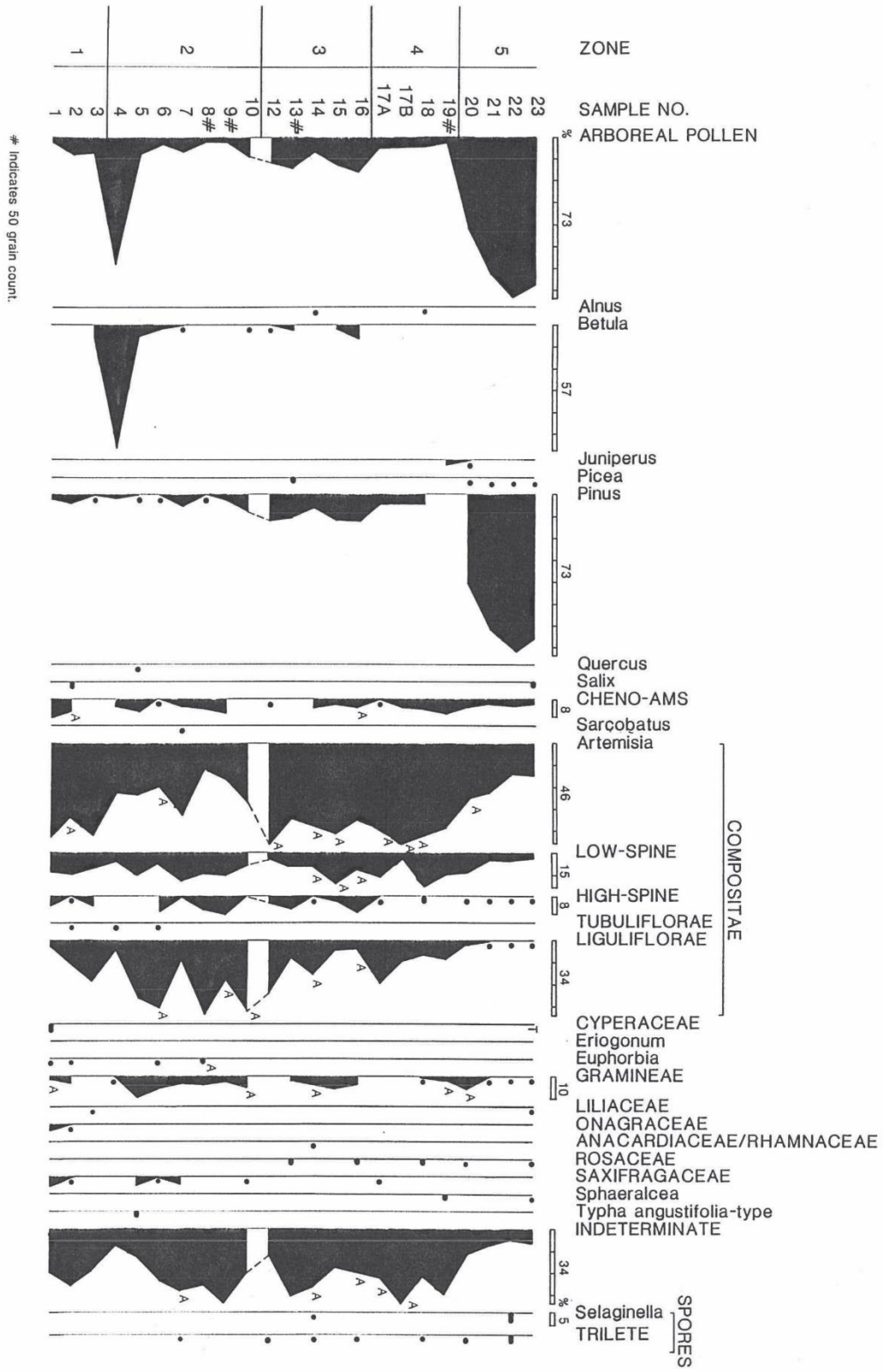


Figure 10. Pollen Diagram for MacHaffie Site Sediment Units.

noted by an "A" next to the pollen frequency on the pollen diagram; "T" on the pollen diagram indicates that the pollen type was observed outside the regular count while scanning the remainder of the microscope slide (Figure 10). Indeterminate pollen includes pollen grains that are folded, mutilated or distorted beyond recognition. These grains are included in the total pollen count.

Phytolith extraction from these sediments was also based on heavy liquid flotation. Fifty ml of sediment was added to a 0.1 molar solution of sodium pyrophosphate and was then diluted. The sample was sieved through 150 µm mesh and allowed to settle. After four hours the clay fraction was poured off. The sample was rinsed numerous times to remove the clay. Hydrogen peroxide (30%) was used to destroy the organic fraction from the remaining sediment. The dried silts and sands were then mixed with zinc bromide (density 2.3) and centrifuged to separate the phytoliths. Phytoliths, in the broader sense, may include opal phytoliths and calcium oxylate crystals. Calcium oxylate crystals are formed by *Opuntia* (prickly pear cactus) and are separated, rather than destroyed, by this extraction technique. Diatoms also float and are recovered using this technique. Any remaining clay is floated with the phytoliths and is further removed by mixing with sodium pyrophosphate and distilled water. The samples are rinsed with distilled water, then alcohols to remove the water. After several alcohol rinses, the samples are mounted in Canada balsam for counting with a light microscope at a magnification of 500x.

Pollen and phytolith samples were collected from each distinct sediment unit identified by John Albanese (1990) (Table 2; Figures 9-11). The colluvial deposit (upper 3.6 ft/1.1 m of profile) contained seven buried sediment units ranging in age from Middle to Late Precontact. No obvious disconformities or erosional surfaces were noted within the colluvium, suggesting that the colluvium accumulated slowly without major episodes of erosional scouring (Albanese 1990:5). The alluvial unit represents the basal approximately 3.9 ft (1.2 m) of the profile. The sedimentary structure reflects bedding and intermittent deposition typical of braided streams. There is occasional evidence for major erosional scouring and debris flow events. Eighteen buried sediment units including three periods of development of A-horizons are noted. The presence of gley soils was interpreted as indicating a mesic climate punctuated by drier conditions throughout most of the early Holocene (Albanese 1990:7).

The pollen record is divided into five zones. Radiometric dates ranging from approximately 10,430 and 9,340 BP have been obtained for the lowest defined zone (Zone 1). Zone 1 includes sediment samples 1-3 and is characterized by a dominance of *Artemisi*a pollen (Tables 2-3, Figures 9-10). Other non-arboreal pollens include *Gramineae*, Cheno-ams, *Low-spine and High-spine Compositae* and *Liguliflorae-type Compositae*. *Cyperaceae* pollen is present only in sample 1. *Pinus* pollen occurs in very small quantity throughout Zone 1, *Salix* pollen is present in sample 2 and *Betula* pollen in found in sample 3. No other arboreal pollen types were recorded in this zone. The pollen record appears to represent vegetation that includes sagebrush throughout the valley, and a well-established riparian community along the drainage. Riparian zone pollens include willows, birches, sedges, messic grasses, and a variety of composites including *Liguliflorae-type* (dandelion-type). Based on pollen frequencies, the Zone 1 climate was similar to today.

Zone 2 extends from sample 4 through sample 11 (Tables 2-3, Figures 8-9). This zone is characterized by a reduction in *Artemisia* pollen and opposing increase in *Liguliflorae-type*

Compositae pollen. In addition, *Gramineae* and *Pinus* pollens increase slightly. A notable feature at the base of this zone is the dramatic rise in *Betul*a pollen in sample 4 and equally dramatic decline in sample 5. This represents a short-lived multiplication in the local birch population. *Typha* pollen is noted only in sample 5, while *Saxifragaceae* pollen is observed in samples 5 through 7. The spike in the birch pollen represents an expansion of birch along the spring and might reflect an increase in wet, boggy floodplain along the drainage. Alternatively, fire might have been responsible for this short-lived escalation in the birch population. Birch is a pioneer tree that commonly grows after a fire (Harlow and Harrar 1941). Birch is not competitive, so as succession progresses the birch population declines.

The pollen record in Zone 2 indicates expansion of the riparian community. The riparian vegetation spread is probably related to a combination of higher precipitation and a raised water table. Both factors would increase the water flow in the spring resulting in wetter localized sediments. A slight increase in the local pine population is also noted supporting the suggestion of somewhat higher precipitation rates. The large quantity of birch pollen near the base of this zone appears to represent an isolated event but indicates large quantities of birch in this area for a short time between 9,340 and 9,130 BP.

Zone 3 is represented by samples 12 through 16. This zone is characterized by a dominance of *Artemisia* pollen. *Liguliflorae* pollen is reduced but still present in moderately high frequencies. Throughout most of this zone, the *Pinus* pollen is increased compared to earlier time periods. *Betula* pollen is present scattered throughout the zone. *Gramineae* pollen is recorded in similar frequencies to Zone 2. Other pollen types which occur sporadically in this zone include *Anacardiaceae/Rhamnaceae* and *Rosaceae*. The pollen record indicates a shrinking riparian community in response to drier conditions between approximately 8,280 and 7,905 BP. This is interpreted from the decrease in *Liguliflorae* pollen as well as the dominance of *Artemisia* pollen throughout the zone. Occasional peaks in *Liguliflorae* pollen are noted, however, they appear to be short-lived and are not typical of the overall pattern. As a generalization, sagebrush expands across the valley and pine forests increase in the higher elevations. Birch and *Liguliflorae-type* composites continue to decline but grasses appear to flourish along the drainage.

Zone 4 extends from sample 17A through 19 and combines a small amount of the upper extreme of the alluvium with the over-riding colluvium. Zones 4 through 5 have not been dated but presumably represent the entirety of the Middle and Late Precontact periods. High-spine Compositae pollen decreases sharply from Zone 3 then appears sporadically here. *Liguliflorae* pollen continues to decline and *Gramineae* pollen disappears from the record or is noted in small quantities. *Artemisia* dominates the pollen record while grasses appear sparser. The riparian zone also appears to continue its decline based on pollen counts and types. This pollen signature appears to represent a well-developed sagebrush-steppe community throughout the valley.

Zone 5 represents the uppermost zone in this record and includes samples 20 through 23 (Tables 2 and 3, Figures 9 and 10). Characteristics of this zone include dominance by unilateral incompatibility pollen, presence of other conifer pollen, such as *Picea*, declining *Artemisia* pollen frequencies, and low *Compositae* frequencies. *Liguliflorae* pollen is noted to be particularly low in this zone. Low frequencies of *Gramineae* pollen were also noted.

Table 2. Provenance of Pollen and Phytolith Samples from the MacHaffie site.

Cultural Component & Sample No./ Sediment Unit	Zone Designation	Depth in cm below present ground surface	Soil Description	Pollen Counted	Phytos Counted
Colluvium Helena 23	5	0-4	Present ground surface	200	200
Helena 22	5	4-11	Micaceous sandy loam with gravel	200	200
Helena 21	5	11-14	Micaceous sandy loam with gravel	200	200
Helena 20	5	14-45	Micaceous sandy loam with gravel	100	200
Helena 19	4	45-78	Micaceous silty sand and gravel	50	N/A
Helena 18	4	78-103	Silty clay with sand and gravel	100	200
Alluvium Helena 17b	4	103	Silty clay with sand and gravel	100	200
Cody 17a	4	110	Silty clay with sand and gravel	100	200
Cody 16	3	110-116	Silty clay with sand and gravel	100	200
Cody 15	3	116-119	Wedge of mica and clay	100	200
Cody 14	3	119-123	Slightly sandy clay, thin carbonaceous bands	100	200
Cody 13	3	123-126	Slightly sandy clay, thin carbonaceous bands	50	200
Cody 12	3	126-130	Micaceous sandy clay with interspersed continuous carbonaceous bands.	100	200
Cody 11	2	130-142	Micaceous sandy loam with gravel	N/A	200
Cody 10	2	142-144	Same as 11 with discontinuous patches of carbonates and organic staining.	100	200
Cody 9	2	144-160	Micaceous sandy loam with gravel	50	200
Cody 8	2	160-163	Micaceous clayey sand and gravel	50	200
Cody 7	2	163-167	Carbonaceous organic staining.	100	200
Folsom 6	2	167-176	Micaceous clayey sand and gravel	100	200
Folsom 5	2	176-182	Very sandy clay with patches of carbonates and organic staining	100	200
Folsom 4	2	182-183	Very sandy clay with patches of carbonates and organic staining	200	200
Folsom 3	1	183-191	Very sandy clay with patches of carbonates and organic staining	100	200
Folsom 2	1	191-200	Micaceous sandy clay, carbonates, some patchy organic staining.	100	200
Folsom/ sterile 1	1	200-220	Micaceous clayey sand and gravel.	100	200

Table 3. Pollen Types Observed in Samples from the MacHaffie site.

Scientific Name	Common Name
Arboreal Pollen:	
Alnus	Alder
Betula	Birch
Juniperus	Juniper
Picea	Spruce
Pinus	Pine
Quercus	Oak
Salix	Willow
Non-Arboreal Pollen:	
Cheno-ams	Includes amaranth and pigweed family
Sarcobatus	Greasewood
Compositae:	Sunflower family
Artemisia	Sagebrush
Low-spine	Includes ragweed, cocklebur, etc.
High-spine	Includes aster, rabbitbrush, snakeweed, sunflower, etc.
Tubuliflorae	Includes eroded Low- and High-spine
Liguliflorae	Includes dandelion and chicory
Cyperaceae	Sedge family
Eriogonum	Wild buckwheat
Euphorbia	Spurge
Gramineae	Grass family
Liliaceae	Lily family
Onagraceae	Evening primrose family
Anacardiaceae/Rhamnaceae	Sumac/Buckthorn families
Rosaceae	Rose family
Saxifragaceae	Saxifrage family
Sphaeralcea	Globe mallow
Typha angustifolia	Cattail
Spores:	
Selaginella densa	Little clubmoss
Trilete	mosses, lycopods, or ferns

The pollen record for this zone indicates that the sagebrush community declined drastically since previous levels and the pine forest increased on the slopes of this valley. The riparian community probably continued to decline although it still included both *Liguliflorae-type* composites and grasses. The dominance of *Pinus* pollen in this zone probably obscures the more local plants, thereby making interpretation of relative size of this habitat difficult. A major problem with placing confidence in the pollen record for Zones 4 and 5 is the highly mixed nature of sediments comprising the colluvium. Still, the general climatic picture is a gradual warming and drying trend over the course of the Holocene with punctuated episodes of cooler and wetter and warmer and dryer weather.

Four classes of phytoliths are commonly identified: festucoid, chloridoid, panicoid and elongate. Of these, the first three are termed short-cell phytoliths, while elongates are long-cell phytoliths and not considered diagnostic. Counts of two hundred short-cell phytoliths were made for each of the phytolith samples examined based on recommendations made by Pearsall (1989) concerning interpretability of short-cell phytolith records and comparability of the 200-item count to pollen counts.

Elongate class phytoliths, observed in abundance in all samples from the MacHaffie site excluding sample 19, were not tallied as they are considered to lack interpretive significance. A count of diatom skeletons was made outside the 200-short-cell counts since their presence probably correlates with a moister environment. Both the pollen and phytolith records should be considered reflective of watershed and general valley vegetation, rather than being site-specific since the lower portion of the record is alluvial and thus responsible for transport of both pollen and phytoliths along the watercourse.

All phytolith samples examined from the MacHaffie site were dominated by festucoid phytoliths. Few panicoid phytoliths were observed, and chloridoid phytoliths were even rarer. Festucoid phytoliths were, in contrast, abundant indicating well established cool season grasses typical of the High Plains and typically interpreted as representing moist or humid habitats. These grasses become dormant during warmer weather.

Lewis (1986a:208) notes grass tribes that commonly produce Festucoid phytoliths include *Festuceae, Hordeae, Aveneae, and Agrostideae*. These grasses are common in the High Plains region and are not necessarily associated with a cool, humid climate. Festucoid-type phytoliths may also be produced by grasses that also produce Chloridoid and Panicoid phytoliths. Short-grass prairie receives 14 to16 inches (36 to 41 cm) of annual precipitation (Rogers 1980). These short grasses are warm-season indicators and are dormant during cooler weather. They survive dry conditions well. The tribes *Chlorideae, Eragrostideae, and Sporoboleae* are commonly listed as chloridoid class phytolith producers (Twiss et al. 1969:111; Lewis 1986a: 208-209). Panicoid phytoliths are commonly produced by members of three grass tribes (*Andropogoneae, Paniceae, and Maydeae*) (Twiss et al. 1969). These grasses are common to the tall-grass prairie, such as the eastern third of South Dakota where annual precipitation averages more than 20 inches per year (Rogers 1980; Lewis 1986a:209). Tables 4 through 6 list the tribes, genera and common names of grasses that typically produce the three distinct short-cell phytoliths that include types listed by Lewis (1986b) for the High Plains.

The phytolith record contains large quantities of Festucoid phytoliths throughout the

stratigraphic column with very little variability in frequency (Tables 4 through 6, Figure 11) indicating that the sediments along the stream have been consistently saturated prior to ca. 9,340 BP. Only the degree of water content has varied. The keys to interpreting this phytolith record appear to lie in the distribution of the non-Festucoid phytoliths and diatoms. Panicoid phytoliths represent warm-season grasses that prefer increased moisture while Chloridoid phytoliths represent warm- season grasses that grow well in drier conditions. Diatoms are present only when the soil is very wet. Therefore, interpretation of variations in the Chloridoid and Panicoid phytolith and diatom frequencies provides the best information regarding paleoenvironmental conditions.

Diatoms abound in the lower portion of the record, peaking in sample 3, at the end of pollen Zone 1. Diatoms decline sharply in sample 4 but continue to be present in quantities larger than two percent until after the Folsom occupation. During Cody occupations diatoms decline to one percent or less in frequency, disappearing from the record in sample 10. Chloridoid phytoliths enter the record in sample 6, near the Folsom/Cody transition dated at the MacHaffie site ca. 9,130 BP. They are recorded in small quantities in samples 6 through 12, with the exception that they are absent in sample 8. Samples 8 through 12 also display small quantities of diatoms. These combined indicators of low diatom frequencies and presence of Chloridoid phytoliths suggest that stream flow declined, or the water table dropped, resulting in at least intermittent drying of sediments along the drainage. Samples 13 through 17B exhibit fluctuating levels of diatoms, between 1 and 2.5 percent, indicating that while drier than during the early Holocene, these levels were still relatively moist. Diatoms were not recorded in samples again until the top of the record in samples 22 and 23. Panicoid phytoliths are present in small but relatively consistent quantities throughout the alluvial deposition between samples 1 and 16. Above this level, however, in the colluvial sediments, Panicoid phytoliths become rare, comprising one percent or less of the total in samples 17A through 18 and 21 through 23.

The diatomatic peak recorded in sample 3 indicates a wet interval and, when compared with the pollen record, strengthens the interpretation of water birch in this area. *Betula* pollen is noted in sample 3 followed by a rapid expansion of birch population in sample 4 and a decline by sample 5. The combined pollen and phytolith records suggest that diatoms responded more rapidly to the increased moisture in the sediments in sample 3, whereas the birch population probably responded over many years or decades to this increased moisture. The large population of birch could not, however, be sustained, as the diatoms reflect a decrease in soil moisture by sample 5. The absence of diatoms from the phytolith record shortly above the transition from alluvial to colluvial deposits indicates that the sediments were drying along the streambank in the colluvial deposits. There was, however, sufficient soil moisture to continue to support a population of Festucoid-type grasses throughout the period represented by the colluvial sediments.

The pollen data indicate the presence of a sagebrush-steppe throughout much of human occupation at the MacHaffie site. Many drainages contained typical riparian vegetation prior to ca. 8,280 BP, and this continued after the increase in sagebrush steppe. Abundant to moderate

Table 4. Grasses that Produce Festucoid Phytoliths.

Tribe	Genus	Common Name
Fetuceae	*Lolium*	darnel
	Festuca	fescue
	Vulpis	six-week grasses
	Hisperochloa	spike fescue
	Dactylis	orchard grass
	Poa	bluegrass
	Milica	milic
	Scolochloa	rivergrass
	Schizachnie	false melic
	Glyceria	manna grass
	Puccinellia	alkali grass
	Catabrosa	brook grass
	Torreyochloa	false manna
	Bromus	brome
	Phragmites	common reedgrass
Hordeae	*Elymus*	wild rye
	Agropyron	wheat grass
	Sitanion	squirrel tail grass
	Eremopyrum	false wheat grass
	Triticum	wheat
	Secale	rye
	Hordeum	barley
Aveneae	*Deschampsia*	hair grass
	Trisetum	trisetum
	Avena	oats
	Arrheatherum	false oat
	Helictotrichon	wedgescale
	Koeleria	koeleria
	Danthonia	oatgrass
Agrostideae	*Polypogon*	beard grass
	Cinna	wood reed
	Calamagrostis	reed grass
	Phleum	Timothy
	Agrostis	bent
	Phippsia	ice grass
	Alopercurus	foxtail grass
	Oryzopsis	ricegrass
	Stipa	needle grass
	Aristida	three-awn

(After Beetle and May 1971; Lewis 1986a; and Porter 1964)

Table 5. Grasses that Produce Chloridoid Phytoliths.

Tribe	Genus	Common Name
Chlorideae	*Bouteloua*	grama
	Buchloe	buffalo grass
	Schedonnardus	tumble grass
	Spartina	cordgrass
	Hilaria	hilaria
Eragrosteae	*Distichlis*	saltgrass
	Calamovilfa	sandreed
	Eragrostis	lovegrass
	Monroa	false buffalo grass
	Redfieldia	blowout grass
Sporoboleae	*Sporobolus*	dropseed
	Muhlenbergia	muhly

(After Porter 1964; Beetle and May 1971; Lewis 1986a)

Table 6. Grasses that Produce Panicoid Phytoliths.

Tribe	Genus	Common Name
Paniceae	*Panicum*	panic grass
	Cenchrus	Sandbur
	Digitaria	crabgrass
	Echinochloa	cockspur
	Setaria	bristlegrass
Andropogoneae	*Andropogon*	bluestem
	Sorgastrum	Indian grass
	Sorghum	sorghum
Maydeae	*Zea*	corn

(After Porter 1964; Beetle and May 1971; Lewis 1986a)

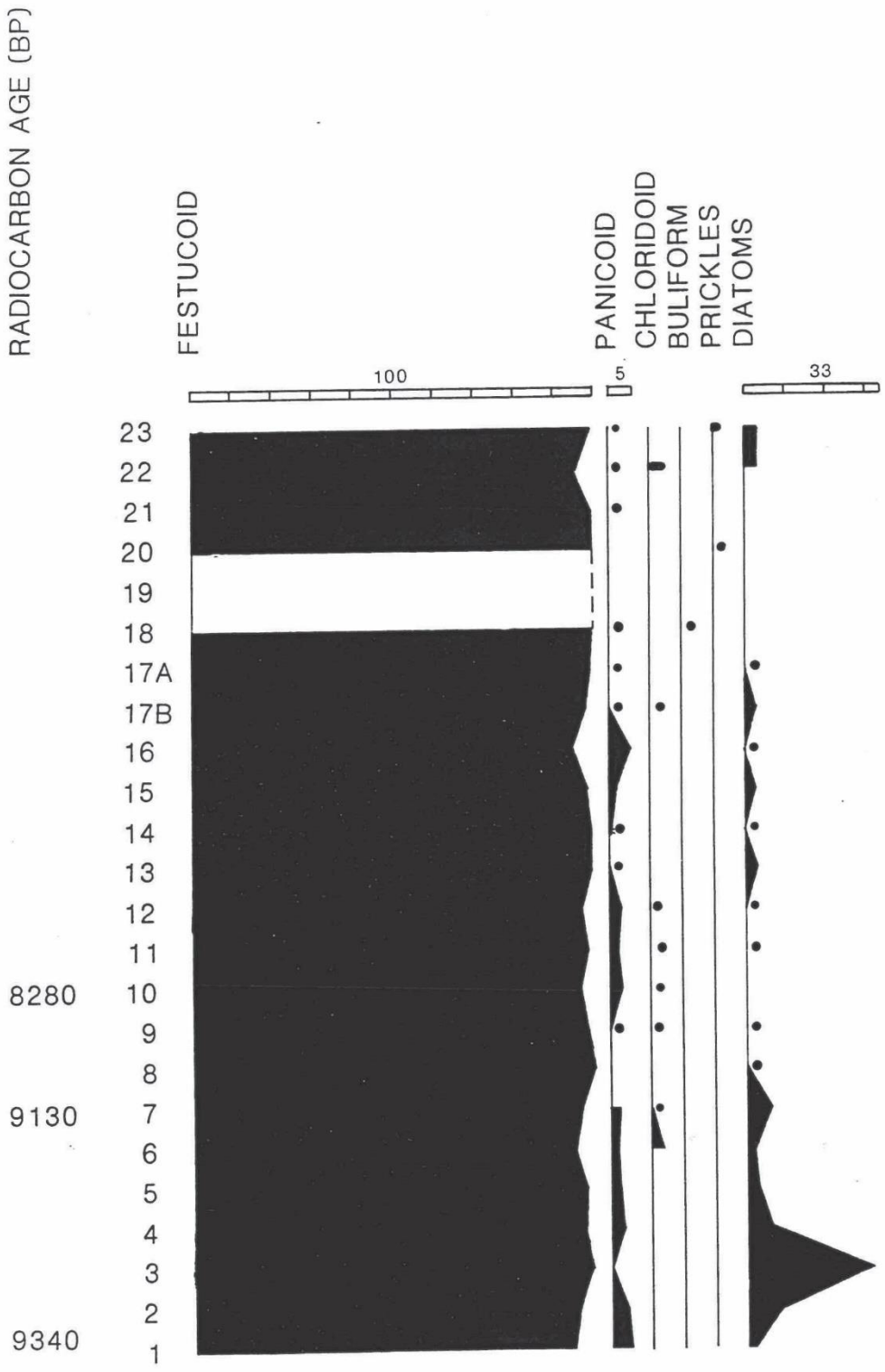


Figure 11. Phytolith Diagram for MacHaffie site Sediment Units.

densities of birches and willows, large quantities of *Liguliflorae-type* composites, grasses, and a few sedges, lilies, and saxifrages were recorded in the sediments. There is no evidence in this portion of the record for forested mid-elevation slopes that exist in the area today. The phytolith record from the Folsom age alluvial deposits indicates wetland sediments through sample 7 dated to ca. 9,130 BP. After this date, soil moisture declines. This suggests a lowering of the water table or reduced precipitation. It should be noted that the pollen and phytolith records do not display as large a change as do the diatoms.

Artemisia pollen increase in sediment units 9 through 17 suggests sagebrush steppe expansion, a lowering of the water table, and concomitant reduction in stream flow. The marked increase in sagebrush steppe after ca. 8,280 BP is consistent with evidence of prolonged Altithermal conditions and sagebrush steppe expansion elsewhere. The phytolith record continues to show a well-developed riparian community, although the sediments in the MacHaffie site proper were less saturated than earlier in the Holocene. There was also sufficient moisture in the sediments along the drainage to support a healthy population of Festucoid-type grasses.

Evidence of continued dry conditions is noted in the colluvial deposits by the retention of the sagebrush-steppe habitat and the decline in both the *Liguliflorae-type* composites and grass populations in the vicinity of the site. An abrupt change in forested slopes is noted in sample 20, when the sagebrush and all composite pollen declines and *Pinus* pollen markedly increases. These conditions were maintained to the top of the profile, representing the present. The reduction in diatoms early in the colluvial record, and their absence from the record until nearly the present, suggests drier conditions along the drainage during this time. Interestingly, Chloridoid grasses were not well established. Cool season (Festucoid) grasses dominate the record with little presence of Panicoid grasses that prefer warm weather and more moisture.

The transition from glacial to non-glacial conditions in alpine and subalpine areas in western Montana and contiguous areas is well established in pollen records from other regional study sites. It consists of a change from tundra and periglacial steppe-type vegetation to a cold-adapted coniferous forest (spruce, fir, and Haploxylon pine). Continued climatic amelioration through the early Holocene is characterized by a transition to a coniferous forest dominated by trees adapted to a warmer climate (Douglas fir and lodgepole pine). Porter et al. (1983:99) indicate that, by 11,500 BP, the transition was complete in mountainous areas of northwestern Wyoming and western Montana. In the Kootenai Valley of western Montana the change to a subalpine coniferous forest adapted to cool conditions was completed by 11,000 BP (Mack et al. 1983). At Guardipee Lake, east of the Rocky Mountains and outside the area of continental ice sheets, a temperate grassland had developed by 12,200 BP. Increasingly arid conditions after 11,500 BP is indicated by elevated sagebrush pollen relative to grass pollen (Barnosky 1989).

Two recent reviews of the Holocene pollen record of the western United States provide a summary of paleoecology in western Montana (Baker 1983; Mehringer 1985). Although vegetational changes may be varied and “complex”, the presence of the mid-Holocene Altithermal is the most consistently recognized feature in the paleoenvironmental records. Vegetation changes at increasing elevations reveal different responses during the Altithermal. Signs of climatic warming and lengthening of the growing season (Davis 1984; Davis et al. 1986) were recorded at higher elevation localities (above 1,800 m ASL) such as Lost Trail Pass

Bog (Mehringer et al. 1977a, 1977b) and Sheep Mountain Bog (Mehringer 1985). Little evidence of moisture stress is noted for the mid-Holocene. Sites at lower elevations near the grassland-subalpine forest ecotone, such as Teepee Lake (Mack et al. 1983), suggest that drier conditions occured somewhat earlier (Fredlund and Bozarth 1987).

Charcoal flecks in sediment samples were routinely removed during the process of extracting pollen and phytoliths. With three exceptions, optical counts of the very limited carbon flecks were statistically meaningless. Sediment samples 2 through 4, however, displayed large quantities of charcoal that could not be separated from phytoliths. It is interesting to note that sample 4 corresponds with the peak in *Betula* pollen. Data reported by Mehringer (1985) indicate that fires were least frequent in western Montana during the Early Holocene (ca. 11,500 to 8,000 BP) with more frequent occurrence during the Altithermal (8,000 to 4,800 BP). A dramatic rise in fire frequency appears during the late Holocene (1,750 BP to present). Several researchers (Barrett and Arno 1982; Hemphill 1983; Onken 1983) attribute this, at least in part, to human activity. Lightning is interpreted as the only natural source of fire ignition in this region (Fredlund and Bozarth 1987). It is possible that the rapid expansion in birch population at the MacHaffie site represents both post-fire succession and increased wet conditions. Local evidence for fire is manifested in the presence of larger quantities of charcoal in samples 2 and 4 than elsewhere in the record from this site. In addition, samples 2 through 4 yielded greater quantities of diatoms, representing the wettest soil conditions during the history of this site. Although heating/cooking facilities were not identified during 1989 through 2018 investigations, prevalent amounts of firecracked rock (FCR) were exposed in 2017 from what appears to be the Folsom component. This implies hearth construction somewhere in the site and may provide an alternate explanation for the increased charcoal density in sediment samples 2 through 4.

Data from Sheep Mountain bog in western Montana and two alpine marshes 6.2 to 16 miles (10 to 25 km) southwest of MacHaffie (Brant 1980) indicate transition to the Holocene was completed by 10,000 BP. By 7,000 BP, regional pollen sequences "without exception indicate apparent warming. The warming and drying trend slowed by 5,400 BP. By 4,000 BP, climatic patterns resulting in more effective moisture held throughout the interior Northwest." At Lost Trail Pass, in the Bitterroot Mountains of western Montana, the advent of the warm middle Holocene occurred shortly before the Mazama ashfall (ca. 6,800 BP), and a return to cooler-moister conditions occurred about 4,000 BP (Mehringer 1985:175). In the Kootenai Valley of northwestern Montana, vegetative changes typical of the early Holocene occurred between 10,700 and 7,100 BP; plant assemblages typical of the middle Holocene predominated from 7,100 to 4,000 BP; and a late Holocene flora occurred between 4,000 and 2,770 BP. A modern upland vegetation has persisted from 2,700 BP to the present (Mack et al 1983). Barnosky (1989) places the beginning of the Altithermal at ca. 9,300 BP and its terminus at ca. 6,000 BP in the plains area of Glacier and Choteau counties in north-central Montana. This time interval for the middle Holocene is considerably different from that indicated by Mehringer (1985) for the mountainous areas of western Montana, ca. 7,000 BP to 4,000 BP. Davis and others (1986) report that in the vicinity of the Snake River Plain in southern Idaho the "Thermal Maximum" of the Altithermal, as inferred from pollen studies, occurred at low elevations prior to the deposition of the Mazama ash ca. 6,700 BP; whereas at higher elevations in the nearby mountains the Thermal Maximum occurred ca. 6,000 BP. The same authors report that on the Yellowstone Plateau east of the Snake River Plains the Thermal Maximum occurred between 7,500 and 6,750 BP, prior to Mazama ash accumulation (Davis et al. 1986:322).

At the time of the Glacier Peak volcanic ashfall (ca. 11,100 to 3,000 BP (Lewis 1986b), the Indian Creek locality, approximately 22 miles (35 km) southeast of MacHaffie, was characterized by subalpine forest. Around 8,300 BP the forest was apparently replaced by sagebrush steppe. Sagebrush steppe persisted until approximately 4,300 BP, when conifer forests began to dominate during the mid-Holocene (Fredlund and Bozarth 1987:1). Changes in the sediment sequence at the Indian Creek site appear to correlate with changes in the pollen record as reported by Fredlund and Bozarth (1987). Three stratigraphic units delineated at Indian Creek are believed to mark the transition from glacial to non-glacial conditions at the end of the Pleistocene (Albanese 1986). The lowest unit (Unit A) is a glacial outwash deposit, while overlying Unit B is an approximately two-meter thick braided-stream sequence consisting principally of silty-clay, sand and gravel strata. Unit B is characterized by the prominent presence of limonitic, hematitic, and manganese-oxide staining and mottling. The iron and manganese-oxide mottling formed through alternating oxidation and reduction conditions resulting from a fluctuating water table (Birkeland 1984:147). Marked evidence of soft sediment deformation also points to the prolonged past presence of water-saturated sediments. The basal portion of the alluvial sequence at MacHaffie correlates chronologically with Unit B at Indian Creek, which represents the early Holocene prior to 8,000 BP (Davis and Root n.d.).

Pollen records for MacHaffie and Indian Creek compare favorably in their identification of a sagebrush steppe between 8,300 BP and 4,300 BP. The increase in *Pinus* pollen toward the terminus of the record at MacHaffie could be temporally coeval with expansion of conifer forest at Indian Creek. Palynological studies at 24JF4 (Cummings 1990), 24JF761 some 4 miles (6 km) west of MacHaffie (Herbort 1987), Quinn Creek (24JF110) approximately 30 miles (48 km) south (Cummings and Moutoux 1997), Indian Creek (Davis and Root n.d., Lewis 1986b), sites 24LC1992/2186, 24LC99 and 24LC2289) approximately 22 miles (35 km) northeast (Travis 2014, 2016; Travis et al. 2012), and the King site (24PH2886) 190 miles (306 km) to the northeast (Brumley and Rennie 1993) indicate that the vegetative community of Montana has been qualitatively similar, with some density fluctuations, since the middle Holocene. However, pollen densities vary from one sampled locale to the next. It is uncertain if these apparent fluctuations reflect wildfire frequency, precipitation and temperature changes, grazing pressures, or other factors.

Recently, Chellman et al. (2021) conducted an ice core study from a snowfield in the Beartooth Mountains of south-central Montana. Their research indicates relatively mild winter conditions from ca. 10,000 to 7,000 BP punctuated by more severe winters ca. 9,100 BP and ca. 7,140 BP. The overall pattern, however, is gradual wintertime warming until ca. 4,230 BP. Between ca. 4,200 and 3,800 BP, low ice accretion rates in the Beartooth snowfield indicated conditions in the region were the warmest of the Holocene with the mildest winters prior to the last millennium. This era coincided with pan-global aridity at ca. 4,200 BP. A rapid transition to cooler conditions and more intense winters occurred ca. 3,930 to 3,560 BP. This pattern persisted until ca. 2,050 BP after which a gradual increase to modern conditions is postulated. The results of the plethora of intra-regional paleoenvironmental studies currently available show more unity than inconsistencies.

Outside the northwest plains, Mehringer (1985:173) contends that the pollen record of the interior Pacific Northwest and the Northern Great Basin also supports the conventional three-part

climatic division of the Holocene-- early (cool and moist), middle (xeric or altithermal) and late (return to cool-moist conditions). Mehringer further states that by 9,000 BP the interior Pacific Northwest and the Northern Great Basin exhibited modern vegetation. Comparable climatic changes and regional vegetative responses are also documented through the arctic and sub-artic (West 1996: 1-146).

2.5 Animal Resources

Graham et al. (1987), in their discussion of the late Pleistocene and early Holocene fauna of Montana, Alberta, and Saskatchewan, contend that during the late Pleistocene the northern plains were grasslands intermixed with microenvironments suited for arctic and boreal plant and animal species. This environmental mosaic extended at least from northern Wyoming to western Alberta. Ultimately, the disappearance of some cold-adapted species after 14,000 BP suggests their northward migration resulting from climatic warming and drying. However, some boreal species appear to have persisted at lower elevations, possibly indicating reduced seasonal extremes when compared to the climate of today.

More recently, Faith and Surovell (2009:20641) summarize contemporary thinking on Pleistocene/Holocene boundary extinctions as:

> During the late Pleistocene, North America lost 35 genera of large mammals. The majority (29 genera), including mastodons, saber-toothed cats, and giant ground sloths, became globally extinct at that time, whereas a handful (6 genera) vanished from North America while continuing to persist elsewhere. For decades archaeologists and paleontologists have debated the causes of their extinction, with explanations including overkill [human caused], environmental change, hyperdisease, and an extraterrestrial impact. Crucial to the development of explanatory models is the chronology of the extinctions, which some envision as a long-term process occurring throughout the late Pleistocene and others characterize as a synchronous event that wiped out all taxa between 12,000 and 10,000 radiocarbon years B.P.

One site that can help answer questions regarding late Pleistocene to early Holocene fauna expected to have been present in the area prior to human occupation of MacHaffie is Sheep Rock Spring (24JF292). That site is located in a similar topographic setting approximately 43 miles (70 km) southwest of MacHaffie. Here, and at least in part in cultural association, are what have tentatively been identified as remains of horse, giant bighorn sheep, wolverine, mountain goat, cheetah, and short-faced bear (Davis and Rennie 2017). It is unfortunate that the rich paleontologic aspect of 24JF292 will likely never be made part of the scientific literature. Farther southeast, near the Montana-Wyoming border, the remains of extinct mammalian species, including horse and camel, have been recovered from False Cougar (24CB84) and Shield Trap (24CB91) caves (Bonnichsen et al. 1986). In addition to extinct faunas, the remains of collared lemming were also recovered. Today they occur no less than 1,553 miles (2,500 km) north of the Pryor Mountains. Blacktail Cave (24LC151), approximately 42 miles (68 km) northwest of MacHaffie is renowned, in part, for muskox and large bear skulls reported from this natural feature. We lack confidence in the origin of much of the cultural remains and faunal materials from Blacktail Cave and do not use this site as an example of local Pleistocene fauna.

Table 7 summarizes selected mid to late Holocene faunal resources which could have occurred with reasonable frequency within a 10 mile (16 km) radius of the MacHaffie site. Because the focus of this report is on the human occupation of the MacHaffie site prior to European influence, temporal coverage of the fauna list ranges from early historic times (pre-European settlement) to the early Holocene. The list excludes fauna introduced to the general study area following European settlement. The arbitrary 10 mile (16 km) radius study area was selected because, in our opinion, most faunal remains brought into a northern plains hunter/gatherer campsite for consumption or food preparation would come from within an area that size. Further, listed fauna in Table 7 is limited to species whose remains may be preserved in the archaeological record.

3.0 GEOMORPHOLOGY

The opening sentence of the abstract to Dr. Richard Forbis' (1955) doctoral dissertation states "The MacHaffie site, a stratified archeological site in western Montana, is composed of three cultural layers separated by sterile soil zones". Puzzlingly, Forbis, Tolstoy, and Fischer's 1951 field notes, as well as depths listed on artifact bags, tend to contradict this statement (UMMC 2020). Forbis (1955:38-47) identified five distinct sediment units. From ground surface downward approximately 16 inches (0 to 41 cm) is sediment deposit V. This he identified as the topsoil composed of humus and subhumus. Sediments are described as silts generally free of naturally occurring large rock. Forbis noted that most Helena Component artifacts (Cultural Level III) are confined to the humus, but some extend into the subhumus (Figures 12 through 19).

Transitioning from the subhumus downward approximately one foot (30 cm) is sediment deposit IV (approximately 16 to 28 inches/41 to 71 cm BS). This deposit is dubbed the "red soil" and noted by Forbis to be culturally sterile. Sediments are again described as silts generally free of naturally occurring rock but also free of organic material. Forbis also observed:

> Old stream channels, clearly indicated in the contour of the ground, were reflected in the topsoil profile. The deepest of them **[indicated on the W-3 profile, Figures 12 and 13]** cut down to the top of the red soil level, pinching out the subhumus, and was refilled with artifact-bearing humus, indicating that the occupation of the top level took place after the channel was cut. The old stream channels in the humus roughly parallel the present course of the creek (Forbis 1955:45).

Sediment deposit III is Forbis' "gray soil". It occurs from approximately 28 to 40 inches (71 to 102 cm) BS. The gray soil was reported to be colluvial with occasional sand and gravel lenses. It is within the gray soil that Forbis identified Cultural Level II, the Yuma [Cody] component, but he also suggests that the Cody materials may not be entirely intact:

> In about the middle of the gray layer, toward the north end of the cut, thin layers of pebbly sand appear, leaving continuous bands lenticular in cross section. These features unquestionably represent ancient stream beds. From the paucity of Scottsbluff artifacts and flakes in these pebbly sands, it seems fair to infer that the stream either postdates or was contemporaneous with the Scottsbluff occupation (Forbis 1955:42).

Table 7: Faunal Resources Expected to Occur within a Ten Mile Radius of 24JF4 from Early Historic Times to the Mid-Holocene.

Birds (+ avian species expected to occur in the study area throughout the year)

Accipitriformes

+bald eagle *(Haliaeetus leucocephal-us)*
+golden eagle *(Aquila chrysaetos)*
Cooper's hawk *(Accipiter cooperii)*
ferruginous hawk *(Buteo regalis)*
+northern goshawk *(Accipiter gentil-is)*
red-tailed hawk *(Buteo jamaicensis)*
rough-legged hawk *(Buteo lagopus)*
sharp-shinned hawk *(Accipiter stria-tus)*
Swainson's hawk *(Buteo swainsoni)*
northern harrier *(Circus cyaneus)*
osprey *(pandion haliaetus)*

Falconiformes

American kestrel *(Falco sparverius)*
merlin *(Falco columbarius)*
peregrine falcon *(Falco peregrinus)*
+prairie falcon *(Falco mexicanus)*

Anseriformes

American wigeon *(Anas americana)*
Barrow's goldeneye *(Bucephala islan-dica)*
blue-winged teal *(Anas discors)*
bufflehead *(Bucephala albeola)*
+Canada goose *(Branta canadensis)*
cinnamon teal *(Anas cyanoptera)*
common goldeye *(Bucephala clangula)*
common merganser *(Mergus merganser)*
gadwall *(Anas strepera)*
green-winged teal *(Anas crecca)*
hooded merganser *(Lophodytes cucull-atus)*
+mallard *(Anas platyrhynchos)*
northern pintail *(Anas acuta)*
northern shoveler *(Anas clypeata)*
snow goose *(Chen caerulescens)*
trumpeter swan *(Cygnus buccinator)*
tundra swan *(Cygnus columbianus)*

Galliformes

+blue grouse *(Dendragapus obscurus)*
+ruffed grouse *(Bonasa umbellus)*
+sharp-tailed grouse *(Tympanuchus phasianellus)*
+spruce grouse *(Dendragapus canadens-is)*

Charadriiformes

American avocet *(Recurvirostra americana)*
black tern *(Chlidonias niger)*
Bonaparte's gull *(Larus philadelphia)*
California gull *(Larus californicus)*
Caspian tern *(Sterna caspia)*
common snipe *(Gallinago gallinago)*
Forster's tern *(Sterna forsteri)*
Franklin's gull *(Larus pipixcan)*
greater yellowlegs *(Tringa melanoleuca)*
herring gull *(Larus argentatus)*
killdeer *(Charadrius vociferus)*
least sandpiper *(Calidris minutilla)*
lesser yellowlegs *(Tringa flavipes)*
long-billed curlew *(numenius americanus)*
long-billed dowitcher *(Limnodromus scolopaceus)*
marbled godwit *(Limosa fedoa)*
mountain plover *(Charadrius montanus)*
red-necked phalarope *(Phalaropus lobatus)*
ring-billed gull *(Larus delawarensis)*
semipalmated plover *(Charadrius semipalmatus)*
semipalmated sandpiper *(Calidris pusilla)*
solitary sandpiper *(Tringa solitaria)*
spotted sandpiper *(Actitis macularia)*
western sandpiper *(Calidris mauri)*
willet *(Catoptrophorus semipalmatus)*
Wilson's phalarope *(Phalaropus tricolor)*

Columbiformes

mourning dove *(Zenaida macroura)*

Apodiformes

calliope hummingbird *(Stellula calliope)*
rufous hummingbird *(Selasphorus rufus)*

Coraciiformes

+belted kingfisher *(Ceryle alcyon)*

Piciformes

black-backed woodpecker *(Picoides arcticus)*
+downy woodpecker *(Picoides pubescens)*
+hairy woodpecker *(Picoides villosus)*
Lewis' woodpecker *(Melanerpes lewis)*
pileated woodpecker *(Dryocopus pileatus)*

Table 7: Faunal Resources Expected to Occur within a Ten Mile Radius of 24JF4 from Early Historic Times to the Mid-Holocene (continued).

Birds (+ avian species expected to occur in the study area throughout the year)

Piciformes (continued)
+northern flicker *(Colaptes auratus)*
red-headed woodpecker *(Melanerpes erythrocephalus)*
three-toed woodpecker *(Picoides tridactylus)*
yellow-bellied sap sucker *(Sphyrapicus varius)*

Cathartiformes
turkey vulture *(Cathartes aura)*

Pelicaniformes
American white pelican *(Pelecanus erythrorhynchos)*
black-crowned night-heron *(Nycticor-ax nyctic-orax)*
great blue heron *(Ardea herodias)*

Suliformes
double-crested cormorant *(Phalacroc-orax auri-tus)*

Gruiformes
American coot *(Fulica americana)*
sandhill crane *(Grus canadensis)*

Podicipediformes
eared grebe *(Podiceps nigricollis)*
horned grebe *(Podiceps auritus)*
pied-billed grebe *(Podilymbus podic-eps)*
western grebe *(Aechmophorus occiden-talis)*

Strigiformes
+burrowing owl *(Athene cunicularia)*
flammulated owl *(Otus asia)*
+great gray owl *(Strix nebulosa)*
+great horned owl *(Bubo virginianus)*
+long-eared owl *(Asio otus)*
+northern pygmy owl *(Glaucidium gnoma)*
+northern saw-whet owl *(Aegolius acadicus)*
+short-eared owl *(Asio flammeus)*
western screech owl *(Otus kennicottii)*

Caprimulgiformes
common nighthawk *(Chordeiles minor)*

Passeriformes
+American crow *(Corvus brachyrhynchos)*
American dipper *(Cinclus mexicanus)*
American goldfinch *(Carduelis tristis)*
American redstart *(Setophaga ruticilla)*
American robin *(Turdus migratorius)*
American tree sparrow *(Spizella arborea)*
bank swallow *(Riparia riparia)*

Passeriformes (continued)
barn swallow *(Hirundo rustica)*
+black-billed magpie *(Pica pica)*
+black-capped chickadee *(Parus atricapillus)*
black-headed grosbeak *(Pheucticus melanocephalus)*
black rosy finch *(Leucosticte arctoa atrata)*
bobolink *(Dolichonyx oryzivorus)*
Bohemian waxwing *(Bombycilla garrulus)*
Brewer's blackbird *(Euphagus cyanocephalus)*
Brewer's sparrow *(Spizella breweri)*
brown creeper *(Certhia americana)*
brown-headed cowbird *(Molothrus ater)*
canyon wren *(Catherpes mexicanus)*
Cassin's finch *(Carpodacus cassinii)*
cedar waxwing *(Bombycilla cedrorum)*
chestnut-collared longspur *(Calcarius ornatus)*
chipping sparrow *(Spizella passerina)*
+Clark's nutcracker *(Nucifraga columbiana)*
clay-colored sparrow *(Spizella pallida)*
cliff swallow *(Hirundo pyrrhonota)*
common grackle *(Quiscalus quiscula)*
+common raven *(Coryus corax)*
common redpoll *(Carduelis flammea)*
common yellowthroat *(Geothlypis trichas)*
dark-eyed junco *(Junco hyemalis)*
dusky flycatcher *(Empidonax oberholseri)*
eastern kingbird *(Tyrannus tyrannus)*
evening grosbeak *(Coccothraustes vespertinus)*
fox sparrow *(Passerella iliaca)*
golden-crowned kinglet *(Regulus satrapa)*
gray catbird *(Dumetella carolinensis)*
gray-crowned rosy finch *(Leucosticte arctoa tephrocotis)*
+gray jay *(Perisoreus canadensis)*
green-tailed towhee *(Pipilo chlorurus)*
Hammond's flycatcher *(Empidonax hammondii)*
Harris' sparrow *(Zonotrichia querula)*
hermit thrush *(Catharus guttatus)*
horned lark (*Eremophila alpestris*)
house finch *(Carpodacus mexicanus)*
house wren *(Troglodytes aedon)*
lapland longspur *(Calcarius lapponicus)*

Table 7: Faunal Resources Expected to Occur within a Ten Mile Radius of 24JF4 from Early Historic Times to the Mid-Holocene (continued).

Birds (+ avian species expected to occur in the study area throughout the year)

Passeriformes (continued)

lark bunting *(Calamospiza melanocorys)*
lark sparrow *(Chondestes grammacus)*
least flycatcher *(Empidonax minimus)*
Lincoln's sparrow *(Melospiza lincolnii)*
loggerhead shrike *(Lanius ludovicianus)*
luzuli bunting *(Passerina amoena)*
Macgillivray's warbler *(Oporornis tolmiei)*
marsh wren *(Cistothorus palustris)*
McCown's longspur *(Calcarius McCownii)*
mountain bluebird *(Sialia currucoides)*
+mountain chickadee *(Parus gambeli)*
northern oriole *(Icterus galbula)*
northern rough-winged swallow *(Stelgidopteryx serripennis)*
northern shrike *(Lanius excubitor)*
northern waterthrush *(Seiurus noveboracensis)*
olive-sided flycatcher *(Conopus borealis)*
orange-crowned warbler *(Vermivora celata)*
ovenbird *(Seiurus aurocapillus)*
pine grosbeak *(Pinicola enucleator)*
pine siskin *(Carduelis pinus)*
pinyon jay *(Gymnorhinus cyanocephalus)*
+pygmy nuthatch *(Sitta pygmaea)*
+red-breasted nuthatch *(Sitta canadensis)*
red crossbill *Loxia curvirostra)*
red-eyed vireo *(Vireo olivaceus)*
red-winged blackbird *(Agelaius phoeniceus)*
rock wren *(Salpinctes obsoletus)*
ruby-crowned kinglet *(Regulus calendula)*
rufous-sided towhee *(Pipilo erythrophthalmus)*
sage thrasher *(Oreoscoptes montanus)*
savannah sparrow *(Passerculus sandwichensis)*
Say's phoebe *(Sayornis saya)*
snow bunting *(Plectrophenax nivalis)*
solitary vireo *(Vireo solitarius)*
song sparrow *(Melospiza melodia)*
+Steller's jay *(Cyanocitta stelleri)*
Swainson's thrush *(Catharus ustulatus)*
Tennessee warbler *(Vermivora peregrina)*
Townsend's solitaire *(Myadestes townsendi)*
Townsend's warbler *(Dendroica townsendi)*
tree swallow *(Tachycineta bicolor)*
veery *(Catharus fuscescens)*
vesper sparrow *(Pooecetes gramineus)*
violet-green swallow *(Tachycineta thalassina)*
warbling vireo *(Vireo gilvus)*
water pipit *(Anthus spinoletta)*
western bluebird *(Sialia mexicana)*
western (Cordilleran) flycatcher *(Empidonax difficilis)*
western kingbird *(Tyrannus verticalis)*
western meadowlark *(Sturnella neglecta)*
western tanager *(Piranga ludoviciana)*
western wood-pewee *(Contopus sordidulus)*
+white-breasted nuthatch *(Sitta carolinensis)*
white-crowned sparrow *(Zonotrichia leucophrys)*
white-throated sparrow *(Zonotrichia albicollis)*
white-throated swift *(Aeronautes saxatilis)*
willow flycatcher *(Empidonax traillii)*
Wilson's warbler *(Wilsonia pusilla)*
winter wren *(Troglodyte troglodytes)*
yellow-breasted chat *(Icteria virens)*
yellow-headed blackbird *(Xanthocephalus xanthocephalus)*
yellow warbler *(Dendroica petechia)*

Mammals

northern water shrew *(Sorex palustris)*
Gapper's red-backed vole *(Clethrionomys gapperi)*
mountain phenacomys *(Phenacomys intermedius)*
meadow vole *(Microtus pennsylvanicus)*
mountain vole *(Microtus montanus)*
long-tailed vole *(Microtus longicaudus)*
Richardson vole *(Microtus richardsoni)*
sagebrush vole *(Lagurus curtatus)*
deer mouse *(Peromyscus maniculatus)*
northern grasshopper mouse *(Onychomys leucogaster)*
house mouse *(Mus musculus)*
bushy-tailed wood rat *(Neotoma cinerea)*
pika *(Ochotona princeps)*
least chipmunk *(Eutamias minimus)*

Table 7: Faunal Resources Expected to Occur within a Ten Mile Radius of 24JF4 from Early Historic Times to the Mid-Holocene (continued).

Mammals (continued)

yellow-pine chipmunk *(Eutamias amoenus)*
red-tailed chipmunk *(Eutamias ruficaudus)*
red squirrel *(Tamiasciurus hudsonicus)*
northern flying squirrel *(Glaucomys sabrinus)*
golden-mantled squirrel *(Citellus lateralis)*
Richardson's ground squirrel *(Spermophilus richardsonii)*
northern pocket gopher *(Thomomys talpoides)*
black-tailed prairie dog *(Cynomys ludovicianus)*
yellow-bellied marmot *(Marmota flaviventris)*
Nuttall's cottontail *(Sylvilagus nuttallii)*
snowshoe hare *(Lepus americanus)*
white-tailed jackrabbit *(Lepus townsendii)*
muskrat *(Ondatra zibethicus)*
beaver *(Castor canadensis)*
porcupine *(Erethizon dorsatum)*
gray wolf *(Canis lupus)*
coyote *(Canis latrans)*
red fox *(Vulpes vulpes)*
black bear *(Ursus americanus)*
grizzly bear *(Ursus arctos horribilis)*
raccoon *(Procyon lotor)*
marten *(Martes americana)*
short-tailed weasel (ermine) *(Mustela erminea)*
mink *(Mustela vison)*
wolverine *(Gulo luscus)*
badger *(Taxidea taxus)*
striped skunk *(Mephitis mephitis)*
river otter *(Lutra canadensis)*
mountain lion *(Felis concolor)*
lynx *(Lynx canadensis)*
bobcat *(Lynx rufus)*
bighorn sheep *(Ovis canadensis)*
wapiti *(Cervus elaphus)*
mule deer *(Dama hemionus)*
white-tailed deer *(Dama virginianus)*
Shiras moose *(Alces shirasi)*
pronghorn *(Antilocapra americana)*
modern bison *(Bison bison)*

Reptiles

bull snake (Pituophis melanoleucus)
common garter snake (Thamnophis sirtalis)
gopher snake (Pituophis catenifer)
prairie rattlesnake (Crotalus viridis)
racer (Coluber constrictor)
rubber boa *(Charina bottae)*
western terrestrial garter snake (Thamnophis elegans)
painted turtle *(Chrysemys picta)*

Amphibians

long-toed salamander (Ambystoma macrodactylum)
boreal (western) toad (Bufo boreas)
northern leopard frog (Rana pipiens)
spotted frog (Rana pretiosa)

Fishes

Yellowstone cutthroat trout (Salmo clarki lewisi)
American grayling (Thymallus arcticus)
mountain whitefish (Prosopium williamsoni)
longnose sucker (Catostomus catostomus)

Invertebrates

Gastropods (snails)

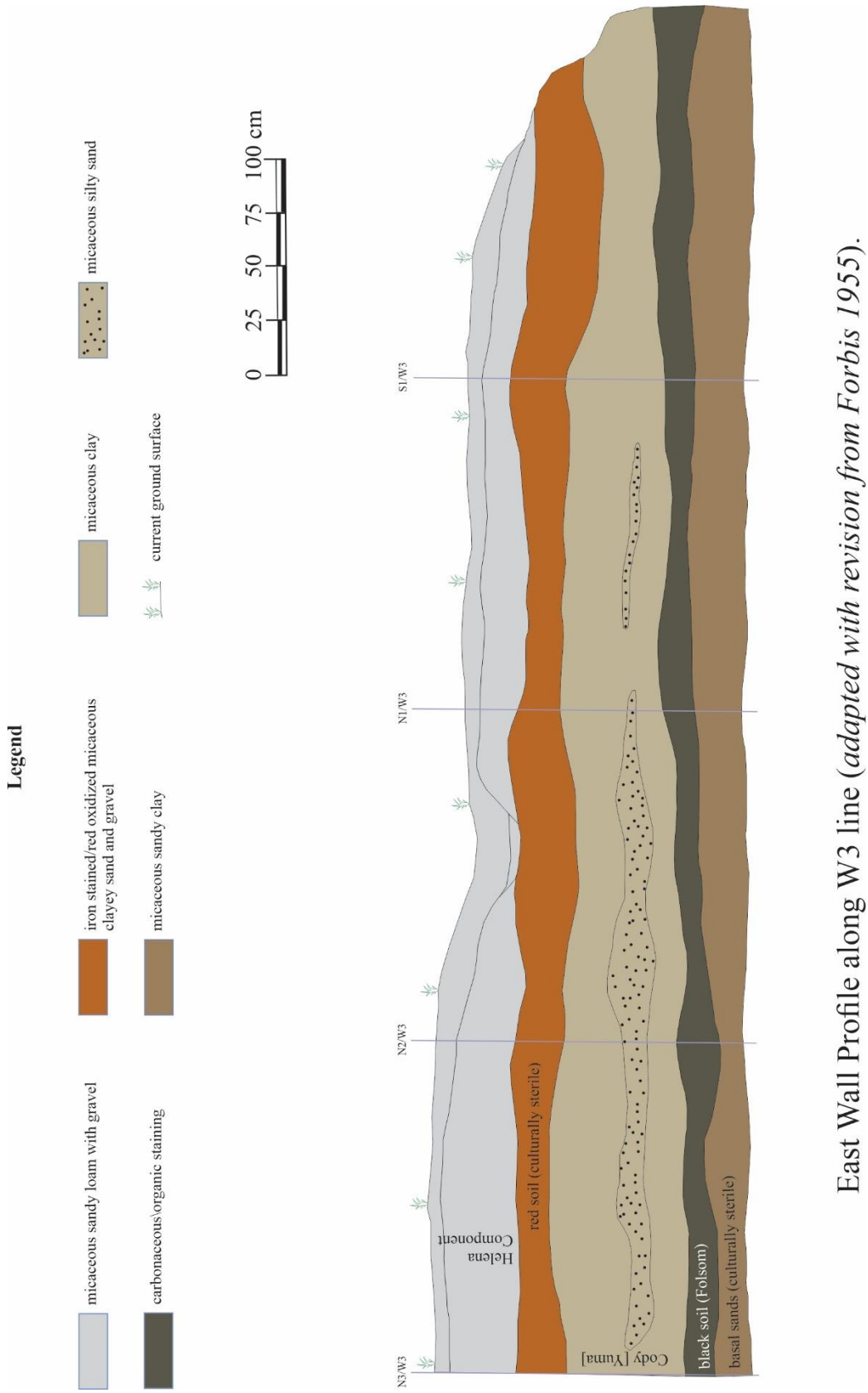
Although several snail species occur in the study area there is no evidence that snails were utilized by indigenous populations as a food source. Further, because of the fragile nature of local gastropod shell it is not suitable for tools or ornaments.

Bivalves (mussels and clams):

fat pea clam (Pisidium rotundatum)
Gould (Margaritifera falcata)
grooved fingernail clam (Spaerium simile)
Lilljeborg's pea clam (Pisidium lilljeborgi)
ridged-beak pea clam (Pisidium compressum)
shinny pea clam (Pisidium nitidum)
short-ended pea clam (Pisidium subtrumcatum)
striated fingernail clam (Spaerium striatinum)
ubiquitous pea clam (Pisidium casertanum)

Sources:

Burt and Grossenheider (1964); Clarke (1981); Gustafson (1996); Herbort (1987); Reichel and Flath (1995); Skaar (1996); Thompson (1982); Weisel (1957)



East Wall Profile along W3 line (*adapted with revision from Forbis 1955*).

Figure 12. East Wall Profile along W3 Line (*adapted with revision from Forbis 1955*).

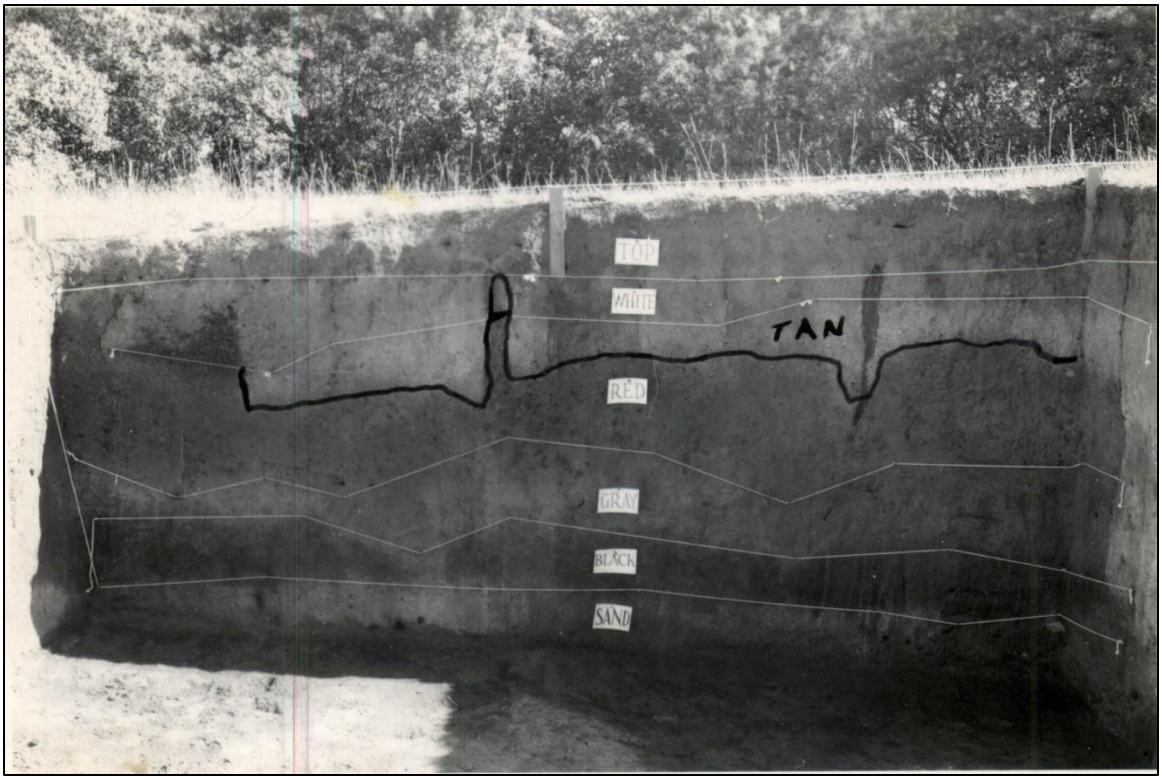


Figure 13. North Wall Profile of Excavation Units S1/E1 and S1/E2.

At varying depths of approximately three to four feet (90 to 120 cm) BS, Forbis identified a "black soil" he designated as sediment deposit II. The black soil is reported to be approximately six inches thick, although discontinuous. It contains the Folsom component and was dubbed by Forbis as Cultural Level I. It is described as "…silts mixed with subangular quartz particles up to 2 mm in length. Also, some pitted dioritic pebbles (up to about 10 cm in length) are found in this layer, as are a limited number of small chunks of hematite which may have been brought in by humans (Forbis 1955:41)". Hematite or red ochre occurs naturally, albeit infrequently, in the local sediments. Small pieces generally less than 1.5 cm in maximum dimension were recovered throughout the site at depths of 50 to 60 cm BS, 84 cm BS, 100 to 110 cm BS, 140 to 160 cm BS, and 180 to 200 cm BS. There is no evidence that the 17 pieces (32.25 grams) of recovered hematite were culturally transported or utilized though a few pieces of cultural material from the Folsom component were intentionally covered in red ochre. The ochre source may have been from small local pieces collected and pulverized. Other possibilities include cultural translocation from well documented exposures in the Crimson Bluffs west of Townsend (38.5 km southeast), or exposures at the south end of Bull Mountain near the confluence of the Boulder and Jefferson Rivers (70.4 km southwest).

The deeply buried black soil reported by Forbis was identified during subsequent excavations in MacHaffie as well, although elsewhere it is only 2.5 to 5 cm thick (Figures 14 through 20). As will be demonstrated later, the Folsom component is associated with this organically rich sediment. As a point of interest, early Paleo-Indian components, especially in the southwestern United States, frequently have an association with an organically rich sediment or "black mat" (Haynes and Huckell 2007). These soils presumably formed in wetland environments where surface and shallow ground water evaporation rates slowed and plant biomass increased during a time of climatic cooling and drying. When identified, these dark organic sediments can provide a visual marker of the Late Pleistocene-Early Holocene transition, although a 1:1 relationship is not implied (Dello-Russo et al. 2016).

Beneath the black soil at MacHaffie, extending to an unknown depth, Forbis described the culturally sterile bedrock sediments as "basal sands" or sediment deposit I:

> These crossbedded, dioritic sands are residual, disintegrational sands. Mixed with diorite pebbles and boulders, the basal sands are found throughout the vicinity of the MacHaffie site. The groundwater table, flowing through the basal sands, prevented excavation to solid bedrock. However, the fact that the sands became more highly consolidated from top to bottom suggested that bedrock is composed of the same material and that solid rock exists not far below the watertable (Forbis 1955:41).

Forbis summarized the origin of MacHaffie site sediments as:

> All of the sediments above the black are transported and appear to have originated in the same geological formation since they grade into each other and are conformable. M. R. Klepper, of the United States Geological Survey, after a brief inspection of the site, hazarded the opinion that the ungraded, sharp-edged material which characterizes the transported soil could hardly have been water-borne (Klepper to Forbis, pers. comm.). He felt that the similarities between the soil on the slope north of the site and the soil at the site itself indicated that the place of origin of the sediments at the site was the slope. The sediments reached the site by the mechanism of soil creep. Deposition of soil has been a factor of little consequence since the time when the Helena Component artifacts were laid down, for they are found on or near the surface. The creek to the north of the site may have cut its channel since then, thus preventing soil creep from the north slope (Forbis 1955:46).

In 1989, John Albanese inspected an approximately 2 meter wide x 2 meter deep x 13 meter long, northeast-trending excavation trench designated by Les Davis as Trench A or 1989 Trench. The trench lies near the center of the "island" within the narrow alluvial drainage (Figures 8, 9, 14 and 15). The main northwest-trending stream channel adjoins the trench at its southwest end. A minor tributary to the main channel lies just northeast of the trench. Two primary sedimentary units were exposed within the test trench: an upper 1.1 $\pm$ meter thick colluvial unit and a lower alluvial unit that extends at least 1.2 meters below the colluvial unit. Maximum depth of the alluvial unit was never reached during excavation, although all indications are that cultural materials do not extend more than 10 cm below the lowest A horizon (Folsom component). It is also apparent that the colluvial unit is heavily disturbed in the northeastern two-thirds of Trench A due to uncontrolled artifact hunting (see Figures 14 and 21).

Colluvial Unit

The colluvium is a massive, silty, clayey (5 to 10%), fine to medium-grained, micaceous

(1 to 3% muscovite and biotite flakes) sand with 5 to 40 percent randomly distributed coarse clasts co A-Horizon, an underlying, slightly calcareous Ck horizon (68± cm), and a lower 13± cm thick, calcareous Bk-horizon (Stage I development). All three horizons probably formed during the same episode of pedogenesis. Age of the colluvium is believed to be Middle to Late Precontact (mid to present-Holocene). A dramatic change in sedimentary regime occurred at approximately the Early/Middle-Precontact transition at MacHaffie. The stream could no longer transport its sediment load over the entire area of its former floodplain. Alluvial deposits were encroached upon and covered by colluvium. The advent of colluviation probably reflects increased aridity and consequent valley slope instability. This supposition is supported by weak calcareous soil horizons. Based on vertically continuous cultural materials through the soil profile, aridity was never sufficiently severe to preclude human occupation of the area for any appreciable length of time.

At least six stratigraphically arranged subdivisions of the colluvium were identified and mapped (Figure 9) although these do not reflect stability. The general lack of disconformities or erosional surfaces within the colluvium suggests that it accumulated slowly without any major episodes of erosional scouring. The archaeological evidence, however, suggests a great deal of bioturbation must have occurred throughout the slowly accumulating sediments. The base of the 1.1 meter thick colluvial unit appears to postdate ca. 7,900 BP and likely coincides with the early portion of the Altithermal. If that presumption is correct, an overall sediment accumulation rate of 13 ± cm per 1000 years is indicated. Radiocarbon dating of specific depths in the colluvium might provide a more accurate calculation if stratigraphically intact organic materials could be identified. As it stands, an inseparable mixture of Middle and possibly Late-Precontact cultural materials extend from ground surface to the alluvium boundary resulting from past vandalism, plant roots, insects, and small burrowing mammals (Figures 14 through 23).

Alluvial Unit

The basal 1.2 ± meter thick alluvial unit displays great complexity within the 13 meter long interval exposed in Trench A (Figure 12). As many as 18 stratigraphically arranged subdivisions of the colluvial unit were identified and mapped. The dominant structure is lenticular stratification characteristic of a shifting sedimentary regime. This type of bedding is typical of braided streams (Picard and High 1973:152). Individual sediment lenses range from 18 to 185 cm in length and 1.25 to 25 cm in thickness. Structure within individual lenses is usually massive, although some lenses contain thin (5 ± cm) bands composed of discontinuous laminae that are 2 ± mm thick. Cross-stratification bedding was not observed.

Small, upward convex bars (30 ± x 7.5 ± cm) and micro-channels (45 ± x 3 ± cm) are common features within the overall sequence. Most lenses are nearly horizontal in the southwestern portion of the trench, while northeast inclinations of 10 degrees are abundant in the northeastern portion. Small-scale, wave-like symmetrical undulations of superimposed layers

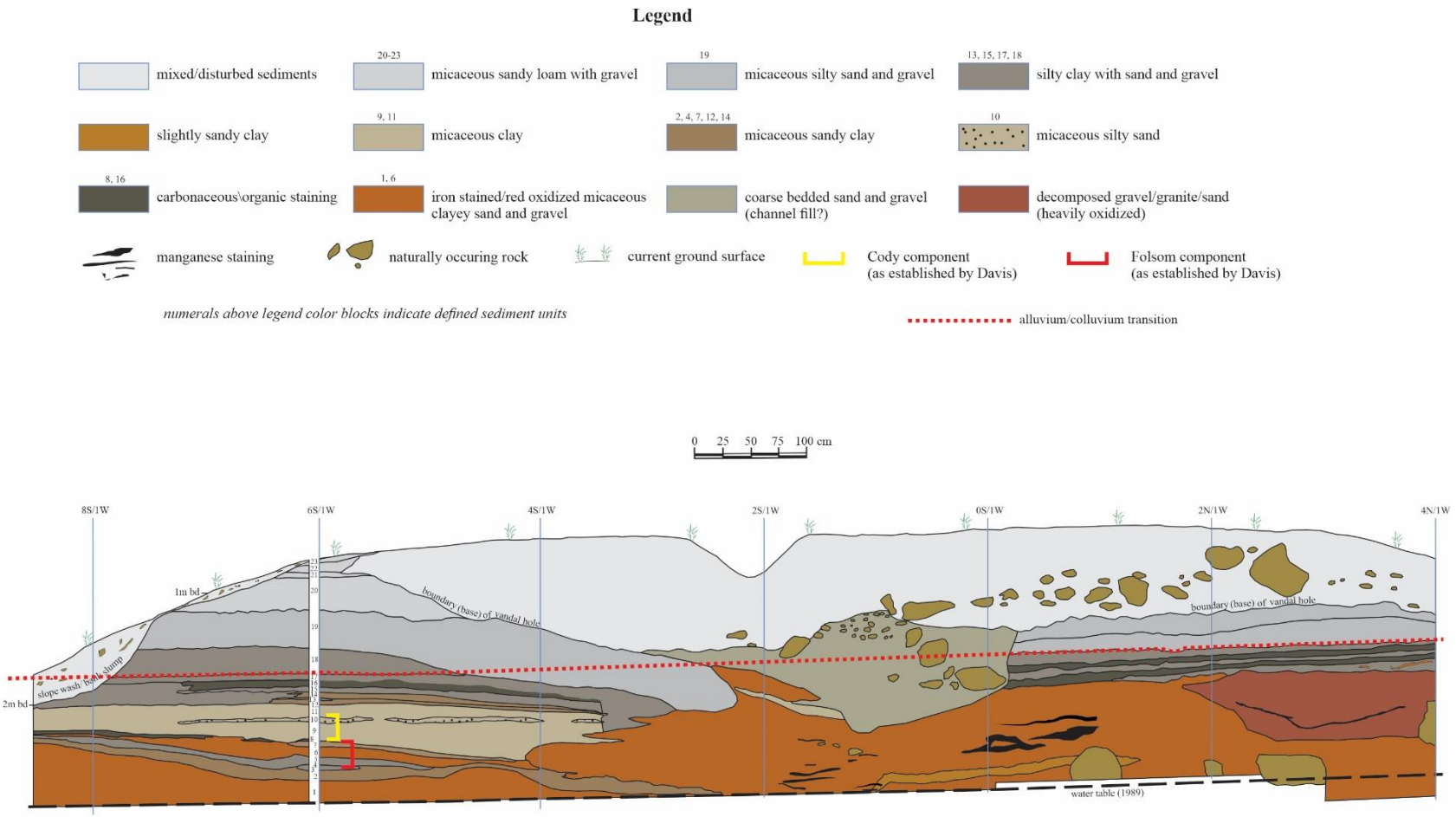


Figure 14. Trench A, West Wall Profile: 1989-1990 Excavation Work.

Trench A, West Wall Profile from Present Ground Surface to Base of Excavation: 0E-1W Line

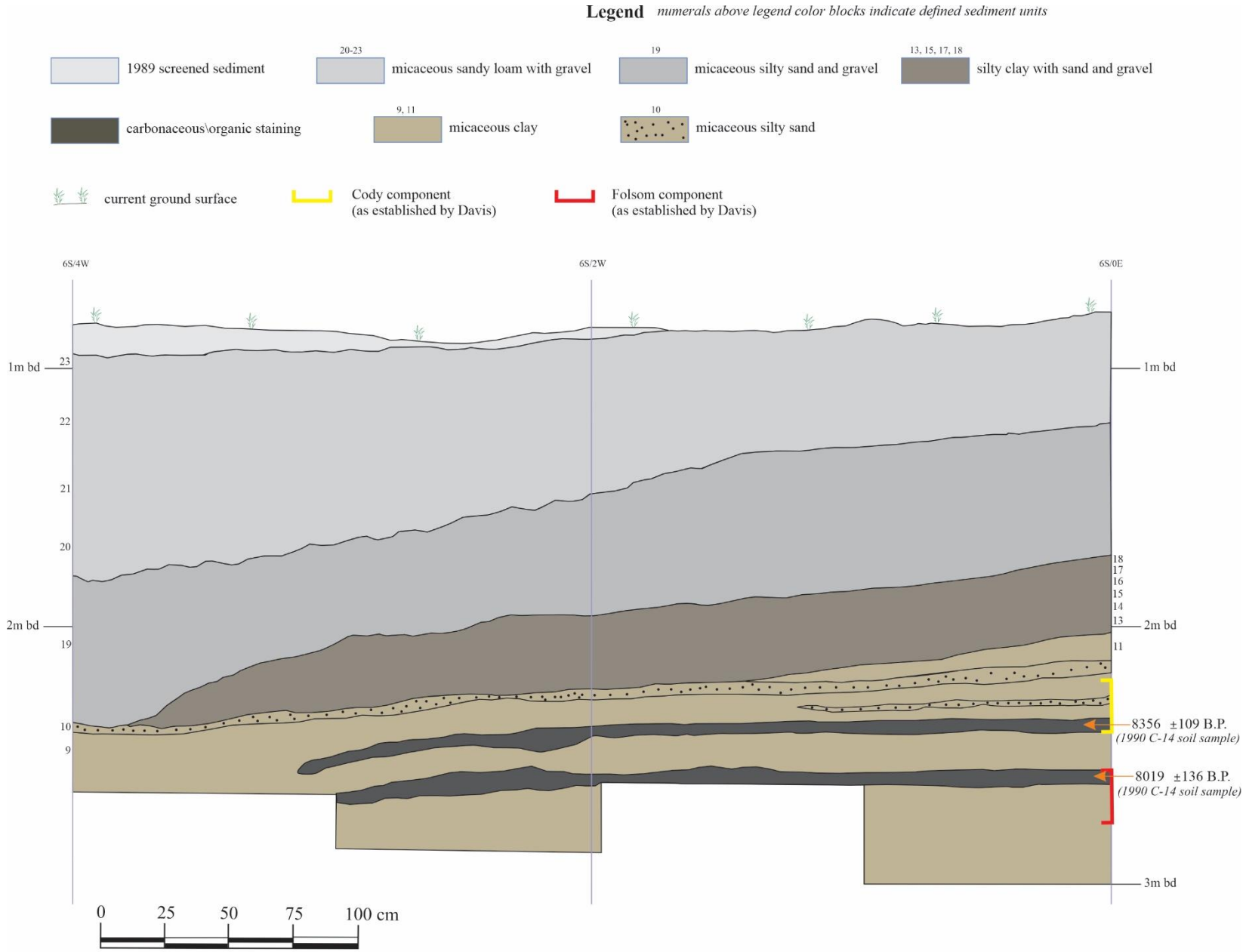


Figure 15. North Wall Profile, Units 6S/2W-6S/4W: 1990-1991 Excavation Work.

North Wall Profile from Present Ground Surface to Base of Excavation: 6S/2W through 6S/4W.

were observed in the central part of the Trench A profile. These small 8 ± by 8 ± cm symmetrical "waves" are probably a result of post-depositional soft sediment deformation.

The lithology of individual lenses varies considerably. Clay lenses, which vary in clay content from nearly pure clay to silty, sandy clay (50% clay content), comprise approximately one-third of the overall section. Clay lenses do not appear to be concentrated in any portion of the trench exposures. Sand is the predominant sediment. The predominant grain size within individual sand lenses varies from fine to medium, medium to very coarse, and granule to 1-cm-long clasts (pebble lenses). Again, significant clustering of certain sand-size lenses does not occur in any portion of the trench. The fluvial sediment contains varying amounts of both muscovite and biotite mica flakes. The mica is derived from the local granodiorite bedrock.

Pedogenic horizons are prominent within the alluvial unit. A succession of three soils comprised of A-C-horizons is present in the southwestern third of the trench. Individual A-horizons range from 5 to 15 cm in thickness. The basal A-horizon rises to the south (3º inclination) and, at the southwestern end of the trench, merges with an overlying A-horizon (see Figures 12 through 17). The uppermost soil has a composite A-horizon that is traceable throughout the site except where past vandalization has occurred. Two lower soils with A-horizons tend to be most visible nearer the south edge of the island with the lower dark soil being the most consistent. This lower A horizon tends to be associated with the Folsom component whereas the sediments an undetermined distance above the lower A-horizon contain Cody materials, but stratigraphic separation is not clean so there is some mixing of Folsom and Cody components. A lack of diagnostic artifacts and stratigraphic breaks among cultural material deposits disallowed documentation of precise component boundaries. Thus, the Cody component can currently only be said to lie within a 20 to 50 cm thick lens composed of very-fine to fine-grained, clayey (30%), silty sand that displays "vague" 5 ± cm-thick horizontal strata. This is a pedogenic C-horizon within which two A horizons are variously present.

The lower A horizons fade out and in some instances are eroded away, being replaced by sand and gravel deposits. This is most apparent as one proceeds north and northeasterly across the island (Figures 8, 12 through 19). In fact, the lower A-horizons are difficult to discern beyond excavation unit 4S/0E and may no longer exist in many locations due to erosion and sediment replacement by ancient stream flows.

Northeast of the 4S/0E unit, a gley soil horizon characterized by prominent iron oxide and manganese oxide staining and mottling is superimposed upon alluvium. Some of the manganese oxide staining is segregated within individual sediment lenses. The prominent mineral staining results from intermittent episodes of oxidation and reduction caused by a fluctuating water table (Birkeland 1984:147). The sediments exposed in excavation unit 4N/0E (Figures 14 and 18) show this effect, but sediments exposed in some units at the south side of the drainage appear similar to the soils mapped and described by Forbis (1955) in 1951 (Figure 19). The transition to gley soil development in the northeastern portion of the trench, plus the inclination of sediment lenses to the northeast, indicates that the locus of sediment deposition and ground water saturation of sediments lies to the northeast of Trench A. The A through C soil horizons formed on the southwestern margin of the ancient alluvial valley outside and above the area of continued ground water saturation. Alluvial sediment deposition was intermittent. At least three periods of nondeposition were sufficiently long to allow the development of A

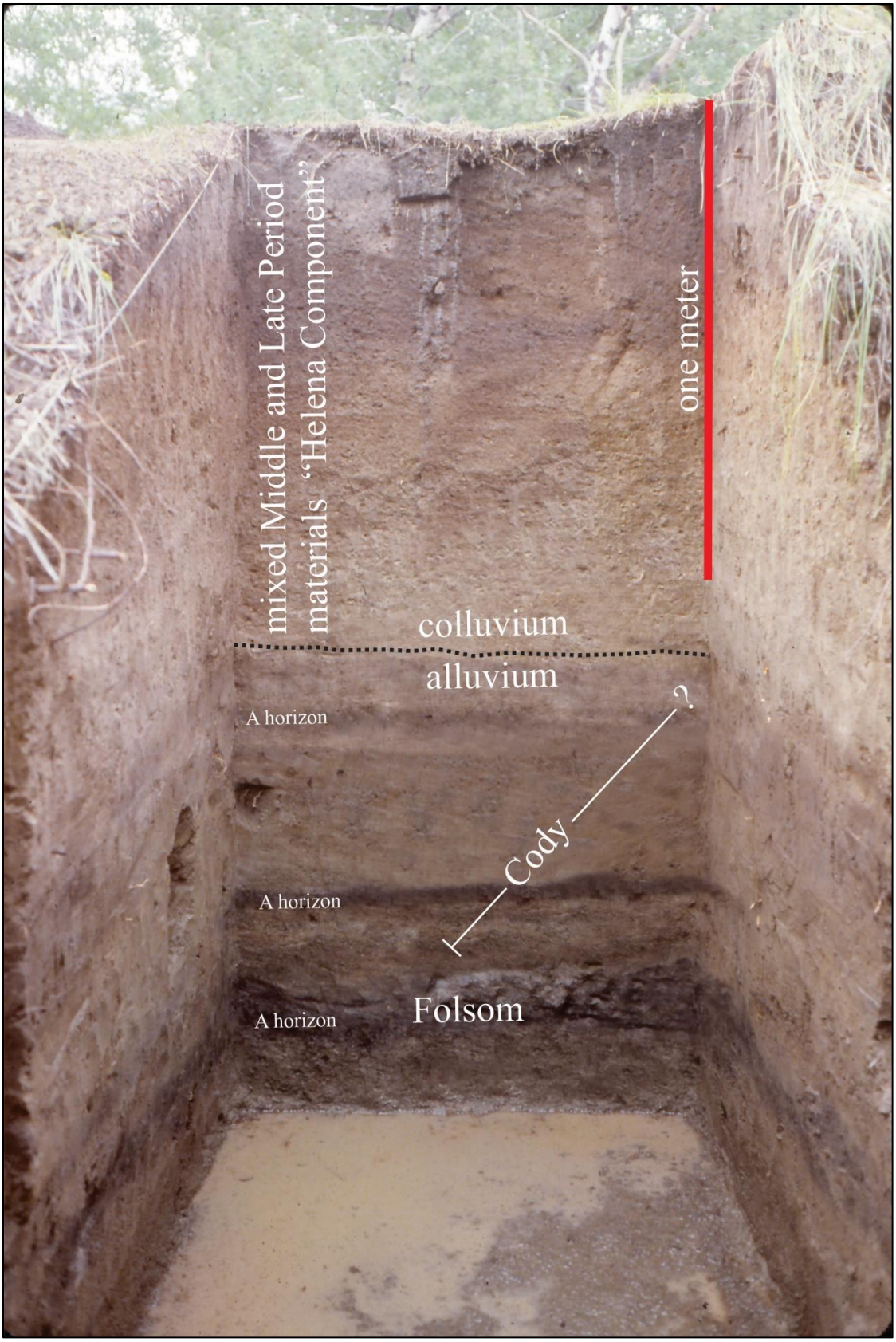
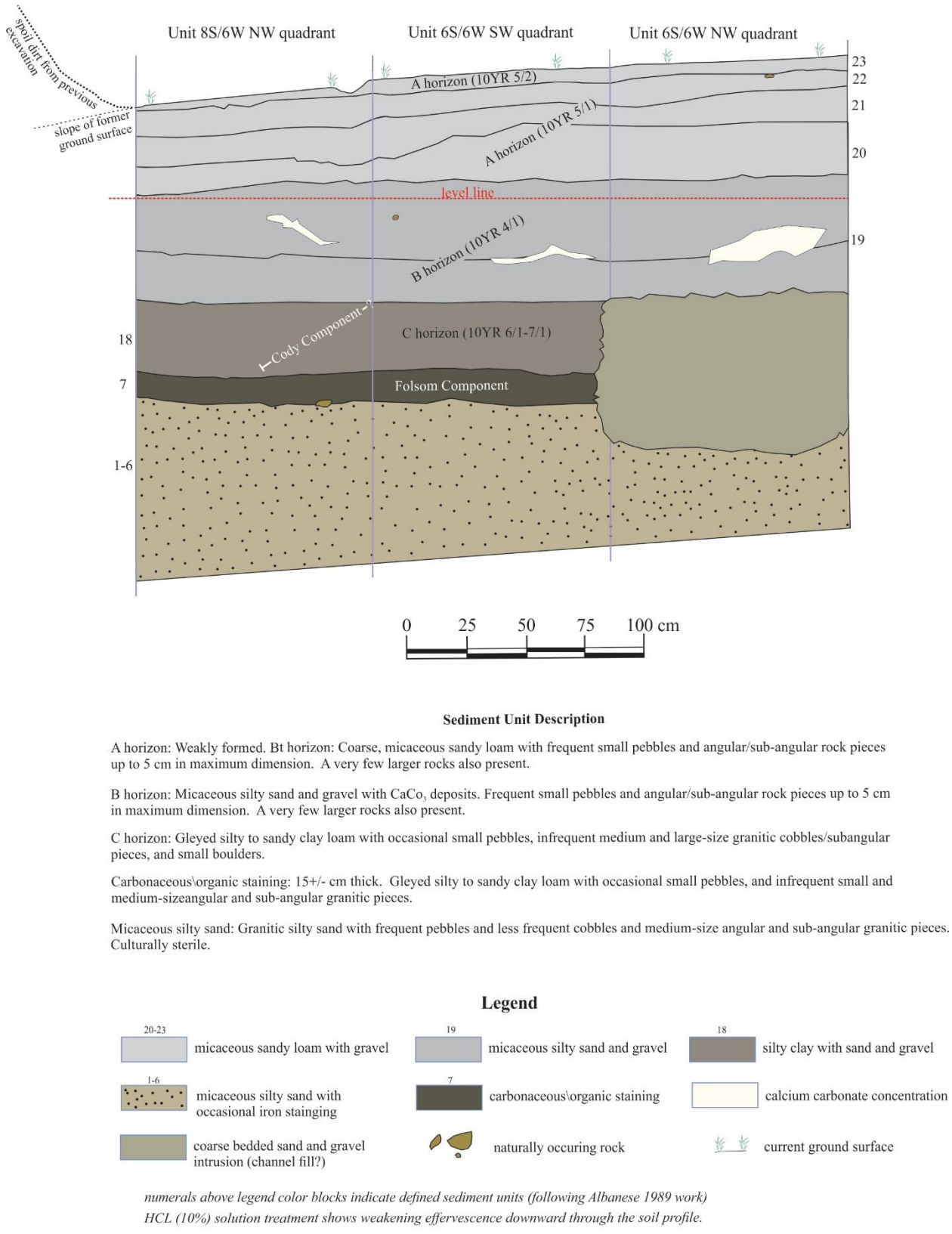


Figure 16. North Wall Profile, Unit 8S/1W: 1989 Excavation Work.



Sediment Unit Description

A horizon: Weakly formed. Bt horizon: Coarse, micaceous sandy loam with frequent small pebbles and angular/sub-angular rock pieces up to 5 cm in maximum dimension. A very few larger rocks also present.

B horizon: Micaceous silty sand and gravel with $CaCo_3$ deposits. Frequent small pebbles and angular/sub-angular rock pieces up to 5 cm in maximum dimension. A very few larger rocks also present.

C horizon: Gleyed silty to sandy clay loam with occasional small pebbles, infrequent medium and large-size granitic cobbles/subangular pieces, and small boulders.

Carbonaceous\organic staining: 15+/- cm thick. Gleyed silty to sandy clay loam with occasional small pebbles, and infrequent small and medium-sizeangular and sub-angular granitic pieces.

Micaceous silty sand: Granitic silty sand with frequent pebbles and less frequent cobbles and medium-size angular and sub-angular granitic pieces. Culturally sterile.

Legend

20-23 micaceous sandy loam with gravel

19 micaceous silty sand and gravel

18 silty clay with sand and gravel

1-6 micaceous silty sand with occasional iron stainging

7 carbonaceous\organic staining

calcium carbonate concentration

coarse bedded sand and gravel intrusion (channel fill?)

naturally occuring rock

current ground surface

numerals above legend color blocks indicate defined sediment units (following Albanese 1989 work)

HCL (10%) solution treatment shows weakening effervescence downward through the soil profile.

Figure 17. West Wall Profile, Units 6S/6W-8S/6W: 2017-2018 Excavation Work.

Figure 18. North Wall Profile, Unit 4N/0E.

Figure 19. East Wall Profile, Unit 2001-C.

horizons (Figures 9, 12 through 20). The ground water table was near the surface during most of early Holocene. All evidence indicates that the early Holocene was a time of general geomorphic stability. Sediment accumulated slowly (50 ± cm per 1,000 years) and intermittently under a low to moderate, braided-stream flow regime.

Again, it should be stressed that the southwesterly portion of the island appears to contain the most intact early Holocene deposits. Evidence for erosional scouring is seen in several of the excavation unit soil profiles (Figures 17 through 20). A 90 cm deep deposit of clustered alluvial cobbles and small boulders was exposed in Unit 6S/6W (Figures 17 and 20). The largest boulder is approximately 50 cm in maximum dimension and weighs an estimated 140 kg. Its top is at or slightly above the Cody component, while the base rocks of the deposit extend approximately 20 cm below the Folsom component. The A horizon associated with the Folsom component and the overlying sediment believed to contain Cody materials are abruptly truncated in the west wall profile of unit 6S/6W (NW quadrant) at the west margin of the alluvial cobble deposit. The sediments there are replaced with a coarse-bedded sand and gravel deposit. All indications are that a high-water flow event passed through this location around the time of the mid-early Holocene transition or at approximately the same time that alluvial sediment deposition was ceasing and being replaced with colluvium. It is hard to imagine what kind of event would be forceful enough to transport cobbles and boulders weighing more than 100 kg, where such a water flow came from, or how the water flow was concentrated at the outside margin of the resulting rock dam. The water flow was sufficiently erosive to head cut at the downstream side of the rock deposit and then redeposit sand and gravel in place of the fine alluvial sandy clay loam. These events undoubtedly removed and redeposited some Folsom and Cody cultural materials downstream of where they were originally abandoned.

Fieldnotes taken by the 1951 crew members mention fecal matter in various shapes and concentrations throughout the soil profile, especially above the Folsom level. The myriad descriptions suggest coprolites of several different mammals, possibly including humans, was represented. As excavations progressed, Forbis reconsidered the initial observations and stated that much of the "feces" was either small clay balls formed from screening damp clay sediment or associated with plant roots (UMMC 2020). One vial among the MacHaffie artifacts is labeled as "feces", but it contains small balls of clay-rich sediment. No other samples of possible fecal matter were collected by the 1951 crew, which is surprising because of the frequent incongruous statements and various monikers decorating the fieldnotes. In partial defense of Forbis, one of his photos (Figure 22) shows rabbit feces contained within a collapsed or infilled burrow, so at least some of the "barnyardy" observations were correct. None-the-less, no dung was identified during the 1989 through 2018 excavations.

The 1951 fieldnotes (UMMC 2020) reference the presence of charcoal; more specifically "charcoal cores". These cores measured "1/16 inch to 1/4 inch" in diameter and were randomly distributed throughout the upper portion of the soil profile, but not concentrated. Because none of the 1951 charcoal samples were retained and because only very infrequent charcoal flecks were occasionally exposed during the 1989-2018 investigations, what was likely described in 1951 was small diameter roots and root hairs. These were also observed with moderate frequency during the 2017 and 2018 work. They were generally very dark brown to black in color. At first glance they give the appearance of having been burned. Upon close inspection, however, some showed signs of decay while others appeared healthy, but none was burned.

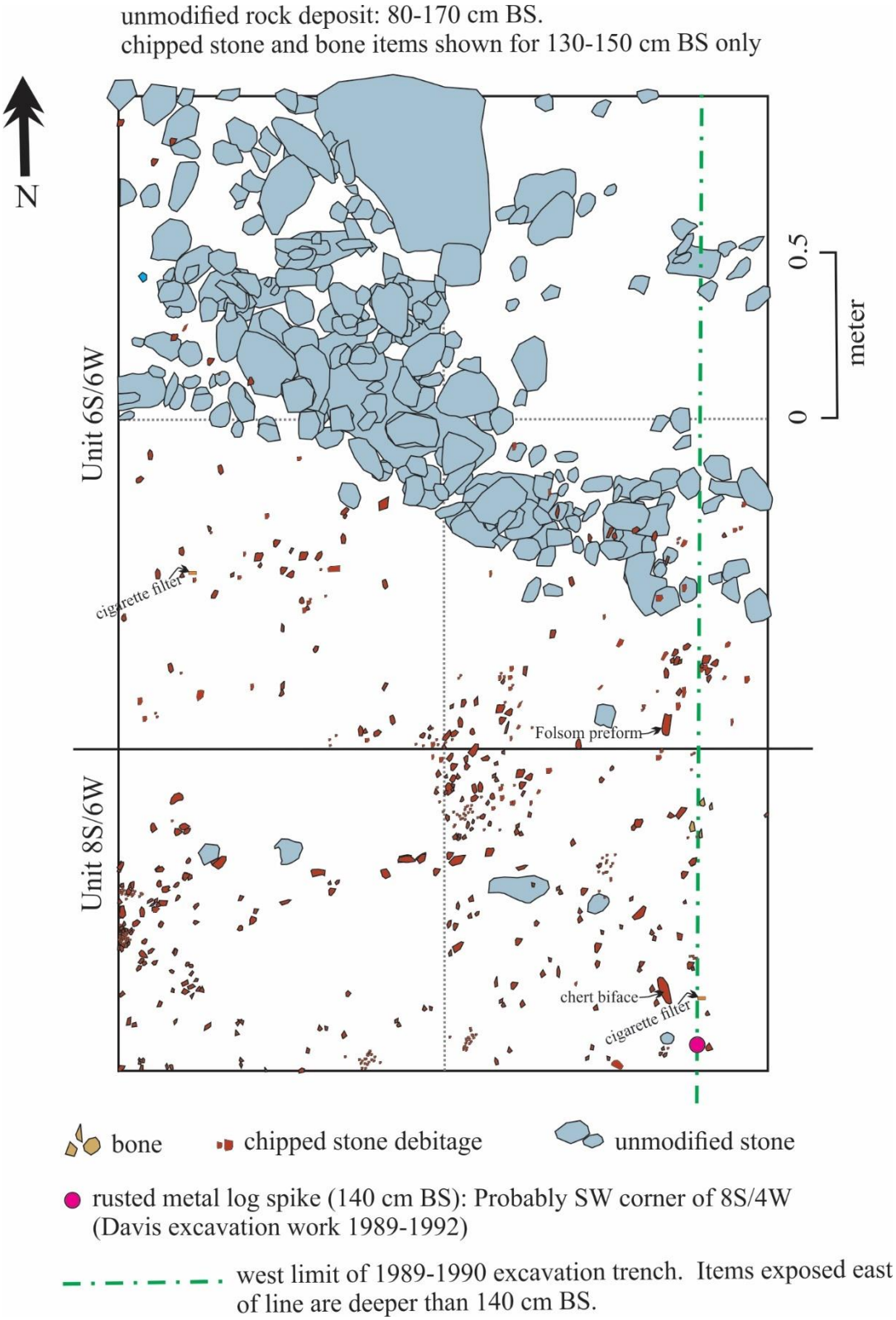


Figure 20. Plan Map of Units 6S/6W-8S/6W Showing Alluvial Rock Deposit and Folsom Component Materials.

Figure 21. Example of Vandal's Pit Exposed in Profile (arrows denote perimeter).

Figure 22. Cluster of Rabbit Feces Probably inside a Collapsed Burrow in "Red Soil".

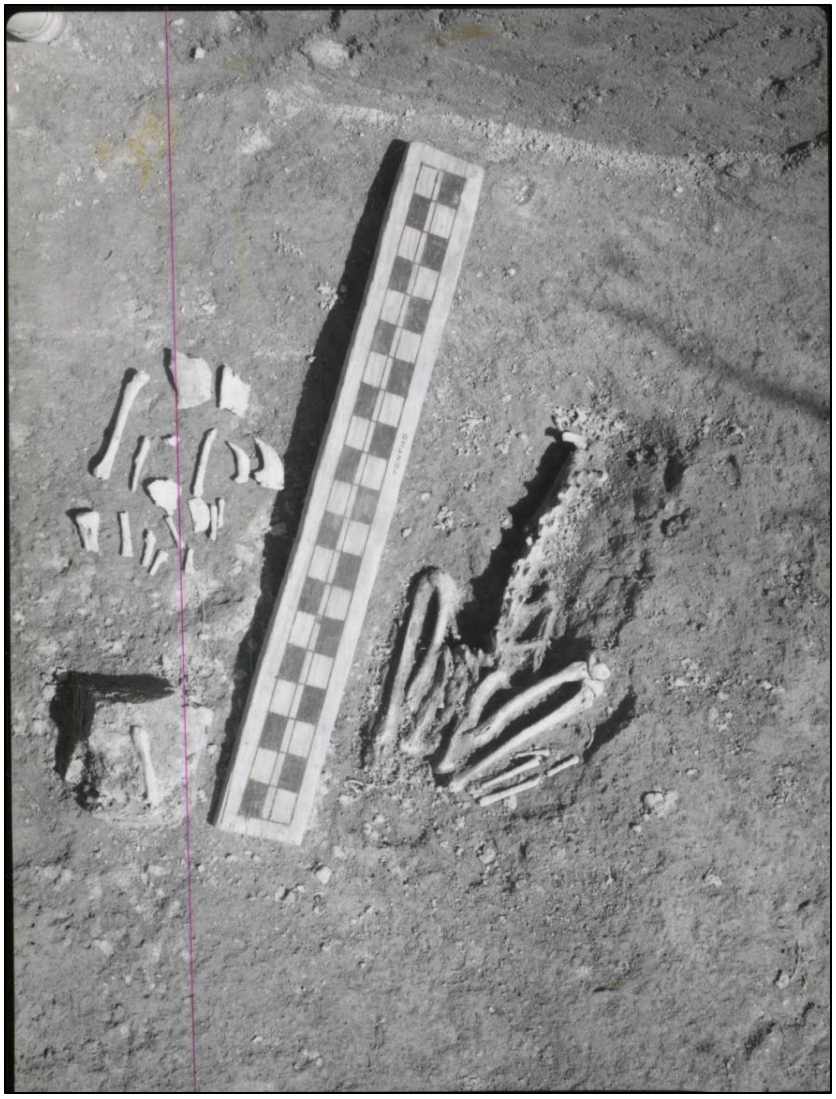


Figure 23. Rabbit Skeleton probably inside a Collapsed Burrow in the Cody Level of N1/W1.

While intact cultural deposits exist at various locations in the alluvium, natural and cultural disturbances have removed, redeposited, and intermixed some Cody and Folsom materials in other locales. Those latter instances are not easily identifiable through excavation. Although we have attempted to segregate artifacts of Folsom and Cody components, some mixing has occurred. In contrast, there is no evidence that any of the Helena Component materials retain contextual integrity. As a final thought on the lower three A horizons, their depths tend to increase below the present ground surface as one moves north and east across the island. This is important for attempting to reconcile the shallower depth of the Cody and Folsom materials as documented by Forbis (1955) in 1951 with those materials recovered from 1989 to 2018. Three possible distinct cultural levels were observed within the alluvial unit in the southwestern reach of the trench. As seen in Figures 12 and 16, the Folsom component lies some 170 to 180 cm below the present ground surface (BS). In Figure 17 the Folsom component

varies from 135 to 160 cm BS with depth increasing from south to north in Units 6S/6W through 8S/6W. One meter southwest of the units profiled in Figure 17, Forbis found the Folsom component to be approximately 90 to 130 cm BS (Figure 11). Similar changes in depth also occur across the island for Cody materials. Forbis documented the Cody component depth from 58 to 90 cm BS in his 1951 excavation block. The 1989 to 2018 work occurred north and east of Forbis' excavation block and identified the Cody component as ranging from presumably 110 to 160 cm BS. However, no diagnostic artifacts were recovered from the Cody component during the 1989 to 2018 excavations to positively place its vertical boundaries.

Les Davis loosely plotted four cultural strata for the Folsom and Cody components in the MacHaffie site. It is not clear how or why these were established, but the Folsom levels (Strata I and II) occur from 200 to 180 cm and from 180 to 170 cm BS respectively while the Cody levels (Strata III and IV) occur at approximately 170 to 150 cm and 150 to 130 cm BS. Our assumption of how the strata were defined is based on vague notes and various illustrations. Further, Davis' cultural strata may be restricted to excavation units 6S/1W through 6S/4W and 8S/1W through 8S/4W. We could see no physical separation of cultural components. While Folsom materials are persistent within the black organic sediment, there is no defensible demarcation between the Cody and Folsom boundary. At least a minor amount of mixing of these components has undoubtedly occurred.

Both MacHaffie and Indian Creek may share a similar alluvial record, with the caveat that the sites lie on different-size drainages and are in different size drainage basins. At a scale of 1:62,500, the stream at MacHaffie is of first order, while Indian Creek is a fourth-order stream. The basal alluvial sequence at the MacHaffie site correlates chronologically with Unit B at the Indian Creek site (Davis and Root n.d.). Sequences at both sites resemble each other with respect to lithology (abundant clays), sedimentary structure (thin lenses), and pedogenic features (prominent iron and manganese oxide mottling). These similarities indicate that moist conditions and similar stream flow regimes existed at both sites prior to 8,000 BP. The abrupt change at the MacHaffie site from alluvial to colluvial deposition occurs sometime after the last Cody people occupied it. The alluvial-colluvial contact at MacHaffie may correlate with the contact between Units B and C at Indian Creek. This correlative sedimentary break at both sites probably reflects the change from early to middle Holocene climatic regimes.

A conspicuous disconformity separates Units B and C at Indian Creek (Davis and Root n.d.). It is marked by a visible break in amount and type of pedogenesis and type of sedimentation. Alluvial fan deposits within Unit C, and their absence in Unit B, suggests that the climate became warmer and dryer during the time of Unit B deposition, with resultant slope instability. That condition favored alluvial fan development and their contained debris flow-deposits (debris-flow deposits are a common feature within Unit C). Sedimentary and pedogenic regime changes between Units B and C occurred ca. 8,400 BP. That sedimentary break coincides with the 8,000 BP date proposed by Fredlund and Bozarth (1987) for the timing of an abrupt transition from subalpine coniferous forest to a sagebrush steppe in the Indian Creek area. The return to a modern type mixed coniferous forest and sagebrush steppe, which started ca. 4,000 BP (Fredlund and Bozarth 1987), is not as apparent from the stratigraphic record. The main evidence for this change in the sedimentary column is the presence of 1 ± meter thick sediment at the top of Unit C. This pedogenic marker indicates that the rapid sediment deposition characteristic of Unit C ceased and geomorphic conditions stabilized (Figure 24).

Six radiocarbon dates secured from cultural horizons within Unit B at Indian Creek range from 11,125 ±130 BP to approximately 9,200 BP. A date of 8,340 ±100 BP was recovered from a cultural horizon situated 10 cm above the top of Unit B (Davis and Greiser 1984). The 11,125 ±130 BP radiocarbon date secured from the Glacier Peak "G" ash in the lower third of Unit B also furnished a chronologic datum. Unit B is overlain by a 6.7 to 10 meter thick, complex sequence of alluvial fan and braided-stream sediments (Unit C). The Mazama ash occurs in the central portion of Unit C. Unit C lacks significant pedogenic development except for a 1 ± meter thick A horizon at its upper boundary. An additional six radiocarbon dates secured from cultural horizons within Unit C range from 8,340 ±390 B.P to 4,000 ±100 BP (Ottersberg 1987). Trying to correlate the Indian Creek sediments to MacHaffie is difficult because chronologic volcanic ash datums such as Glacier Peak and Mazama are not present in the MacHaffie site.

4.0 DATA RECOVERY METHODS AND DOCUMENTATION

Although limited and poorly documented excavation occurred at the MacHaffie site, investigation headed by Dick Forbis in 1951 is the first for which anything meaningful can be said (Figures 25 and 26). Enveloping the area where Wesley Bliss recovered one or two incomplete Cody points in 1947 (see Figure 8: units S1/W2 and S1/W3), Forbis established a grid system oriented to magnetic north and composed of a block of individual five-foot (1.52 meter) squares (Figure 8). At the south side of the drainage channel, two isolated excavation units (S6/W1 and N1/W11) of like dimension were laid out (Figure 8).

Three smaller units are drawn on a site plan map along the drainage bounding the island at its north side, but it is uncertain if these were excavated. No associated cultural materials are in the UM collection. The corners of each excavation unit were marked with wooden stakes. Units were numbered E1 *et seq.* and W1 *et seq.* along the main east-west line; and N1 *et seq.* and S1 *et seq.* along the main north-south line. The intersection of the main north-south line and the main east-west line was approximately 15.2 meters (50 feet) north of datum (Forbis n.d., 1955:49-59).

The 1951 datum, assigned an elevation value of zero feet, was established as highest elevation in relation to the excavation grid. Elevations below datum of the tops of all unit corner stakes were obtained with the use of a hand level and stadia rod. All measurements were in feet and tenths of feet. Excavation work, for the most part, consisted of shovel shaving 0.5 inch (1.27 cm) layers of sediment at a time. Forbis noted that "This procedure allowed the precise location of a majority of the Scottsbluff and Folsom artifacts. It also served to indicate, early in the course of excavation, the presence and location of a Folsom layer, the existence of which had not been suspected (Forbis 1955:52)". Each artifact of interest to Forbis and exposed *in situ* was plotted below datum and bagged according to vertical provenience. Most of the cultural material, however, was assigned proveniences difficult to understand. This required us to insert our own assumptions. Recognizing that the landform slopes downward from east to west, Forbis made the following adjustment:

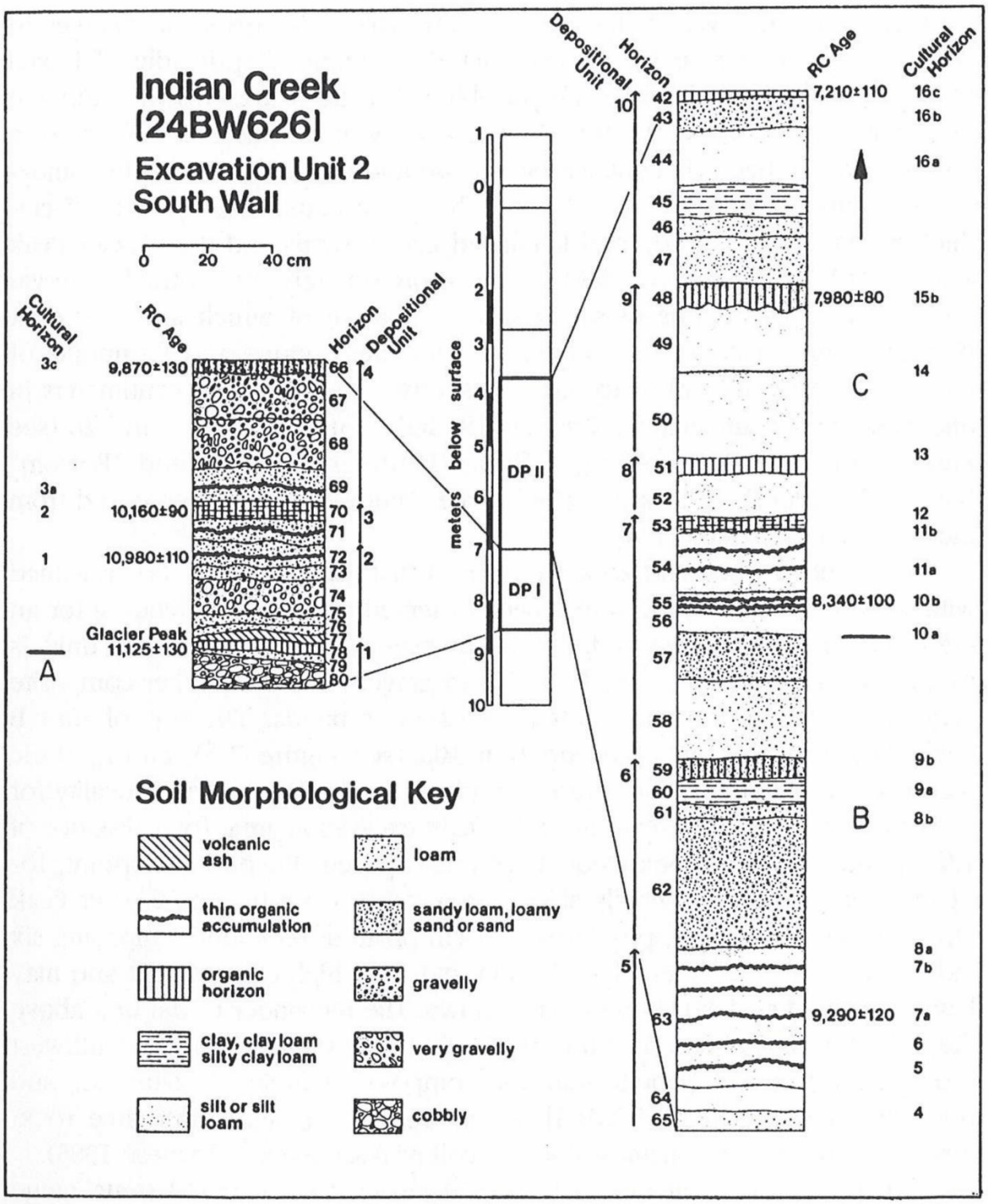


Figure 24. South Wall Profile, Excavation Unit 2. Indian Creek site (24BW626).

> Artifacts in the most westerly squares, therefore, are farther below datum, although not necessarily farther below the surface of the square in which they are found, than artifacts from near the north-south line…artifact depths were adjusted according to the distance they were from the W-3 line (Figure 3). For artifacts which originated west of it, a number was subtracted from the datum depth equal to the figure arrived at by calculating the mean depth of the surface of the square in which it was found from the mean depth of the surface at the W-3 line. (.25' for artifacts in W4 squares; .50' for W5; and 1.0' for W6.) For artifacts originating in squares east of the W-3 line, a similar calculation was made, but the figure arrived at was added to rather than subtracted from the datum depth of the artifact (.25' for artifacts from W3 squares; .25' for W2; .75' for W1.) (Forbis 1955:56-57).

So, subtracting artifact depth from the mean surface depth should provide the depth below ground surface measurement. In practive, unfortunately, this formula does not work. For example, a bag of debitage recovered from unit N1/W2 is labeled "1.5 feet deep, Level III". The northeast corner stake elevation is 1.85 feet below datum, and the mean ground surface is 2.1 feet below datum. Obviously, the provenience listed on the bag does not suggest the materials were collected 0.35 feet above the ground surface. We can oly conclude that depths written on artifact baggies are below surface measurements, not below datum or even below adjusted datum height measurements. This assumption is validated when comparing artifact bag labels with Forbis' artifact catalogue information (UMMC 2020). Adding to the frustration in deciphering artifact provenience is Forbis' contention that "Owing to the slope of the site, actual depths below datum are meaningless; and owing to variability in the thickness of the deposits, the depths of artifacts below the surface are equally uninformative (Forbis 1955: 61)".

Forbis' crew used six inch (15.2 cm) thick levels proceeding downward 0.5 inch (1.3 cm) at a time. Forbis also defined three cultural levels with Level I as the Folsom component, Level II being Cody deposits, and Level III being the so-called Helena Component. For purposes of this study, we have converted the standard measurements used by Forbis to metric and attempted to determine below ground surface measurements in order to correlate the later work of Davis (1989 to 2010) and Rennie (2017 to 2018). Even though confidence in the accuracy of these converted measurements is only moderate, the conversions are consistent.

Sediments excavated in 1951 were passed through wire mesh, presumably 0.25 inch (0.635 cm). Chipped stone debitage and bone was grossly bagged by unit and vertical layer. Sediment samples from some soil zones were reportedly collected, and unit profiles were drawn. On page 37A of Dick Forbis' fieldnotes, he cautions that John Sperry was incorrectly using the term "Folsom stratum" in early entries in his logbook to refer to the "Scottsbluff" [Cody] component (UMMC 2020).

Davis' excavation work (1989 through 2010) was located generally east of Forbis' excavation block, with a few units located to the north, west, and south (Figures 8, 27 and 28). A common datum was established and can be seen in Figure 8 as the ON/OE point. Unit size at ground surface varied from 1 to 2 meters square. Excavation levels also varied, ranging from 10 to 20 cm in thickness with a limited number exceeding 30 cm in thickness. Additionally, the sediments from some units were removed with a backhoe to the estimated depth of the Cody component without further examination. Hand troweling and shovel shaving are reported as the standards for sediment removal. Approximately 90 square meters of excavation has occurred at MacHaffie, which covers at least 65 percent of the site area.

Figure 25. Dick Forbis, Robert Fischer, and John Sperry Excavating at 24JF4 (1951).

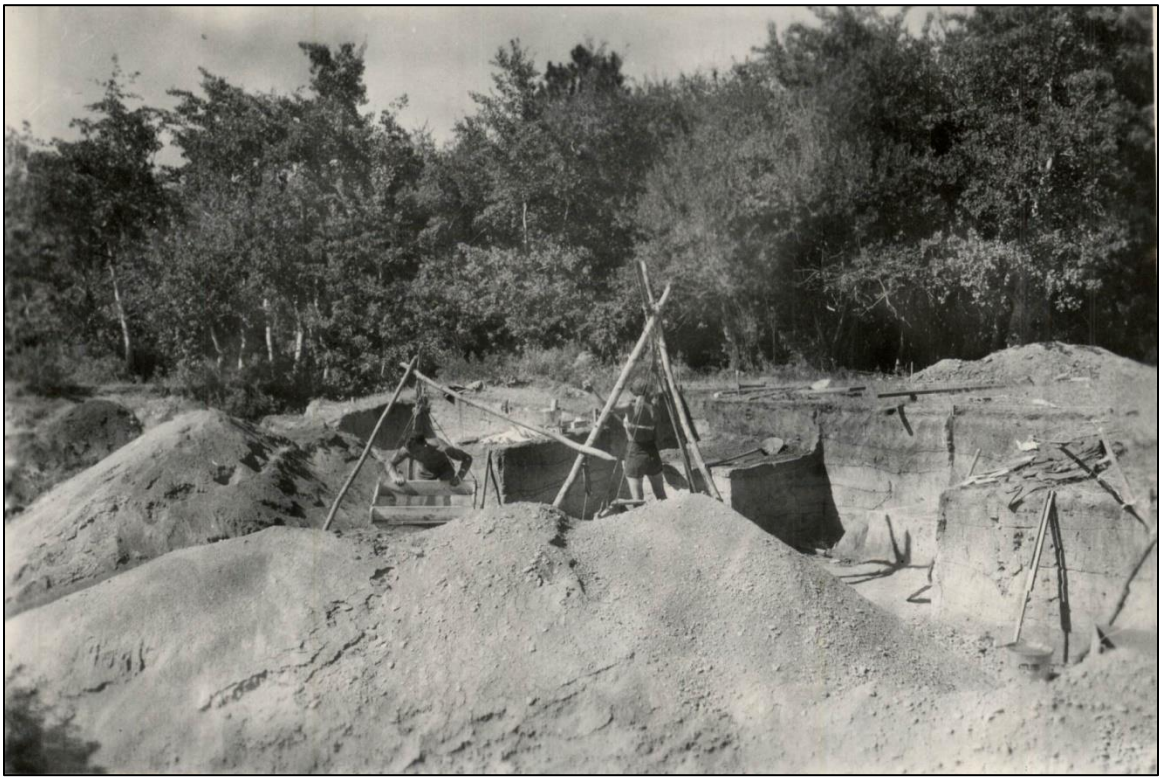


Figure 26. John and Dodie Sperry Excavating at 24JF4 (1951).

Although some units were tied to a common datum (0S/0E) distinct from that used by Forbis, others were randomly placed. Orientation of most of Davis' units appears to follow neither True nor Magnetic North. Inexplicably, some unit designations were changed over time. Level records and field notes as well as excavation unit plan maps from 1993 through 2010 are often minimal in content, incomplete, or non-existent. While level records and field notes reference unit depths below datum, the datum used was typically some corner or mid-point of an excavation unit giving a zero depth at present ground surface. Also, inexplicably, depths on artifact bags were almost always listed in below surface measurements (Davis n.d.). Some sediments were dry screened through 0.25 inch wire mesh. Some sediments were water screened through a combination of stacked 0.25 inch, 0.125 inch (0.318 cm), and window screen wire mesh. Sediment profiles were drawn in several locations, and John Albanese was on-site to document the geomorphology. When encountered, organically rich sediment samples were submitted for C-14 analysis. Additionally, sediment collected from a continuous column was submitted for palynological studies. The results of that study are in Section 2.4 of this report.

Prior to 2017 and 2018 excavation, a data recovery plan was submitted to the Montana State Historic Preservation Officer and the Archaeological Conservancy for review and comments (Appendix 1 of this report). The fieldwork focused on two areas (Figures 8, 29 and 30). One locale was an open trench (220 cm E/W x 4 m N/S) begun in 2010. Unit boundaries (4N/8E and 6N/8E) were re-established based on the 98A datum-- the only physical datum still present (Figure 8). Apparently, sediments were stripped off without examination to a depth of 170 cm BS, then the base of excavation was covered with plywood for future work. The intent of continuing excavation in this trench was to determine the maximum depth of cultural deposits at the east end of the island. Bedrock boulder deposits were exposed in the north end of the trench (6N/8E) beginning at a depth of 180 cm BS. The south end of the trench (4N/8E) contained limited amounts of bedrock but also contained a small amount of chipped stone and firecracked rock. That unit was excavated to a depth of 220 cm BS where numerous large granitic cobbles and small boulders were exposed. Cultural materials were not recovered deeper than 210 cm BS with the majority occurring at 170 to 190 cm BS.

The second locale investigated in 2017 and 2018 consists of two adjoining 2 meter square units designated 6S/6W and 8S/6W. They are situated between Davis' units designated 6S/4W and 8S/4W, and Forbis' 1951 excavation block. The purpose was to confirm if clear stratigraphic separation occurs in the upper 1 meter of sediment (see Forbis 1955), to better define the Cody and Folsom levels, and to connect the sediment units and cultural levels identified by Forbis with that identified later by Davis and Albanese. Placing the excavation units as close as possible to Forbis' 1951 block would hopefully provide the information needed.

Excavations in 2017 and 2018 were conducted in 10 cm thick levels using hand trowels. Depths were taken below ground surface in each unit. Excavated sediments were randomly dry screened through either 0.25 inch or 0.125 inch wire mesh. Cultural material was bagged in the field to provenience, then cleaned and separated for cataloguing. When possible, all cultural material and other items of interest were mapped in place before being removed.

Figure 27. Dick Forbis (L) and Les Davis (R) in Foreground during 1991 Excavations.

Figure 28. Sub-Folsom Level Excavations (1991). Folsom Paleosol visible in Profile.

All cultural materials have been catalogued in the Montana Department of Natural Resources and Conservation's Artifact Database designed in MicroSoft Access. The main database is composed of several discrete databases, each specific to a class of cultural material. As an example, bifaces are coded 1 to infinity by site number in the bifaces database and debitage is coded 1 to infinity by site number in the debitage database. Each artifact (groupings of similar pieces for debitage) is placed within a re-sealable baggie, and a card with salient catalogue information is included. All cultural material has been organized by cultural component and excavation unit and placed in labeled plastic storage bins. Associated inventory sheets are also included. All MacHaffie site cultural remains that we could locate have been organized, catalogued, boxed, and donated to the University of Montana Anthropological Curation Facility under Accession #2010.09.33. A summary of the excavation units applicable to MacHaffie and cultural resources recovered from each is found at Appendix 3 of Volume II, this report. Appendix 4 of Volume II provides an overview of cultural resource proveniences and the depth below ground surface of various cultural components as identified by past and present research.

5.0 DATA ORGANIZATION AND ANALYTICAL METHODS FOR THIS STUDY

5.1 Descriptive and Analytical Procedures

Analysis of most artifact collections present challenges to subsequent researchers as data recovered from MacHaffie exemplifies. Most of the cultural material collected in 1951 and 1989 through 2010 were not catalogued, many slides and photos are unlabeled, some field notes and level records are incomplete or non-existent, and some artifacts documented by Forbis (1955) and Knudson (1982) are missing. Multiple datums, proveniences, and grid designations have been used, and only the physical datum designated as 98A (see Figure 8) still exists. Depths below datum are found in field notes and level records, but generally not referenced on artifact bags. To consistently discuss cultural material proveniences throughout the site, all artifact depths from Forbis' 1951 work were converted by us to centimeters below present ground surface to allow for provenience comparisons.

Binford (1979, 1980), Binford and Binford (1966), and Kelly (1988) outline the concept of technological organization as a relationship among tools, planning of activities, and activity engagement. Activity planning is influenced by mobility, labor force, fixed and mobile resource targets, procurement time frames, season, terrain, and weather. We will attempt to look at technological organization of the various groups that visited MacHaffie based on defining characteristics and assess how evidence supports or refutes what is currently known.

Definitions of terms used to organize the culturally modified stone, as well as procedures used to visually organize selected data, are presented in detail in Baumler and Davis (2000), Brumley (1981), Kooyman (2000), Munson and Ferguson (1999), Rennie (2002), and Whittaker (1994). Cultural materials recovered and discussed herein are organized into several groupings for analytical purposes. The first grouping is referred to as Cultural Material Units (CMU). The

Figure 29. Excavations in 4N/8E and 6N/8E in 24JF4 (2017): Folsom Component.

Figure 30. Excavations Underway in Units 6S/6W and 8S/6W (2018). Surface of Boulder in Unit 6S/6W is Top of Alluvial Cobble Deposit: See Figure 20.

CMU designations for site 24JF4 are based on the year a cultural item was collected. Defined CMUs for the site are summarized in Table 8. In addition to CMUs, the recovered cultural items are grouped by artifact type, then by lithologic class. Numerous terms and artifact categories are utilized throughout. A glossary of many of these terms can be found in Appendix 5, Volume II of this report. These definitions explain how cultural materials were categorized for this study.

Table 8. Cultural Material Unit (CMU) Definitions Assigned to 24JF4.

CMU	Definition	Principal Investigator or Discoverer
1	Out-of-context items or pieces that otherwise lack vertical and horizontal provenience information.	Wesley Bliss, Pamela Bompart, John Byrd, Leslie Davis, Richard Forbis, Edmund MacHaffie, June MacHaffie, or Carling Malouf
2	Cultural remains recovered during 2017 and 2018 excavation work.	Patrick Rennie
3	Cultural remains recovered during 2001 and 2008 excavation work.	Leslie Davis
4	Cultural remains recovered during 2000 excavation work.	Leslie Davis
5	Cultural remains recovered during 1998 excavation work.	Leslie Davis
6	Cultural remains recovered during 1996 excavation work.	Leslie Davis
7	Cultural remains recovered during 1992 excavation work.	Leslie Davis
8	Cultural remains recovered during 1991 excavation work.	Leslie Davis
9	Cultural remains recovered during 1990 excavation work.	Leslie Davis
10	Cultural remains recovered during 1989 excavation work.	Leslie Davis
11	Cultural remains recovered during 1951 excavation work.	Richard Forbis

5.2 Faunal Analysis

The majority of the MacHaffie faunal material was analyzed by T. Weber Greiser (2022). It was identified to genus, species, element, and side, when sufficient diagnostic landmarks were present. All pieces were weighed and size-graded following the same procedures used in the lithic analysis discussed later. Bone condition, notable features, and evidence of butchering or other modifications were noted. All bone retained by Dick Forbis and reposited at the University of Montana, all bone recovered and retained by Les Davis, and all bone recovered during the 2017-2018 excavation work was analyzed and is reported for this study. Dr. Jack Fisher, Jr. analyzed selected bison and canid bones for Dr. Les Davis in 1991 and 2000 (Fisher 1991, 2000,

2018), some of which Davis submitted for radiocarbon dating. Fisher's data is incorporated in this analysis (Appendix 7).

To aid with species and skeletal element identification, curator Dr. Angela Hornsby facilitated access to the collection of contemporary comparative fauna housed at the Philip L. Wright Zoological Museum, Division of Biological Sciences, The University of Montana. In addition, various illustrated guides of animal crania and post-crania were consulted (Brown and Gustafson 1979; France 2009; Hoffman and Pattie 1968; Lawrence 1951; Olsen 1964). Also, Kerry Foresman's *Mammals of Montana* (Foresman 2012) was used to help identify contemporary mammals in the general area and their current names, genus, and species.

5.3 Lithic Analysis

Information recorded for the recovered chipped stone generally follows procedures established or refined by many researchers and currently accepted as useful (Rennie 2002). See Knell (2012) for a summary of lithic analytical approaches. Additionally, fracture patterns exhibited among the projectile points, bifaces, and endscrapers are described by type, evidence of heat-treating was noted, and attention is paid to the kinds of lithic reduction strategies reflected among the cores and lithic debitage in site 24JF4. Throughout this manuscript artifacts may be referenced by catalogue number or by the MANA designations (lithic raw material subdivision) they represent. We illustrate each projectile point and fragment by cultural component even if they are not culturally/temporally diagnostic. Projectile points are typed, and their condition and evidence of damage or modification is described. A series of metric observations were also taken on each projectile point. A diagram illustrating these measurement locales is found in Appendix 8 of Volume II.

Non-hafted bifaces and other formal tool types are described by reduction stage, shape and condition. Structural problems, knapping problems, and evidence of use/transport wear and intentional retouch are also noted. Cores are described as to type, shape and extent of utilization. When applicable, evidence of subsequent use of cores for purposes other than debitage generation is also noted. Additional information about the formal lithic artifacts might be obtained through microscopic/high-magnification use-wear study and serum analysis. To date a limited amount of immunological study has been conducted and only on an unknown number of Cody artifacts. Those items reportedly tested positive for deer and canid serums (Newman 2000 in Davis 2000).

All stone artifacts and debitage are segregated by defined lithic raw material groupings. These groupings are based, first, on lithologic class and, second, on perceived visual and textural differences. This approach is established elsewhere (see Ingbar et al. 1989; Kornfeld et al. 2010, Hall and Larson 2004) as Minimum Analytical Nodule Analysis (MANA). Once segregated, each distinct lithic material grouping was assigned an alpha-numeric code found in Rennie (2002). The alpha-numeric MANA codes that apply to MacHaffie site artifacts are defined in Appendix 6, Volume II of this report. The utility in subdividing lithics into MANA categories is to provide a meaningful way to identify tools and detritus likely produced from the same piece of stone. Those groupings also provide a meaningful means of discussing the kinds and varieties of lithic raw materials in an archaeological site. A weakness in applying the MANA approach is

that the larger the piece of lithic raw material is prior to reduction, the greater the possibility for variability in the color/texture range of the piece. This could result in multiple MANA designations being assigned to items generated from only one core. An additional issue is that small (size grades 3 and smaller), thin flakes of semi-translucent chert from the same core can be difficult to consistently assign to a MANA code.

Unmodified debitage and debitage with edge-flaking or other modification (DEF/M) are size-graded generally following methods established by Ahler (1989) and more recently discussed and applied by Baumler and Davis (2000:24). This study involved a series of five stacked screens of sequentially half-size smaller openings. The uppermost screen (SG1) consists of 1-inch-square wire mesh. The bottom screen (SG5) is composed of 0.0625 inch (window screen size) wire mesh. The utility of size grading is explained as, "Frequency and, in some cases, weight by size class provide a meaningful expression of the relative volume of the assemblage comprised by smaller and larger artifacts within as well as across the different raw material groups (Baumler and Davis 2000:24)." Benefits and weaknesses in a size-graded, aggregate approach are detailed elsewhere (e.g., Andrefsky 2001; Root 2004). Baumler and Davis (2004:57) discourage use of mass analysis when only 0.25 inch or larger screen is employed in artifact recovery because the sample will not adequately reflect the whole assemblage. Although we agree with the overall sentiment, size grading adds value to any collection because it shows the upper size range of pieces that could be expected in the early stages of core reduction and helps us understand the nature of the toolstone being reduced. We also see in the literature a general misunderstanding of debitage production whereby small-size pieces that lack cortex tend to be identified as tertiary flakes which is often synonymous with pressure flakes formed during final stages of tool production or resharpening. Contemporary flintknappers will confirm that very small debitage with diagnostic platforms is a common, often unintentional by-product of percussion knapping (see also Root 2004; Tuohy 1987) at all stages of tool production or refinement. Additionally, frequently during percussion knapping the hammer or bopper will be set aside and pressure flakes will be removed to isolate or better set a platform. Then percussion work resumes. These are true pressure flakes and could be classified as "tertiary". However, they are not related to late stage tool production or refinement. Unless the debitage is dominated (we suggest 75% or greater) by size grades 3 and 4 pieces, we are unwilling to talk confidently about late stage pressure flaking evidence for most assemblages.

Flakes were separated from shatter and distinguished based on their condition using terms (*complete*, *broken*, and *flake fragment*) established by Sullivan and Rozen (1985). Following Sullivan and Rozen (1985:759), the term debitage includes diagnostic flakes that exhibit analytically intact margins and largely intact platforms (complete flakes); flakes that retain their platforms or proximal edges but otherwise appear to be incomplete (broken flakes); flakes that lack proximal portions and sometimes extreme distal edges (flake fragments); and shatter. Shatter includes both angular pieces that lack intentional flake production characteristics and thin, flake-like pieces that cannot be easily oriented to distal or proximal ends, interior or exterior surfaces. Sullivan and Rozen (1985) use the term "debris", but we use "shatter" to avoid confusion when discussing "chipped stone debris" meaning debitage. Much of the larger size-grade shatter tends to be angular, whereas most of the mid and late stage shatter is thin and flake-like. Detailed summaries of the utility and shortcomings of the Sullivan and Rozen typology are presented and summarized elsewhere (e.g., Andrefsky 2001; Baumler and Davis 2000:24-25; Prentiss 1998; and Roll 2003).

Flakes and shatter were further sub-divided by reduction stage based on extent of cortex and number and orientation of flake scars on the exterior surface of a piece. Following Knell (2012), percent of dorsal cortex is coded as 0 if cortex is absent, 1 if cortex covers 1% to 49% of the surface, 2 if cortex covers 50% to 99% of the surface, and 3 if there is 100% surface coverage. This attribute helps to substantiate interpretations of on-site vs. off-site lithic reduction. It also is a guide to assigning flake reduction stage (primary, secondary, and tertiary).

Next, the kind of platform exhibited on broken and complete flakes is noted, as is general flake shape and manner of flake termination. Platforms are categorized by type to help distinguish middle and late stage biface manufacture from unprepared flake core reduction. Flake thickness and bulb of percussion thickness are noted to try to distinguish hard hammer from soft hammer percussion evidence. Flake terminations that form sharp thin edges are referred to as feathered. Hinge terminations show a rounded and outward tilting end. Step terminations generally have rounded edges at the exterior flake surface and a 90-degree edge at the interior side thus distinguishing these pieces from broken flakes that generally lack the rounded terminal edge. These attributes help distinguish core types and reduction stages represented, a knapper's skill, material problems, the amount of force applied, and type of material used in flake removal (Knell 2012; Kooyman 2000). Combining debitage attributes with attributes coded for other tools and cores of the same MANA code sets the stage for analysis of individual MANs.

Primary flakes are produced during decortication of the raw piece of toolstone. They typically exhibit 50% to 100% cortex coverage on the exterior (dorsal) surface. They also typically exhibit either point or flat platforms. Secondary flakes are pieces removed following decortication of a parent piece and reflect initial edging through mid-reduction stages of biface and core production. Secondary flakes generally exhibit less than 100% cortex coverage, generally exhibit at least one exterior surface flake scar, and can exhibit point, flat, or faceted platforms. Tertiary flakes are pieces representing the final refinement stages in biface production or tool rejuvenation. They can be produced through both percussion and pressure. Tertiary flakes generally have no cortex and can exhibit several exterior surface flakes scars.

Our analysis of chipped stone debitage is largely based on experimental data. It is intended to provide multiple lines of evidence for reaching conclusions regarding the human behavior that selected and produced the chipped stone items at MacHaffie. The approach is a combination of mass analysis, item completeness, and minimum analytical nodule analysis (MANA) but tends to under-utilize a refitting strategy. Although refitting is likely the most informative and least subjective of the various debitage analytical techniques, it is also the most time consumptive. Refitting of MacHaffie debitage, for the most part, is restricted to the efforts of Ruthann Knudson (1982).

Documented attributes of pieces defined here as DEF/M largely duplicate those for debitage but include the number of modified edges each piece exhibits, and location and type of modification. Suggestions for what activities formed the DEF/M follow results of experiments carried out and reported by McBrearty et al. (1998); Odell and Odell-Vereeken (1980:99); and Tringham et al. (1974:188-189).

Firecracked rock (FCR) of similar rock type, size and fracture type from the same excavated depth and excavation unit were counted, weighed collectively, and generally discarded. A small sample was retained for future study including serum analysis. If both water fracture and heat spalled characteristics (Rennie 2001) are present, that specimen was coded as water fractured only. The smallest size-range grouping for FCR is 0-5 cm in maximum dimension, the next smallest is 5-10 cm, and the largest grouping is 10-15 cm. No piece of FCR exceeded 15 cm.

6.0 THE FOLSOM ARCHAEOLOGICAL CULTURE

Projectile points constitute one of the few artifact classes that are time markers in North American precontact archaeology. Periodically one or more style of projectile point was adopted and the precursors were abandoned at roughly the same time over wide geographic expanses (Brumley and Rennie 1993; Frison 1991; Peck 2011; Reeves 1983). The impetus for these changes is not satisfactorily explained. The oldest currently recognized archaeological culture represented at the MacHaffie site is Folsom. Depth of the component below present ground surface was most shallow at the west end of the island (approximately 90 to 135 cm BS) and deepest at the east margin (approximately 170 to 200 cm BS). The term "Folsom", like most archaeologically defined pre-contact cultures, is based on a distinctive style of projectile point that appears to have reasonably discrete temporal and geographic distribution—but the latter parameter tends to be more subjective. Folsom projectile points first appear in North America ca. 10,900 BP and largely disappear by 10,150 BP (Amick 1999, Frison 1991, Hofman 1998, Peck 2011). As can be seen with Figure 31, Folsom dates cluster around the 10,500 BP threshold but some dates, especially those from MacHaffie and Rattlesnake Pass in Wyoming, may suggest continuation of the Folsom Archaeological Culture much later than generally accepted. In fact, the sampling of sites and dates used for this study suggest an average expected Folsom date of 10,247 BP.

Those making and using Folsom projectile points succeed people who used a Clovis technology, but the temporal separation is too fine to distinguish through radiometric assay. We do not know if an overlap between Clovis and Folsom exists, or if Clovis gives way to Folsom in one fell swoop (Collins 1999:12). Most would agree that Folsom likely developed from people using the earlier Clovis technology. Another projectile point style known as Agate Basin (Frison and Stanford 1982) appears to be a contemporary of Folsom and dates from ca.10,550 to 9,350 BP (Frison 1991:59). Its slender lanceolate form with a typically narrowed and squared or rounded base distinguish these from Folsom. Both Agate Basin and Folsom points tend to exhibit collateral flaking. Shelley and Agogino (1983: 115) suggest that approximately six percent of Agate Basin points exhibit a short medial flute implying that they should be considered part of the fluted point tradition. We see these "flutes" as incidental. They likely formed during basal thinning efforts of the preform but were not intentional fluting efforts. Like Folsom, Agate Basin is found throughout the Great Plains but extends east as far as Ohio. Unlike the accepted archaeological perception of Folsom, the recognition of this point style outside of the Plains bears no focus on the associated subsistence economy of the people making and using these points. The relationship between Folsom and Agate Basin (including the Hell Gap variant) will continue to be debated. We see the two cultural complexes as temporally

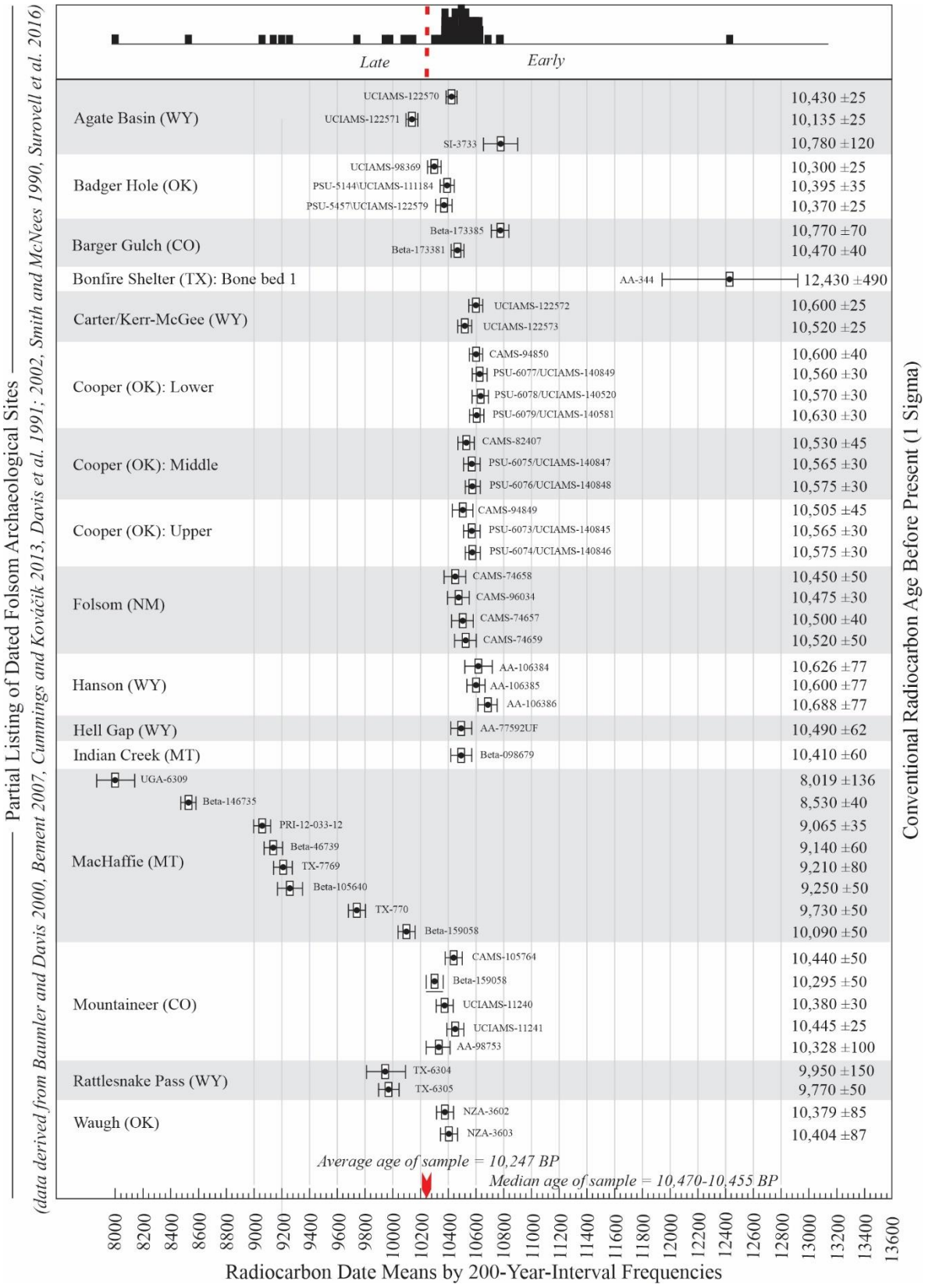


Figure 31. C-14 Chronology for a Sample of Dated Folsom Sites.

and geographically coeval but culturally distinct, a concept first articulated by Husted and Mallory as part of their Western Macrotradition hypothesis (Husted 1995:41).

Most contemporary archaeologists hold that the Folsom point is associated with the atlatl and dart weaponry system (Hunzicker 2008:292) but preserved hafted Folsom points and their propellant have not been recovered to date. Worthy of consideration is that experiments demonstrate large Paleo-Indian points are as effective as small projectile points when used with a bow and arrow (Lahren 2006:67-76). Some argue that Paleo-Indian evidence of the bow and arrow in North America can be found in the Arctic and Alaska and is probably a result of cultural transmission from eastern Asia (Hamilton 1970; MacNeish 1959; Maschner and Mason 2013; West 1981, 1996). Some see evidence among Paleo-Indian components throughout the eastern portion of the continent as well (Amick 1994). Other researchers (Blitz 1988; Fagan 1995:181; Nassaney and Pyle 1999) contend that the bow was introduced to, or invented in, the Arctic ca. 5,000 BP. Evidence includes fragments of a wooden bow from a dated site in western Greenland (Maschner and Mason 2013:136). We know the bow and arrow and atlatl and dart systems co-existed in the Arctic, Alaska, the southeastern United States, Mexico, and South America until quite recently (Cortés 1971; Pyszczyk 2003; Spencer and Jennings 1976). In other areas of the world, hunter-gatherer societies typically use a combination of weaponry systems (Ellis 1997). Still, several dry caves from the northern plains, Great Basin, and Southwestern United States have yielded bow and arrow and atlatl and dart pieces. Sometimes these weaponry systems are discrete, sometimes they are mixed, but a specific transitional date seems variable (+/- 200 years) from site to site. After ca. A.D. 600 all stratified cave components from these regions show evidence of only the bow and arrow (Brumley 2012; Hughes 1998; Jennings 1957, 1980; Pyszczyk 2003; Schott 1993, 1997; Thomas 1978; Webster 1980). Prior to that there is only evidence for the atlatl and dart system.

The Folsom point was first identified as a distinctive type during 1926 to 1928 excavation of a *bison antiquus* kill (29CX1) near Folsom, New Mexico. Whereas Clovis points have been found in association with a range of extinct Pleistocene fauna, Folsom points are generally found in association with extinct bison species, although smaller contemporary game animals can also be associated. This suggests that most Pleistocene megafauna were extinct by Folsom time. Traditionally it has been held that people using a Folsom technology were largely Plains based populations with a subsistence economy centered on the long-horned bison (Amick 1999; Bamforth 2002, 2011). Loebel et al. (2016: 145-146) see Folsom in Wisconsin and Illinois as specialized in hunting caribou. Frison (1978:13) correctly observed that Folsom "…represents what was apparently a successful hunting and gathering adaptation over a large geographic area in many different natural environments". Probably due to the early perception of a strictly Plains association, archaeologists assigned a more restricted geographic range for Folsom than for Clovis. As seen in Figure 32, the assigned geographic range for Folsom is largely limited to the early Holocene grasslands of west-central North America. The west boundary of this region generally follows the Rocky Mountain Front, the east boundary runs from Lake Winnipeg southeasterly to the Mississippi River, then southerly through central Iowa and northwest Missouri to the Ozark Mountains where it tends to concentrate at the east side of the range. The north boundary is the Boreal Forest and the south boundary is northern Mexico (Amick 1999; Billeck 1998; Hlady 1970; Hurst 1943; Justice 1987, 2002a, 2002b; Kehoe 1966a; Largent et al. 1991; Peck 2011). This area is where Folsom sites are most common but does not imply an area of containment. Although rare or even anomalous, fluted points stylistically consistent with

Folsom have been found in central Baja California (Aschmann 1952), the Snake River Plain (Moe 1982) and the Great Basin (Grayson 2011). Folsom points, however, appear absent from Oregon, Washington and most of California (Cressman 1977; Jennings 1978; Justice 2002b, Willey 1966), but temporally coeval fluted points occur east of the boundary in Figure 32. This creates problems for defining what Folsom is and what it is not. Some fluted points assigned to the Gainey, Barnes, Debert, Cumberland, and Dalton groupings easily fall within Folsom stylistic parameters but are not called Folsom because their geographic locations preclude a bison-centric subsistence (Jennings 1978; Justice 1987; Willey 1966). Admittedly, many of these eastern fluted varieties are stylistically atypical of Folsom (Figure 33). Some exhibit slightly expanding bases and slightly constricted necks which give a roughly "fish-shaped" outline. Dalton points also commonly exhibit serrated triangular bodies with deeply concave bases that have short, parallel sides. Stylistically this form is not common to Folsom or the Great Plains Region, but a point that could pass for Dalton was found at cultural level 4 (9,230 ±150 BP) in Mummy Cave, Wyoming (Husted and Edgar 2002:36, 177.b), Medicine Lodge Creek, Wyoming (Levels 16 and 21: 8,570 ±230 and 9,470 ±40 BP) (Frison and Walker 2007:34), and among the undated Larson Cache materials that are assigned to the Cody Complex (Ingbar and Frison 1987:462.h). Similar looking points designated "Deception Creek" are known from the Colorado high country and dated to ca. 8,500 BP (Pitblado 2003:116-117). Additionally, a perforator or drill made on a large point base that resembles Dalton, Meserve, James Allen, or Golondrina was recovered during excavations at Sheep Rock Spring (24JF292) in southwestern Montana. The level was dated to 5,260 ±80 BP but the piece may be much older, suggesting it was collected elsewhere and reworked by a later inhabitant of the site (Davis and Rennie 2017:24, 53).

The stereotypical or classic illustration of a Folsom point is a fluted, lanceolate form (in outline) with parallel sides that curve inward (excurvate) near the distal end to form a somewhat rounded tip (Figure 33). The base is concave, although not deeply so. The basal concavity extends laterally a sufficient distance to give the extreme proximal margins sharp points or narrow "ears" (auriculate). Fine pressure flaking of the preform, often in some parallel sequence, is a hallmark of Folsom technology. Also, most Folsom points are ground along their basal edges (Largent et al. 1991:38). Another defining characteristic is that Folsom point production is expected to see a 30 percent failure rate (Scott 1996; Sellet 2004: 1558-1559).

The distinguishing attribute of a stereotypical Folsom point is a comparatively broad and thin median flute or channel formed by the removal of a longitudinal flake running from the proximal basal concavity. Replicative experiments demonstrate that channel flakes can be removed through a variety of techniques involving pressure or indirect percussion (Crabtree 1966; Gryba 1988; Eugene Gryba pers. comm. 2019; Lahren 2006; Sean McQueen pers. comm. 2019). Channel flake removal through pressure can be accomplished using hand-held pressure flakers, braces, anvils and simple mechanical lever systems (Lahren 2006:64-65; Nami 1999:99). Channel flake removal for the classic Folsom point occurs on both faces of the point. The channel flake, if successfully removed, tends to travel at least two-thirds the length of the body, making the body remarkably thin once both faces are fluted. The Folsom point preform is a flattened bi-convex or lenticular shape in cross-section. Following fluting of both faces the cross-section shape becomes biconcave. Flenniken (1978:479) contends that Folsom preforms were typically made from large thin and straight flakes (presumably flakes with understated bulbs of percussion).

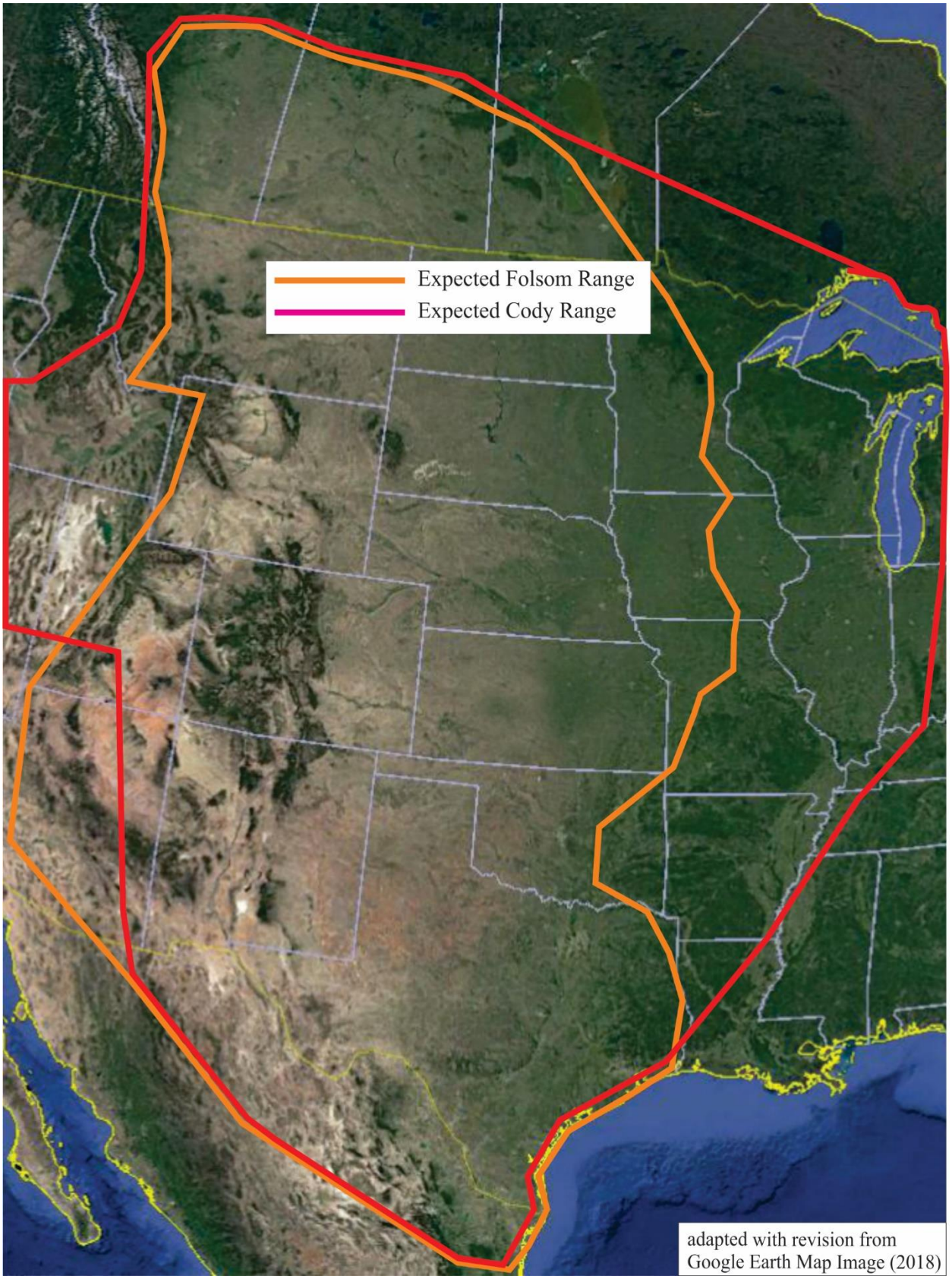


Figure 32. Areas Expected to Contain Folsom and Cody Sites in North America.

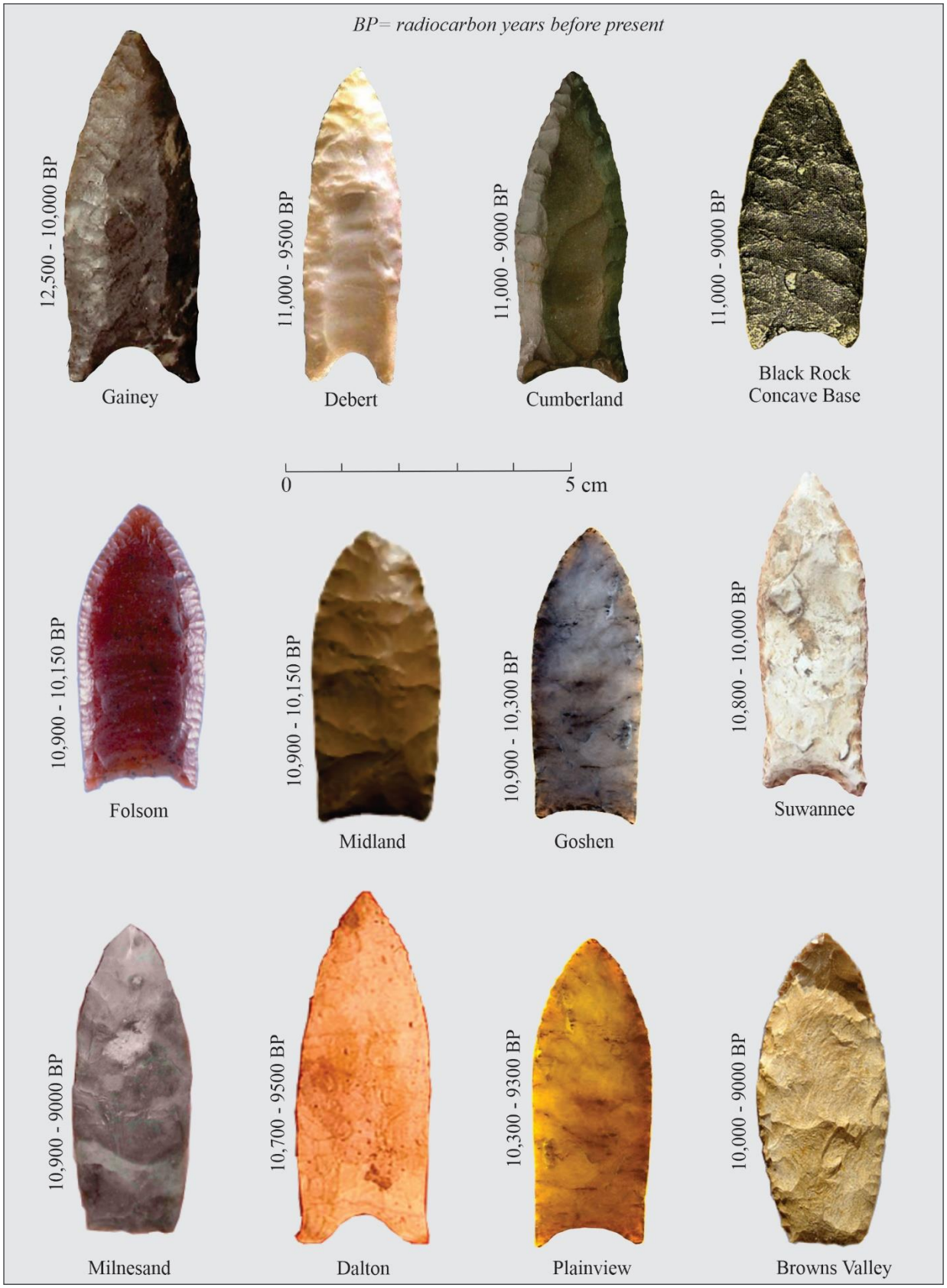


Figure 33. Folsom and Selected Contemporary Projectile Point Types of North America.

Most Folsom projectile points range from approximately 25 to 65 mm in maximum length with an approximate average length of 36 mm. The problem with the available metric data is that few Folsom points represent their original manufacture characteristics. Most available for study exhibit one or more resharpening or rebasing events that have significantly altered the original shapes and sizes (Amick 1995, 1999; Hunzicker 2008; Largent et al. 1991). Folsom points from the Cooper site in Oklahoma that do not appear to have been modified (n=2) average approximately 51 mm in length (Bement 1999:115). Other sources suggest that the initial length of many Folsom points was 75 to 80 mm (Collins 1999:26).

Metric attributes not associated with length are more reliable and indicate that Folsom points have an approximate average width of 20 mm, average basal width of 17 mm, average maximum width of 20 mm, average maximum thickness of 3.7 mm, and an average body thickness (when both faces are fluted) of 3 mm. Flute scar measurements average approximately 27 mm in length and 12 mm in width (Gryba 1988).

Baker (1998) defines 11 stages critical to the successful manufacture of a Folsom point:

1. Blank.
2. Initial shaping & thinning.
3. Pressure shaping & thinning.
4. Specialized pressure shaping & thinning of one face (Face A).
5. Channel flake platform [nipple] preparation (Face A).
6. Channel flake removal (Face A).
7. Pressure shaping & thinning of second face (Face B).
8. Channel flake platform [nipple] preparation (Face B).
9. Channel flake removal (Face B).
10. Post fluting retouch.
11. Margin polishing

As an alternate consideration to Baker's (1998) process, we have observed through experiments and failed Folsom point preforms that pressure thinning and shaping of both faces of the preform occur prior to nipple preparation for channel flake removal. Here we suggest that Baker's stages 4 and 7 occur sequentially followed by stages 5 through 6 and 8 through 9. This approach is also consistent with that followed by the late knappers Ray Alt and Don Crabtree (Crabtree 1966; Lahren 2006:62-64).

Baker (1998) also notes that Stages 6 and 9 "…are the most common in the archaeological record. Apparently, mistakes in the other stages could be worked around and a successful outcome was still possible. A mistake in Stage 6 or 9 was generally fatal". Of course, pieces resulting from failures could have been recycled into other tools and now lack recognizability as some stage in Folsom point manufacture. Most of the time required to make a fluted point is in the percussion thinning and pressure shaping of the point. Preparing the base and setting platforms for channel flake removal is relatively simple. Experienced knappers have little trouble removing channel flakes.

Emphasis has been placed here on the prominent fluting of opposing faces, but Folsom collections can contain projectile points or preforms with only one fluted side, or even no fluting.

These point styles have been designated Midland, or Plainview (Amick 1995, 1999; Dibble 1968; Holliday et al. 2017; Figure 33). Other contemporary unfluted lanceolate varieties found in the Great Plains include Goshen and Milnesand (Frison 1996; Sellards 1955; Figure 33). We found no data to illustrate expected ratios of unfluted, single fluted, and double fluted points among various collections, site types or geographic localities. However, one researcher observed that the frequency of unfluted points in Folsom collections increases with distance from a reliable toolstone source (Amick 1995:35).

East of the Folsom boundary, unfluted lanceolate varieties such as Gainey, Suwannee, and Browns Valley (Jenks 1937) points also occur (Figure 33). These point styles are either temporally coeval or overlap and extend beyond the later temporal boundaries of Folsom. Stylistically, many fall within parameters of the *Folsom Complex** (*our use of the term implies some relationship among Folsom, Midland, Plainview, Goshen and possibly Milnesand points, but we do not speculate on what that relationship is).

Throughout the Great Basin and Snake River Plain, an unfluted lanceolate form called "Black Rock Concave Base" is both stylistically similar and a contemporary of Midland, Goshen, and Planview (Figure 33). Fluted points occur in the arctic and subarctic at the time of Folsom, but these tend to be made of ground slate rather than chipped stone (Jennings 1978; Willey 1966). Fluted points contemporaneous with Folsom also appear in Central and South America, but these tend to be stemmed forms called fishtail points; the fluting is generally not as intrusive (Jennings 1983; Willey 1971).

Experts in Folsom archaeological culture (Amick 1999:1-5; Collins 1999:21) identify several traits they see as defining characteristics:

1) Preference for high quality toolstone;
2) Production of diverse/distinctive tool forms;
3) Utilization of multiple stone working techniques with bifacial cores providing the basis for mobile toolkits;
4) Conservation of toolstone through use of small pieces and recycling of broken tools;
5) Infrequent use of expedient tools, frequent use and transport of complex tools;
6) Maintaining long-term utility of standardized cores as opposed to individual tools;
7) Toolkit diversity geared toward reducing subsistence risk;
8) Blades (excluding channel flakes) were not being intentionally produced;
9) Very thin bifaces nearly biplanar in cross-section; and
10) Fluting of Folsom points is a more involved process than for fluting Clovis points

Traits 2, 4, 5, 6 and 9 are not present at MacHaffie. Trait 1 might be applicable but use of the high-quality, regional, Madison Group chert is restricted to neither Folsom nor the MacHaffie locality. Further, a minor amount of poor quality toolstone was brought to MacHaffie and reduced through percussion, but not further used on-site to any noticeable extent. This is also a typical pattern among Precontact archaeological campsites and lithic reduction sites in Montana. Trait 7 will be left for more experienced and knowledgeable researchers to ponder. Among traits that characterize Folsom assemblages elsewhere, only the first part of trait 3, and trait 8, appear to be applicable to the Folsom component at MacHaffie. In all fairness, though, the first part of

Trait 3 and Trait 8 are characteristic of most regionally defined archaeological cultures. The exception, specific to Trait 8, is true microblade cores associated with some Clovis age components. Implying that these traits are unique to Folsom, at least in Montana, is inaccurate. Further, the concept of "toolkit" is difficult for us to grasp so it may or may not apply at MacHaffie depending on the definition.

Both speculation and experimentation provide explanations for why Folsom people made such effort to flute projectile points (Bradley 1993). Collins (1999:24) notes:

> For whatever its purpose, the fluting of Folsom points was evidently an important objective that knappers considered worth the costs of tedious preform preparation, specialized procedures and probably equipment for channel flake removal, frequent failure, and increased fragility of the resulting points. It also seems likely that not every would-be knapper could master the techniques.

Frison (1991:51) and Frison and Bradley (1980:111) initially felt that the risky fluting of the Folsom point is more an artistic expression than functional. Bradley (1982:197) went on to state that he saw no functional benefit to the Folsom fluting process. It might be part of a controlled ritualistic activity intended to achieve, through sympathetic magic, success in a planned hunt. Later on, however, these and other researchers changed their opinions that Folsom fluting is indeed functional and provides for a secure friction fit in the haft, requiring little or no mastic or sinew binding. The fluting process may afford additional protection to the point or foreshaft (Ahler and Geib 2000; Frison 1993:243; Frison and Bradley 1980:111; Mason 1982:85; Roberts 1935:21; Wilmsen 1974:52). One experiment demonstrated that nearly full-length hafted, fluted points tend to experience less overall damage than basally hafted points. They can also be rejuvenated and reused three to five times before replacement is needed (Hunzicker 2008:302-303). Thus, weakening of the point (removal of mass) by fluting appears to allow for a stronger more durable piece when full-length hafted.

Similarly, experimentation with Clovis-style fluted points has demonstrated that the practice redirects impact-related stresses. Upon impact the thinned (fluted) base is likely to break first thereby reducing risk of breakage elsewhere on the point. This would increase re-use potential of the same point (Kent State University 2017). The evidence suggests that fluting of bifacial preforms tends to make a more durable point in the haft. Design durability, knapping skill requirements, and aesthetic values likely gave way to more practical artifacts that were easier to produce and offered the same lethal qualities.

Folsom is rare in Montana. Based on our review of the literature, and communications with others, we are aware of 34 localities that produced approximately 50 Folsom points or preforms (Table 9; Figure 34). This, in part, is what makes MacHaffie unique in the state. Approximately 14 percent of the known Folsom points found in Montana come from 24JF4. The authors are aware of only one other locality in Montana that has reportedly produced as many Folsom specimens (see Table 9). It is in the Tongue River drainage of southeastern Montana and has never been formally recorded or investigated (John Byrd pers. comm. 2019). As a caveat, we realize that more Folsom pieces exist unreported in private and government agency collections. A comprehensive search of Montana was just not feasible for this undertaking.

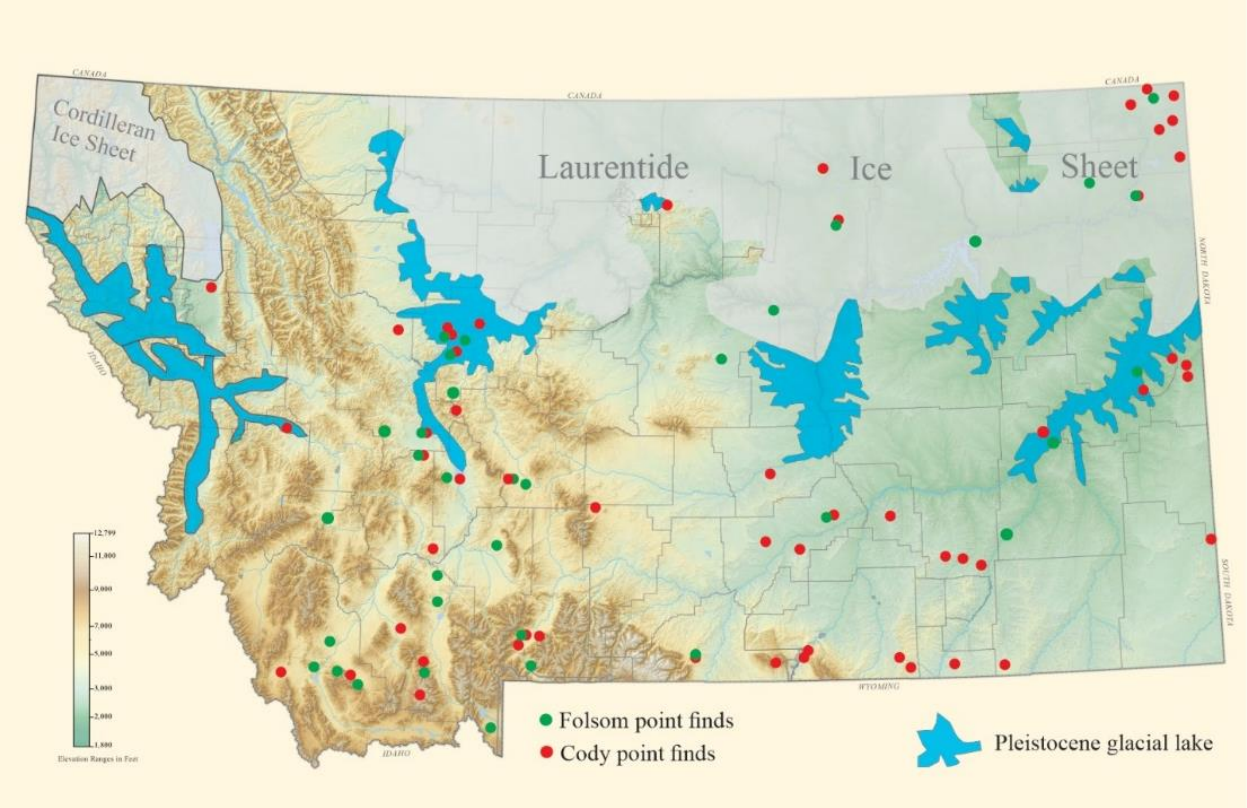


Figure 34. Map Showing Reported Folsom and Cody Projectile Point Finds in Montana.

Folsom points in Montana are primarily surface finds with no contextual integrity. If a pattern exists, it is that Folsom clusters in the southwest, south-central, and northeast portions of the state. The central and north-central part of the state and areas west of the Continental Divide are lacking in Folsom finds. Although Folsom postdates the maximum extent of continental glaciation and resulting glacial lakes, these former water body boundaries are shown in Figure 34 for general reference. Excluding finds in north-central and northeast Montana, Folsom tends to be situated outside the presumed ice sheet and glacial lake margins. Current information suggests that Folsom is found more frequently in the mountains, valleys, and foothills of southwest and south-central Montana than on the Plains. This patterning should raise questions as to whether Folsom people were specialized bison hunters. A more generalized subsistence base is implied through topographic distribution of Folsom artifacts.

Here we should point out the subjectivity of Table 9. A few references were not used because the point illustrations did not fit our perception of a Folsom point, or some other inaccuracy or inconsistency was observed. Also, unless found in association with fluted Folsom points, reported unfluted lanceolate points and preforms (Plainview/Midland/Goshen) are not included as Folsom finds. Beyond a vaguely referenced and unrecorded site north of Norris, MT (Jasmann:1963:12) and the hard to decipher site form for 24MA205/24MA206 near Ennis, MT, only Indian Creek and MacHaffie appear to have reasonably intact Folsom components. However, clearly identifiable Folsom points were not recovered at Indian Creek. Instead, the Folsom

Table 9. Reported Folsom Point Finds in Montana.

County	Site Number or locality	Number of Finds	Context	Reference
Beaverhead	Clark Canyon Reservoir area; unspecified; upper Blacktail drainage; Dillon area	1; 1; 1; 1	surface (all)	Don Copple (DNRC-Dillon Unit) pers. comm. 2018; Jasmann 1963:16; Lahren 2006
Broadwater	24BW626	?	buried	Baumler and Davis 2000; Davis et al. 1987
Carbon	24CB401	1	surface(?)	MTSHPO CRIS files
Cascade	Near head of Hound Creek	1	surface	John Byrd pers. comm. 2019
Cascade	24CA12; Great Falls area	1; 3	surface (all)	MTSHPO CRIS files; Shumate 1982
Custer	On Tongue River near Brandenberg ~30 miles south of Miles City	7	surface	John Byrd pers. comm. 2019
Custer	South side of Yellowstone River between Kinsey and Miles City	1	surface	John Byrd pers. comm. 2019
Custer	North of Miles City (24CR410?)	1+	surface?	Tom Roll pers. comm. 2019
Dawson	24DW220	1	surface	MTSHPO CRIS files
Deer Lodge	24DL807	1	surface	David Ferguson (pers. comm 2019)
Fergus	James Kipp Recreation Area	1	surface	John Byrd pers. comm. 2019
Fergus	24FR6	2	surface	MTSHPO CRIS files
Gallatin	Dry Creek area/Bridger Range foothills; ~ 6 miles South of West Yellowstone	1; 1	surface (all)	Jerry Hoffman pers. comm. to Les Davis 2012; Tom Roll pers. comm. 2019
Jefferson	24JF4: MacHaffie	7	buried & surface	Forbis 1955; Davis et al. 1991; Rennie et al. (this report)
Jefferson	Prickly Pear Creek dredge piles (MT City)	1	surface	John Byrd pers. comm. 2019
Lewis & Clark	Continental Divide crest south of MacDonald Pass	1	surface	John Byrd pers. comm. 2019
Lewis & Clark	Lake Helena	1	surface	Edmund MacHaffie collection (Forbis 1951 field notes and photographs)
Madison	24MA205/24MA206; Gravelley Range; NW1/4 Section 4, T3S R1W	1-3?; 1; 1	surface; surface; buried	MTSHPO CRIS files; Jerry Hoffman pers. comm. to Les Davis 2012; Jasmann 1963:12
McCone	Fort Peck Reservoir area	1	surface	Taylor n.d.
Meagher	Edge of Big Belt Mountains SW of White Sulphur Springs	1; 1	surface; surface	John Byrd pers. comm. 2019; Lahren 2006:64 and Larry Lahren pers. comm. 2019
Park	Rock Creek north of Tom Miner Basin	1	surface	Lahren 2006:64 and Larry Lahren pers. comm. 2019
Phillips	SE of Malta	1?	surface	Hoy 1969
Roosevelt	North of Poplar	1	surface	John Byrd pers. comm. 2019
Roosevelt	24RV1	2+	surface	MTSHPO CRIS files; Johnson 1977
Sheridan	24SH561	1	surface	Jerde 1981; Joyes and Jerde 1970
Yellowstone	24YL780	1	surface	MTSHPO CRIS files

An obsidian fluted point fragment, recovered from the Gardiner Post Office site in southern Park County, is generally regarded as Clovis (Arthur 1966:94-95, 100; Lahren 2006:45), but one researcher refers to it as a Folsom point (Jasmann 1963:15)

component was defined by a basal-lateral margin fragment of a possible Folsom point, a rather non-descript preform, channel flake fragments, a large quantity of late reduction stage lithic debris, and a C-14 date of 10,630 ±280 BP (Baumler and Davis 2000; Davis et al. 1987).

7.0 THE FOLSOM COMPONENT IN THE MACHAFFIE SITE

As previously noted, a discrepancy exists between Forbis' 1951 assessment of the vertical provenience of MacHaffie Folsom deposits (approximately 90 to 130 cm BS) and that observed with the 1989 through 2018 excavation work (approximately 135 to 160 or 160 to 200 cm BS depending on horizontal distance northerly and easterly of excavation unit 6S/6W). Based on the geomorphologic evidence, this discrepancy appears to reflect easterly downsloping of the "island" during Paleo-Indian times. Davis et al. (1991:2, 2002:19) identify two distinct Folsom strata designated as Stratum I (sub-Folsom) and Stratum II (Folsom). Because we could find no explanation for how these two Strata were denoted, we consider the Folsom component as a single entity and use "sub-Folsom" to denote non-culture bearing sediments below the Folsom component. In unit 2000-B the depth of the sub-Folsom layer is reported to be approximately 230 cm BS (Davis 2000). Because no supporting evidence could be found to validate this statement, we contend that the maximum depth of Folsom deposits in the MacHaffie site is approximately 2 m BS. With the recovery of a Folsom point preform (#17) in 2018 we are confident of the vertical provenience of the Folsom component in the MacHaffie site.

Detailed descriptions of the various artifact classes and faunal resources pertaining to the Folsom component in the MacHaffie site are presented hereafter. Table 10 provides a summary by count and weight of all cultural material currently assigned to the Folsom component for which we had knowledge of. This amounts to a total of 5,679 items with a combined weight of 20.1 kg (44.3 lbs.).

Table 10. Summary by Count and Weight of Folsom Cultural Material.

	Cultural Material Categories												
	Hammerstone	FCR	Bone	Core	Unmodified Debitage	DEF/M	Endscraper	Biface	P.P.	Drill/ Awl	Burin/ Graver	Spokeshave	Total
Count:	2	31	611	18	4,983	6	0	20	7	0	1	0	5,679
%Total #:	<1%	<1%	11%	<1%	88%	<1%	0%	<1%	<1%	0%	<1%	0%	100%
Weight (gms):	907.80	3,295.00	1,508.69	4,334.35	8,931.38	177.66	0.00	887.98	71.10	0.00	2.85	0.00	20,116.81
%Total #:	5%	16%	7%	22%	44%	<1%	0%	4%	<1%	0%	<1%	0%	100%

Abbreviations: FCR- firecracked rock; DEF/M- debitage with edge-flaking or other edge modification; P.P.- Projectile point

Debitage counts include Knapping Features 1, 2, and 4. Projectile point counts include preforms.

7.1 Faunal Remains (see Appendix 7)

The earliest faunal analysis of MacHaffie site skeletal remains was conducted by Morris Skinner, George Goodwin, and T. Donald Carter of the American Museum of Natural History (Forbis 1955). Bison bone fragments were most common but limited in quantity. It was surmised that only a single individual was represented, mostly by small fragments of limb elements. In addition to bison bone, limited amounts of wolf, deer, rabbit, and small rodent were present. The rabbit and small rodent bones may be neither cultural nor contemporaneous with Folsom. Instead, they may reflect natural deaths in burrows that penetrated the Folsom deposits. Forbis did not observe obvious thermal damage to the Folsom bone pieces (Forbis 1955:140). Morris Skinner suggested that the bison remains were larger than modern bison, but in the absence of diagnostic elements or metric comparative data, he was unable to assign the remains to a sub-species (Forbis et al. n.d.:179).

In only one instance did Forbis (1955:141) report on a possible, but unlikely, bone implement. This was a bison long bone fragment that was apparently hacked. The fate of this piece is unknown, but it is not with the UM collection today. In XU C-2, at a depth of 180 to 200 cm BS, Les Davis' crew recovered a concentration of 22 ochre-stained bison-size bone fragments. A few reportedly were burned. The intentional ochre staining matches that of an ochre coated chert flake found and an additional bone fragment at the same depth in unit C-7 approximately 5 m to the south. No additional information is available, so we cannot speculate on an association with a cultural feature. Of possible relevance, one researcher contends that the use of hematite in Plains archaeological context was never extensive but "…was greater during the Paleo-Indian period than it was later…Red ochre does not appear in Clovis and Folsom kill sites but is found in most investigated campsites (Roper 1987:82-83)".

Dr. John (Jack) W. Fisher, Jr. examined a few of the MacHaffie bones from excavation years 1989-1990, 2000 and 2001. In addition to obvious bison-size bones and several fragmentary, unidentifiable bones that are likely large ungulate (bison), the Folsom layer yielded small to medium-size ungulate bone (probably deer, pronghorn, or bighorn sheep), and the lower leg, tail, lumbar vertebrae and mandible bones of a large canid (*Canis* sp., cf. *Canis lupus*). Additionally, a limited number of small rodent bones among the Folsom-age sediments are believed to be incidental (Fisher 2000, 2018).

Greiser's (2022) study of the Folsom component faunal remains involved 611 complete bones and fragments weighing a combined total of 1,508.69 grams (Table 10). The bones show variable degrees of weathering. Few, if any, show thermal alteration. In fact, the dark colored pieces may be a product of mineral staining.

Identifiable species include bison, wolf (*Canis lupus*), lynx/bobcat (*Lynx* sp.), rabbit (*Sylvilagus* spp.), Richardson's ground squirrel (*Urocitellus richardsonii*), and black-tailed prairie dog (*Cynomys ludovicianus*). Mountain goat (*Oreamnos americanus*), big horn sheep (*Ovis canadensis*), mountain lion (*Puma* (formerly Felis) *concolor*), and mule or white-tailed deer (*Odocoileus* spp.) may also be represented. Much of the bone available for study is considered "scrap", or fragmetns too small to positively identify to skeletal element or genus and species. By count bone scrap accounts for 74 percent of all bone pieces by count and 23 percent by weight. To illustrate the small size of the scrap pieces, four are size-grade 1, 80 pieces are

size-grade 2 and 64 pieces are size-grade 3. These pieces could represent a variety of large, medium, or small mammals and birds. In most instances, only a single animal is represented. As examples, medium-size ungulate bones are restricted to a deer (*Odocoileus* spp.) femur fragment (#324), and a bighorn sheep or mountain goat axis vertebra (#188).

The greatest number of identifiable ungulate bones and bone fragments are assigned to bison (n=199). Presumably the bison remains are from the extinct *Bison antiquus* but a detailed metric study of the diagnostic bone pieces was not made in 2022. One carpal (#329) appears to be from a sub-adult. The majority is comminuted and referenced here as bison-size bone scrap (n=148). Identifiable skeletal elements include skull fragments (n=31), a horn core fragment, a right upper molar (#187), tooth enamel fragments, a hyoid fragment, a petrus bone (#81), a thoracic vertebra (#184), vertebrae fragments and rib fragments (n=5), a proximal scapula fragment, a radius fragment, large metacarpal and metatarsal (#199) fragments – both with green breaks, carpals (#313), a second phalange (#53), and a sesamoid (#174). Due to the fragmentary nature, it is difficult to determine if more than one animal is represented. The only evidence of butchering is the green break on a distal metacarpal (#198) perhaps for marrow extraction.

Carnivore remains (n=47) include those initially identified by Jack Fisher (Fisher 2000). Large canid bones, possibly from a single individual, dominate the carnivore materials. Because of their size similarity to wolf (*Canis lupus*) skeletal elements in the P.L. Wright Zoological Museum comparative collection, they are catalogued as *Canis lupus*. The represented skeletal remains include a tooth and two mandible fragments, a lumbar and two caudal vertebrae, scapula, humerus, left and right radius, ulna, two carpals, femur, patella, tibia, fibula, six metapodials, a tarsal, 12 phalanges, and six fragments unidentifiable to element. Although fragmentary, many of the leg bones are identifiable to side. The long bones, vertebrae, metapodials, one phalange, and the fragments appear to have green breaks. While the number of green breaks may indicate the animal was butchered, a possible cut mark was identified on one metapodial fragment (#361). The only complete bones are carpals, tarsals, and many of the phalanges. All bones except one phalange were recovered from Excavation Unit (XU) 2000-C; a single phalange was found in XU 6S/2W, approximately 5 meters to the southeast. It is likely that the outlier phalange is from the same individual as the 2000-C canid bones. Other than a rabbit skeleton from the Helena component, the probable wolf remains comprise the most complete animal skeleton recovered from the site.

Les Davis (Davis et al. 2010:134-135) cites sources for the consumption of dogs and wolf/dog hybrids among late precontact and early contact Plains Tribes during times of stress when other food sources such as bison were not available. What appears to be butchering of a wolf at the MacHaffie Site may be evidence for the practice among Paleoindians on the Northwestern Plains.

A felid calcaneum (#315) came from XU N2/W5, one of the units excavated by Forbis in 1951. It is tentatively assigned to Lynx (*Lynx* sp.) following discussions with various colleagues, but the piece is smaller than the mountain lion and larger than the lynx or bobcat data to which it was compared.

Rabbit hind leg bones and a metapodial were recovered, but skeletal material is insufficient to determine if the animal was processed by humans or if it died of natural causes in

a burrow or elsewhere in or near the site and was later incorporated into the Folsom age sediments. As many as three Richardson's ground squirrels are also represented. The remains consist of two partial skeletons and a mandible with an incisor. The remains most likely represent individuals that excavated burrows into the cultural occupation levels in which they died.

Although the faunal sample is small, bison bone dominates, but likely represents a single animal. Still, a broad range of animal resources were utilized by Folsom occupants. Green bone fractures and a large percentage of small bone fragments implies meat and soft tissue removal followed by bone comminution. Presumably these small bone pieces were subsequently subjected to stone boiling for further processing. Identifiable skeletal elements of cultural affiliation are dominated by lower leg bones (n=67). Skull pieces (n=37) are a distant second, and upper leg and axial skeleton fragments are nearly equally represented with 13 and 12 pieces respectively. Further, skeletal sides are equally represented. In only one instance (#322) is there a potential indicator for a season of site occupation. This possible femur fragment is from a small mammal (unidentified as to genus) that was either full-term fetal or neonatal. This may indicate a spring death.

7.2.1 Lithic Material Culture

Firecracked Rock (Tables 10, Figures 35-39)

Firecracked rock (FCR), if present, was generally not documented in 1951. Only a single heat spalled piece (Fig. 36.128) of a dark-gray basalt (BAS1) was collected from the Folsom level (105 to 120 cm BS) in unit S1/W5 and bagged as "possible hearth stone" by Dick Forbis. Similarly, FCR was not encountered during Les Davis' 1989 through 2010 work in the Folsom component. Unexpectedly, a small amount of FCR was recovered in 2017 at the east side of the island in excavation unit 4N/8E (180-190 cm BS). The recovered FCR is primarily a tan colored granite (GRAN5). Only one piece is of a medium-grained sedimentary quartzite (n=1). All exhibit various shades of pinkish-tan to dusky red coloration resulting from thermal alteration. These lithic materials are locally available and occur as "float" in sediments surrounding the site. As well, granitic bedrock exposures of the Boulder Batholith surround 24JF4. The FCR exposed through excavation in 2017 was thinly scattered or intermixed among alluvial cobbles and pebbles.

In total, 31 pieces of FCR (3.3 kg) are associated with the Folsom component. The FCR recovered in 2017 and 2018 (30 pieces weighing 3.2 kg) occurred from 180-190 cm BS in excavation unit 4N/8E. Twelve (40% weighing 825 g) exhibit heat spalling while the remainder is classified as indeterminate fracture type. None of the FCR associated with the Folsom component exhibits definite water fracture. Twenty-nine are of tan granite (GRAN5) from the local Boulder Batholith. Only one piece recovered during the 2017-2018 excavations is sedimentary quartzite. Twenty pieces (67%) are smaller than 5 cm in maximum dimension. The other ten pieces fall between 5 and 10 cm in maximum dimension.

No definite heating or cooking facilities have been found at MacHaffie. The presence of FCR associated with the Folsom level, however, indicates that such a feature exists, or once

existed. Because the FCR is concentrated in excavation unit 4N/8E (Figures 39-39), this is the portion of the site where future investigations might uncover Folsom thermal features. It also indicates, when compared to the distribution of chipped stone items, discrete spatial patterning of Folsom activities.

A post-fieldwork experiment conducted by Rennie demonstrated that the granite (GRAN5) selected for use in heating or cooking applications shows water fracture poorly when heated and subjected to immersion. Because of this, the thermally altered and fractured pieces are generally indistinguishable by fracture type. Reddening or blackening is typically the distinguishing factor of the thermally altered stone among the local granite. Thus, the indeterminate and heat spalled fracture types could have been formed through either heating or heating and immersion in water. We are not confident about the kinds of heating and cooking activities taking place at MacHaffie, other than to say they are limited. Local quartzite cobbles exhibit expected fracture type distinctions when subjected to heating and heating and submersion in water (see Rennie 2001). Still, no definite water fractured quartzite pieces were recovered. Based on available evidence, it does not appear that stone boiling occurred in the MacHaffie site during Folsom times.

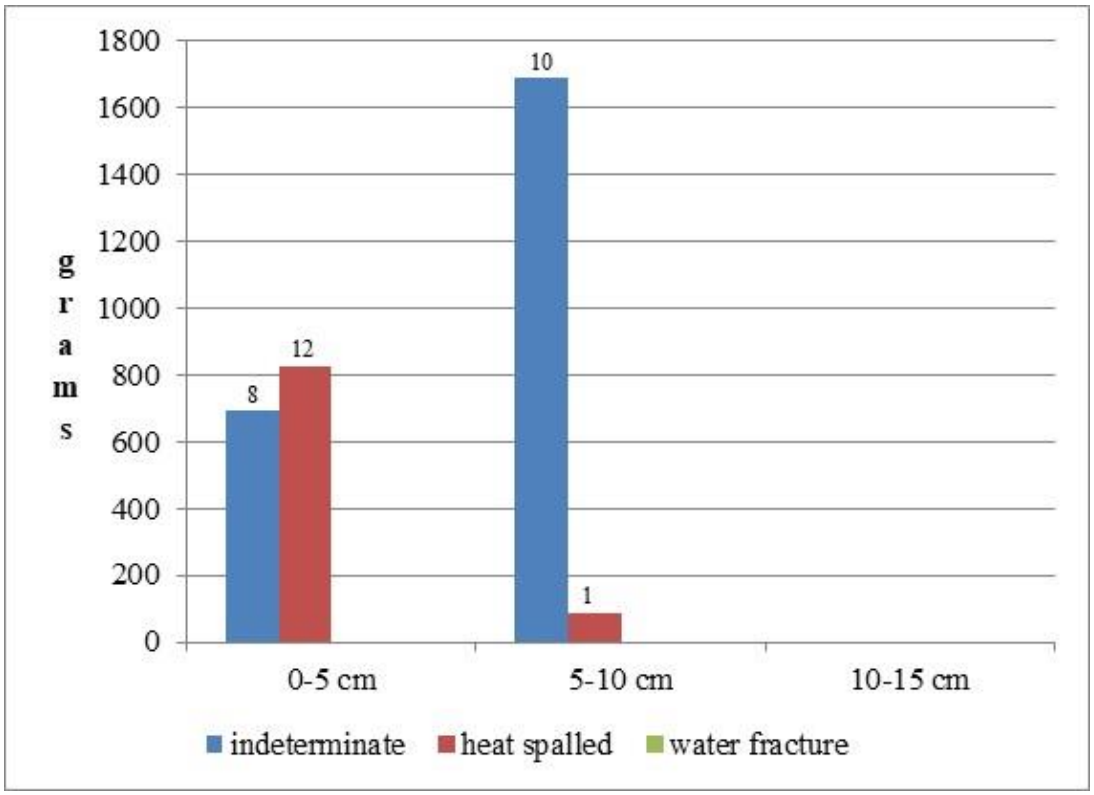


Figure 35. Counts and Weights of FCR per Size-Range and Fracture Type.

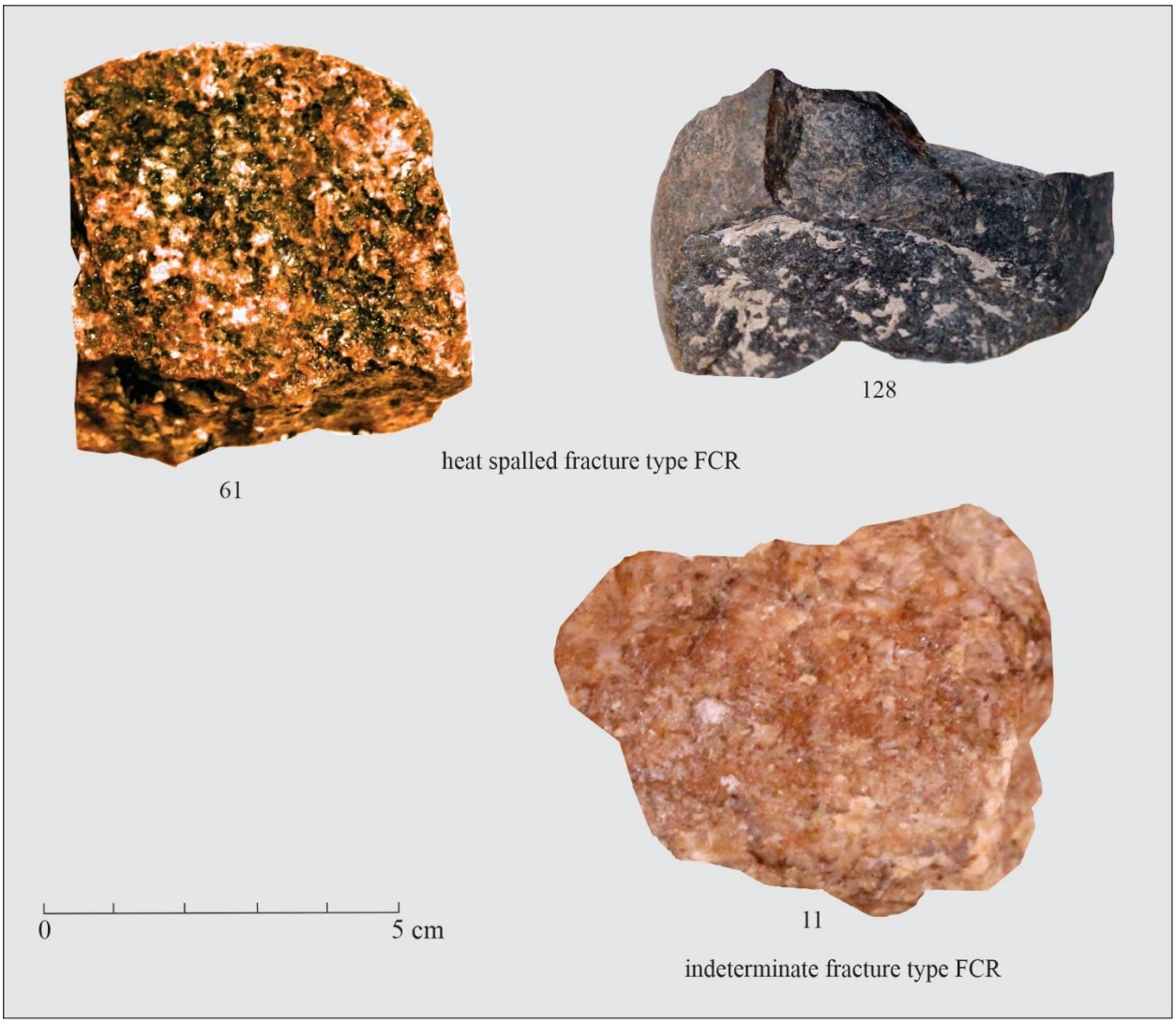


Figure 36. Heat Spalled and Indeterminate FCR Type Examples from the Folsom Component.

Figure 37. Experimental Water Fracture and Heat Spalled FCR Types using Local Rock.

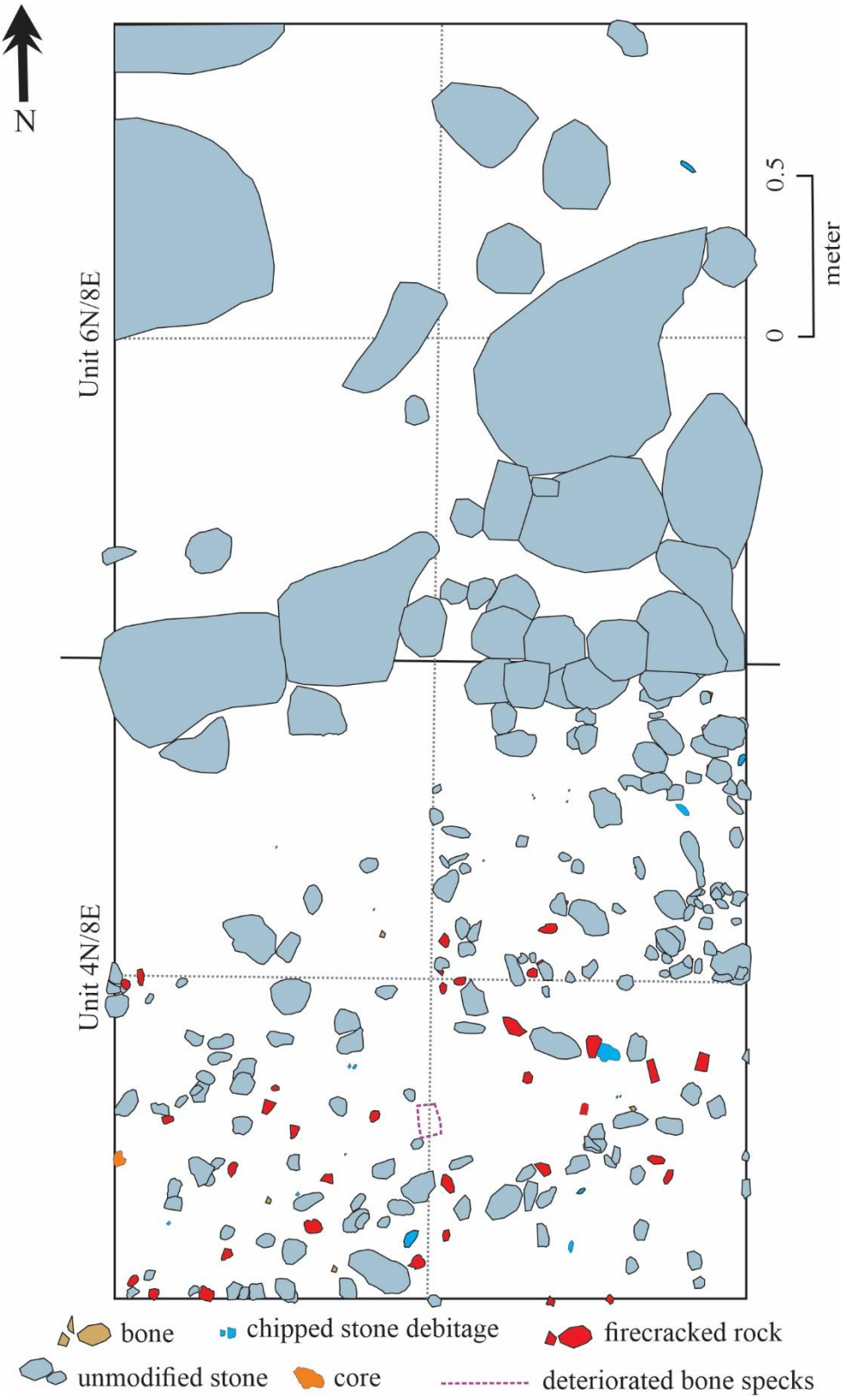


Figure 38. Plan Map of Units 4N/8E and 6N/8E at 180-200 cm BS Depth.

Figure 39. Oblique Plan View Looking East at Units 4N/8E and 6N/8E at 180 to 190 cm BS Depth. FCR and Unmodified Alluvial Pebbles and Cobbles Scattered at South End of Excavation Block and Naturally Deposited Boulders at North End.

Abraded Stone/Ground Stone (Table 10, Figure 40)

Two probable hammerstones are documented for MacHaffie. One is a medial fragment (#1) recovered among the debitage assigned to Knapping Feature 1 in excavation unit C-5. It is a siliceous tan granite assigned lithic material code GRAN5. No battering is apparent on the fragment, but the ends are missing and the fractured edges are somewhat rounded. Its occurrence among Knapping Feature 1 debitage gives it possible cultural association. Similar naturally occurring rocks are rare in sediments containing the Folsom component. The fragment measures 4.2 cm in length, 5 cm in width, and 2.7 cm in thickness. It weighs 126.2 grams.

The second probable hammerstone is a complete, large, rather oblong shaped, tan granite cobble (GRAN5) that exhibits minor battering along a 6 cm segment of edge near one end (#2). The specimen weighs 781.6 g and measures 15 cm in maximum length and 8.5 cm in maximum width or thickness. It was recovered at a depth of 180-200 cm BS in unit 2000-C. Presumably the piece was utilized as a hammerstone, but it is quite large and cumbersome to wield single-handedly with precision. Perhaps its use was restricted to the mashing of large animal bones. The resulting bone fragments would have been used, presumably, in stone boiling activities. Still, the hammerstone was situated immediately outside of Knapping Features 2 and 4 so some connection seems likely.

Figure 40. Possible Hammerstones from 24JF4.

Projectile Points/Preforms and Channel Flakes (Tables 10 and 11; Figures 41 and 42)

Three projectile point fragments and four projectile point preform fragments are assigned to the Folsom component. The manufacturing strategy is consistent with Folsom techniques elsewhere in that small pressure flakes are removed serially at a 90º angle to the lateral margins and terminate at the center of the body to form a subtle longitudinal ridge. The ridge, ultimately, is necessary for successful channel flake removal.

One piece (Fig. 41.19) was likely broken in its haft and transported to MacHaffie before it was removed and discarded. Only one side is fluted. Basal margins are smooth and lightly ground, so presumably this was a finished point preform. Item #28 (Fig. 41) is the proximal corner of a Folsom point. Such diagonal breakage is common during channel flake removal—at least using hand-held pressure flakers (Gryba 1988:58-59) or a chest crutch device (Sean McQueen pers. comm. 2020). The piece probably represents a nearly finalized point broken during final pressure flaking. Because only the proximal portions of points #19 and #20 are present, no attempt was made to assess a hafted retouch index (Andrefsky 2006).

Point base #20 may be a preform because it does not show the final basal margin shaping and grinding of most finished Folsom points. The bending fracture that traverses the distal edge of the piece is more indicative of an impact. If this piece was manufactured at MacHaffie no associated debitage, cores, or tools were recovered. Alternately, if the point broke while hafted, it was removed and discarded at MacHaffie.

The most interesting aspect of #20 is the lithic material it is made from. Whereas the chert constituting #12, #17 through #19, and #28 (Fig. 41) could have originated in most Montana sources, the dark-green, opaque material of #20 is currently recognized from the Tom Miner Basin and Cooke City areas of the upper Yellowstone River drainage, and the Mill Creek/Main Boulder River headwaters, (Larry Lahren pers. comm. 2020; Rennie n.d.). Wyoming sources are reported in the Shoshone River headwaters (Ann Johnson pers. comm. 2019). The lithic material is a highly silicified wood. It is not a CCS that forms in limestone deposits. Excluding trade, this suggests that the Folsom people who occupied MacHaffie visited the upper Shoshone or Yellowstone River drainages.

Two of the preforms (#17 and #18) fractured in an identical manner during fluting. In the case of #17 a channel flake was removed but plunged at its termination resulting in a hinge fracture that broke the preform. No effort was made to flute the opposite face or re-tip the piece and use it with only one flute. In the case of #18, the first channel flake terminated in a step fracture approximately half-way into the body resulting in a flute that is more reminiscent of Clovis than Folsom. This piece was found in 1946 by June MacHaffie and initially suggested to be Clovis (Forbis n.d.:1; Forbis and Sperry 1952:127; Long 1987:46; Malouf 1965:12). The second channel flake removed from the opposite face plunged in the same manner as that described for #17, and the preform broke. This type of plunging fracture appears to be common among Folsom preforms (Crabtree 1966; Lahren 2006:63). Preforms #12 and #50 are not fluted (pre-fluting stage) and exhibit transverse fractures that split the pieces laterally.

Table 11. Metric, Nonmetric, and Provenience Data for Folsom Projectile Points and Preforms.

Record #	Excavation Unit	Excavated Level Depth	CMU	Lithic Material Code	Condition	Preform	Type	Flaking Pattern	Cross Section	Outline Symmetry	Basal Edge Shape
12	98-South Block	150-160 cm BS	5	YBCCS31	body-base	biface	Folsom?	parallel	bi-convex	symmetrical	convex
17	6S/6W	150-160 cm BS	2	BCCS18	body-base	biface	Folsom	parallel	concave/convex	symmetrical	straight
18		Surface	1	BCCS19	body-base	biface	Folsom	parallel	bi-concave	symmetrical	straight
19	S2/W2	80-90 cm BS	11	GBCCS10	base	indeterminate	Folsom	indeterminate	concave/convex	symmetrical	concave
20	N2/W2	128 cm BS	11	GRCCS1	base	biface	Folsom	indeterminate	bi-concave	symmetrical	concave
28	N2/W5	97 cm BS	11	BCCS41	base fragment	biface	Folsom	parallel	indeterminate	N/A	concave
50	cutbank profile	39 cm BS	1	GBCCS18	body-base	biface	Folsom?	parallel	bi-convex	symmetrical	convex

Fracture Type	Basal Edge Height	Base Height	Base Width	Shoulder Height	Shoulder Width	Neck Width	Neck Thickness	Max. Body Thickness	Channel Flake Nipple Width	Channel Flake Point of Release Width	Flute Length 1	Flute Length 2	Flute Width (proximal end 1)	Flute Width (proximal end 2)	Flute Width (distal end 1)
transverse		23.12	22.18	56.62	27.31	23.4	5.08	7.16							
plunging			17.8	41.18	26.74	22.73	4.45	4.53	5.29	3.02	47.9		5.6		19.66
plunging			23.83	38.41	29.13	25.79	5.36	7.01	6.74	3.03	52.71	31.8	7.13	13.6	20.54
transverse	4.68	18.3	21.34			19.6	3.55	4.28			13.72		9.53		10.2
bending	2.29	16.8	19.61			20.27	3.63	3.63	4.97	3.02	22.71	18.8	9.04	7.8	11.46
indeterminate	3.5						4								
transverse			39.2	55.7	41.1		8.8	8.8	4.2	6.98					

Flute Width (distal end 2)	Body Thickness along Flute	Number of sides fluted	Weight (grams)	Comments
			15.1	Possible Folsom point preform that broke during manufacture at the midline. Found at Folsom depth and generally resembles preforms 17 and 18.
	4.45	1	8.6	Broke during manufacture. Did not recover tip, channel flake or debitage matching the point's MANA unit.
13.9	5.61	2	14.65	June MacHaffie find 1947 (Forbis #1004). One side fluted similar to Clovis, opposite side where plunging fracture occurred fluted as Folsom.
	3.73	1	1.7	Found during screening in 1951 (Forbis #1500). Only one side fluted. Did not recover tip, channel flake or debitage matching the point's MANA unit.
7.6	2.85	2	2.65	Found in context in 1951 (Forbis #1001). Did not recover tip, channel flake or debitage matching the point's MANA unit.
			0.9	Forbis artifact #1000. Point base fragment. Probably broke during an attempt to straighten or shape a basal "ear",or during channel flake removal.
			27.5	Bliss and Hughes (1947) artifact #40; Smithsonian Institution National Museum of Natural History accession #206347, catalogue #406713. Presumed to be a Folsom point preform but found at the Cody level according to Bliss. Depth is approximately 20 cm higher than the Cody level depth defined by Forbis (1955).

Projectile point/prefrom measurements are in millimeters

Figure 41. Projectile Point and Preform Fragments Assigned to the Folsom Component.

Preform #50 is both interesting and problematic. It is interesting in that it exhibits an intentionally pressure flaked and beveled projection or "nipple" (James Krakker pers. comm. 2019) centered at its proximal margin. It seems too well-formed to not be a channel flake platform. The piece is problematic in that it was collected by Wesley Bliss in 1947 from the cutbank profile and at a depth of 39 cm BS. From this stratum Bliss also collected a Cody Knife (DNRC Projectile Point database catalogue #49) suggesting that the deposit was of the Cody component (Bliss et al. 1947). Further, the lithic raw material (GBCCS18) is most common among the Cody materials in the site and rare among the Folsom materials. Because of the slightly rounded basal shape and the potential channel flake platform, preform #50 is included with the Folsom materials and is presumed to have become mixed with more recent Cody materials.

Although the pieces give a sense of uniformity in design, comprehensive metric data is unavailable because of the incomplete nature of the recovered Folsom points and preforms. Items 19 and 20 have average base widths of 20.48 mm, average neck widths of 19.94 mm, an average maximum thickness of 3.95 mm. The thickness of the body of item #20 where both faces are fluted is 2.65 mm. Average channel flake scar widths at their proximal ends is 7.83 mm, and the channel flake platform or nipple at its point of release from the preform body is a mere 3.02 mm. This is the most consistent of the metric data taken. Among three specimens where channel flake point of release is still visible (#17, #18, #20) that measurement only varies by 1/10 of a millimeter. Preform #50 is the outlier. Not only is it the thickest and broadest piece, the channel flake point of release is twice as wide as the negative scars on pieces #17, #18, and #20. Item #50 still exhibits an intact and fully formed channel flake platform that measures 4.2 mm across its exterior (proximal) surface. As could be expected, average body thickness of preforms (#12, #17, #18) is slightly thicker than the more finished pieces (#19, #20) at 6.23 mm and substantially thicker for item #50 at 8.8 mm. Preform #50 is curated at the National Museum of Natural History (NMNH) and is not part of the UM collection. Projectile point feature measurements are illustrated in Appendix 8, Volume II of this report.

Each of these pieces is of a distinct chert MANA designation (BCCS18, BCCS19, BCCS41, GBCCS10, GBCCS18, GRCCS1 and YBCCS31), and all are of high-quality toolstone. The materials are highly siliceous, uniform in quality, cryptocrystalline in texture, and slightly to highly vitreous in luster. Because these materials are common among Madison Formation chert in Montana, it is not easy to determine which pieces were heat treated. Ingbar and Hofman (1999:101) observe that "…Folsom knappers appear to have been highly selective of raw materials for use in tool manufacture even compared to other fluted point using groups". This contention is supported by the Folsom component at MacHaffie only as far as point and preform manufacture goes.

Two probable channel flakes are assigned to the Folsom component (Fig.42). One (#4925) is largely complete with a crushed platform. A small piece of the distal end is also missing. Item #8703 (Forbis artifact #5002) is a flake fragment missing the proximal end. Both pieces exhibit feathered terminations. Both channel flakes are of distinct chert MANA designations representing high quality lithic material (YBCCS1b and RCCS6), but the MANA designations are also distinct from any of the recovered Folsom points or preforms. Item #4925 measures 33 mm in maximum length, 16 mm in maximum width and 1.5 mm in maximum thickness with a weight of 1.45 g. Item #8703 (Forbis artifact #5002) measures 14 mm in

maximum width and 2.4 mm in maximum thickness with a weight of 1.1 g. Length is undetermined because the flake is incomplete.

Amick (1999:2) notes that "Nearly all Folsom assemblages contain channel flakes or failed preforms indicative of the importance of regular refurbishing of hunting weaponry". The MacHaffie site is no exception, however, we question if this aspect is unique to Folsom people. Instead of channel flakes, notching flakes likely exist (but are under-reported) among Middle and Late Precontact components. Is this not also evidence of the importance of refurbishing weaponry systems?

As a final thought regarding the MacHaffie Folsom points and preforms, we wonder why no attempt was made to recycle these refined bifacial artifacts for other tools. These would serve well for a variety of cutting and scraping tasks, so it seems odd to leave them behind. We also wonder why no distal end was recovered considering that most of the site has been excavated.

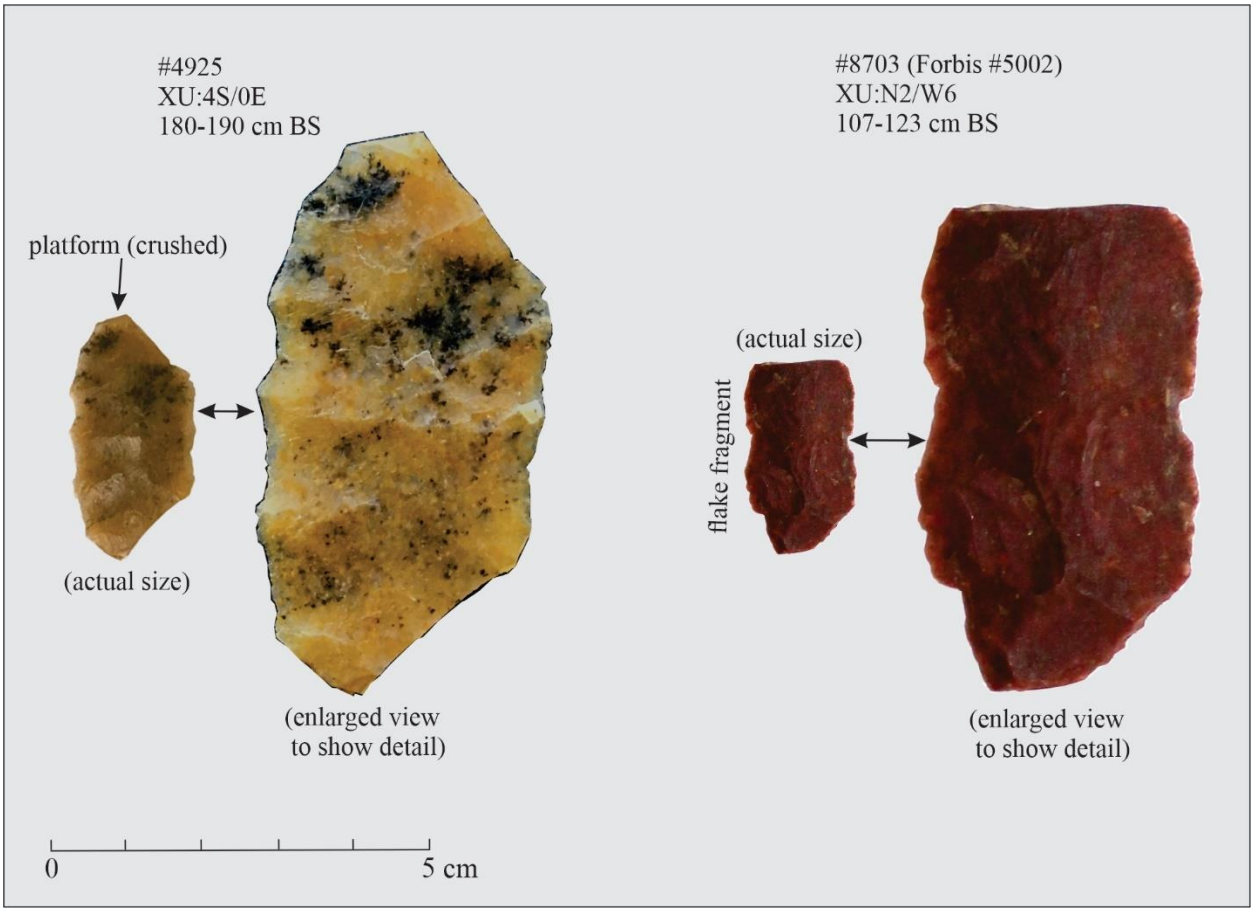


Figure 42. Probable Channel Flakes from 24JF4.

Bifaces (Tables 10 and 12; Figure 29-36, 39)

Nineteen non-hafted chert bifaces and fragments are made on 10 distinctive MANA designations: BCCS7, BCCS21, BCCS29, BCCS41, BCCS31, CCCS6, RCCS26, RCCS31, RCCS48, YBCCS1d, YBCCS22, YBCCS23, YBCCS24, YBCCS33a, YBCCS51 and YBCCS52. Only the MANA designations BCCS29 and BCCS41 are represented by more than one biface (n=3 pieces each). Additionally, there is a biface fragment of a fine-grained sedimentary quartzite (SDQZT2f). The total collection weighs 938.31 g. Eight of the bifaces were recovered and catalogued by Forbis, 11 were recovered by Davis, and one (#148) was recovered in 2018.

Ten are complete, eight are distal-medial or proximal-medial fragments, one is probably a proximal fragment, and one is a fragment of a biface edge. The ten complete bifaces average 7.3 cm in length, 4.97 cm in width, 1.7 cm in thickness, and 64.3 grams in weight. A majority are stage II bifaces (n=13), with the remainder being more refined stage III artifacts (Callahan 1979). The majority (80%) tend to be roughly ovate in shape and bi-convex in cross-section. Edge dulling or use-wear, as well as polish or abrading, was not observed. Eleven of the bifaces appear to have been made on large, thick flakes. The original blank of the remainder is not identifiable. Few of the bifaces broke during manufacture, so it is puzzling why so many were discarded when many could be further refined or even used to generate numerous additional flakes for cutting and scraping implements. The reason that biface # 148 was rejected is discussed in detail in the Knapping Feature 4 section.

Some were intended to be projectile point preforms, but most are fairly thick and appear better suited to flat and thin flake production. These might be better classified as bifacial cores. Only a few would be suited as cutting and scraping implements, but retouch and edge dulling were not observed. Edge grinding geared toward strengthening the edge for percussion thinning, however, is observable on several of the pieces. Some percentage were likely derived from heat-treated material, but it is not entirely clear which those might be because most of the selected lithics are very high quality—waxy to vitreous in luster, cryptocrystalline in texture, and generally free of internal anomalies. The biface collection is typical of campsite or secondary stone reduction sites, however. The Folsom component bifaces tend to be larger than those of comparable Middle and Late Period sites from the general area (e.g., Rennie and Hughes 1998; Rennie 2017). It is worth noting that no evidence of ultrathin biface production or intentional radial fracturing of flakes and bifaces, as observed elsewhere (see Root et al. 1999), appears among the MacHaffie Folsom component. Only biface #32 exhibits a fracture similar to a radial break, but no crush point could be identified so this is currently assumed to have been a random occurrence of a transverse fracture resulting through thinning. One point of uncertainty is why Forbis assigned bifaces #92 and 93 and possible 88 and 91 (Fig.43) to the Folsom component (Forbis artifact #s 3007, 1002, 5000, and 3002 respectively) when their depths below ground surface appear more consistent with Cody component levels.

Endscrapers, drills, awls, perforators, and spokeshaves (Table 10)

No endscrapers, drills, awls, perforators or spokeshaves assignable to the Folsom component have been recovered from the MacHaffie site.

Table 12. Metric, Nonmetric, and Provenience Data for Folsom Bifaces.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Shape	Cross-Section	Reduction Stage	Tool Condition
3	2000-6	180-200 cm BS	3	indeterminate	indeterminate	convex-asymmetrical	III	edge fragment
5	2000-4	180-200 cm BS	4	flake	indeterminate	bi-plano	II	proximal-medial fragment
17	8S/2W	160-170 cm BS	9	flake	ovate	bi-convex	II	complete
18	8S/2W	160-170 cm BS	9	flake	ovate	bi-convex	II	complete
19	8S/2W	180-190 cm BS	8	indeterminate	indeterminate	bi-convex	II	proximal fragment
20	6S/4W	170-180 cm BS	8	flake	ovate	bi-convex	III	proximal-medial fragment
23	6S/4W	170-180 cm BS	9	flake	ovate	bi-plano	II	complete
32	8S/2W	180-190 cm BS	9	indeterminate	ovate	bi-convex	III	distal-medial fragment
33	8S/2W	170-180 cm BS	9	flake	ovate	bi-convex	II	complete
35	6S/2W	180-190 cm BS	9	indeterminate	ovate	bi-convex	II	proximal-medial fragment
38	98-South Block	180-1900 cm BS	5	flake	ovate	plano-convex	II	proximal-medial fragment
88	S1/W4	87-96 cm BS	11	flake	triangular	bi-convex	II	complete
89	N2/W4	120 cm BS	11	flake	ovoid	bi-convex	II	complete
90	N2/W4	134 cm BS	11	flake	ovoid	bi-convex	II	complete
91	S1/W3	85-94 cm BS	11	indeterminate	indeterminate	bi-convex	II	distal-medial fragment
92	N2/W8	73 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment
93	S2/W3	82 cm BS	11	indeterminate	triangular	bi-convex	III	complete
94	N1/W6	113 cm BS	11	indeterminate	ovate	bi-convex	III	distal-medial fragment
95	N2/W3	149 cm BS	11	indeterminate	ovate	bi-convex	III	distal-medial fragment
148	8S/6W	140-150 cm BS	2	indeterminate	ovate	bi-convex	II	complete

Retouch/Use-Wear	Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
none	BCCS21		2.9	0.7	1.45	Transverse fracture. Probably broke during manufacture.
none	BCCS7	4.3	5.6	1.3	53.85	Transverse fracture, probably broke during manufacture.
none	CCCS6	6.4	4.3	1.3	34.3	
none	BCCS41	9.4	5.7	2.46	138	
none	BCCS41	1.5	3.6	1.2	5.35	Transverse fracture. Probably broke during manufacture. The piece is included with the Knapping Feature 2
none	YBCCS23	6.2	5.3	1	45.65	Transverse fracture. Probably broke during manufacture.
none	YBCCS52	9	4.4	2.5	41.35	Possible Folsom Point preform.
none	RCCS26	3.7	5.2	0.9	24.7	Transverse fracture. Probably broke during manufacture.
none	RCCS31	5.1	3.1	0.9	20	
none	RCCS48	3.5	6.4	1.3	45.35	Transverse fracture. Probably broke during manufacture.
none	YBCCS24	4.4	4.2	1	25.6	Transverse fracture. Probably broke during manufacture.
none	YBCCS33a	5.5	7.6	1.7	62.28	Forbis artifact #5000. Made on a broad flake that terminated in a hinge fracture. Large edge retouched on interior surface.
none	BCCS29	9.7	5.8	2.4	147	Forbis artifact #4003.
none	BCCS29	6.9	5.8	1.5	65.63	Forbis artifact #3002.
none	YBCCS9	3	3.7	1	15.3	Forbis artifact #3005.
none	YBCCS1d		4.8	1.2	31.96	Forbis artifact #3007.
none	YBCCS22	6.3	3.4	0.95	21.82	Forbis artifact #1002.
none	YBCCS51		4.2	1.3	43.74	Forbis artifact #3000.
none	SDQZT2f		3.4	0.88	17.92	Forbis artifact #3006.
none	BCCS41	7.9	3.8	1.5	46.73	Associated with Knapping Feature 4. Probably intended as a Folsom point preform. Discarded because of a natural internal fracture and a material flaw at one lateral edge.

biface measurements are in centimeters

Figure 43. Non-Projectile Point Bifaces Assigned to the Folsom Component (1).

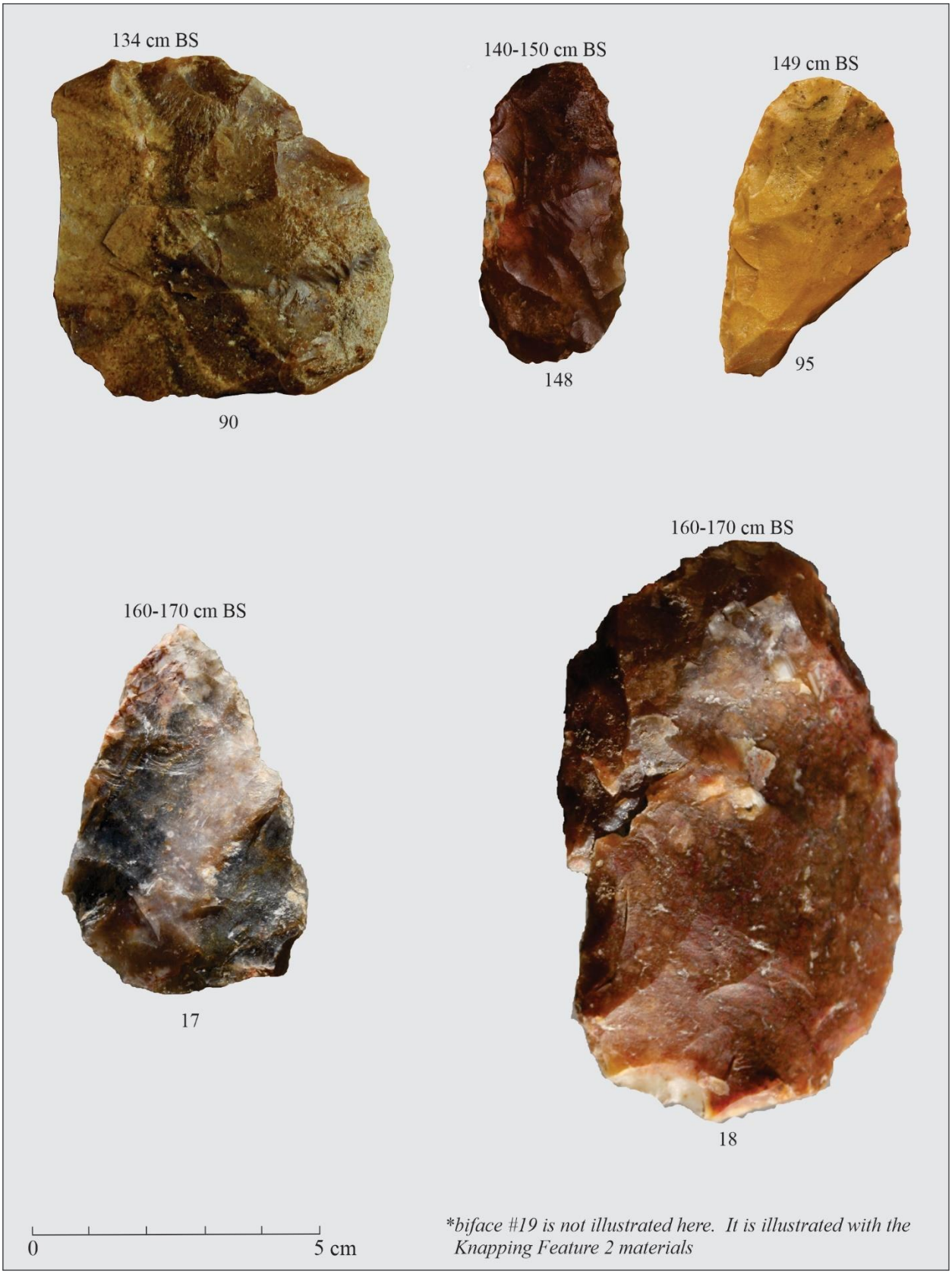


Figure 44. Non-Projectile Point Bifaces Assigned to the Folsom Component (2).

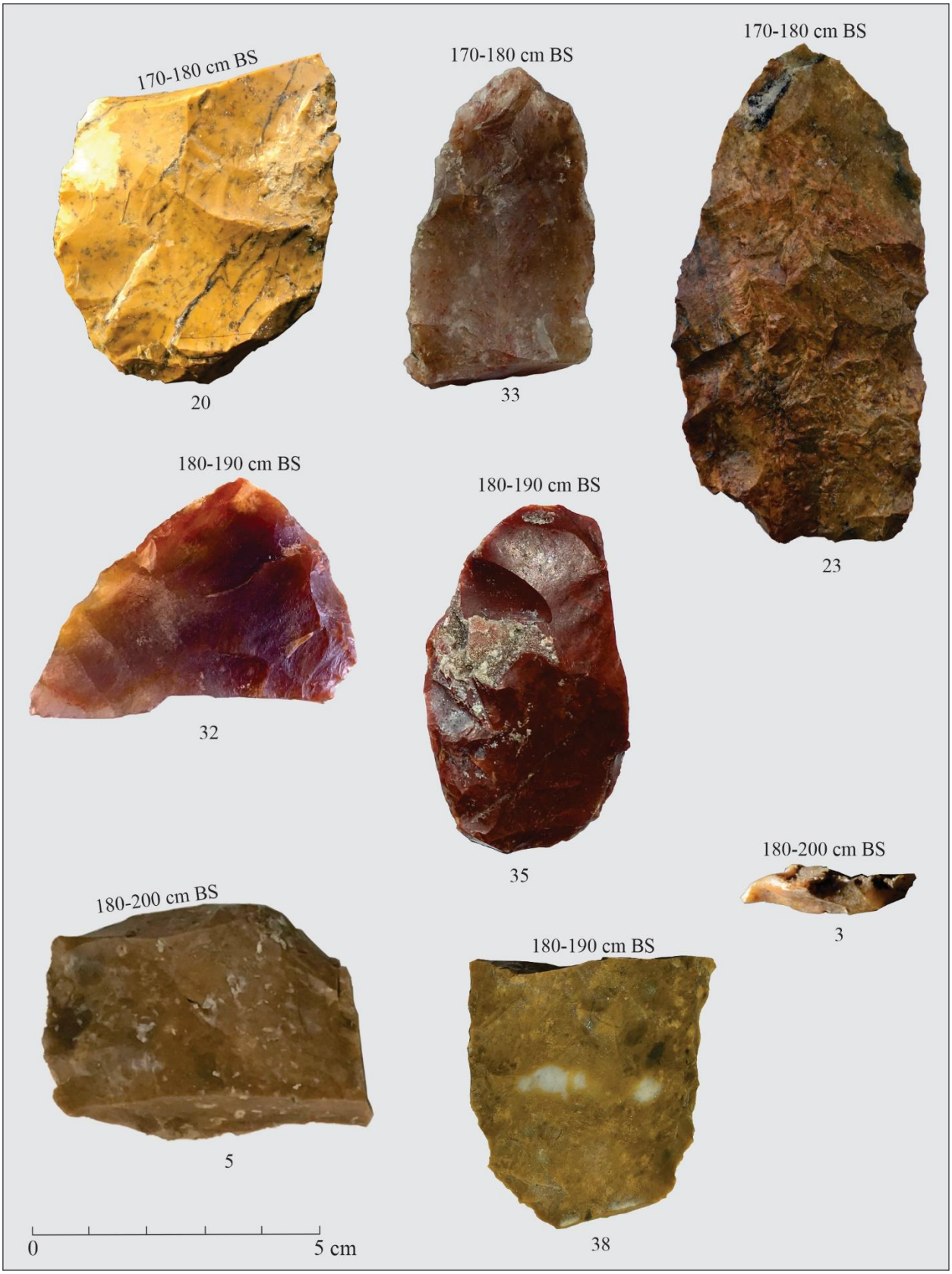


Figure 45. Non-Projectile Point Bifaces Assigned to the Folsom Component (3).

Burins/Gravers (Table 10; Figure 46)

The possible graver is made on a small, complete, moss agate (CCCS3) secondary percussion flake with a point platform and four intersecting exterior surface flake scars. It was recovered in 2000 at a depth of 180-200 cm BS within excavation unit 2000-6 (Figure 8). A short, probably inadvertently formed projection appears to have been utilized for cutting or scoring work. The projection forms a chisel-like point, but it does not appear to have been modified with secondary retouch. The distal end of the projection appears to be slightly crushed or broken based on minor hinge-like negative scars at its margins. Presumably the damage is a result of use-wear whereby a dense material was cut or scribed (Odell and Odell-Vereeken 1980). The piece measures 3.3 cm in length, 2.6 cm in width, 0.4 cm in thickness, and it weighs 2.85 grams. The chisel-like projection is 4 mm long, 7 mm wide at its base, and it tapers to 2.6 mm wide at its broken tip surface.

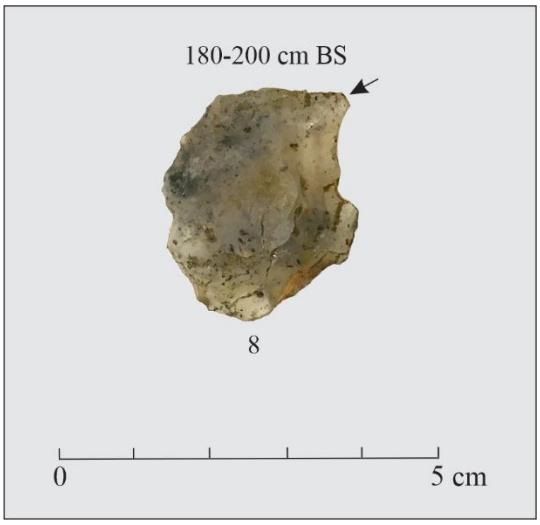


Figure 46. Possible Folsom Graver from 24JF4.

A notched chert flake of the MANA designation BCCS41 is included here only because its intended function, if one existed, is uncertain (Figure 47). The artifact could have just as easily been categorized as DEF/M. The piece is associated with the Knapping Feature 1 debitage and was recovered from excavation unit C-5 at a depth of 180-200 cm BS. It is an elongate flake fragment with a feathered termination. The flake exhibits no cortex and three exterior surface intersecting scars suggest it was probably a mid-reduction stage percussion biface thinning flake. The flake fragment has overall dimensions of 2.6 cm in length x 1.4 cm in width x 0.2 cm in thickness and it weighs 1 gram. Two vertically sequential narrow symmetrical notches have been pressure flaked into one lateral edge of the piece near its mid-point. Each notch is oriented 90 degrees to the long axis of the flake. Both notches measure 1 mm wide and run 2 mm deep into the flake body. The notches form, or are separated by, a small sharp projection that measures 2 mm long x 1.8 mm wide. The gap in the lateral edge of the flake formed by removal

of the two notches is 6 mm across. The top of the projection is slightly below the level with the adjoining lateral edge of the flake. The piece may have been intended for scribing or graving small diameter (<6 mm diameter) objects of wood or bone. Alternately, it may be the product of busy work having no real purpose.

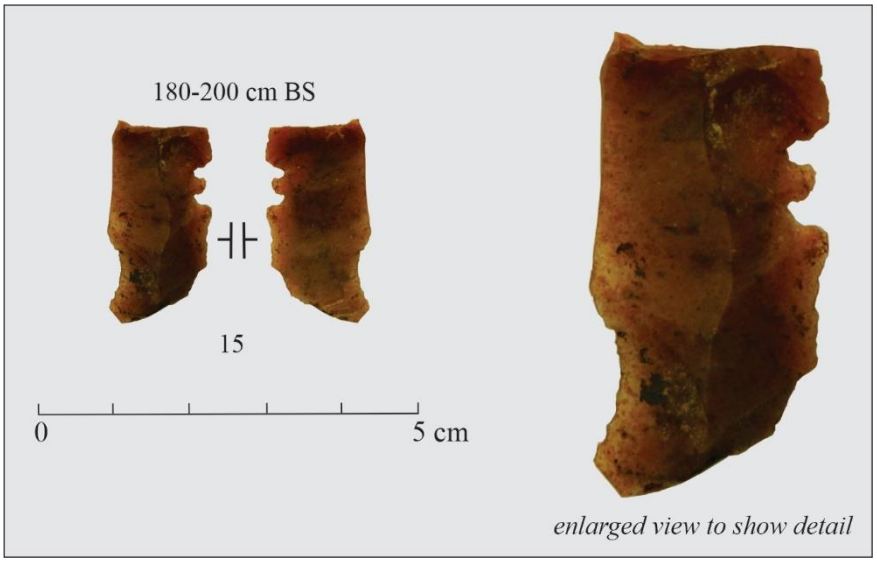


Figure 47. Notched Flake from the Folsom Component in 24JF4.

Cores (Tables 10, 13; Figures 48-53)

Thirty-one cores weighing a total of 4,334 grams are assigned to the Folsom component. One (16a-16c) constitutes three fragments of presumably the same core. Six cores were recovered and catalogued by Forbis, 23 were recovered by Davis, and two were recovered in 2017. The cores are generally heavily utilized but most are not fully exhausted. The cores also show a wider range in tool stone quality than the Folsom bifaces. All but one are of chert and comprise 20 distinct MANA designations: BCCS7, BCCS9, BCCS16, BCCS21, BCCS28, BCCS29, BCCS33, BCCS38, BCCS41, BCCS44, BCCS45, BCCS46, CCCS6, RCCS2, RCCS26, YBCCS1d, YBCCS18, YBCCS28, YBCCS50 and YBCCS52. The MANA designations BCCS9, BCCS21, BCCS33 and YBCCS1d are represented by two cores each with the BCCS29 and BCCS41 MANA designations represented by four pieces each. The outlier (Fig.52.1) is of local tan granite (GRAN5). This material is similar in texture to medium-grained sedimentary quartzite. Although flakes with reasonably sharp and durable edges can be generated from this material, refining a piece through pressure flaking would be difficult.

Table 13. Metric, Nonmetric, and Provenience Data for Folsom Cores.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Core Type	Shape	Extent of Utilization	Condition	Retouch/Use-Wear
1	4N/8E	180-190 cm BS	2	block	unprepared	blocky	minimal	complete	none
5	4N/8E	180-190 cm BS	2	pebble	bipolar	pebble	moderate	complete	none
12	2000-6	180-200 cm BS	3	pebble	bipolar	amorphous	minimal	complete	none
13	2000-6	180-200 cm BS	3	indeterminate	unprepared	amorphous	extensive	complete	none
14	C-7	160-180 cm BS	3	indeterminate	unprepared	amorphous	extensive	complete	none
15	C-7	160-180 cm BS	3	indeterminate	unprepared	amorphous	extensive	complete	none
16a-16c	C-5	180-200 cm BS	3	indeterminate	unprepared	amorphous	extensive	fragments	none
17	C-4	180-200 cm BS	3	indeterminate	unprepared	amorphous	extensive	complete	none
18	C-2	180-200 cm BS	3	small nodule	unprepared	amorphous	minimal	complete	none
19	C-2	160-180 cm BS	3	indeterminate	unprepared	amorphous	extensive	fragment	none
20	C-2	180-200 cm BS	3	small cobble	unprepared	amorphous	moderate	fragment	none
21	C-1	180-200 cm BS	3	indeterminate	unprepared	amorphous	extensive	complete	none
22	C-1	180-200 cm BS	3	indeterminate	bifacial	tabular	extensive	complete	none
29	2000-4	160-180 cm BS	4	indeterminate	unprepared	amorphous	extensive	fragment	none

Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
GRAN5	4.5	6.5	4	85	SW quadrant (1x1 m subdivision)
YBCCS28	4.4	4	3.4	64.85	SW quadrant (1x1 m subdivision); tested pebble of moderate quality.
BCCS16	3.6	2.2	1.5	13.15	Small bipolar core, not suitable for free-hand reduction work. Exhibits desire to produce small (short and thin) and straight flakes.
CCCS6	5.6	2.6	1.5	18.6	Exhausted flake core. Probably free-hand reduction core, but currently too small to be useful for such work.
RCCS48	7.8	4	3.4	139.5	Free-hand percussion core
BCCS41	6.5	4.4	2.6	137.7	Free-hand percussion core
BCCS41	4.2	7.2	3.4	232.8	Possible core fragments of similar size associated with Knapping Feature 1. Core fragments included with the Knapping Feature 1 debitage baggies.
BCCS21	4.3	3.5	2.7	37.75	Exhausted core
BCCS21	8.5	6.3	5.5	172.1	Very poor quality piece. Heavily intermixed with limestone. Only small areas of tool quality chert available. A few small flakes randomly removed from the tool quality zones.
BCCS44	6.7	3.5	2.5	61.9	Still useable piece. Many small, straight flakes randomly removed rom the core.
BCCS33	3.5	5	2.5	76.5	Four fragments from a small chert cobble. Lithic material is atypical for local chert varieties and may have been imported from elsewhere. One side of core is almost polyhedral in form.
BCCS45	7	7.2	3	147.3	Final series of flakes removed (2 cm W x 3 cm L) not large enough for medium or large points.
BCCS45	13.3	6.7	2.8	255.14	Still useable piece. Final series of randomly removed flakes were small (SG2) and straight.
YBCCS1d	4.5	5.5	2	43.85	Still useable piece. Many small, straight flakes randomly removed rom the core. Cortex on one short surface/edge.

core measurements are in centimeters

Table 13. Metric, Nonmetric, and Provenience Data for Folsom Cores (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Core Type	Shape	Extent of Utilization	Condition	Retouch/Use-Wear
31	2000-A	160-180 cm BS	4	small nodule	unprepared	amorphous	minimal	complete	none
39	2000-B	180-200 cm BS	4	pebble	bipolar	pebble	minimal	complete	none
45	2000-C	160-180 cm BS	4	flake	unprepared	amorphous	moderate	complete	none
46	2000-C	160-180 cm BS	4	flake	bifacial	ovate	moderate	complete	none
56	98-South Block	180-190 cm BS	5	indeterminate	unprepared	amorphous	extensive	complete	none
57	8S/4W	170-180 cm BS	8	small nodule	unprepared	blocky	moderate	complete	none
58	8S/4W	190-200 cm BS	8	small nodule	unprepared	blocky	moderate	complete	none
59	6S/4W	170-180 cm BS	8	indeterminate	unprepared	amorphous	minimal	indeterminate	none
60	6S/4W	170-180 cm BS	8	small nodule	bifacial	ovate	moderate	complete	none
72	98-South Block	190-200 cm BS	5	medium nodule	unprepared	amorphous	extensive	complete	none
73	4S/0E	180-190 cm BS	10	medium nodule	unprepared	amorphous	extensive	complete	none
75	0N/0E	180-190 cm BS	10	indeterminate	unprepared	amorphous	extensive	complete	none
78	S1/E1	out-of-context	1	indeterminate	unprepared	amorphous	extensive	complete	none
79	N2/W3	139 cm BS	11	indeterminate	unprepared	blocky	extensive	complete	none
80	S1/W6	107-123 cm BS	11	indeterminate	unprepared	ovoid	extensive	complete	none
81	N1/W4	119 cm BS	11	indeterminate	unprepared	ovoid	extensive	complete	none
82	S1/W5	119 cm BS	11	indeterminate	unprepared	amorphous	extensive	complete	none
96	N2/W6	105-120 cm BS	11	nodule	unprepared	blocky	moderate	complete	none

Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
BCCS28	5.6	3.1	2.5	46	Very small minimally worked core exhibiting 3 overlapping, bladelet-like flake removal scars on the one clean surface. Remainder of core is covered in cortex. The piece could only reduced to any degree through bipolar reduction.
BCCS21	4.2	3.3	2	31.85	Cortex covers exterior surface.
BCCS29	12.6	9.2	4	290	Random flake removals from around perimeter of piece.
BCCS41	7.5	5.2	2	82	Random flake removals from both faces.
BCCS9	8.95	7.3	3.86	263	Some cortex on one surface.
BCCS44	7.22	5.87	3.86	213	Cortex covers most of one face and one end.
BCCS9	7.06	4.9	2.77	95.1	Cortex covers most of one side.
BCCS44	5.6	6.5	2.2	95.65	Some cortex (discontiguous) on one surface.
BCCS44	8.3	6.4	3.1	174	Best described as a Stage I biface. Some cortex on both faces.
BCCS41	9	7	5.5	418	Discontinuous cortex around perimeter.
BCCS9	8	6.6	1.9	168	Some cotrex on exterior surface.
YBCCS52	5.7	4.5	2.6	51.45	Marginal quality chert.
BCCS29	10.5	6.4	4.6	259	Forbis artifact #4005. Assigned by Forbis to Folsom based on material type.
BCCS41	5.3	4.1	2.6	72.16	Forbis artifact #4001
BCCS41	6.1	4.5	2.6	73	Forbis artifact #4004
BCCS41	8.1	4.7	3.6	127	Forbis artifact #4002
BCCS41	8.8	6.6	3.5	189	Forbis artifact #4000
BCCS33	6.2	6	3.5	200	Opportunistic flake core.

core measurements are in centimeters

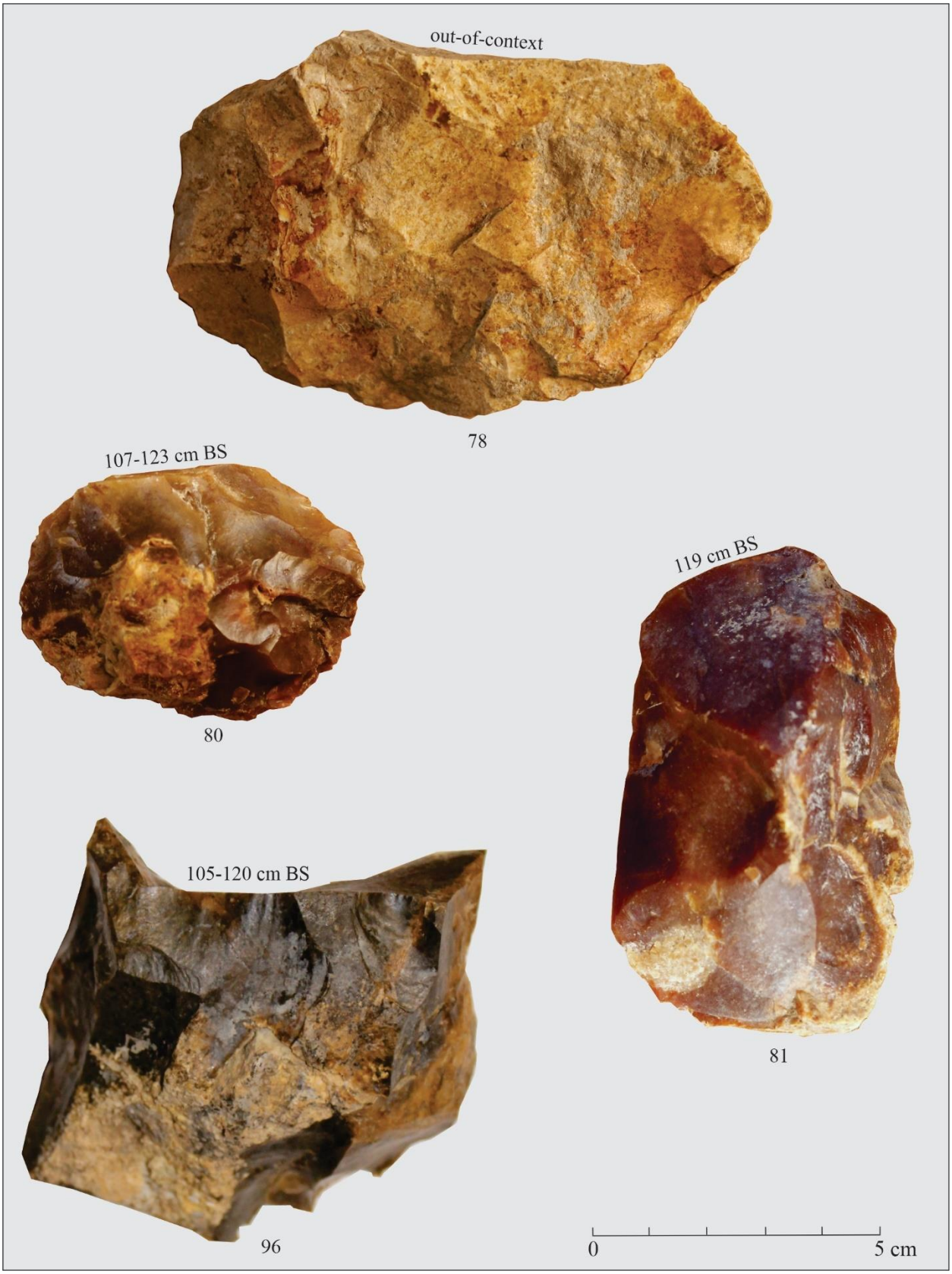


Figure 48. Cores Assigned to the Folsom Component (1).

Figure 49. Cores Assigned to the Folsom Component (2).

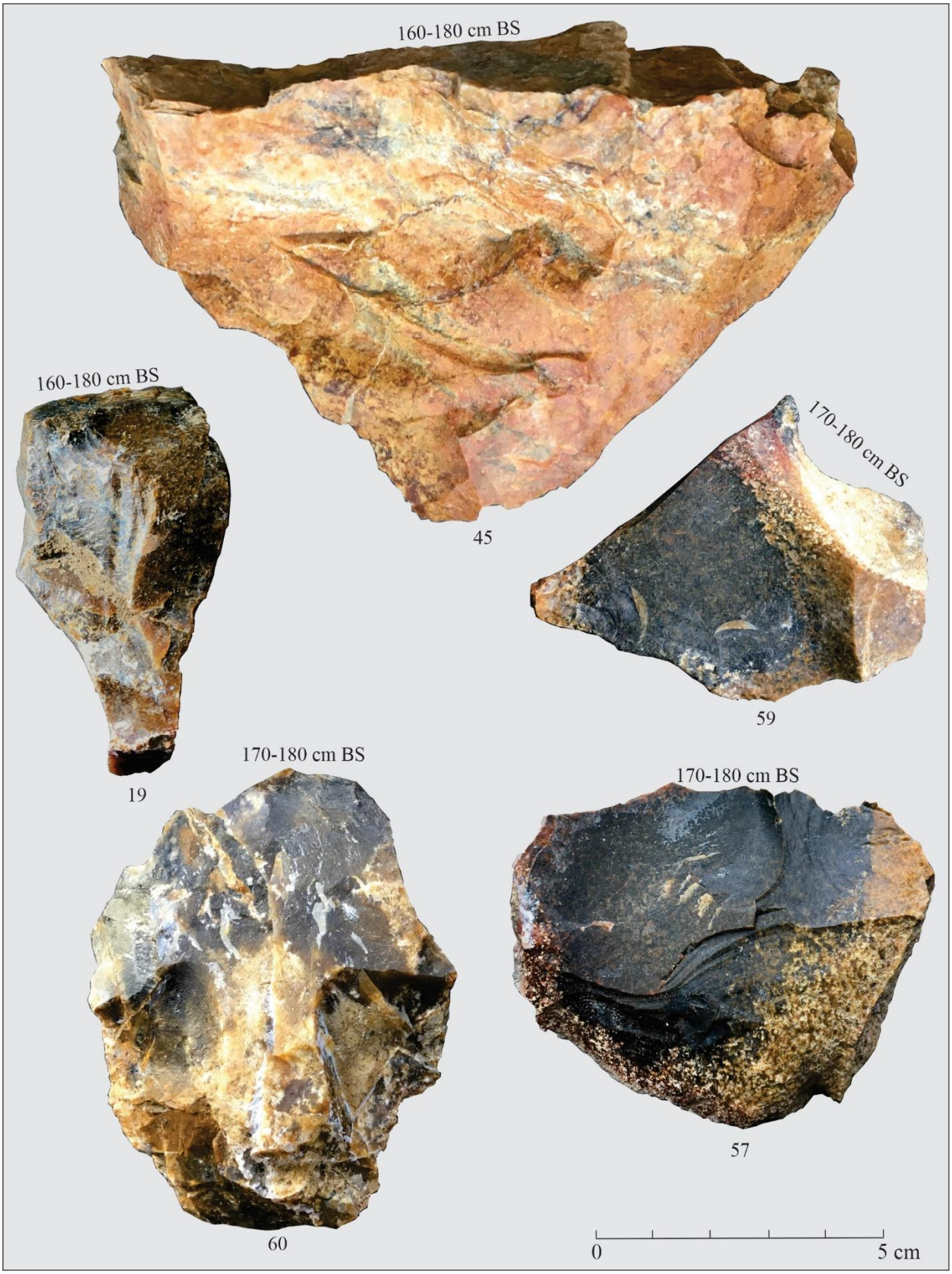


Figure 50. Cores Assigned to the Folsom Component (3).

Figure 51. Cores Assigned to the Folsom Component (4).

Figure 52. Cores Assigned to the Folsom Component (5).

Figure 53. Cores Assigned to the Folsom Component (6).

Three cores are bipolar (Fig. 51. 5, Fig. 53.12, Fig. 52.39), three are bifacial (Fig.50. 60, Fig. 49.46, Fig. 53.22), but the majority (n=25 or 81%) are unprepared or opportunistic flake cores. The bipolar cores were chert pebbles reduced in this manner to generate short, thin and straight flakes. They were minimally utilized, so the resulting flakes were not in high demand. Two of the cores (Fig. 50.45. and Fig. 49.46) are produced on large, thick flakes. Eight are small to medium-size chert nodules or blocky pieces, but it is difficult to tell how much they have been reduced from their original forms. Core #20 (Fig. 53) consists of four fragments from a small chert cobble. The lithic material is atypical for local chert varieties and may have been imported. It also feels much lighter than expected and may be somewhat desilicified. One side of the small core is polyhedral in form.

The original form of the lithic raw material for the remainder of the cores could not be determined. Presumably they were either large, thick flakes or small to medium-size nodules or chunks based on what the local limestone formation typically produces. Ten pieces (32%) retain minor to moderate zones of limestone cortex. Three fragments of presumably the same core (#16a-16c) are considered here as a single piece. This core is included, illustrated, and discussed in detail in the Knapping Feature 1 section.

The bipolar cores average 4.0 cm in length, 3.2 cm in width, 2.3 cm in thickness and have an average weight of 36.6 grams. The bifacial cores average 9.7 cm in length, 6.1 cm in width, 2.6 cm in thickness, and have an average weight of 170.38 grams. The unprepared cores average 6.9 cm in length, 5.4 cm in width, 4.1 cm in thickness, and have an average weight of 139.2 grams.

Four pieces of a very small nodular chert core (#20: MANA designation BCCS45) were recovered from the same excavation unit (C-2). The lithic material is atypical of local chert varieties and may have been imported. It is also poor quality being somewhat grainy. One side of the core is almost polyhedral in form, but it would be incorrect to call this a blade core.

A significant aspect is that the overall toolstone quality of most cores is inferior to the bifaces. The collection of generally unprepared, unstandardized, opportunistic flake removal cores does not fit the accepted pattern of Folsom technology focused on maintaining the long-term utility of standardized cores (Amick 1999:3). It also calls into question why an archaeological culture recognized for selecting high quality toolstone would reduce marginal to poor quality pieces when surrounded by a smorgasbord of remarkable CCS. Although the associated debitage suggests a great deal of middle stage biface thinning and shaping, it is not possible to know what kinds of bifaces or flake blanks were taken from the site. Amick (1999:2) notes that “It is generally accepted that large bifacial cores provided the foundation of mobile toolkits for Folsom groups”. Folsom people who visited MacHaffie may provide an exception to the rule. There is no evidence for a pattern of large, refined biface manufacture. To the contrary, the collection of non-projectile point bifaces and discarded core pieces strongly suggest more emphasis on reduction of unstandardized cores and rudimentary bifaces simply to produce small and medium-size, thin, and generally straight flakes. Presumably the desired flakes and bifaces were removed from the site for later use.

Amick (1999:2) also contends that “The small size and degree of material conservation displayed among many Folsom stone tools is remarkable”. Some of the cores were probably

discarded when flakes could no longer be easily removed. As noted by Callahan (1979:66), "When the hammer becomes too much heavier than the core, it tends to push the core rather than remove the flake." However, many cores of the Folsom component could still produce small or medium-size flakes. The number of discarded useable flakes that could be pressure flaked into medium-size projectile points or other tools is also noticeable when compared to many local Middle and Late Period components. If resource conservation was an issue, then fewer pieces of usable lithic material would be expected. Perhaps it is the universal case for humanity that when resources are plentiful, conservation is not given much thought.

Debitage with Edge-Flaking/Modification (DEF/M) (Tables 10 and 14; Figure 54)

Six secondary flakes that exhibit post-production edge modification are assigned to the Folsom component. Four were recovered and catalogued by Richard Forbis, and two were recovered by Les Davis. One (Fig. 54.6) is clearly derived from a mid-reduction stage biface. The others could have been removed from early to mid-reduction stage bifaces, or unprepared cores. Interestingly, the only DEF/M made on a definite biface thinning flake is also the only non-chert piece in the group; the only material that is not locally available. It (#6) is made of rhyolite (RHY2), the source for which is presently unknown. The smallest DEF/M measures 2.4 cm, average widths of 1.3 cm, average thicknesses of 0.7 cm, and weighs 1.4 grams. The other five DEF/M have average lengths of 4.6 cm, average widths of 4.6 cm, average thicknesses of 0.99 cm, and an average weight of 28.23 grams. Microwear studies, which were not conducted, may better interpret the function of the recovered DEF/M.

Five of the pieces are chert covering four distinct MANA designations (BCCS29, BCCS41, RCCS2 and YBCCS3). Only MANA designation RCCS2 is represented twice (#29 and 30). Three of the DEF/M (#5, 30 [Forbis #2002], and 31 [Forbis #3003]) exhibit well-patterned, intentional retouch of the exterior surfaces of one lateral margin only. Further, #31 was intentionally retouched to give the flake a drop-point knife blade style appearance.

One DEF/M (#32 [Forbis # 3004]) exhibits unifacial flake removals of the exterior surface of one lateral edge, and unifacial edge flaking of the interior surface of the opposite lateral edge. Another DEF/M exhibits only bifacial flaking along both lateral margins (#6), and one piece (#29 [Forbis #3001]) shows bifacial retouch of a short segment of one lateral edge. The bifacial edge flaking of DEF/M (#6) may not be intentional. This post-production edge-modification is largely erratic, shallow, broad, fine, feather-terminating micro-flake removals. Most of these flake scars extend less than 2 mm from the edge of the piece into the flake body. Experiments demonstrate that this kind of edge damage or use wear could result from bi-directional cutting of moderately soft or moderately hard material (cf. Odell and Odell-Vereeken 1980).

Table 14. Metric, Nonmetric, and Provenience Data for Folsom DEF/M.

Record #	Excavation Unit	Excavated Level Depth	CMU	Debitage Type	Reduction Stage	Exterior Surface Flake Scar Count	Flake Scar Orientation	Lithic Material Code
5	C-9	160-180 cm BS	3	flake	secondary	1		BCCS41
6	C-5	160-180 cm BS	3	flake	secondary	2	intersecting	RHY2
29	N2/W6	107-123 cm BS	11	flake	secondary	4	intersecting	RCCS2
30	S1/W1	85 cm BS	11	flake	secondary	3	intersecting	RCCS2
31	N2/W5	107 cm BS	11	flake	secondary	3	intersecting	YBCCS3
32	N2/W6	116 cm BS	11	flake	secondary	4	intersecting	BCCS29

Flake Shape	Flake Condition	Flake Termination Type	Platform Type	Flake Type	Type of Edge Modification	Number of Retouched Edges	Size Grade	Max. Length
elongate	complete	feather	point	shaping/thinning	unifacial flaking	1	3	2.4
ovate	broken		faceted	biface thinning	bifacial flaking	2	1	4.4
ovate	complete	feather	flat	shaping/thinning	bifacial flaking	1	1	3.5
elongate	complete	feather	flat	shaping/thinning	unifacial flaking	1	1	10.4
ovate	fragment	feather	indeterminate	shaping/thinning	unifacial flaking	1	2	2.6
indeterminate	fragment	feather	indeterminate	shaping/thinning	alternating unifacial flaking	2	1	4.7

Max. Width	Max. Thickness	Weight (grams)	Comments
1.3	0.7	1.4	Shallow, but continuous and well-defined flake removals from exterior surface of one lateral edge.
4.1	0.7	18.15	Shallow and somewhat erratic flake removals from entirety of both lateral edges.
6.8	1.3	35.09	Forbis artifact #3001. Bifacial flaking of short segment of one lateral edge.
4.4	1.3	76.28	Forbis artifact #2002. Shallow, unifacial flaking along a short segment of exterior surface of one lateral margin.
5.5	0.97	13.38	Forbis artifact #3003. Patterned, intentional, unifacial flaking along exterior surface of one lateral margin. Piece was shaped into a drop-point knife style pattern.
5.8	0.96	25.08	Forbis artifact #3004. Patterned, intentional, unifacial flaking along exterior surface of one lateral margin and interior surface of opposite lateral margin.

DEF/M measurements are in centimeters

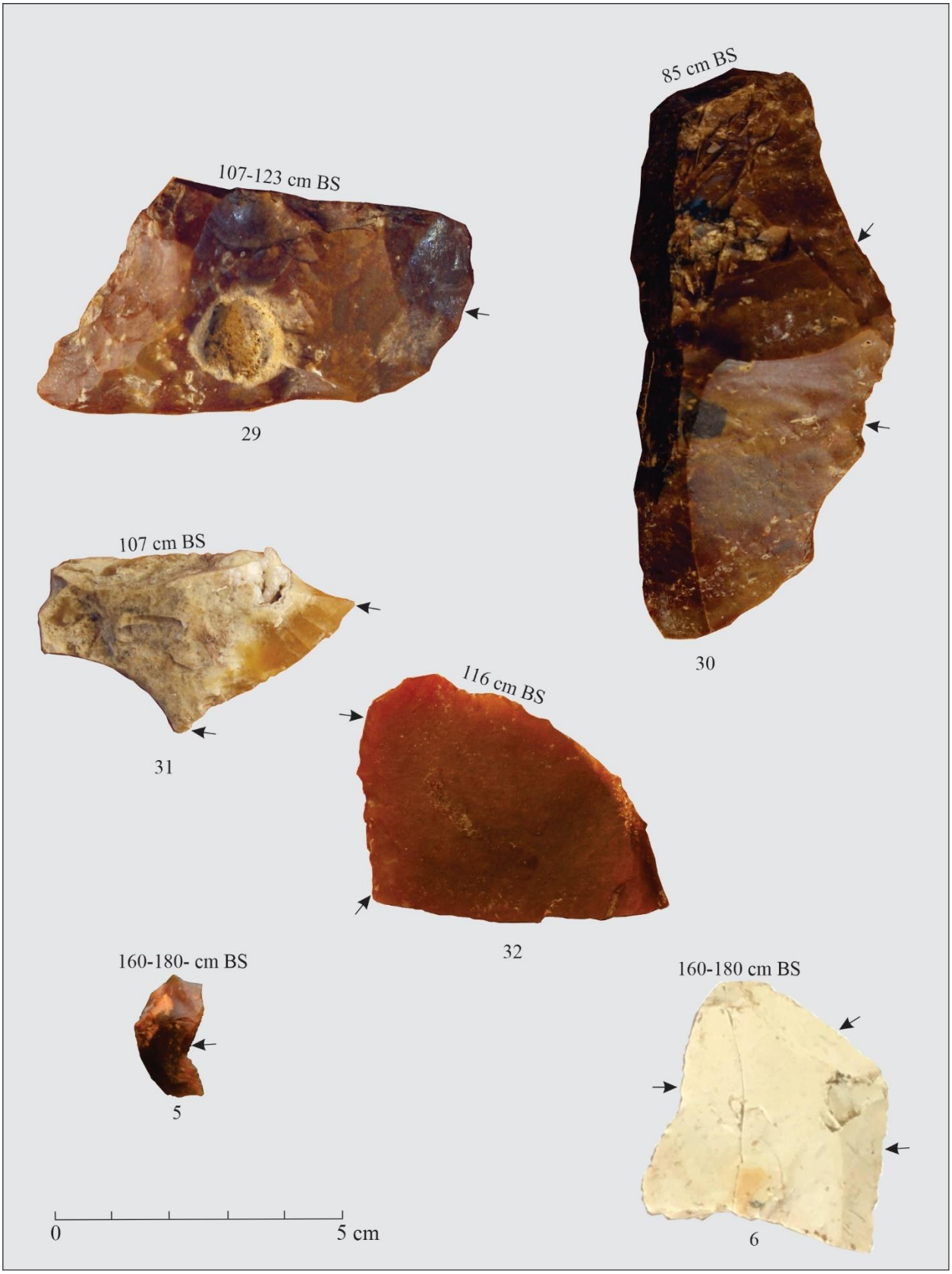


Figure 54. DEF/M Assigned to the Folsom Component. Arrows Indicate Edge Modification.

Unmodified Debitage (Tables 10, 15-17; Figures 55-56)

A total of 1,094 pieces of lithic debitage (4,885.38 g) is assigned to the Folsom component and constitute items that did not correlate to a defined Knapping Feature (see Sections 6.1.1-6.1.3). The lithic materials fall under 128 distinct MANA designations and are generally described as andesite, basalt, granite, microcrystalline/cryptocrystalline silicate (CCS or "chert"), clear quartz crystal, sedimentary quartzite, and siliceous mudstone. In terms of lithic raw materials represented, 92 percent of the debitage is chert. Although the color and texture range is great, there is a preference for reddish to reddish-brown material (55% of all CCS). Little of the lithic debitage appears to have removed from heat-treated preforms. However, heat-treating of the highly siliceous local chert is not always easy to recognize. Approximately 29 pieces exhibit potlids on one or more surface attesting to rapid cooling. Most of the chert was likely obtained from local sources (see Figure 3). The red and reddish-brown to honey-brown chert assigned MANA units BCCS41 and RCCS48 most likely came from the extensive chert quarry designated 24JF881 approximately 400 m northwest of MacHaffie (see Figure 3) where visually and texturally identical cherts dominate. Another chert source of similar color and texture was largely destroyed by residential and commercial development in the Jackson Creek Saloon locality approximately 1.6 km to the northwest.

Neither obsidian nor dacite was recovered from the Folsom component. This is interesting because most archaeological sites in southwest Montana contain a minor to modest amount of these materials. Even the presumed Folsom component at Indian Creek contained a small quantity of dacite and obsidian (Davis and Root n.d.). Equally interesting is the selection of lithic materials utilized at MacHaffie. Although surrounded by deposits of high-quality chert, a modest amount of poor-quality chert was being reduced, as was medium to fine-grained quartzite cobbles. Another local lithic reduced through percussion is a medium-fine grained siliceous granite. Presumably, flakes utilized as simple cutting and scraping implements were derived from this material, but one must question why? Similarly, a single clear quartz crystal flake was recovered from the Folsom component. The piece was likely removed through bipolar reduction considering its small-size, but to what end?

Recovered from the Folsom component over a horizontal distance of approximately 20 meters were pieces of a distinct chert or chert-like material assigned the MANA designation of GBCCS10. The material is very light and possibly demineralized or desilicified. Two of the flakes exhibit more recent flake scars that partially cut through a series of older, weathered and discolored flake scars. This suggests great antiquity to the history of the core. Another interesting piece is a CCCS2 chert flake (#758 from unit C-7) that is inexplicably lightly covered in red ochre. This appears intentional, because red ochre staining was not observed on any other artifacts in the Folsom component. The reader should recall, however, that several pieces of bison-size bone fragments were also intentionally coated with ochre from the same depth and from nearby excavation unit C-2. Presumably there is a direct association.

Shatter accounts for 22 percent of the debitage, but very little angular shatter (n=52 or 22% of all Folsom shatter) is present. Additionally, 54 (5%) pieces of debitage exhibit some cortex and 96 percent of the pieces with cortex are chert. This suggests initial edging of bifacial cores and initial preparation of nonstandardized cores occurred off-site.

Table 15. Flake Platform Morphology among Folsom Unmodified Debitage.

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
AND2	1					1
BAS1	1					1
BCCS1						0
BCCS2						0
BCCS3		1	1			2
BCCS4	5		2			7
BCCS5	1					1
BCCS6	2					2
BCCS7	1		1			2
BCCS9	9		12	2		23
BCCS11						0
BCCS12	1		3			4
BCCS16						0
BCCS18	1			1		2
BCCS19	1	1				2
BCCS21	7		8	1		16
BCCS23		2	2			4
BCCS24	1					1
BCCS25	1					1
BCCS26	1					1
BCCS28	11		3	1		15
BCCS29	1		5			6
BCCS32	1					1
BCCS36	1					1
BCCS38	2	1	2	1		6
BCCS41	50	28	109	9		196
BCCS42			1			1
BCCS43	1					1
BCCS44	1					1
BCCS46	1	1		1		3
BCCS47	1					1
BPCCS5	2		2			4
CCCS1			1			1
CCCS2	4	1	3			8
CCCS3	6	2	14	2		24
CCCS5	10	8	1	1		20
CCCS6	9	7	2	1		19
CCCS7	3	1	10			14
CCCS8	1					1
CCCS9	1	1				2
GBCCS3	1					1
GBCCS10	2		1			3
GBCCS11						0
GBCCS13				1		1
GBCCS17	1					1
GBCCS18	8	9	2	2		21
GBCCS20	5	1	1			7
GBCCS21			1			1
GBCCS36		1				1

Table 15. Flake Platform Morphology among Folsom Unmodified Debitage (continued).

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
GBCCS39		1	1			2
GBCCS43			1			1
GRAN3	2					2
GRAN5	26		10	1		37
QTZCRY2						0
RCCS2	1		7			8
RCCS3	1		1			2
RCCS4			5			5
RCCS5			1			1
RCCS6	4	2	5			11
RCCS8						0
RCCS11	1	1	2			4
RCCS12	3		3	1		7
RCCS13			5			5
RCCS15						0
RCCS16						0
RCCS19	2		6	1		9
RCCS20			1			1
RCCS22	1		5			6
RCCS26	1		2			3
RCCS27			1			1
RCCS28	1					1
RCCS30	1					1
RCCS32			2			2
RCCS33	1					1
RCCS35		1	1			2
RCCS47	1		2			3
RCCS48	11	6	21	5		43
RCCS56	1	1				2
SDQZT4m	1					1
SDQZT5j	1		1			2
SLM1			1			1
WCCS3	1					1
WCCS4						0
WCCS5	2		4			6
WCCS10	1					1
WCCS11						0
WCCS12	1		1			2
WCCS14	1	2				3
WCCS15	1					1
YBCCS1a	1		2	1		4
YBCCS1b			1	1		2
YBCCS1d	2		1	1		4
YBCCS2						0
YBCCS3			1			1
YBCCS4	3		4	1		8
YBCCS5		1				1
YBCCS7	1					1
YBCCS8			1			1

Table 15. Flake Platform Morphology among Folsom Unmodified Debitage (continued).

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
YBCCS9	1	1				2
YBCCS11		1	2			3
YBCCS12		1	1			2
YBCCS15	1		1			2
YBCCS18	1		2			3
YBCCS19	1					1
YBCCS21						0
YBCCS22			2			2
YBCCS23	1		3			4
YBCCS24		1				1
YBCCS25			1			1
YBCCS27	1					1
YBCCS28	2	1	2			5
YBCCS29						0
YBCCS30	3		8			11
YBCCS31	1					1
YBCCS33a						0
YBCCS35	1		1			2
YBCCS37	1	1				2
YBCCS39	1					1
YBCCS40	1		1			2
YBCCS42	2					2
YBCCS43		1				1
YBCCS45	1		2	1		4
YBCCS49	1					1
YBCCS50	5		1			6
YBCCS51	1		3	1		5
YBCCS52	4		2			6
YBCCS54			1			1
YBCCS55	1		4			5
	261	87	323	37	0	708

Table 16. Size Grade and Weights for Folsom Unmodified Debitage.

	Size Grade										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
AND2	1	7.69									1	7.69
BAS1	1	35.05									1	35.05
BCCS1					2	2.65					2	2.65
BCCS2					1	0.35					1	0.35
BCCS3			2	6.85							2	6.85
BCCS4			3	19.45	8	4.6					11	24.05
BCCS5	1	17.82									1	17.82
BCCS6			2	12.78							2	12.78
BCCS7			2	15.35	5	2.15					7	17.5
BCCS9	3	46.93	10	54.03	15	8.73					28	109.69
BCCS11					2	2.8					2	2.8
BCCS12			2	17.4	3	1.55					5	18.95
BCCS16			1	4.92							1	4.92
BCCS18	2	64.44			1	0.55					3	64.99
BCCS19			3	26.05							3	26.05
BCCS21	3	77.35	4	16.9	12	6.4	1	0.15			20	100.8
BCCS23			1	8.05	5	2.21					6	10.26
BCCS24					1	0.7					1	0.7
BCCS25			6	34.45							6	34.45
BCCS26	1	18.2									1	18.2
BCCS28	1	10.1	6	30.15	10	6.8					17	47.05
BCCS29			2	2.81	4	0.85					6	3.66
BCCS32	2	45.99									2	45.99
BCCS36					1	0.75					1	0.75
BCCS38	2	11.76	2	10.19	7	4.2					11	26.15
BCCS41	19	474.25	79	222.54	157	75.5	38	3.8			293	776.09
BCCS42					1	0.35					1	0.35
BCCS43					1	1.6					1	1.6
BCCS44			2	16.9	1	2.15					3	19.05
BCCS46	2	80.48	2	18.55	1	0.65					5	99.68
BCCS47			1	4.5							1	4.5
BPCCS5			3	3.3	6	1.8					9	5.1
CCCS1					3	1.65	1	0.1			4	1.75
CCCS2	2	55.15	2	5.48	10	6.15	1	0.15			15	66.93
CCCS3	1	17.8	9	46.7	21	10.67					31	75.17
CCCS5	6	69.7	17	60.91	9	4.93					32	135.54
CCCS6	5	204.38	14	43.81	9	8.67					28	256.86
CCCS7			6	22.25	11	8.55	1	0.05			18	30.85
CCCS8					1	1.4					1	1.4
CCCS9			4	26.15							4	26.15
GBCCS3			1	1.1							1	1.1
GBCCS10			3	22.85	1	2.0					4	24.85
GBCCS11					2	0.8					2	0.8
GBCCS13			1	7.35							1	7.35
GBCCS17	1	14.15									1	14.15
GBCCS18	11	260.56	5	18.25	8	4.63					24	283.44
GBCCS20	3	103.89	4	15.72							7	119.61
GBCCS21					1	1.55					1	1.55
GBCCS36			1	2.2							1	2.2

Table 16. Size Grade and Weights for Folsom Unmodified Debitage (continued).

	Size Grade										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
GBCCS39			1	1.4	1	0.6	2	0.25			4	2.25
GBCCS43					1	0.2					1	0.2
GRAN3			2	3.79							2	3.79
GRAN5	17	595.71	29	204.88	24	23.04	9	0.7			79	824.33
QTZCRY2			1	1.85							1	1.85
RCCS2			5	9.49	10	5.7					15	15.19
RCCS3					4	2.15					4	2.15
RCCS4			2	7.92	7	1.83	4	0.3			13	10.05
RCCS5			1	3.3	1	2.1	2	0.3			4	5.7
RCCS6	1	47.69	3	13.7	24	10.25	2	0.3			30	71.94
RCCS8			1	1.1							1	1.1
RCCS11			1	2.9	8	4.5	2	0.25			11	7.65
RCCS12			3	21.95	8	2.15	3	0.35			14	24.45
RCCS13					5	2.3					5	2.3
RCCS15					1	0.2					1	0.2
RCCS16							1	0.05			1	0.05
RCCS19	1	19.3	2	4.31	8	3.5	6	0.55			17	27.66
RCCS20			1	14.12							1	14.12
RCCS22			3	4.1	5	2.25					8	6.35
RCCS26			1	8.57	3	0.77	2	0.2			6	9.54
RCCS27			1	0.65							1	0.65
RCCS28					1	0.65					1	0.65
RCCS30			1	2.68							1	2.68
RCCS32			3	13.17	2	1.15					5	14.32
RCCS33			1	6.3	1	1.13					2	7.43
RCCS35	1	8.42			1	1.35					2	9.77
RCCS47			2	3.4	3	1.05					5	4.45
RCCS48	6	120.46	18	42.8	39	28.33	3	0.15			66	191.74
RCCS56					1	0.25					1	0.25
SDQZT4m					1	1.35					1	1.35
SDQZT5j			1	3.1	1	1.9					2	5
SLM1			1	2.05							1	2.05
WCCS3					1	1.05	1	0.2			2	1.25
WCCS4			3	5.85							3	5.85
WCCS5			4	5.78	3	0.8					7	6.58
WCCS10			1	2.25							1	2.25
WCCS11					2	0.4					2	0.4
WCCS12			1	8.6	1	0.15					2	8.75
WCCS14			3	7.25							3	7.25
WCCS15					1	0.4					1	0.4
YBCCS1a			3	14.47	2	1.2					5	15.67
YBCCS1b			3	11.2	1	0.1					4	11.3
YBCCS1d			3	11.2	1	0.25					4	11.45
YBCCS2			1	7.9							1	7.9
YBCCS3							1	0.2			1	0.2
YBCCS4	3	107.73	1	1.55	4	1.5					8	110.96
YBCCS5					1	1.01					1	1.01
YBCCS7	1	33.66									1	33.66
YBCCS8					1	0.3					1	0.3

Table 16. Size Grade and Weights for Folsom Unmodified Debitage (continued).

	Size Grade										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
YBCCS9	2	56.5	1	7.8	1	1.0					4	65.3
YBCCS11			1	1.5	2	1.5					3	3
YBCCS12					2	1.75					2	1.75
YBCCS15					2	0.9					2	0.9
YBCCS18	4	225.55	3	43.09	4	1.55					11	270.19
YBCCS19					1	2.05					1	2.05
YBCCS21					1	0.15					1	0.15
YBCCS22					2	0.35					2	0.35
YBCCS23	1	30.83	3	6.13	2	0.45					6	37.41
YBCCS24			1	3.55							1	3.55
YBCCS25							1	0.1			1	0.1
YBCCS27	1	31.32			2	0.2					3	31.52
YBCCS28			2	10.79	3	1.55					5	12.34
YBCCS29					1	0.25					1	0.25
YBCCS30	1	8.5	1	2.2	6	3.4	6	0.4			14	14.5
YBCCS31	1	11.5	1	1.0	1	0.6					3	13.1
YBCCS33a					1	0.65					1	0.65
YBCCS35			4	12.4							4	12.4
YBCCS37					2	0.7					2	0.7
YBCCS39			2	7.25							2	7.25
YBCCS40	1	17.15			1	0.35	1	0.1			3	17.6
YBCCS42			2	4.85							2	4.85
YBCCS43			1	6.45	1	0.5					2	6.95
YBCCS45	1	7.87	3	14.03	3	2.42					7	24.32
YBCCS49	1	11.0									1	11
YBCCS50			3	41.4	3	2.13					6	43.53
YBCCS51			1	3.27	4	2.85					5	6.12
YBCCS52	4	176.25	1	7.95	5	11.16					10	195.36
YBCCS54					1	1.01					1	1.01
YBCCS55			1	1.65	4	3.0	1	0.1			6	4.75
	114	3,125.13	338	1,426.83	553	324.87	89	8.55	0	0	1,094	4,885.38

Table 17. Morphology by Size Grade of Folsom Unmodified Debitage.

	Complete Flakes	Broken Flakes	Flake Fragments	Shatter	Count
Size-Grade 1	83	7	11	13	114
Size-Grade 2	220	17	42	59	338
Size-Grade 3	316	16	86	136	554
Size-Grade 4	47	1	11	29	88
Size-Grade 5	0	0	0	0	0
	666	41	150	237	1,094

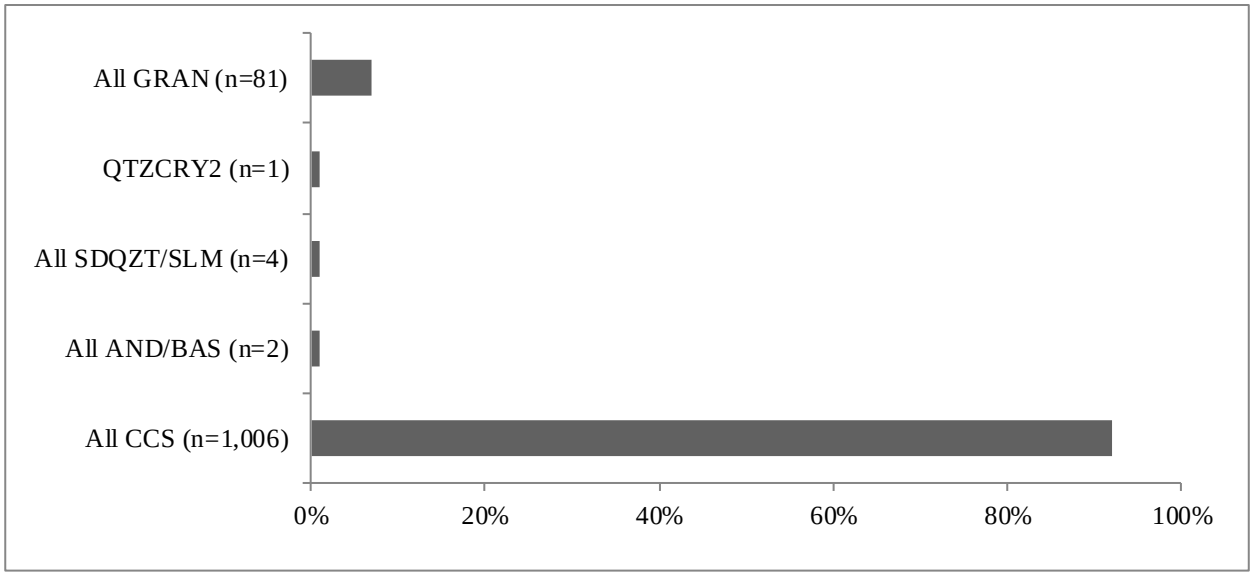


Figure 55. Count Percentages by MANA Designation for Folsom Unmodified Debitage.

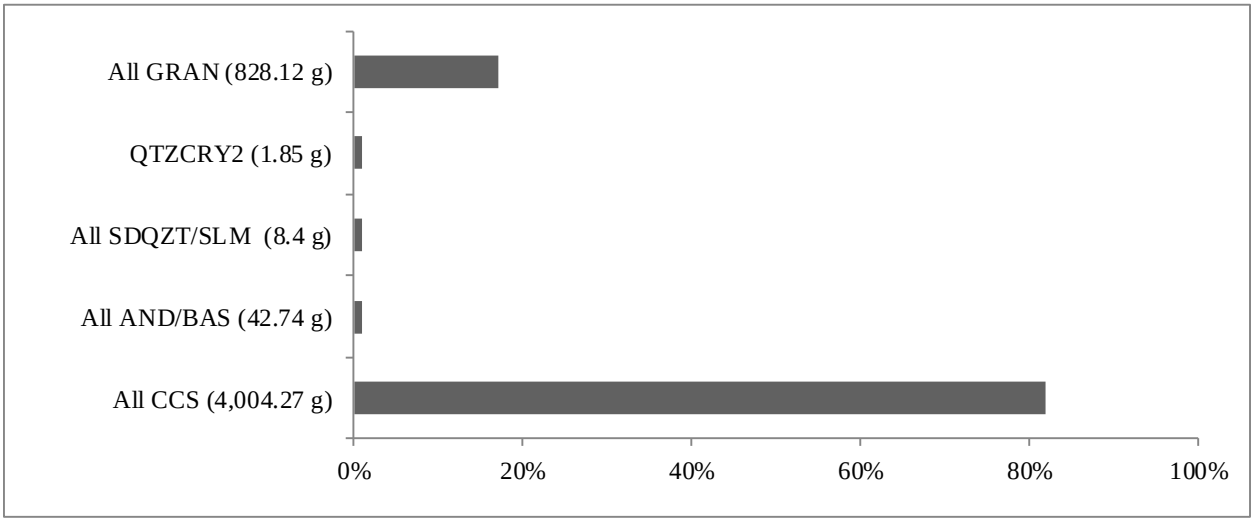


Figure 56. Weight Distribution by MANA Designation for Folsom Unmodified Debitage.

Forty-four (4%) pieces of debitage are classified as primary reduction stage. Nine of these are of andesite, granite, and silicified limestone or mudstone. All others fall under several chert MANA designations. However, cortical and noncortical surfaces of the local fine-grained granite (GRAN5) are not easily distinguished, so a higher percentage of the GRAN5 material may be primary reduction pieces instead of secondary reduction pieces.

Eight hundred sixty-seven (79%) are secondary reduction-stage pieces, and 183 (16%) are classified here as tertiary reduction-stage, knowing that many could be produced through percussion flaking. Of 833 pieces considered to be flakes or portions of flakes, 376 (45%) exhibit only one obvious exterior surface flake scar, 441 (53%) pieces have two or three exterior surface flake scars, and only 16 pieces (2%) show four or more. Among the pieces that exhibit two or more flake scars (n=457), 396 (87%) of those flake removal scars intersect. Only 60 (13%) flakes exhibit exterior surface flake removal scars that run parallel to each other. This implies more bifacial knapping than other types of core reduction. Importantly, there is no evidence among the debitage of polyhedral blade core preparation or reduction.

Six hundred sixty-six (61%) of the debitage pieces are complete flakes, four percent (n=41) are broken flakes, and 14 percent (n=150) are flake fragments (Table 17). Among 802 of the pieces with intact distal ends, 787 (98%) exhibit a feathered termination. Hinge and step terminations occur among only two percent (n=14) of the flakes. Not a single overshot (outrepasse') flake was identified. This suggests that Folsom knappers exhibited a great deal of control over the stone breaking process. Two hundred fifty-eight (39%) of the complete flakes are elongate in form and 407 (61%) are ovate to ovate-expanding. The shape of the remainder could not be determined because they are sufficiently incomplete. It should also be noted that approximately 16 of the flakes were inadvertently split longitudinally during the knapping process.

Complete or partial platforms (Table 15) are found on 708 (65%) specimens, but many of the so-called point platforms may be more incidental than intentional. In our experience, they are the most common platform type produced during knapping and can form intentionally or inadvertently during edge abrading, incidentally during percussion work, or during pressure thinning and shaping. More concerning is that we cannot readily distinguish between incidental edge trimming/abrading flakes, incidental percussion flakes, and small pressure flakes with point platforms. Because of this, we are hesitant to place too much emphasis on the stage in a lithic reduction sequence based on point platforms alone. That being said, 261 (24%) diagnostic flakes exhibit flat platforms, eight percent (n=87) exhibit faceted platforms, and 30 percent (n=323) exhibit point platforms. Thirty-seven flakes (3%) exhibit crushed platforms. None exhibit flat-beveled or flat but angled platforms. Forty-four flakes are decortication pieces while 772 (71%) of the debitage pieces are general shaping or thinning flakes (those flakes with one to three exterior surface flake scars that lack a faceted platform or lip at the interior flake surface margin of the platform). Later reduction stage biface-thinning flakes (those flakes with one or more exterior surface flake scars that exhibit a faceted platform or lip at the interior flake surface margin of the platform, generally larger than Size-Grade 3) comprise seven percent (n=74) of the diagnostic pieces. Approximately 55 of those flakes have platforms with maximum lengths or widths between 5 and 8 mm suggesting soft hammer (antler billet) removal (Allan 2018). Finishing flakes or probable pressure flakes account for only 18 percent (n=201) of the debitage.

Two bipolar flakes represent the outer edges of sheared chert pebbles. This illustrates the wide range of lithic reduction techniques in play at MacHaffie beginning with Folsom occupants. Additionally, two channel flakes (#4925 and #8703) are among the diagnostic debitage pieces. The majority of flakes exhibit subtle bulbs of percussion, only two flakes exhibit pronounced bulbs of percussion. It appears that soft hammer reduction was far more common than hard hammer (hammer stone) work.

Mass analysis illustrates the dominance of Size-Grade 3 pieces (51 percent or n=554), with Size-Grade 2 pieces representing a close second (31 percent or n=338). Pieces in the largest size grade (SG1) constitute 10 percent of the debitage (n=114), and pieces in the smallest recovered size grade (SG4) account for 8 percent (n=88). The latter may be an inaccurate representation because 0.25 inch mesh was used to screen most excavated sediment, and many small pieces could have been missed (Tables 16-17).

Debitage not associated with a designated Knapping Feature suggest a focus on large flake and medium-size Stage II-III biface production. Pressure flaking of formal tools was limited. The bulk of the knapping activities involved middle reduction stage work. The amount of debitage is small and suggests that extensive knapping or even repeated knapping events did not occur at MacHaffie by Folsom occupants. There is also little evidence of pressure flaking suggesting that blanks, not finished tools, were produced and transported elsewhere. The Folsom preforms were likely brought to MacHaffie as refined blanks and little pressure flaking beyond setting channel flake platforms and removal of the channel flakes occurred.

The debitage also shows that a range of material types were selected and reduced through percussion. Surprisingly, a modest amount of these lithic raw materials was marginal, at best, for stone tool manufacture. The materials used to reduce the stone are not clearly identifiable. While the larger chert materials could be easily reduced through soft hammer percussion, the bipolar reduction of chert pebbles and the reduction of sedimentary quartzite and granite was probably accomplished with a hard hammer. Why at least one definite hammerstone was not recovered is puzzling. Recall that the two items designated as probable hammerstones do not exhibit battering marks, and the largest would not be useful in any knapping application.

7.2.2 Knapping Feature 1 (Tables 18 and 19; Figures 57-59; Appendix 9)

Contained in excavation unit C-5 at a depth of 180-200 cm BS was a concentration of chipped stone debitage, three associated core fragments, and a notched flake. These items are believed to represent a nearly complete knapping sequence through which a single large block or nodule of reddish-brown to honey colored chert (BCCS41) was reduced on-site. The manufacturing attributes suggest a combination of soft-hammer percussion and subsequent pressure flaking (Fig. 57-59), although pressure flaking appears to have only occurred to a limited extent. The general lack of prominent bulbs of percussion and limited ripple marks is more consistent with soft hammer reduction work. Based on depth below ground surface and the selection of the BCCS41 lithic material, this knapping feature is assigned to the Folsom component. It was collected as a bulk sample in 2001 by Les Davis and later water screened through 0.0625 inch mesh. As a result, very small-size debitage is present in conjunction with

the larger debitage pieces. This is the only knapping feature sufficiently complete for which aggregate analysis is truly applicable, even though variants of MANA and aggregate analyses are used throughout.

Two thousand four hundred eighty-seven pieces of debitage (1,803.11 g) constitute what is defined here as Knapping Feature 1 (Tables 18-19). Very little debitage (n=34) recovered from the 180-200 cm BS depth in the excavation unit is of a MANA designation distinct from BCCS41. This may indicate good stratification with little mixing of earlier or later components—at least at this particular depth in this particular excavation unit. Although the BCCS41 MANA unit is the dominant chert throughout the Folsom component, unless a concentration of this material could be discerned it was not grouped with a Knapping Feature. It is likely that much of the BCCS41 material is associated with the designated Folsom Knapping Units. A summary of the MacHaffie site knapping features and possible associated artifacts can be found at Appendix 9, Volume II of this report.

Core

Three fragments of what appears to be an unprepared or multi-directional flake core (#16a-16c) of the MANA designation BCCS41 (Fig. 57) were recovered among the Knapping Feature 1 material. Because they are dimensionally similar, they are considered here as a single item. All show flake removals from at least two distinct faces. All three fragments could still generate small flakes. Presumably these pieces contributed to the associated debitage. The three core pieces are amorphous in shape and average 4.2 cm in maximum length, 7.2 cm in maximum width, and 3.4 cm in maximum thickness. Combined the three pieces weigh 232.8 grams.

Notched Flake

A notched, size-grade 2 flake fragment was found among the Knapping Feature 1 debitage. This piece (Miscellaneous Lithic #15) has been described and illustrated in detail in the burins/gravers subsection above (see page 103; Figure 47).

Unmodified Debitage

Decortication of the original piece occurred, for the most part, off-site, and probably at the source. Only 26 pieces are considered here to represent decortication. These primary reduction pieces exhibit one exterior surface flake scar each with 50 to 60% cortical surfaces. They are largely represented by the smallest size-grades with only two flakes in the largest size-grades. Most of the debitage (n=2,409 or 97%) is considered here to be secondary flakes and shatter. Tertiary flakes account for only 52 pieces. Shatter constitutes approximately 56 percent (n=1,394 pieces at 354 g) of the debitage. This percentage seems quite high, but the majority is not angular. The majority is flat, flake-like fragments of the Size-Grades 4-5 range (n=956 or 69% of the shatter), many would classify as dust or debris. Twelve flakes are thin and substantially concave in cross-section at the proximal end. These probably reflect platform trimming work. Two flakes are considered outrepasse' in that the terminal ends fully removed segments of a biface edge. Five pieces are longitudinally split.

Figure 57. Knapping Feature 1.

Mass analysis illustrates the dominance of Size-Grades 3 to 4 pieces by count (82% or n=1,037), and the under-representation of size-grade 1 pieces (n=25 or 1%). Size-Grade 2 pieces dominate the collection by weight. Broken flakes and flake fragments account for only 243 of the total and are most common among the Size-Grade 2 to 3 pieces. Complete flakes account for only 34 percent (n=848) of total and are primarily found among the Size-Grade 1 to 3 classes. Baumler and Davis (2004:61) observed that "… when the ratio of Size-Grade 3 to Size-Grade 4 pieces exceed 1.48 the whole debitage assemblage is present". The ratio of Size-Grade 3 to Size-Grade 4 pieces is 1.04 demonstrating that Knapping Feature 1 is largely complete and suitable for mass analysis. Still, considering that percussion and pressure reduction of a 12 cm x 20 cm block of obsidian produced 7,967 pieces of debitage from Size-Grade 1 through approximately Size-Grade 5 (Tuohy 1987) it is reasonable to assume that Knapping Feature 1 is either incomplete, or the primary products were flake blanks.

Most of the debitage (97%) exhibit 1 or 2 exterior surface flake scars of variable orientation. This suggests core shaping and thinning during early and mid-stages of the reduction sequence. Obvious biface-thinning flakes (both percussion and pressure) account for only 17 percent (n=423) of the pieces.

Most of the flakes are of small size and ovate in form. Fifty-nine percent of the pieces have identifiable platforms. Point platforms dominate (n=592) while flat and faceted platforms are a distant second in frequency. Approximately 101 of the faceted flakes have platforms with maximum lengths or widths between 5 and 8 mm suggesting soft hammer removal (Allan 2018). Forty-four flakes exhibit crushed platforms. Feathered-terminations dominate among the flakes and flake fragments (n=977 or 96%). Only 19 step-fractures and 16 hinge-fractures were observed.

The debitage assigned to Knapping Feature 1 was probably formed when a moderate-size chert block was initially reduced off-site (probably at 24JF881), then transported to MacHaffie and secondarily reduced through soft hammer percussion and a lesser amount of pressure thinning. The desired products may have been a series of large flakes, or one or more medium or small stage II-III bifaces produced from the large flakes. The debitage does not suggest production of highly refined bifaces or resharpening of refined bifaces. Yet a modest percentage of small and thin pressure flakes exhibit very fine finishing and retouch characteristics, and the careful preparation and grinding of the faceted platforms show a high level of knapping skill. The debitage also shows a lack of knapping mistakes such as stacking or other flake removal problems.

Three small (Size-Grade 3) pieces of granite (GRAN5) shatter were recovered among the BCCS41 debitage. Although no definite hammerstones have been recovered, these three pieces raise the possibility that they were derived inadvertently from a hammerstone. They could also be debitage derived from a granite core as this particular MANA designation was utilized with unexpected frequency for flake production.

Table 18. Flake Platform Morphology: Knapping Feature 1.

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled/ Flat-angled	Count
BCCS41	105	168	592	44	1	910

Table 19. Size Grade and Weights of Unmodified Debitage: Knapping Feature 1.

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
BCCS41	25	494	304	804	1,037	434	995	68	126	3	2,487	1,803

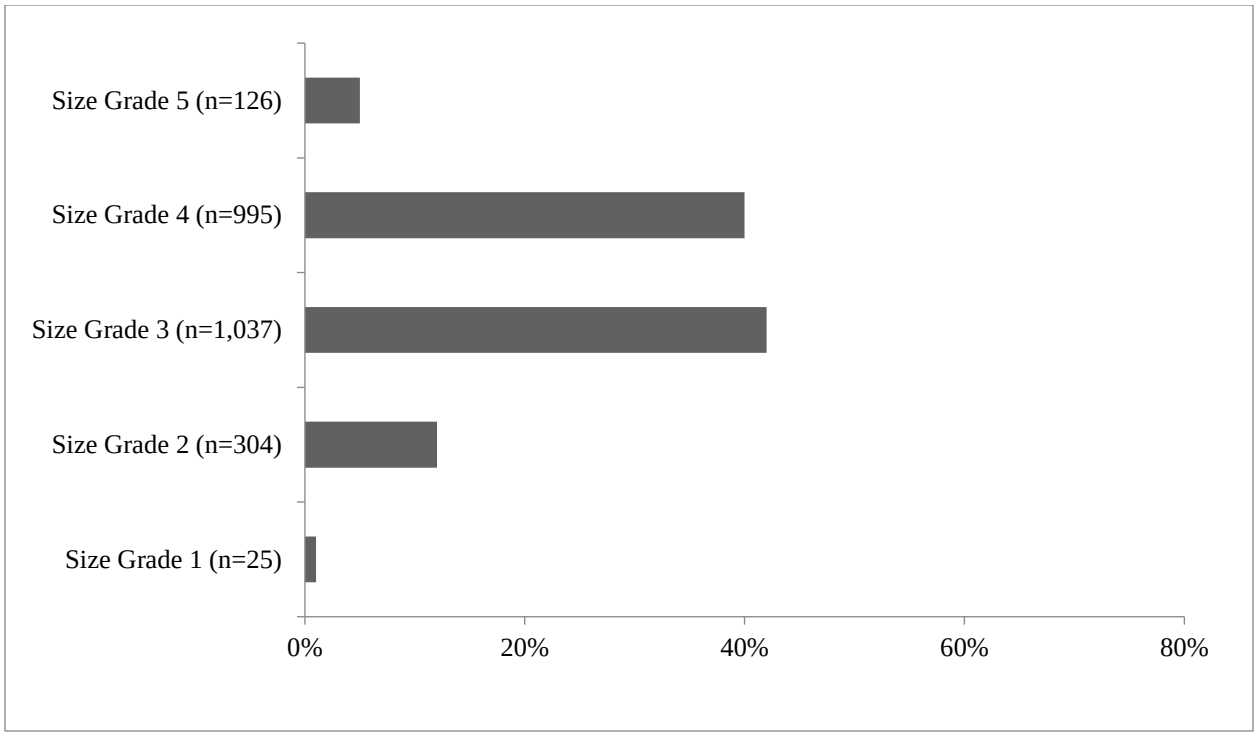


Figure 58. Unmodified Debitage Size Grade Distribution: Knapping Feature 1.

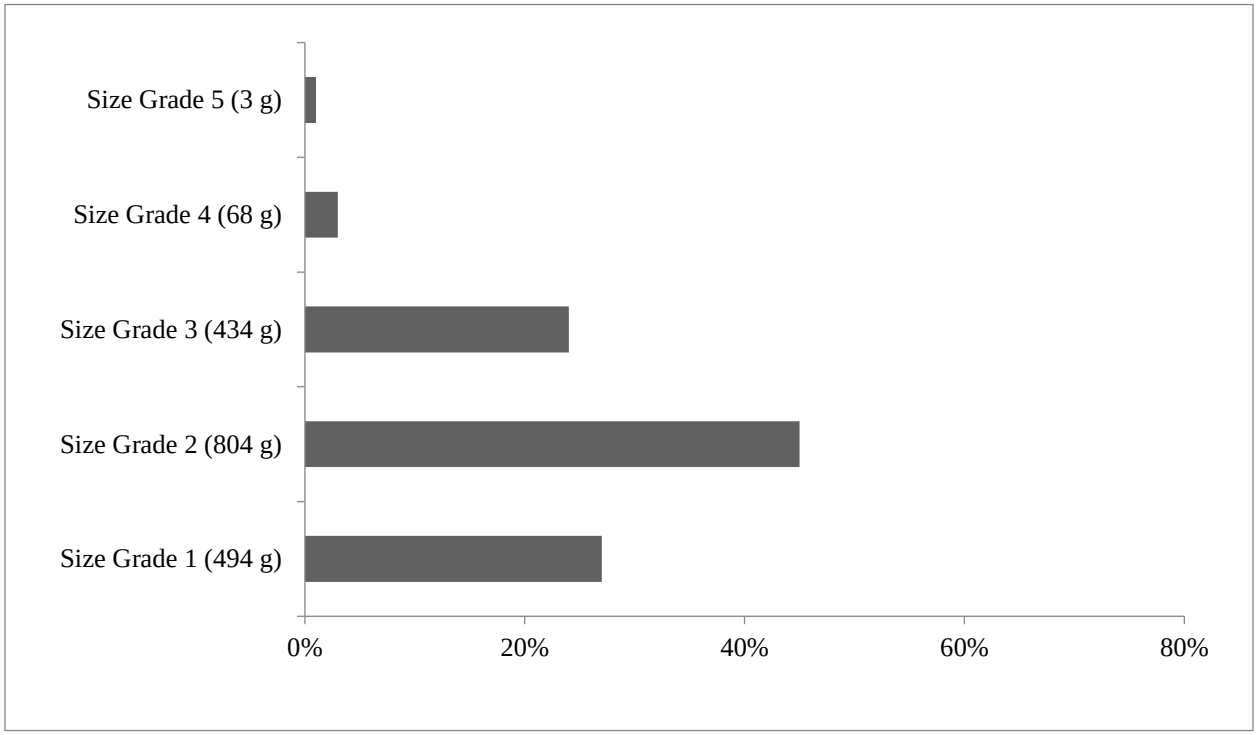


Figure 59. Unmodified Debitage Weight Distribution: Knapping Feature 1.

7.2.3 Knapping Feature 2 (Tables 20 and 21; Figures 60-62; Appendix 9)

Contained in excavation units 6S/2W, 6S/4W, 8S/2W and 8S/4W at a depth of 170-200 cm BS was chipped stone debitage and an associated biface fragment that represents a limited knapping sequence through which a relatively large reddish-brown chert nodule (BCCS41) was reduced though soft hammer percussion. A limited amount of pressure flaking is also noted (Fig. 60). Five hundred seventy-six pieces of debitage with a combined weight of 1,309.25 g and a proximal or distal edge fragment of a stage II biface (Fig. 60.19) constitute Knapping Feature 2. Feature 2 is important for at least two reasons. First, very little debitage recovered from the 180 to 200 cm BS depth in the excavation units is of a MANA designation distinct from the BCCS41 MANA designation comprising Knapping Feature 2. As noted for Knapping Feature 1, this may indicate that little or no mixing of unrelated materials has occurred in this part of the site—at least at this particular depth. Second, the debitage illustrates limited reduction of an unprepared chert nodule with varying amounts of cortex.

Dr. Leslie Davis defined the 170 to 200 cm BS depth in the portion of the site as "Folsom" and obtained four C-14 dates from an organic sediment at two meters BS. However, the four dates average approximately 9,118 BP, and appear to be approximately 1,000 radiocarbon years too recent to represent Folsom, expected to fall within the 10,950 to 10,150 BP time frame (Frison 1991). The chronometric dates are more consistent with Cody, but little of the BCCS41 chert is present in the Cody component.

Biface

A stage II biface fragment (Fig. 60.19) was recovered among the Knapping Feature 2 debitage. It represents an edge of what was probably a typical ovate biface. The biface fragment exhibits a transverse fracture and likely broke during manufacture. The fragment is bi-convex in cross section and has a maximum length of 1.5 cm, a maximum width of 3.6 cm, a maximum thickness of 1.2 cm, and weighs 5.35 g.

Unmodified Debitage

Sixteen pieces (3%) weighing 368 grams are primary reduction flakes, but no shatter is represented. Five hundred fifty pieces (77% or 897 g) are considered here to be secondary flakes and shatter, and shatter constitutes approximately 33 percent (n=146 pieces at 101 g) of the secondary reduction items. Tertiary or final reduction stage finishing flakes, probably removed through pressure as opposed to percussion, account for only 10 pieces (20% of total). Less than ten percent (n=54) of the pieces exhibit cortex.

Mass analysis illustrates the dominance of Size-Grade 3 pieces by count (51% or n= 291), and the dominance of Size-Grade 1 pieces by weight (82% or 738 g). Broken flakes and flake fragments account for only 16 percent of the total and are most common among the Size-Grade 2 to 3 pieces. Complete flakes (n=341 or 59% of total) dominate all size-grade classes. The ratio of Size-Grade 3 to Size-Grade 4 pieces is 2.53 demonstrating that Knapping Feature 2 is incomplete and unsuitable for mass analysis (see Baumler and Davis 2004:61).

Much of the debitage exhibit two or three exterior surface flake scars of variable orientation (especially in the Size-Grade 2 to 3 range), suggesting bifacial thinning during mid and late stages of the reduction sequence. Yet, obvious biface-thinning flakes account for only seven pieces. Most of the flakes are short and ovate in form. Sixty-four percent of the pieces have identifiable platforms. Point platforms dominate (n=219) while flat platforms are a distant second in frequency (n=102). Faceted platforms occur on 35 of the flakes, and approximately 13 of the faceted flakes have platforms with maximum lengths or widths between 5 and 8 mm suggesting soft hammer removal (Allan 2018). The remainder (n=12) of platforms have been crushed. Feathered terminations dominate among the flakes and flake fragments (n=402 or 70%). Step-fractures and hinge-fractures are non-existent, as are outrepasse' pieces.

The debitage assigned to Knapping Feature 2 was formed when a moderate-size, cortex covered chert nodule was initially reduced to a minor extent (decortication) off-site, then transported to MacHaffie and further reduced through soft hammer percussion. Although the debitage indicates limited production of flake blanks, at least one stage II or III biface may have been produced. Presumably the desired flake blanks and bifaces were transported elsewhere. It is likely that Knapping Features 2 and 4 represent the same event and the same knapper, but they are currently designated as discrete. Considering that approximately 75% of the excavated sediments from the units containing Knapping Feature 2 were water screened through fine mesh, debitage in the smallest size-grades should have been recovered if it was present.

Table 20. Flake Platform Morphology: Knapping Feature 2.

MANA designation	Flat	Faceted	Point	Crushed	Indeterminate	Count
BCCS41	102	35	219	12	0	368

Table 21. Size Grade and Weights of Unmodified Debitage: Knapping Feature 2.

	Size Grade by Count and Weight								Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*Count*	*weight (g)*
BCCS41	25	738	145	425	291	138	115	8	576	1309

Figure 60. Knapping Feature 2: Debitage from 8S/4W. Biface Fragment from 8S/2W.

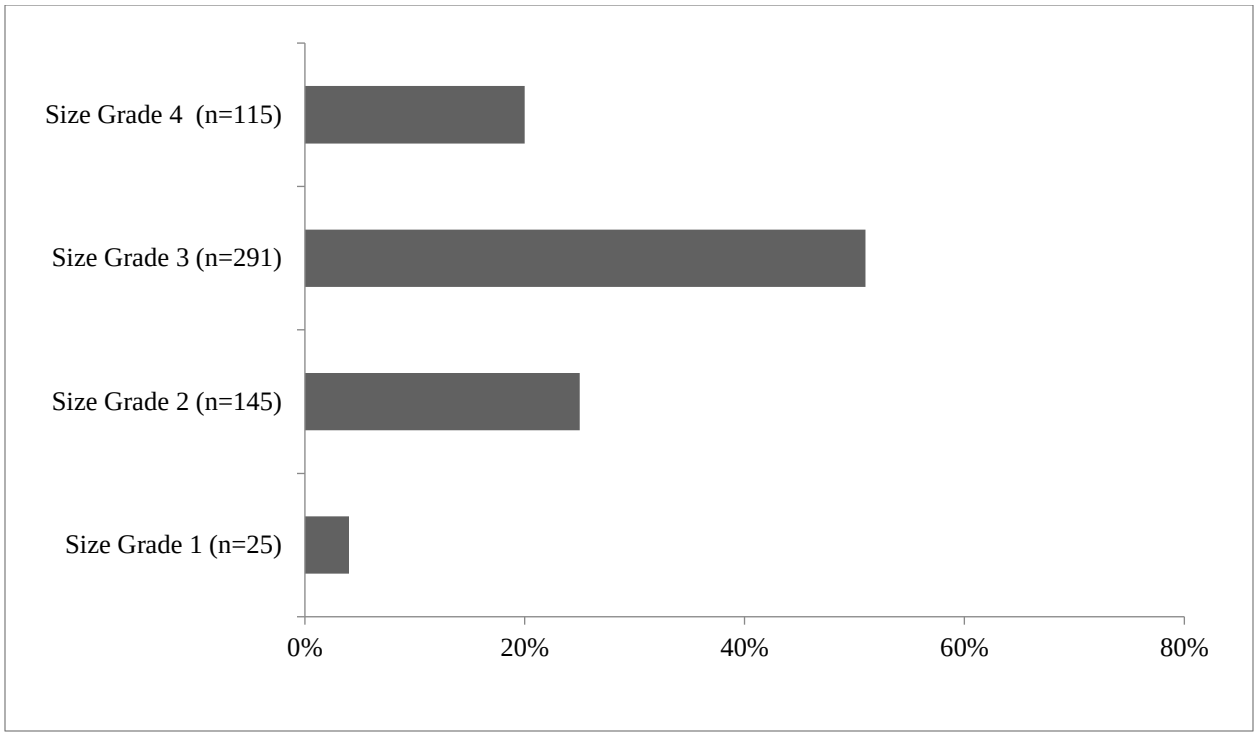


Figure 61. Unmodified Debitage Size Grade Distribution: Knapping Feature 2.

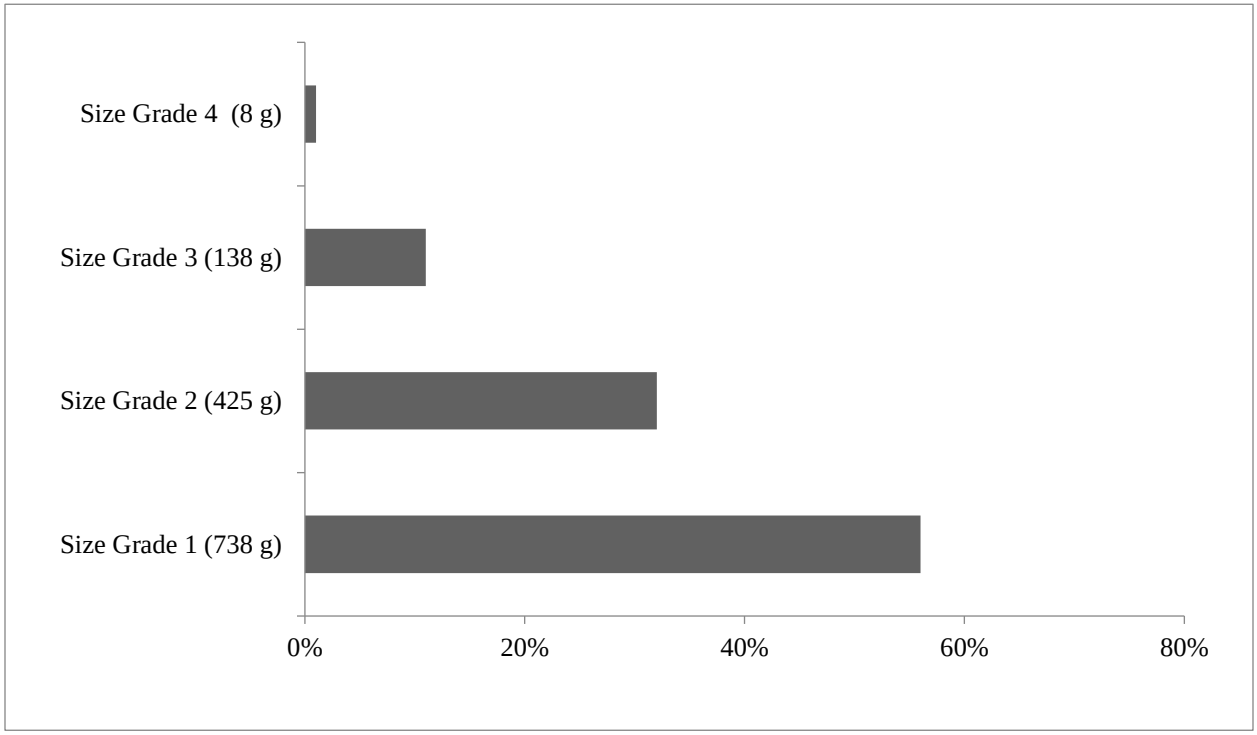


Figure 62. Unmodified Debitage Weight Distribution: Knapping Feature 2.

7.2.4 Knapping Feature 4 (Tables 22 and 23; Figures 63-65; Appendix 9)

Contained in excavation units 6S/6W and 8S/6W at a depth of approximately 140-160 cm BS was debitage and a rejected biface generated when a relatively large reddish-brown chert core, possibly a stage I biface (BCCS41), was reduced though probable soft-hammer percussion. Because the excavated sediment was screened through a combination of 0.25 inch and 0.125 inch mesh, much of the smallest size-grade debitage could have been missed. The evidence also suggests that at least one of the resulting flake blanks was highly-refined through pressure flaking (Fig. 63) and presumably removed from the site. It appears that more than one large flake blank was produced from the initial core, but only one Stage II biface (#148) was recovered in clear association. The debitage suggests that at least one additional piece was reduced beyond that of Biface #148 and presumably removed from the site. Most of the thin, late reduction and retouch flakes could not have originated from biface #148. As previously noted, Knapping Features 2 and 4 likely represent the same event but they are considered separate entities here.

Eight hundred twenty-six pieces of debitage (933.6 g) and a complete stage II biface (Fig. 63.148) constitute what is defined here as Knapping Feature 4. Knapping Feature 4 is important for at least two reasons. First, very little debitage recovered from the 140-160 cm BS depth in the excavation units containing Knapping Feature 4 is of a MANA designation distinct from the reddish-brown chert (BCCS41). Presumably little or no mixing of Knapping Feature 4 and unrelated materials has occurred in this part of the site. Second, the debitage illustrates reduction of an unprepared chert core with varying amounts of cortex down to at least one medium-size bifacial blank (#148) and at least one highly refined biface.

Biface

A stage II biface (Fig. 63.148) likely represents an effort to produce a Folsom point preform. The artifact is ovate in outline with a roughly bi-convex cross-section. It measures 7.9 cm in length, 3.8 cm in width, 1.5 cm in maximum thickness, and it weighs 46.73 grams. It was likely discarded for two reasons. First, an internal fracture visible only at the current reduction stage would have resulted in failure. Second, a zone of silicified limestone at one lateral margin caused a stacked area where a series of flake removals terminated in step fractures. It would have been extremely difficult to remove this anomalous material zone without severely damaging the biface. Almost all the flake scars appear to be from soft hammer percussion.

Unmodified Debitage

Only four pieces (<1%) weighing 25 grams are primary reduction (decortication) flakes, but no shatter was observed among the pieces representing the initial stages of reduction. Cortex is present on only eight of the pieces assigned to Knapping Feature 4. Six hundred ninety-seven pieces (84%) weighing 897 grams are considered here to be secondary flakes and shatter. Shatter constitutes approximately 62 percent (n=432) of the secondary reduction items. Tertiary or final reduction stage finishing flakes account for 125 pieces (15% of total). Approximately half of the sediment containing Knapping Feature 4 were screened through 0.125 inch wire mesh, and the remainder through 0.25 inch wire mesh.

Mass analysis illustrates the dominance of Size-Grade 3 pieces by count (65% or n=

541), and the dominance of Size-Grade 2 pieces by weight (54% or 503 g). Broken flakes and flake fragments account for only nine percent of the total and are most common among the Size-Grade 2 to 3 pieces. Complete flakes (n=319) account for 39 percent of total. Shatter dominates the knapping feature debitage (52% of total), but these pieces are largely thin, flake-like fragments that could not be easily oriented to interior or exterior surfaces. Further, they largely fall within the Size-Grade 3 to 4 classes. However, the ratio of Size-Grade 3 to Size-Grade 4 pieces is 4.33 demonstrating that Knapping Feature 4 is incomplete and unsuitable for mass analysis (see Baumler and Davis 2004:61).

Much of the debitage exhibits multiple exterior surface flake scars, especially in the Size-Grade 2 to 3 range. This suggests bifacial thinning during at least mid and late stages of the reduction sequence. Bulbs of percussion tend to be subtle and diffuse. Obvious biface-thinning flakes account for only 44 (5%) pieces. Most of the diagnostic flakes are short and ovate in form (29%). Sixty-four percent of the pieces have identifiable platforms. Point platforms dominate (n=186) while flat platforms are a distant second in frequency (n=73). Faceted platforms occur on only 57 of the flakes. One platform type is best described as flat-beveled, and the remainder (n=20) have been crushed. Among the faceted platform pieces, approximately 35 have platforms with maximum lengths or widths between 5 and 8 mm. Feathered terminations dominate among the flakes and flake fragments (n=367 or 44% of total). Only a single step fracture and hinge termination was noted. Outrepasse' pieces are non-existent.

The evidence suggests that the debitage assigned to Knapping Feature 4 was formed when a moderate-size, moderately refined chert nodule or stage I biface was reduced through soft hammer percussion and subsequent pressure flaking. Although the debitage indicates production of at least one mid stage biface (#148) and at least one well-refined bifacial blank, several large flakes could have also been generated and subsequently transported elsewhere. A high percentage of small and thin pressure flakes, many of which exhibit very fine finishing and retouch characteristics, reflect a high level of knapping skill. In fact, the evidence for Knapping Features 1, 2, and 4 indicates that the knapper was skilled. This is reflected in the careful preparation of platforms and the lack of knapping mistakes. There is no good evidence of heat-treatment among the Knapping Feature material, but the BCCS41 chert is so vitreous that heat-treating would not improve knappability to a meaningful extent.

Figure 63. Knapping Feature 4: Debitage and Biface from Unit 8S/6W.

Table 22. Flake Platform Morphology: Knapping Feature 4.

MANA designation	Flat	Faceted	Point	Crushed	Flat-Beveled	Count
BCCS41	73	57	186	20	1	337

Table 23. Size Grade and Weights of Unmodified Debitage: Knapping Feature 4.

	Size Grade by Count and Weight								Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*Count*	*weight (g)*
BCCS41	12	179	148	503	541	233	125	19	826	934

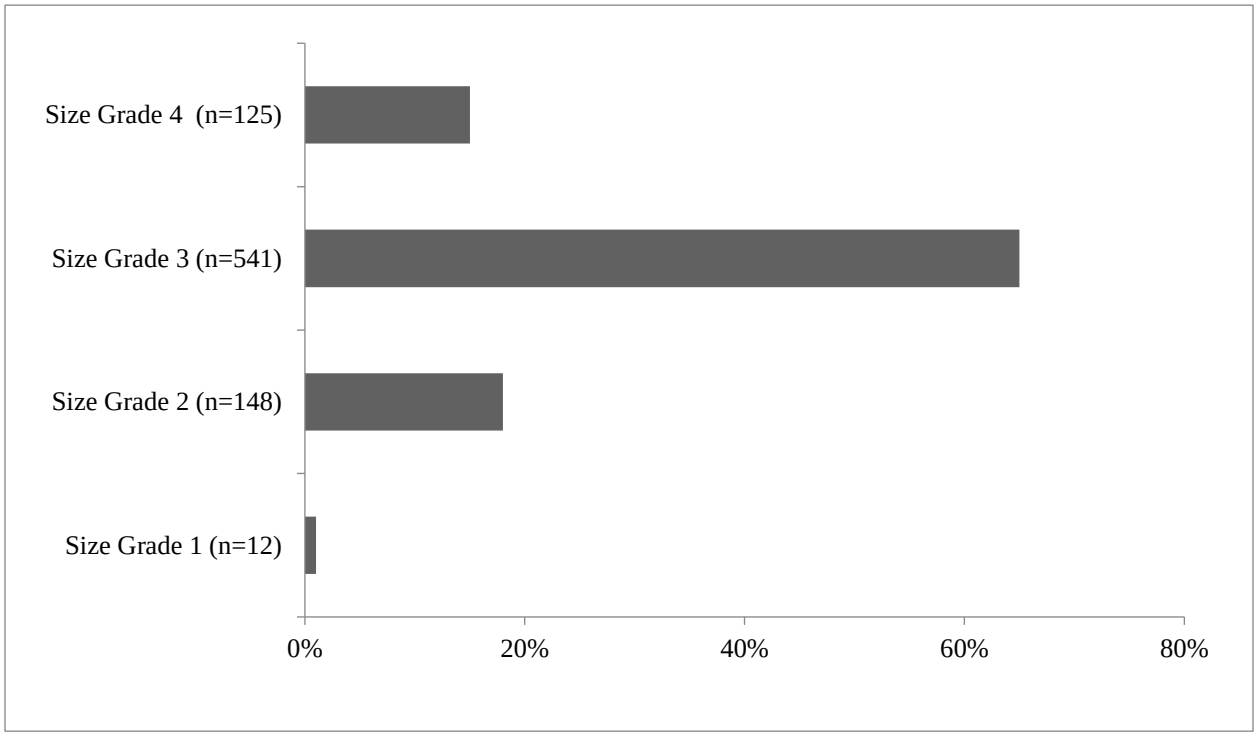


Figure 64. Unmodified Debitage Size Grade Distribution: Knapping Feature 4.

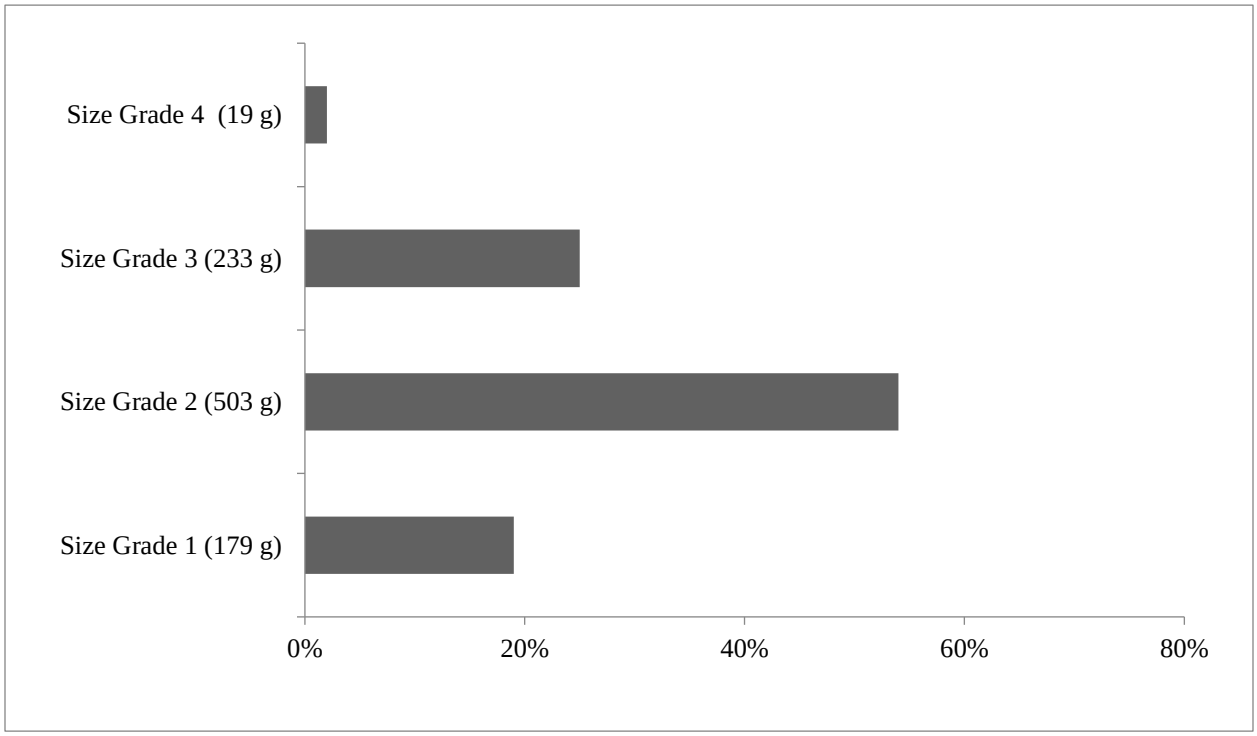


Figure 65. Unmodified Debitage Weight Distribution: Knapping Feature 4.

7.3 Minimum Analytical Nodule Analysis (Table 24; Figures 66-68)

An unexpected pattern is found when the MANA approach is applied to the Folsom component. Among the projectile points (including preforms), the MANA unit designated GRCCS1 (#20) has no associated debitage, cores, or tools. The MANA units designated YBCCS31 (#12), BCCS18 (#17), BCCS19 (#18) and GBCCS10 (#19) have only three or four pieces of debitage associated, but no tools or cores. The GBCCS18 (#50) MANA unit has slightly more debitage (n=24) than the others but also no tools or cores. Neither of the lithic materials comprising the probable channel flakes are represented by projectile points or other tools or cores. Further, very little debitage of the same lithic material codes (YBCCS1b: n=4 and RCCS6: n=30) was recovered from the Folsom component. Only the BCCS41 point fragment (#28) has numerous associated cores, tools, and debitage.

The debitage appears to be randomly distributed across the site and generally between four and eight meters from a given projectile point or channel flake. This likely implies two things. First, MacHaffie was a temporary and minimally used stopping point where Folsom occupants removed and discarded damaged hafted projectile points. Second, instead of on-site

production, point preforms were brought to MacHaffie for fluting and basal shaping. The finished points were then hafted or otherwise moved off-site for later use.

Non-hafted bifaces and the unprepared, opportunistic (i.e., multi-directional) flake cores tend to cluster separately. Two of the bifaces are of distinct lithic material codes (RCCS31 and SDQZT2f) with no debitage, tools, or cores of the same MANA unit. More peculiar is that four of the unprepared cores of MANA units BCCS33 and BCCS45 have no associated debitage. Excluding the BCCS41 MANA unit which dominates the lithic suite, 12 bifaces and nine cores are of MANA units represented by ten or fewer pieces of debitage, but none of the debitage was recovered from the same excavation unit where the biface or core of like lithic material was found. The outliers appear to be two bifaces and a core of MANA units CCCS6 and RCCS48 that had up to10 pieces of associated debitage in the same excavation unit. Another exception is a core of local granite (GRAN5) and 79 pieces of associated debitage from excavation unit 4N/8E.

One hundred thirty-four MANA units are assigned to the Folsom component. Only BCCS21, BCCS29, BCCS41, CCCS6, RCCS48, YBCCS1d, and YBCCS52 include multiple tool types and debitage, but the number of constituent pieces is small. Bifaces, bifacial cores, and unprepared cores were brought to the site for limited additional reduction. Many of the bifaces are best described as quarry blanks. Most were produced elsewhere, and some were not further refined before being lost or discarded. The collection of artifacts shows a preference for multi-direction flake cores over bifaces with a 1.6:1 ratio.

Off-site decortication and initial preparation of cores is further supported by the fact that only 10 percent of the debitage exhibit up to 49 percent cortical coverage, two percent exhibit 50% to 99% coverage, and 6 percent exhibit 100% coverage. Only three non-hafted bifaces exhibit some cortex, as do ten unprepared cores.

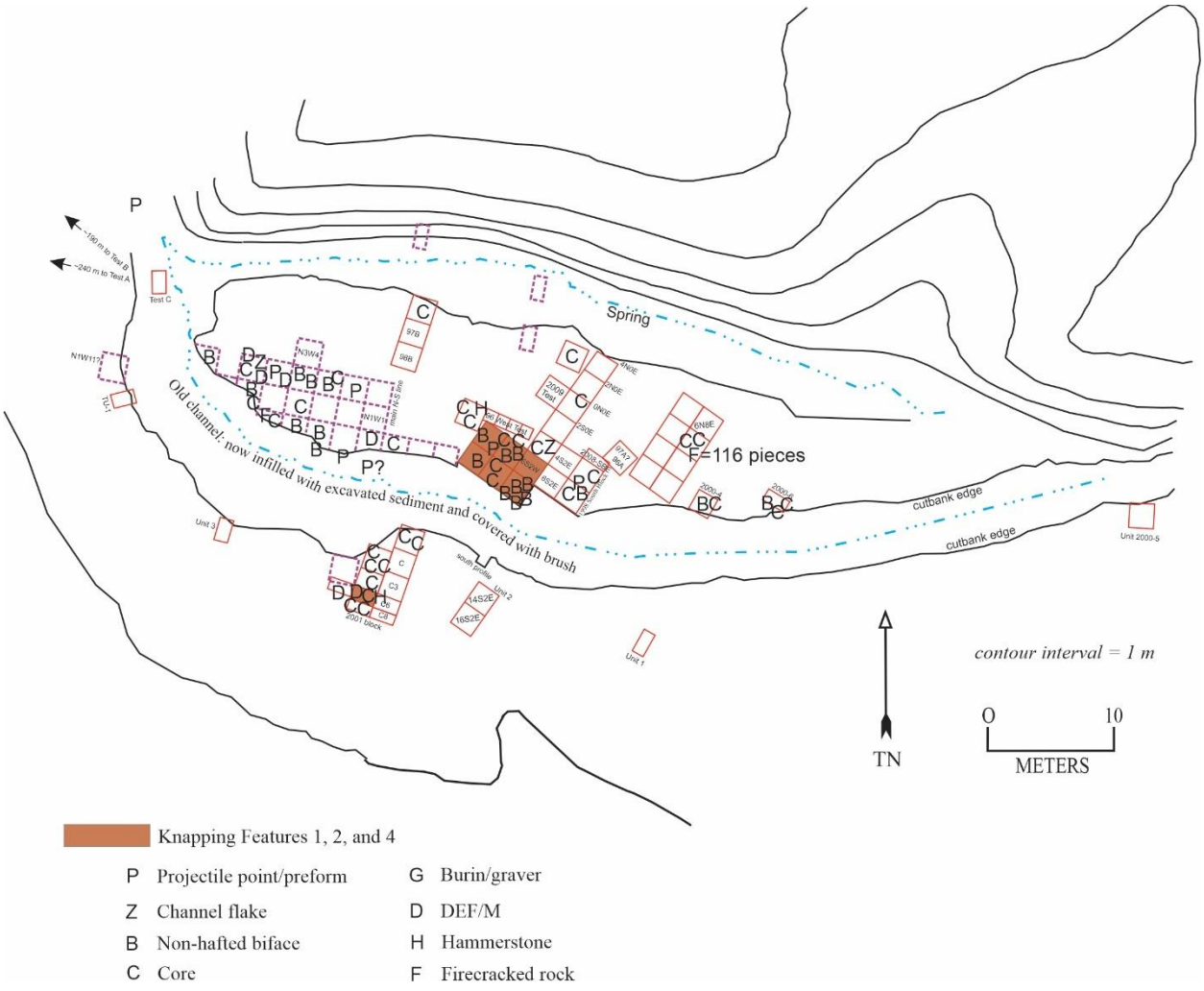


Figure 66. Distribution of Selected Folsom Cultural Material in 24JF4.

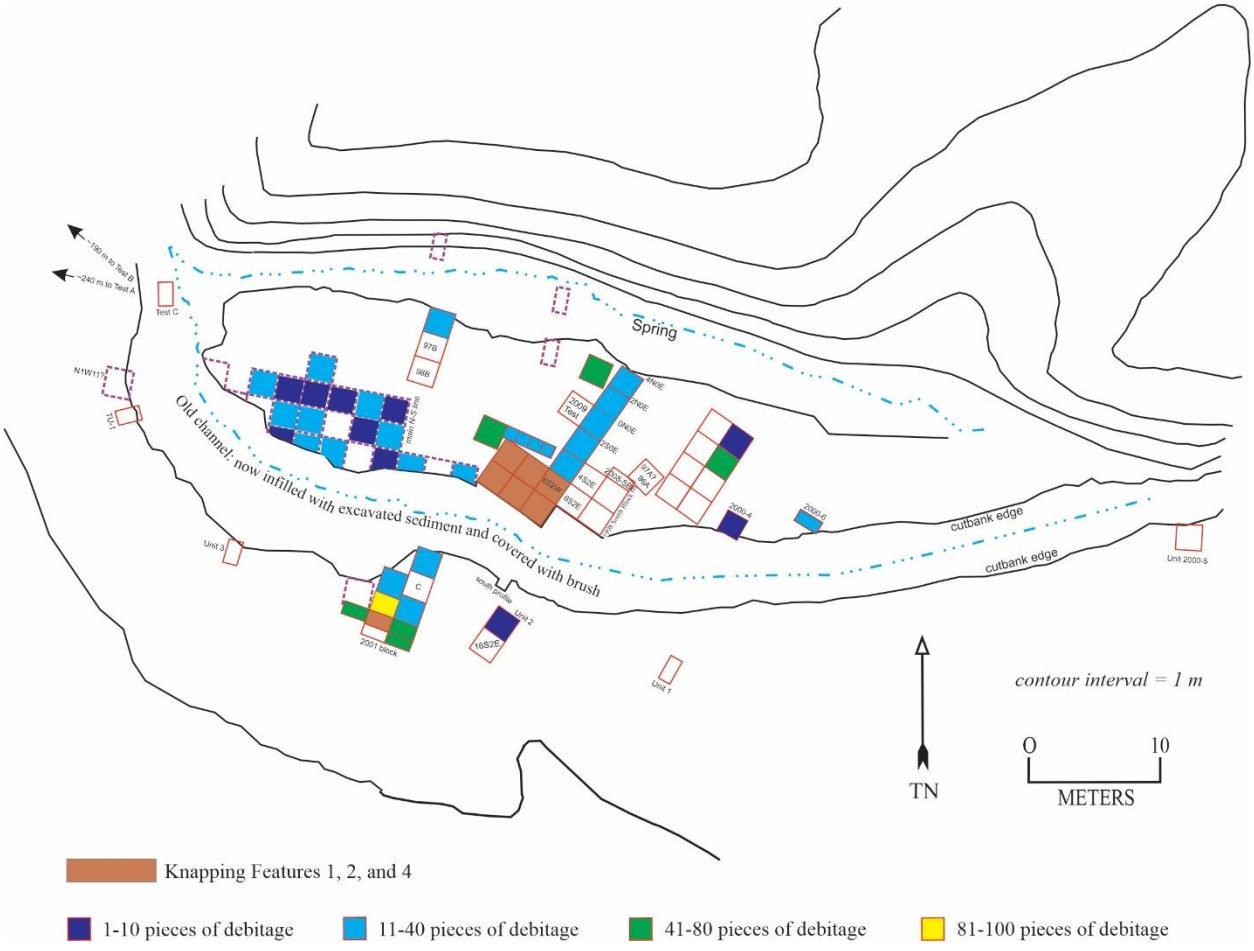


Figure 67. Distribution of Folsom Debitage in 24JF4.

Table 24. Folsom Component MANA Units and Associated Artifacts.

MANA designation	projectile point/preform	hammerstone	graver	endscraper	biface	core	DEF/M	debitage
AND2								1
BAS1								1
BCCS1								2
BCCS2								1
BCCS3								2
BCCS4								11
BCCS5								1
BCCS6								2
BCCS7					1			7
BCCS9						3		28
BCCS11								2
BCCS12								5
BCCS16						1		1
BCCS18	1							3
BCCS19	1							3
BCCS21					1	3		20
BCCS23								6
BCCS24								1
BCCS25								6
BCCS26								1
BCCS28						1		17
BCCS29					2	2	1	6
BCCS32								2
BCCS33						2		0
BCCS36								1
BCCS38								11
BCCS41	1				3	8	2*	4,179+
BCCS42								1
BCCS43								1
BCCS44						1	3	3
BCCS45						2		0
BCCS46								5
BCCS47								1
BPCCS5								9
CCCS1								4
CCCS2								15
CCCS3			1					31
CCCS5								32
CCCS6					1	1		28
CCCS7								18
CCCS8								1
CCCS9								4
GBCCS3								1
GBCCS10	1							4
GBCCS11								2
GBCCS13								1
GBCCS17								1
GBCCS18	1							24
GBCCS20								7
GBCCS21								1

Table 24. Folsom Component MANA units and associated artifacts (continued).

MANA designation	projectile point/preform	hammerstone	graver	endscraper	biface	core	DEF/M	debitage
GBCCS36								1
GBCCS39								0
GBCCS43								2
GRCCS1	1					1		79
GRAN3								1
GRAN5		2					2	15
QTZCRY2								4
RCCS2								13
RCCS3								4
RCCS4								30
RCCS5								1
RCCS6								11
RCCS8								14
RCCS11								5
RCCS12								1
RCCS13								1
RCCS15								17
RCCS16								1
RCCS19								8
RCCS20					1			6
RCCS22								1
RCCS26								1
RCCS27								1
RCCS28					1			0
RCCS30								5
RCCS31								2
RCCS32								2
RCCS33								5
RCCS35					1	1		66
RCCS47								1
RCCS48							1	0
RCCS56					1			0
RHY2								1
SDQZT2f								2
SDQZT4m								1
SDQZT5j								2
SLM1								3
WCCS3								7
WCCS4								1
WCCS5								2
WCCS10								2
WCCS11								3
WCCS12								1
WCCS14								5
WCCS15								4
YBCCS1a					1	1		4
YBCCS1b								1
YBCCS1d							1	1
YBCCS2								1
YBCCS3								0

Table 24. Folsom Component MANA units and associated artifacts (continued).

MANA designation	projectile point/preform	hammerstone	graver	endscraper	biface	core	DEF/M	debitage
YBCCS4								8
YBCCS5								1
YBCCS7								1
YBCCS8								1
YBCCS9					1			4
YBCCS11								3
YBCCS12								2
YBCCS15								2
YBCCS18								11
YBCCS19								1
YBCCS21								1
YBCCS22					1			2
YBCCS23					1			6
YBCCS24					1			1
YBCCS25								1
YBCCS27								3
YBCCS28						1		5
YBCCS29								1
YBCCS30								14
YBCCS31	1							3
YBCCS33a					1			1
YBCCS35								4
YBCCS37								2
YBCCS39								2
YBCCS40								3
YBCCS42								2
YBCCS43								2
YBCCS45								7
YBCCS49								1
YBCCS50								6
YBCCS51					1			5
YBCCS52					1	1		10
YBCCS54								1
YBCCS55								6
*includes notched flake of Knapping Feature 1, +includes Knapping Features 1, 2, and 4 debitage, FCR not included in the above counts								

Only MANA unit BCCS41 can be demonstrated to have been reduced intensively at MacHaffie. Blocky cores or early-stage bifaces were thoroughly reduced in two distinct areas of the site (Fig. 66) By-products left at MacHaffie include one projectile point fragment, 293 pieces of random debitage, three defined knapping features comprised of 3,886 pieces of debitage, three non-hafted bifaces, eight flake cores, one DEF/M, and one notched flake. The minimally represented pieces with post-production edge modification attest to the activities conducted by Folsom occupants. Those primarily being flake blank production, a limited refinement of blanks

and bifaces, removing and rehafting projectile points, and limited food preparation evidenced by processed bison bone and FCR.

One goal of this study involves identification of mobility patterning of the site's occupants based on abandoned residues. As noted by Lewis Binford (1980:4) "…human systems of adaptation are assumed to be internally differentiated and organized arrangements of formally differentiated elements. Such internal differentiation is expected to characterize the actions performed and the locations of different behaviors. This means that sites are not equal and can be expected to vary in relation to their organizational roles within a system".

We began with an assumption that past occupants of the MacHaffie site were nomadic hunter-gatherers dependent upon natural resources and technologically limited in resource modification or stabilization. Building on these assumptions we should inquire how MacHaffie is comparable to regional archaeological sites of similar purpose. Specifically, can "regular or determined variability" among the archaeological remains at MacHaffie be expected or even determined?

Binford aptly observed that:

> The archaeological record is at best a static pattern of associations and covariations among things distributed in space. Giving meaning to these contemporary patterns is dependent upon an understanding of the processes which operated to bring such patterning into existence. Thus, in order to carry out the task of the archaeologist, we must have a sophisticated knowledge and understanding of the dynamics of cultural adaptations, for it is from such dynamics that the statics which we observe arise. One cannot easily obtain such knowledge and understanding from the study of the archaeological remains themselves (Binford 1980:4).

Following ethno-archaeological studies of Nunamiut, San, and Australian Aborigine peoples, Binford (1980) defined two idealized types of hunter-gatherer subsistence systems, but we will use the concepts to look at activities and resources not directly related to food acquisition. The first type of subsistence system is the *Forager*. Foragers have highly mobile base camps and tend not to store food but gather food daily on an "encounter" basis. Foragers typically range outward from residential camps seeking food or other resources, then return to residential bases by evening of each day, unless an overnight camp is established by a specific task group. Residential camps are the locations where most processing, manufacturing, gear maintenance, and domestic activities occur. They are intermittently moved based on resource availability, but do not necessarily occupy a former residential locality. When critical resources are infrequent or unreliable, redundant use of residential campsites can be expected. Task specific sites away from residential camps are designated as the *Location*. Because locations are occupied briefly, scattered over the landscape, and little in the way of food procurement or other resource stockpiling occurs there, "the use, exhaustion, and abandonment of tools is at a very low rate (Binford 1980:5-9)". Thus, Forager locations can be difficult to identify because of a paucity or total absence of concentrated cultural remains.

The second defined hunter-gatherer subsistence system is the *Collector*:

> Collectors are characterized by (1) the storage of food for at least part of the year and (2) logistically organized food-procurement parties. The latter situation has direct "site" implications in that special task

> groups may leave a residential location and establish a field camp or a station from which food-procurement operations may be planned and executed. Logistical strategies are labor accommodations to incongruent distributions of critical resources or conditions which otherwise restrict mobility. Put another way, they are accommodations to the situation where consumers are near to one critical resource but far from another equally critical resource. Specially constituted labor units-task groups-therefore leave a residential location, generally moving some distance away to specifically selected locations judged most likely to result in the procurement of specific resources. Logistically organized task groups are generally small and composed of skilled and knowledgeable individuals. They are not groups out "searching" for any resource encountered; they are task groups seeking to procure specific resources in specific contexts. Thus we may identify specific procurement goals for most logistically organized groups… Sites are generated relative to the properties of logistical organization itself, but they are also generated with respect to specific types of target resources (Binford 1980:10).

In addition to the residential camp and location site, field camps, stations, and caches are expected site types associated with Collectors, although the various site types may not always be discretely located. Further, a multitude of variables can influence the look of any individual, or combination of, site types. While residential bases may look similar, the kinds and quantities of cultural remains at a Collector location site may differ from a Forager location site if the occupants sought a greater quantity of resources for a larger group. One example is a communal bison kill conducted by logistically organized groups focused on obtaining a large volume of a particular resource for both immediate consumption and to place a portion in reserve. Another example more relevant to MacHaffie is a toolstone quarry and collection locality. A *field camp* is a task group's temporary assembly point. It is where members sleep, eat, maintain gear, and coordinate activities while away from their residential base. *Stations* are localities where task groups serve as sentries or scouts to observe and report on the movement of game, or the presence of potential adversary groups. Stations can also consist of ambush sites or blinds. *Caches* are common among Collectors and offer temporary storage of goods, both within and outside of the residential base (Binford 1980:10-12).

This so-called Middle-Range Theory was proposed to better understand archaeological data and past people's behavior. The inference is that hunter-gatherer mobility should be patterned with respect to spatial and seasonal resource availability, so site types and associated material culture variability could be explained. Although initially met with accolades, many researchers have abandoned the "New Archaeology" by pointing out rather obvious conclusions—people and the resources they depend on are not always predictable and Binford's research and conclusions were based on tautological reasoning. Cultural responses to unexpected stresses placed upon subsistence systems or previously predictable resources may not be readily identifiable in archaeological remains (e.g. Habu and Fitzhugh 2002). Regardless of inherent shortcomings, we will utilize Binford's model and examine the MacHaffie site under one possible type of subsistence or other resource extraction system.

In addition to Binford's Middle Range Theory model, Knell (2012) defined two Paleo-Indian land use strategies that operate in conjunction with MANA analysis. A *core area* is defined as "… a regularly and intensively used part of a group's annual range that has one or more source of toolstone and sufficient balance of desirable biotic (floral and faunal) resources to support one or more bands of hunter-gatherers for two or more consecutive seasons (Knell 2012:329)". Alternatively, a *nonregional land use strategy* applies when hunter-gatherer groups

exploit local toolstone sources, replenish toolkits, and subsist on the available biota but quickly move to another area or region (Knell 2012:329).

The Folsom component is best categorized as a Collector type of *Location* defined by Binford (1980:9), although available evidence does not make it a great fit. In this scenario, a task group left a residential base to collect a small but desired amount of tool quality chert from at least three known sources. Assuming most chert pieces were brought to MacHaffie from the closest sources, it is difficult to see a possible direction from which residential base occupants went forth to collect toolstone (Figure 68). As seen in Figures 3 and 68, chert sources surround the MacHaffie site. Within 2 km of MacHaffie are nine documented chert quarries (Figures 3 and 68: 24JF3, 24JF5, 24JF226, 24JF760, 24JF879, 24JF880, 24JF881, 24JF883, and 24JF884). The full color and texture range of most of the modified chert materials from the Folsom component can be found in a combination of sites 24JF226, 24JF881 and any of the other listed chert sources in Figures 3 and 68. While site 24JF881 is dominated by orangish, red and reddish-brown tones and 24JF226 is dominated by light brown, gray and bluish-gray colors, the other sources produce a wide range of dark gray, light gray, yellow, brown and reddish tones. Arbitrarily placing residential bases at four corners bounding the chert quarry cluster does not help to identify a probable residential camp locale. The most logical setting seems to be a residential base situated 1.5 or more kilometers southeast or northeast of MacHaffie. It should be pointed out, however, that a residential camp has not been identified.

Once obtained, decortication, initial edging, and presumably spall production occurred at the collection sites. The minimally prepared pieces were then transported to MacHaffie (Figures 3 and 68). Further percussion refinement of the quarried pieces occurred, and the desired end products were transported to the residential base for final pressure flaking or later use. The primary tasks at MacHaffie consisted largely of percussion refinement of flakes, early-stage bifaces, and unprepared cores. The distribution and density of debitage in the site (Figure 67) attests to this. Interestingly, a modest amount of core and debitage material is poor quality. In an area where there is no shortage of highly siliceous chert, the selection of materials that would largely reduce to shatter is inexplicable. Another matter that is not easy to explain is why several cores and early reduction stage bifaces do not appear to have been further refined at MacHaffie.

Weaponry maintenance and retooling also occurred, but secondary to blank refinement. The lack of heating or cooking features, and the paucity of faunal remains may imply a stay of only a few hours at a time, and possibly a single occupation event. Certainly, there is no evidence for redundant use of the site by Folsom people. The dominance of the MANA unit BCCS41 (probably obtained from 24JF881) and the comparatively small amount of debitage supports this interpretation. In fact, all cultural material recovered from the Folsom component could have been produced in a short amount of time by fewer than five individuals reducing a small number BCCS41 pieces in two adjoining locations in the site (Figures 66-67). The generally intact and uncorrupted nature of the Knapping Features suggests that subsequent knapping activities did not occur until the Folsom debitage was sufficiently covered with sediment to isolate them from later Cody occupation events.

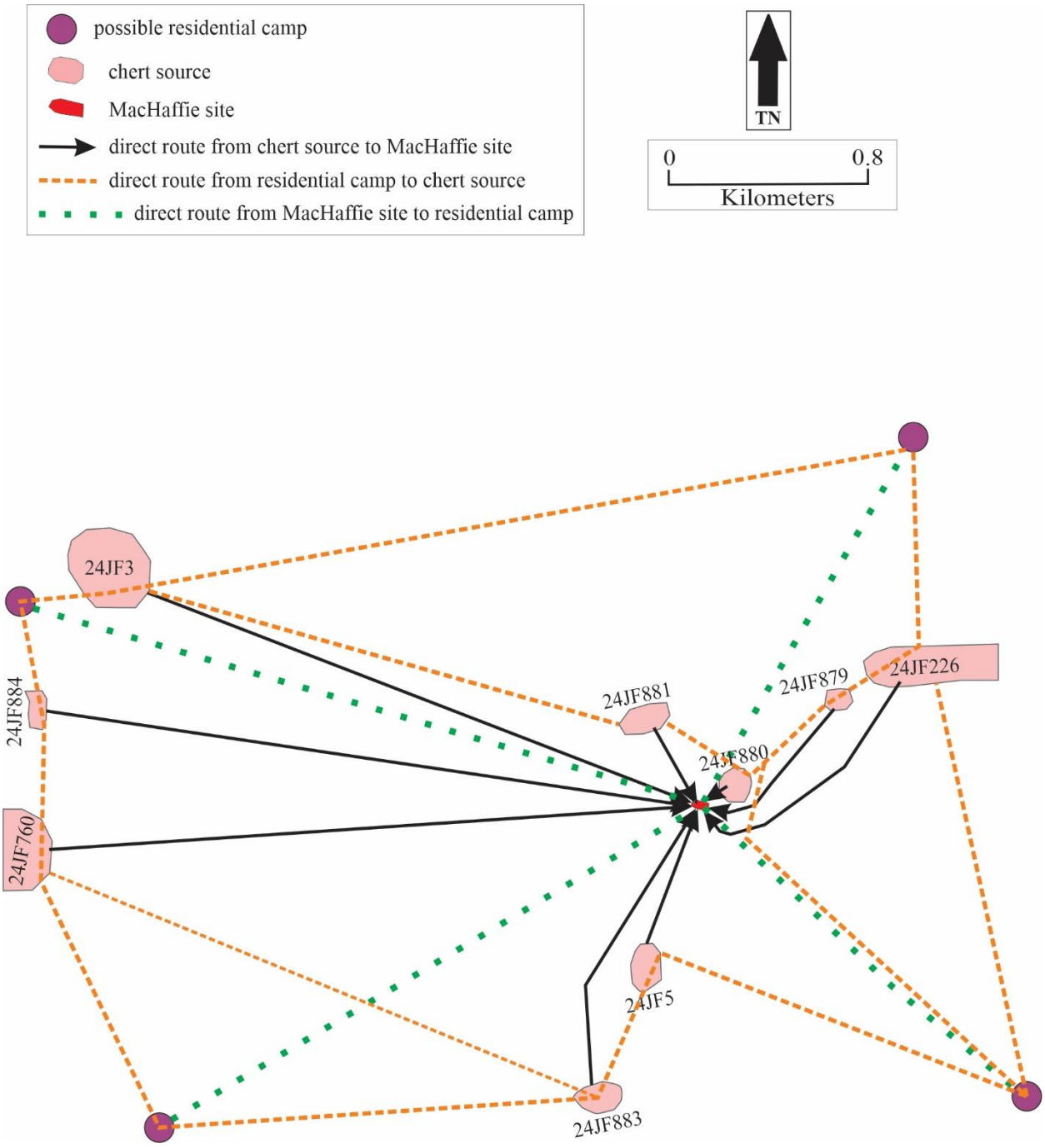


Figure 68. Binford (1980) adapted Collector Model applied to the MacHaffie site.

Folsom occupants generally followed a *nonregional land use strategy* (Knell 2012:329), while at 24JF4. This category, however, is also not a great fit for MacHaffie because numerous toolstone sources and similar biotic communities are found within a 161 km radius of the site. Similarly, LaTourneau's (1992) discussion of Folsom tool-type distribution with respect to a toolstone source also does not fit well with the MacHaffie. Overall, the Folsom component is similar to other regional Precontact secondary lithic reduction sites irrespective of time frame (e.g., 24BE559: Davis et al. 1997). It is also dissimilar to many Folsom components described outside of Montana (Amick 1999; Root et al. 1999). We are uncertain if this suggests geography, resource availability, or the local environment was more influential on group behavior than cultural elements or systems. MacHaffie, for whatever reason, appears to be a short-term stopping point between a base camp and one or more chert quarries. The dominant activity of Folsom occupants consisted of mid-stage reduction of chert cores.

8.0 THE CODY ARCHAEOLOGICAL CULTURE

Overlying the Folsom component in 24JF4 is the Cody component. The stratigraphic separation of Cody and Folsom is not ideal, some mixing has undoubtedly occurred. Although the lower vertical extent of Cody is relatively well established, the upper limit is not, but does not exceed the alluvium. Evidence for Cody at MacHaffie comes from the findings of Edmund MacHaffie, the subsequent visits of the 1947 and 1948 River Basin Surveys party, and the work of Richard G. Forbis in 1951. No diagnostic Cody artifacts were recovered after 1951. Our basis for vertical and horizontal placement is largey imported chert assigned the MANA codes GBCCS18 and GBCCS20. These lithic materials also dominate the debitage recovered during the 1947 through 1951 work where Cody points were found in clear association. Radiometric dates also provide expected Cody time frames for the upper part of the alluvium.

Excavations at the Folsom type site prompted a wide-spread attempt to establish projectile point typologies, chronologies, and their geographic distributions. The term "Yuma" was coined by E.B. Renaud (1932). He applied it to a range of distinct lanceolate and stemmed points from Yuma County, Colorado. These were later determined to have mixed temporal contexts (Figgins 1927, 1933, 1935; Fischel 1939; Gebhard 1949; Howard 1935). The grouping included unfluted, lanceolate forms (e.g., San Jon, Meserve, Midland, Planview) and stemmed projectile points (e.g., Alberta, Eden, Scottsbluff). Oddly, the term may have encapsulated Folsom points in some instances (Wormington 1948:3-7).

"Yuma" was intended to distinguish Paleo-Indian points that post-date Folsom, but the stemmed varieties it encapsulated could only be demonstrated to be stylistically distinct. Temporal context remained speculative. Many archaeologists formed a dislike for both the name and its overly broad definition (Jennings 1955:19; Wormington 1948:103-105). A lack of temporal and stylistic criteria consensus resulted in the assignment of multiple names by individual researchers—both for individual point styles, and groupings of point styles (e.g., Alberta, Eden, Scottsbluff, Cody, Colorado Points, Plano, San Jon, Browns Valley, Plainview, Meserve) (Jennings 1955: 20; Wormington 1948: 3-7).

Reasonably stratified or single component sites suggested stemmed styles (Alberta, Eden

and Scottsbluff) of the Yuma grouping were temporal if not cultural successors to Clovis and Folsom. In 1941, Harold Cook and others documented "Yuma" points among bison bones at the Finley kill site near Eden, Wyoming (Hack 1943; Howard 1941, 1943). These consisted of Eden style points that exhibit little in the way of a stem or shoulder and at least one Cody knife (Frison and Todd 1987:413). Howard (1943:232) notes that the term "Eden Yuma" was suggested at the joint meeting between the University Museum of Philadelphia and the Laboratory of Anthropology. The meeting was held primarily to establish guidelines for distinguishing Folsom from Yuma points. Howard (1943:232) suggested using "Scottsbluff Yuma" for stemmed and shouldered varieties found *in situ* during 1932 excavations at the Scottsbluff Bison Quarry in Nebraska (Barbour and Schultz 1932a, 1932b, 1936). Wormington (1948:1-15) recognized the problem of lumping multiple poorly dated point styles under the "Yuma" umbrella and encouraged assigning names to the various styles based on their type-site designations. She also later shortened these designators to "Eden" and "Scottsbluff" (Wormington 1949:58; 1957:118).

Excavations at the Horner site in northwestern Wyoming produced both Eden and Scottsbluff projectile points as well as Cody knives (Frison and Todd 1987; Jepson 1951). It is Jepson (1951:24) who coined the term "Cody complex" during the original excavations from 1949 through 1952. By 1957, Wormington (p.136) promoted the use of "Cody" as the archaeological culture whose diagnostic artifacts included Eden and Scottsbluff points. She also argued that the point types were sufficiently distinct that their names should be kept.

Around the time Wormington promoted using "Cody", others were re-entering the Yuma pitfall by grouping every Post-Folsom/Pre-Altithermal Paleo-Indian point type of the Great Plains and adjoining areas under the Plano Complex or Plano Culture (Jelks and Jelks 1988:378; Jennings 1955:20). Dilution of the already broad reaching term occurred when Jennings later expanded the Plano definition to include early Post-Altithermal and geographic areas where bison was not the subsistence focus (Jennings 1974:109, 1978: 50, 58-60; Pettipas 1982:46-48). Because the "Plano" umbrella offered nothing toward understanding Paleo-Indian projectile point typologies, chronologies, and geographic distribution, it too has been abandoned.

As noted in the introduction to this report, the MacHaffie site was critical to understanding the temporal disassociation of Folsom and subsequent projectile point styles because it contained Cody (Yuma) materials stratigraphically higher in the soil profile than Folsom (Forbis 1955). Today, Alberta, Eden, Scottsbluff, Firstview, and two forms of the Cody knife (Figure 69) are diagnostic artifacts of the Cody Complex (Collins et al. 1997; Frison and Todd 1987; Knell and Muñiz 2013; Peck 2011). Cody Complex diagnostics are:

> **Scottsbluff points** have wide triangular-to parallel-sided blades, distinctly indented parallel-sided stems, straight bases, and moderately controlled pressure flaking that tends to be perpendicular to the edges and overlaps near the middle. **Eden** points are relatively narrow and parallel-sided with slightly indented parallel-sided stems (occasionally produced only by grinding), strait bases, and highly controlled serial pressure flaking that is perpendicular to the edges and meets evenly in the middle, producing a distinct diamond cross section… Cody projectile points are considered to be some of the best made projectile points in the High Plains from any time period [**The shouldered Cody knife** exhibits a]… triangular blade that is set at an oblique angle to a strait-sided, straight-based stem, produced by indenting only one side… [**The second form of Cody Knife**] has a symmetrical, triangular blade with a centered square stem (originally identified as a Scottsbluff-point variant). Both types are very thin, exhibit evidence of knife use and resharpening, and are technologically distinct from Cody projectile points (Bradley 1998:169-170).

Figure 69. Cody Points/Knives and Selected Contemporary Projectile Points of North America.

Bradley and Stanford (1987:412) experimentally replicated Cody points (Eden points) through a seven-stage process. The first stage is lithic material selection. Stage 2 is biface production and general shaping and thinning through both soft and hard soft hammer percussion. Stage 3 consisted of nonserial pressure flaking to refine biface surfaces and straighten edges, but a medial flake scar ridge was not produced. Stages 4 to 7 each consisted of serial, comedial pressure flaking necessary to generate a pronounced median ridge and create regular, parallel flake removals. The authors observed that:

> Each [serial pressure] flake removal required a carefully prepared platform. It had to be fairly strong and yet retain a fairly sharp margin angle. If this was not done, flakes would often step-fracture before reaching the median. When this occurred, it was very difficult to correct because in order to maintain the even median ridge, a flake could not be removed from the opposing edge to intersect with the step-fracture. This pressure technique, therefore, demanded very careful and consistent application (Bradley and Stanford 1987:417)".

Alberta points (Fig. 69) are stylistically similar to Scottsbluff points. The threshold is subjective as no one has quantified metric data to allow consistent distinction between these point types. What can be gleaned from the literature we examined is that Alberta points tend to be larger overall or tend to have longer stems or broader stems or more defined shoulders or rounded shoulders, and some exhibit convex bases. Further, irregular flaking is more common among Alberta points than Eden or Scottsbluff types (Kornfeld et al. 2010:86-89; Trevor Peck pers. comm. 2019; Wormington and Forbis 1965:18, 173). Some researchers suggest that the Alberta point style is slightly older than Scottsbluff and Eden points (Kornfeld et al. 2010:89; Peck 2011:75-77), but radiometric and reliable contextual data are so limited it is difficult to substantiate such a claim. However, all researchers, agree that Alberta, Scottsbluff, and Eden points and Cody knives are diagnostic artifacts of the Cody archaeological culture (Knell and Muñiz 2013; Kornfeld et al. 2010:89; Peck 2011:75).

Cody succeeds Folsom, but it is uncertain if Folsom people developed the Cody technology ca. 10,000 BP. It is also uncertain what the relationship is among Cody and the temporally overlapping Agate Basin and Hell Gap point styles. Cody, like Folsom, was thought to be a Plains adapted culture with a subsistence base focused on now extinct bison species (Jennings 1974; Knell and Muñiz 2013; Kornfeld et al. 2010:89; Wedel 1978). Mounting evidence suggests that Cody peoples were adept bison hunters, but also heavily exploited mountain and foothill resources from spring through fall (Johnson et al. 2004; Johnson and Reeves 2013; Knell and Muñiz 2013; Kornfeld et al. 2010; Labelle 2012; MacDonald and Nelson 2019; Todd 2015; Vivian et al. 2008). While bison provided the most concentrated supply of food, shelter, clothing, and tools to Native inhabitants, the lesser game and plant resources of the foothills and mountains were also of great importance.

Like Folsom before it, most researchers associate Cody points with the atlatl and dart weaponry system (Knell and Muñiz 2013). The stemmed and shouldered design change from the lanceolate, fluted Folsom form distinguishes the two types. Depending on the authority cited, the Cody complex could date as tightly as 9,300 to 8,500 BP (Kornfeld et al. 2010:92), or as broadly as 10,000 to 8,000 BP (Morlan 2012:273-275). Knell and Muñiz (2013:3) see an even longer presence of Cody noting that "…Cody… is one of the longest-lasting North American Paleo-Indian traditions (~2,800 calendar years) and is second only to Clovis in geographic

expanse (extending from the Great Basin to the St. Lawrence River and from the Canadian Plains to the Texas Gulf Coast…)". A sample of dated Cody sites in Figure 70 illustrates the longer span of time for Cody when compared to Folsom. It also indicates an average expected age for Cody materials to be approximately 8,898 BP.

Figure 32 provides a visual representation of the general geographic distribution of the Cody Complex. Although north and south boundaries are similar to Folsom, Cody materials are distributed farther east and west. Some of this may be a matter of stylistic semantics. As examples, Windust (specifically the Type B point style) can be very similar to Scottsbluff points (Figure 69). Windust appears across the Columbia Plateau, the northern portion of the Great Basin, northern California, and the Snake River Plain by 10,000 BP and persists until as late as 8,000 BP (Rice 1972). Temporally and geographically overlapped by Cody is a point style designated "Hardin Barbed". Although some varieties are deeply corner-notched, some of the less shouldered examples could be indistinguishable from Cody (Figure 69). The point style is found from Arkansas north to Wisconsin and east to Ohio (Justice 1987). Apparently following Cody in time, but occasionally sharing stylistic similarities, is the Borax Lake Widestem point (Figure 69). This point style is recognized for areas west of the established Cody boundary in California and the western extreme of the Great Basin (Justice 2002b). Other point styles previously lumped under "Yuma" and "Plano" have been dated and found to be either temporally disassociated with Cody, temporally coeval but associated with an economy that did not focus on bison, or temporally coeval but so stylistically dissimilar that they are assigned to different archaeological cultures (e.g., Hell Gap, Agate Basin, Angostura) (Frison 1978; Kornfeld et al. 2010; Peck 2011; Wheeler 1954a).

At least 56 localities in Montana have produced approximately 87 Cody points (Table 25; Figure 34). That suggests Cody is expected to occur in Montana 1.8 times more frequently than Folsom. Although Cody persisted twice as long as Folsom, the percentage of point finds suggests either population densities were lower, or Cody people occupied Montana with less frequency than Folsom people. Considering that ten pieces assigned to the Cody component in 24JF4 are Cody points, the uniqueness of the MacHaffie site is again seen. No other site in Montana has produced as many Cody specimens, and most finds lack contextual integrity.

Deaver and Deaver (1986:79) located only two "Eden/Scottsbluff" points in the BLM Butte District collections for southwest Montana or mentioned in the statewide site forms at the Montana State Historic Preservation Office. Our current information for southwest and south-central Montana shows 37 (45% of total) reported finds. Eastern Montana has approximately 41 (50% of total) reported surface finds, and 23 (56%) of those finds occur along the eastern extreme of the state (Table 25). Like Folsom, northwest, north-central, and central Montana is lacking in Cody materials. Cody, however, is more common in the pine parkland of southeastern Montana than Folsom, and bison would have been the dominant large game species in this area. Still, for Montana, both Folsom and Cody people seem to be more focused on resources of the mountain valleys and foothills than those of the open plains. This probably demonstrates that although their economy was centered on bison, they were adept at broad-spectrum foraging and hunting. Table 25 is subjective in that we listed finds that appeared to fit our perception of Cody points, or those references without illustrations we consider credible. We also have no reason to believe that Table 25 provides a complete list of Cody point finds in Montana.

Table 25. Reported Cody Projectile Point Finds in Montana.

County	Site Number/locality/collection	Number of Finds	Context	Reference
Beaverhead	24BE559; 24BE734	6?; 1?	buried; surface	Bonnichsen et al. 1992; MTSHPO CRIS files
Big Horn	24BH206; 24BH1726; Westmoreland Mine/Decker area	2; 1; 1; 1	buried; surface; surface; surface	Husted 1969:52; MTSHPO CRIS files; David Ferguson pers. comm. 2019; Carbone 1972:40
Blaine	24BL756	1	surface	John Brumley pers. comm. 2017
Broadwater	Canyon Ferry inundated area	3	surface	Helmick 1984
Carbon	Cody points found in Pryor Mountains; 24CB221	3; 1	surface; buried	John Byrd pers. comm. 2019; Husted 1969:31
Carter	24CT478	1	surface	MTSHPO CRIS files
Cascade	Great Falls area; St. John's Creek west of Cascade	2; 1; 1	surface (all)	Shumate 1982; John Byrd pers. comm. 2019
Custer	North side of Yellowstone River between Miles City and Kinsey	1	surface	John Byrd pers. comm. 2019
Dawson	24DW9; 24DW10; Oscar T. Lewis collection	1; 1; unspecified	surface; surface; unspecified	MTSHPO CRIS files; Aaberg et al. 2006:167
Flathead	24FH874	1	surface	Reeves 2003:663
Granite	North side of Clark's Fork River west of Drummond	1	surface	John Byrd pers. comm. 2019
Jefferson	24JF4; Whitehall area; MT City area	10?; 1; 1; 2	buried & surface	Forbis 1955; Davis et al. 2019; David Ferguson pers. comm. 2019; John Byrd pers. comm. 2019
Lewis & Clark	Lake Helena	1	surface	Edmund MacHaffie collection (Forbis 1951 MacHaffie Site field notes and photographs)
Madison	24MA14; 24MA2220; Gravelly Range	1; 1; 1	surface (all)	MTSHPO CRIS files; Jerry Hoffman pers. comm. to Les Davis 2012
Meagher	Jim Ball Basin; SE flank of Big Belt Mountains	1; 1	surface (all)	John Byrd pers. comm. 2019
Musselshell	5 miles south of Roundup	1	surface	John Byrd pers. comm. 2019
Park	24PA302; 24PA804; North Gold Prize Site; mouth of Tom Miner Basin	1; 1; 1; 1	surface (all)	Huppe 1988; MTSHPO CRIS files; Tom Jerde pers. comm. 2019; Arthur 1966:96, 100
Phillips	SE of Malta; 24PH3418	1; 3	surface (all)	MTSHPO CRIS files, Hoy 1969
Powder River	24PR405	1	surface	Deaver 1981
Roosevelt	24RV1	2+	surface	MTSHPO CRIS files, Johnson 1977
Rosebud	24RB753; 24RB1073; 24RB1605; 24RB2504	1; 1; unspecified	buried; surface; surface	McLean 1976; Meyer and Munson 1998; David Ferguson and Gene Munson pers. comm. 2019; Fredlund 1972
Sheridan	24SH509; 24SH530; 24SH560; 24SH561; 24SH578; 24SH579; 24SH586; George Melby and Tom Samsel collections	1; 1; 3; 1; 1; 1; 1; 3; 3	surface (all)	Jerde 1981, 1992; Joyes and Jerde 1970; Tom Jerde pers. comm. 2019
Sweet Grass	Sweet Grass Creek NE of Big Timber	1	surface	Larry Lahren pers. comm. 2019
Teton	Bud Bisnett collection. Found north of Choteau.	1	surface	John Byrd pers. comm. 2019
Treasure	24TE30	1	surface	Fredlund and Fredlund 1977
Wibaux	24WX1003; 24WX1007	1;1	surface (all)	MTSHPO CRIS files
Yellowstone	24YL1; 24YL780; Joan Conley collection	1; 1; 1	buried; surface; surface	Mulloy 1958; MTSHPO CRIS files; Tom Jerde pers. comm. 2019

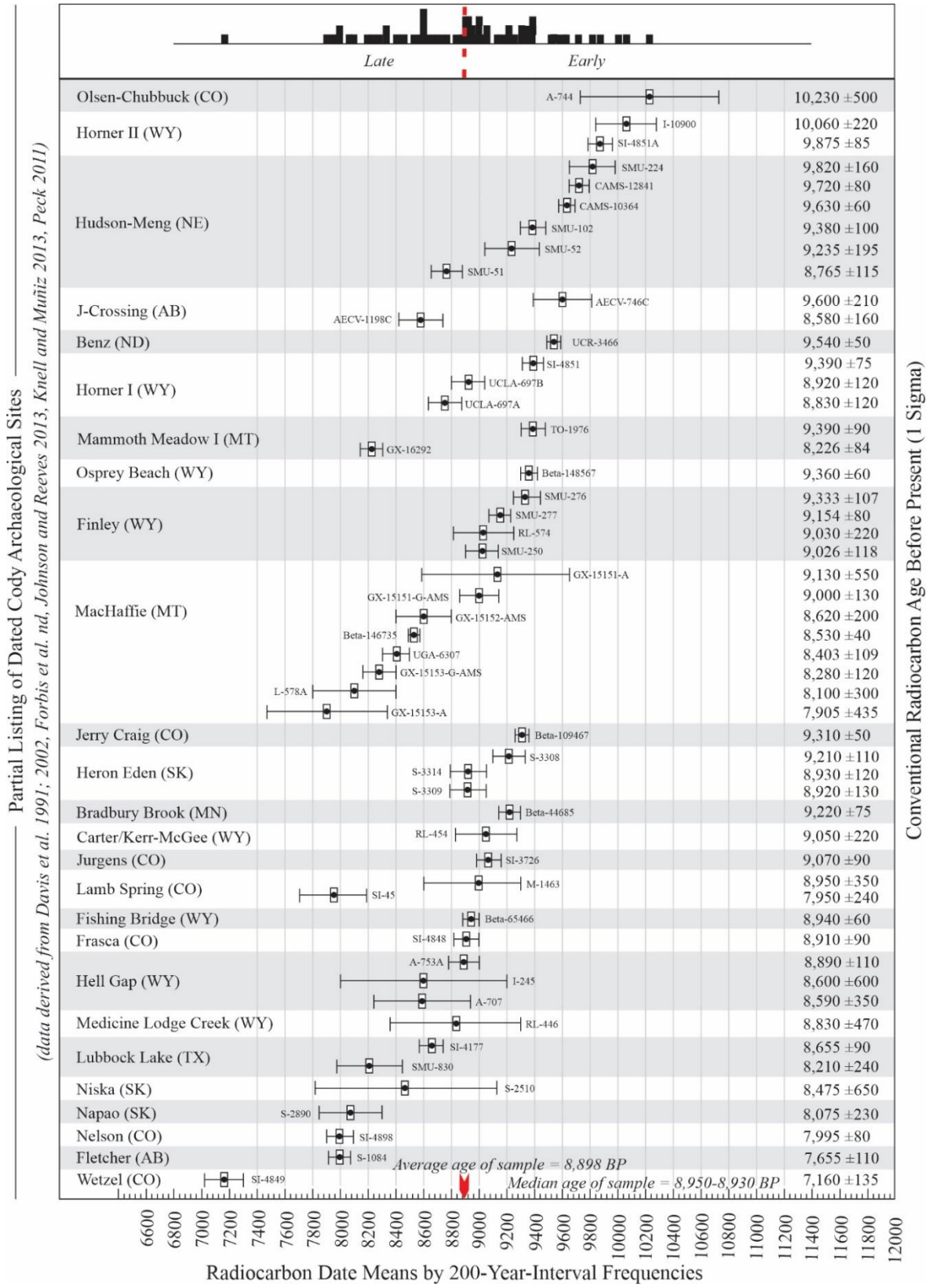


Figure 70. C-14 Chronology for a Sample of Dated Cody Sites.

9.0 THE CODY COMPONENT IN 24JF4

Depth discrepancies for the Cody component in MacHaffie are observed when comparing the 1951 excavation work to that of 1989 through 2018. We suggest this is related to a sharp easterly decline of the Paleo-Indian age landform. Forbis documented the Cody component depth from approximately 58 to 90 cm BS in his 1951 excavation block. The 1989 through 2018 work north and east of Forbis' excavation block identified the Cody component from possibly 110 to 160 cm BS but increasing in depth as one trends easterly. Davis et al. (1991:2, 2002:19) identify two Cody strata designated Stratum III (Scottsbluff?) and Stratum IV (Scottsbluff). We could find no explanation for how these two Strata were defined. Hereafter we consider the Cody component to be a single entity ranging vertically from the top of the alluvium to the top of the Folsom component. Hindering our ability to stratigraphically define the Cody component is the fact that no artifacts diagnostic of Cody were recovered during the 1989 through 2018 work.

Detailed descriptions of the various artifact classes and faunal resources pertaining to the Cody component are presented hereafter. Table 26 provides a summary by count and weight of all cultural material currently assigned to the Cody component in 24JF4. In total, 4,408 items with a combined weight of 17.7 kg (39 lbs.) have been assigned to the Cody component.

Table 26. Summary by Count and Weight of Cody Cultural Material.

	Cultural Material Categories												
	Abraded/Ground Stone	FCR	Bone	Core	Unmodified Debitage	DEF/M	Endscraper	Biface	P.P.	Cultural Stone	Hammer Stone	Cody Knife	Total
Count:	2	0	263	9	4,061	14	12	34	10	1	0	2	4,408
%Total #:	<1%	0%	6%	<1%	92%	<1%	<1%	<1%	<1%	<1%	<0%	<1%	100%
Weight (gms):	46.70	0	3,718.45	849.50	10,491.45	797.60	308.52	1,334.93	27.70	85.02	0	25.50	17,685.37
%Total #:	<1%	0%	21%	5%	59%	5%	2%	7%	<1%	<1%	0%	<1%	100%

Abbreviations: FCR- firecracked rock; DEF/M- debitage with edge-flaking or other edge modification; P.P.- Projectile point

Counts include debitage associated with Knapping Features 3 , 5 & 6.

9.1 Faunal Remains (see Appendix 7)

Forbis noted that *bison* sp. remains in the Cody component possibly represent two individuals. Smaller mammal remains include a possible juvenile bear or bison, deer, pronghorn, rabbit, and small burrowing rodents, although there is no indication that burrowing rodent or rabbit remains were culturally utilized. They likely post-date the Cody component and represent animals that died in their burrows. Bison and medium-size mammal remains are largely comminuted. The majority of identifiable skeletal elements are represented by lower limb bones. A few burned bone fragments were noted in 1951. The bone was generally well preserved, although several pieces exhibit weathering.

One interesting bison bone (Fig. 71, #177) is a complete left radius recovered from unit 8S/2W at a depth of 140-150 cm BS. A segment of the anterior surface has been smashed open, probably with a large stone, producing an oblong hole 15 cm long and 3 cm wide. Presumably this was done to remove yellow marrow from the interior cavity. The radius has a maximum length of 35.9 cm and a maximum shaft diameter of 21 cm. Following measurement locations defined by Todd (1987, Appendix 1:376-380), Fisher (1991) calculated the following: greatest breadth of proximal articular surface = 9.95 cm, greatest breadth of distal end = 10 cm, greatest depth of proximal end = 5.32 cm, greatest depth of distal end = 6.5 cm. Fisher (1991, 2000) also obtained the following measurements on an astragalus (#208) that Les Davis later submitted for C-14 assay: greatest length of lateral half measurement = 8.43 cm, greatest length of medial half = 7.74 cm, greatest depth of lateral half = 4.68 cm, greatest breadth of distal end = 5.8 cm. It was noted by Fisher **(**1991, 2000, 2018**)** that the bison bone he examined from MacHaffie compare favorably with adult male bison from the Horner site (Todd 1987) and the Finley site (Bedord 1974) in Wyoming. The bison represented there are identified as extinct *Bison antiquus* or a closely related species.

The proximal end of a deer (*Odocoileus* sp.) antler (Davis et al. 1991) was recovered from the Cody component. The antler was shed naturally, not hacked from the skull. It has been suggested that the lack of hammerstones may imply the use of antler billets for stone knapping. Although this deer antler piece is too light for soft-hammer percussion, it may have been part of a pressure flaking implement similar to one recovered in site 24PA490 (Rennie 2020).

The 2022 study (Greiser 2022) examined 263 complete bones and fragments weighing a combined total of 3,718.45 grams. Identifiable species include bison (*Bison* sp.), beaver (*Castor canadensis*), hare *(Lepus spp*.), rabbit (*Sylvilagus* spp.), and vole (*Arvicolinae* (formerly *Microtinae*) spp.). Seventy-one percent of the bone by count and only eight percent by weight is considered "scrap". Presumably these pieces formed through intensive pulverization subsequent to subjection to stone boiling, but boiling pit features or water fractured FCR was not recovered to support this assumption. These pieces are too small to positively identify skeletal element or genus and species. To illustrate the small size of the scrap pieces, three are size-grade 1, 51 pieces are size-grade 2, and 132 are size-grades 3-4. The majority is probably from large or medium ungulates, and probable represent only one or two animals per species utilized by humans.

The majority of 113 identifiable ungulate bones and bone fragments from the Cody levels are probably bison. They constitute 46 percent of all bone pieces by count and 98% by weight. Identifiable bison remains include rib fragments, a caudal vertebra, scapula fragments, humerus fragments, a complete radius, radius fragments, an ulna fragment, a metacarpal fragment, a carpal, femur fragments, a proximal tibia, a proximal metatarsal, and tarsals. The more complete bison bones from the Cody component indicate that only one adult is represented. Evidence of butchering consists of the impact hole in a complete radius (Figure 71), and green breaks on five other leg bones. It is assumed that this damage reflects marrow extraction and efforts to render grease from processed bone. The only medium-size ungulate remains identified in the Cody component consists of a 3rd lower molar (#181) of either a bighorn sheep or mountain goat.

Figure 71. Bison Radius with Marrow Extraction Hole.

As a side note, the left proximal bison metacarpal fragments (#197) from 140-150 m BS in the Cody component match the distal metacarpal (#198) from the Folsom component at a depth of 160-170 cm BS. Both elements were recovered from XU 6S/2W. Such vertical separation may indicate at least some mixing of Folsom and Cody cultural materials over time.

A partial rabbit skeleton (#274) was recovered during Dick Forbis' 1951 excavations in XU N1/W1, Level 6 (Figure 23). Skeletal remains include a right maxilla and mandible, both humerii, and a left femur. These remains may have been brought to the site by Cody occupants, or more likely, the animal that died naturally, presumably inside a burrow. If the latter scenario is correct, then the rabbit post-dates the Cody occupation.

A large beaver incisor fragment (#260) was recovered from XU S1/W3 at 80-90 cm BS. It is possible that this incisor fragment comes from the same individual as a second beaver incisor fragment (#259) recovered from XU S1/W4 at 50-60 cm BS. However, the depth of the incisor fragment in XU S1/W4 would associate it with the Helena Component if sediment mixing is not the issue. Both units were excavated by Forbis in 1951. Considering that the MacHaffie site locality likely featured a reliable stream flow and riparian zone vegetation over time, the beaver remains may or may not be cultural. If the incisors were utilized as tools by past occupants of the site, then they may have been translocated from elsewhere. While there is wear at the ends of the incisors, it is unclear if it is natural or cultural.

Small rodents, probably meadow vole, of the sub-family *Arvicolinae* are represented by a mandible with an incisor, a second incisor, and fragments of a probable third animal. The

remains most likely represent individuals that died in burrows that cut through the cultural occupation levels. There is no indication that these were utilized as a food source by Cody occupants.

9.2.1 Lithic Material Culture

Firecracked Rock (Table 26)

No FCR has been documented in association with the Cody component. One possible surface hearth feature identified by Dick Forbis in 1951 appears from the associated photo to be a limited concentration of unburned bone fragments:

> One presumed hearth was discovered in squares S1/W3 and S1/W4. Its exact shape could not be determined, but it appeared to be roughly circular and about 5 ft in diameter. Sediment was not discolored by fire. Burned bone, burned flakes, and a few flecks of charcoal were found in the hearth area. The hearth was not outlined by stones nor did the stones appear to have been in a pit in which the fire was built. Minute specks of red ochre were detected more frequently near the hearth than at any other place in the Scottsbluff layer, but its incidence there did not appear to have any necessary connection with use of the hearth (Forbis 1955:42, UMMC 2020).

Later, Forbis et al. (n.d.:170) describe the same possible feature as:

> One reddish, fire-stained area extended through two excavation units (S1/W3 and S1/W4). Its borders Were indefinite and its exact shape is unknown; though it appeared to be roughly circular and about 5 feet In diameter. There was no pit, and the earth below was not baked. While it contained no large stones, it did yield some charcoal, burned bone and chips. Flecks of red ochre were more common in and around the hearth than elsewhere, but its incidence is not known to have any necessary connection with burning.

Davis (2009: 3) shows a stratigraphic profile in an undesignated excavation unit where a dark stain is identified as "This Scottsbluff hearth is underlain by the Folsom horizon and sub-Folsom zone". Unfortunately, we could find no additional information regarding this possible hearth in associated reports, level records, or field notes. Thus, it remains uncertain if Cody occupants constructed heating or cooking facilities at MacHaffie. They likely did because most of the bone pieces show evidence of on-site processing. Forbis et al. (n.d.:144) note that "Charcoal was collected wherever possible, but only in the Scottsbluff layer was there a sufficient amount for radiocarbon dating purposes".

Cultural Stone (Table 26; Figures 72-76)

Cultural stone, or manuport, refers to unmodified stone believed to reflect cultural import, but the function of the item is uncertain. An elongated or tapering, roughly triangular-shaped piece of culturally unmodified dark-gray mudstone (SLM4) with naturally rounded edges and flattened surfaces was recovered in 1951 from a depth of 84 cm BS in unit S1/W1 (#11; Forbis artifact # 5202 A-D). A 1951 excavation photo shows the tip missing at the time it was exposed *in situ*. It is uncertain where the tip was ultimately recovered. Subsequently, the piece

broke into three additional fragments sometime after excavation. All pieces were found together in a paper bag in 2018 and rejoined at that time.

The item measures 15.1 cm in maximum length and 1.3 cm in maximum thickness. The widest end measures 2.6 cm and naturally tapers to a somewhat rounded point of 0.8 cm in width. It weighs 85.02 g. The item was imported to the site possibly from either the Missouri River or Prickly Pear Creek considering its stream-rolled characteristics. Purpose for the cultural translocation is unknown. Dr. Larry Lahren informed that a similar item was recovered from the Agate Basin component (SU-1) in the Myers-Hindman site (Larry Lahren pers. comm. 2020). That piece is described in his dissertation as an edge ground cobble (Lahren 1976:58).

One suggested function is an indirect percussion punch used in flint knapping. It should be stressed that there is no evidence of human modification (i.e., grinding, polish, abrasions, pecking, etc.) to this stone. To test this notion, four similar stones were collected from the Prickly Pear Creek dredge piles 1 km north of MacHaffie. Two were tested as indirect percussion punches to remove flakes from a chert biface. Twenty-five direct percussion blows were applied to the proximal ends and distal faces of each punch using a quartzite hammerstone. This produced pock marked zones where direct percussion was applied and short, flake removals at the distal ends (Figure 73). Because damage to both indirect percussion punches was similar, only one example is illustrated here. The lithic material was largely ineffective in indirect percussion flake removal. Because there is no battering of either end or faces and because the fracture patterns are dissimilar to the damage caused to the two experimental pieces, it is unlikely that the manuport was utilized in indirect percussion work.

To test if the breakage resulted from crushing, a third test subject was laid on a concrete driveway and the upper surface was struck with a hammerstone. The resulting fractures are similar to the breakage pattern of cultural stone #11, but a crush point obvious on the experimental piece is not visible on the manuport (Figure 74).

Melvin Beattie, an experienced traditional hide tanner, basket maker, tipi maker, and flintknapper could not identify a use for the MacHaffie manuport in the leather tanning process. An additional experiment using the fourth collected test stone was conducted by Mr. Beattie to determine if cultural stone #11 could have been used as an awl or fid in basket making. The hypothesis was that the piece may have been used to pry basket cordage apart to insert binding strands or spokes into the opening (Figures 75 and 76). Mr. Beattie also tested whether the manuport could be used for compressing a basket's binding strands to make a tighter weave. This experiment quickly demonstrated that the dimensions of cultural stone #11 are too thick, and the narrow end is too blunt for it to have been used in weaving basketry. The intended purpose for the MacHaffie manuport remains a mystery.

Figure 72. (left side photo) Cultural Stone of Undetermined Function assigned to the Cody Component. Red Dotted Lines indicate Rejoined Fragments. (right side photo) Cultural Stone #11 when Exposed by Dick Forbis' Crew in 1951.

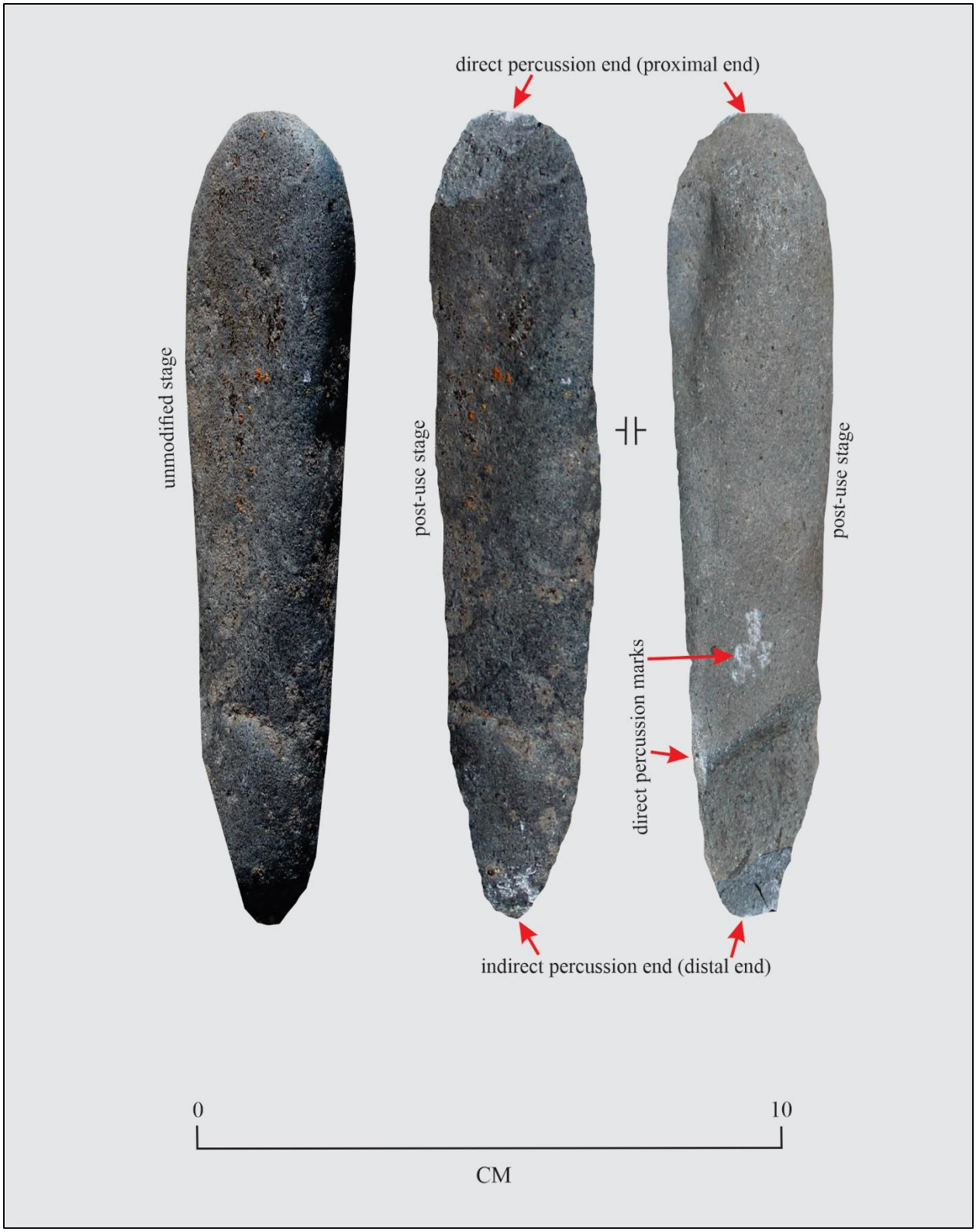


Figure 73. Indirect Percussion Punch 1 before and after Experimentation.

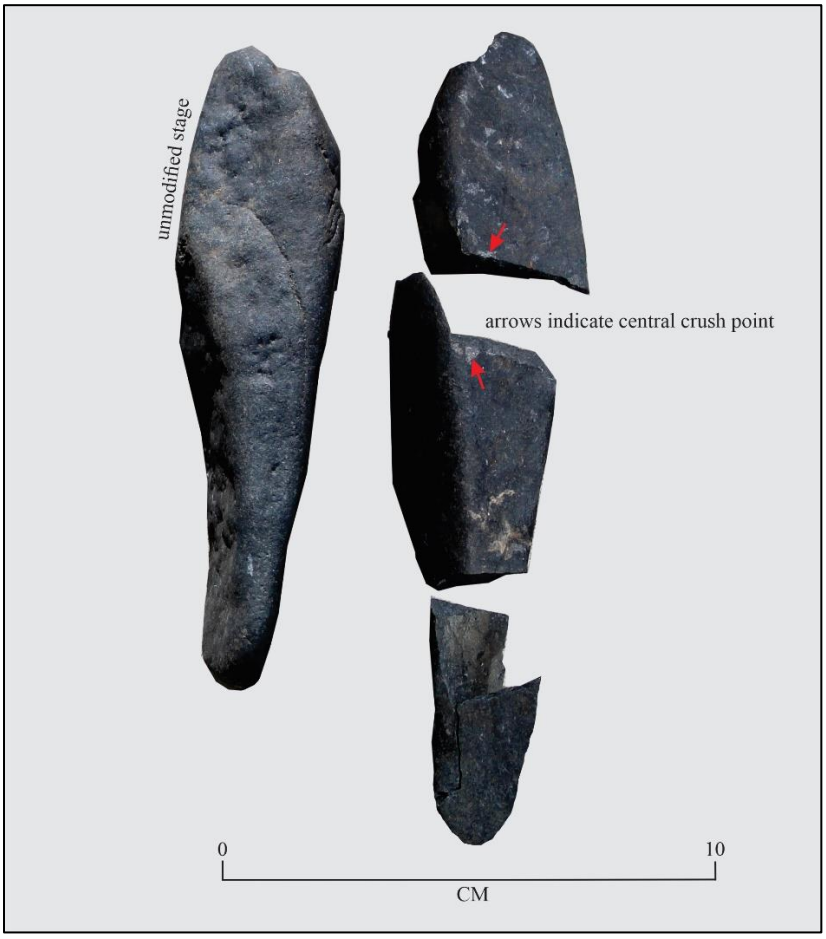


Figure 74. Radial Fracture/Crushing Experiment Results.

Figure 75. Using Metal Awl or Fid to Create Space for another Spoke.

Figure 76. Using Metal Awl or fid to insert the Top Weaver into a Rim.

Abraded Stone/Ground Stone (Table 26; Figures 77 and 78)

Two similar atlatl dart-size shaft abraders are assigned to the Cody component. Abrader # 3 was recovered in 1991 from excavation unit 8S/2W at a depth of 160-170 cm BS. Abrader #4 was recovered in 1951 from excavation unit S1/W4 at a depth of 58 cm BS. The Cody component in excavation unit 8S/2W begins at approximately one meter BS and extends downward to approximately 160 cm BS. Davis designated the depth that abrader #3 came from as "Sub-Scottsbluff", so the piece could be from either Cody or Folsom component. In excavation unit S1/W4 the Cody component was much closer to the ground surface but generally occurred at approximately 60-85 cm BS (Forbis 1955). A photo taken by Dick Forbis in 1951 (Figure 78) shows shaft abrader #4 in association with projectile points #30 and #31 (Figure 79). This provides strong evidence for dart shaft manufacture and hafting/re-hafting of projectile points in this locality by Cody people.

Both abraders are complete and well used. The rather soft, medium-grained, granular sandstone from which they are made is not found within 80 km of the MacHaffie site. Both have the texture of 40 or 50 grit sandpaper. Abrader #3 has overall dimensions of 2.85 cm in maximum length, 3.31 cm in maximum width, and 1.71 cm in maximum thickness. It weighs 19.3 g. The semi-circular groove that runs the length of the piece is 2.7 cm long, 1.5 cm wide at the top of the groove, 1.4 cm wide at the base of the groove, and 0.45 cm deep. The abrader is 1.3 cm thick beneath the groove.

Abrader #4 is Forbis' artifact #5201 (Forbis 1955). It has overall dimensions of 4.65 cm in maximum length, 2.7 cm in maximum width, and 1.4 cm in maximum thickness. It weighs 27.4 g. The semi-circular groove that runs the length of the piece is 4.5 cm long, 1.1 cm wide at the top of the groove, 0.8 cm wide at the base of the groove, and 0.3 cm deep. Beneath the groove the abrader is 1.25 cm thick.

Although not exclusive to Cody, shaft abraders should be considered an expected artifact type in Cody components. Similar abraders were recovered at the Hell Gap, Horner and Osprey Beach sites in Wyoming (Frison and Todd 1987:263; Johnson et al. 2004:273-281; Larson et al. 2009:192), the Claypool and Jurgens sites in Colorado (Dick and Mountain 1960:234; Wheat 1979:133), and the Lime Creek site in Nebraska (Davis 1962:56).

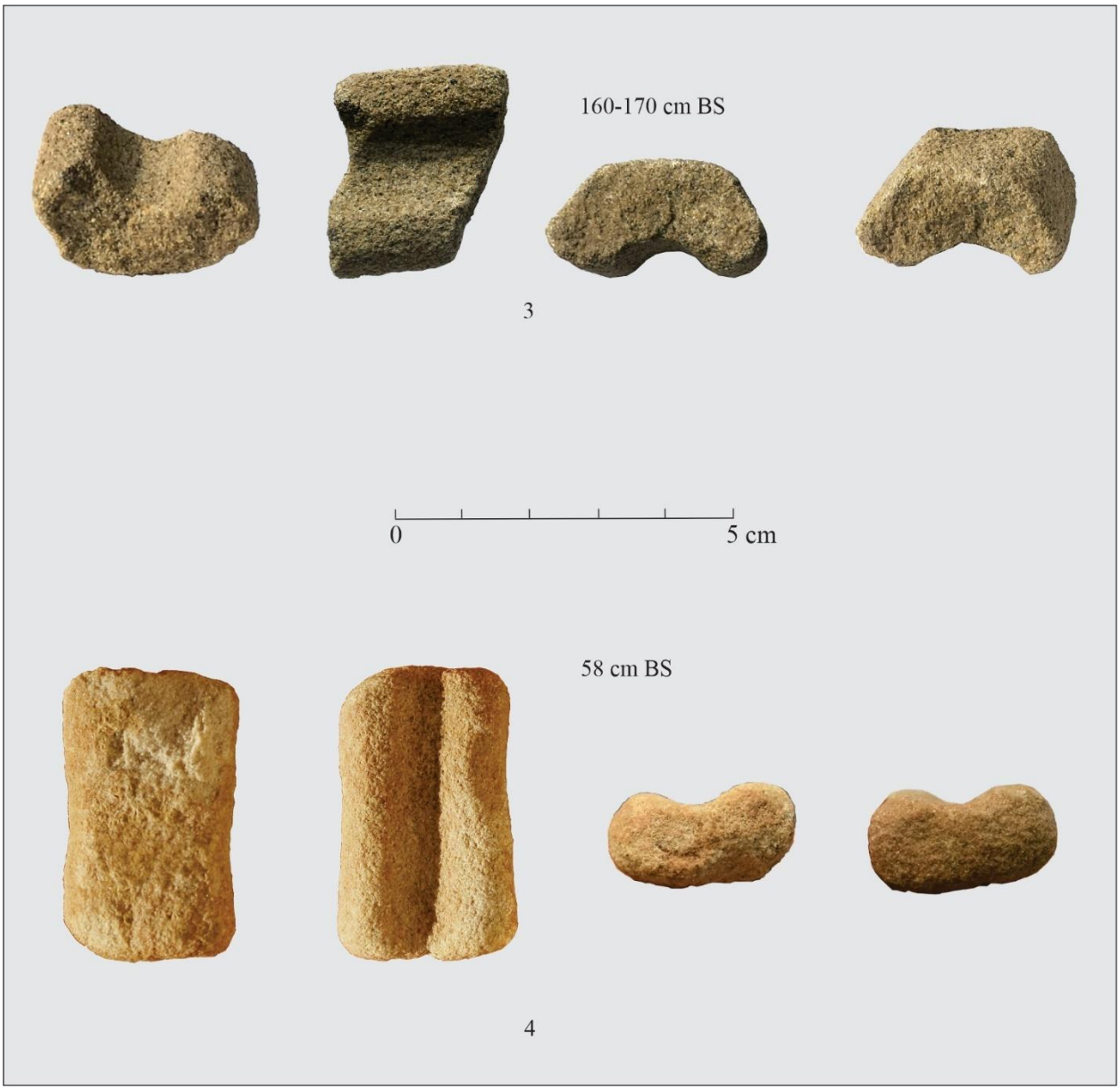


Figure 77. Various Views of the Two Shaft Abraders Assigned to the Cody Component.

Figure 78. Shaft Abrader #4 and Projectile Points #30 and #31 Exposed during 1951 Excavations.

Projectile Points (Tables 26 and 27; Figure 79)

One projectile point fragment (#13) presumed here to be associated with the Cody component was recovered from 1989 through 2018. That piece is an obliquely parallel flaked projectile point or preform tip that probably broke during manufacture. Although it was recovered from a depth associated with the Folsom component, it is stylistically dissimilar to Folsom point preforms and more like Cody. Items #29 (Forbis artifact #1212) and #25 (Forbis artifact #1735) were surface finds. Item #29 was found by Edmund MacHaffie and item #25 was found by Dick Forbis' 1951 crew. All other Cody points were recovered during Richard Forbis' 1951 excavation.

The point bases (#21, #25 and #26) were likely broken by use-impact then transported in their hafts to MacHaffie before removal and discard. Each is made of a distinctive chert MANA designation (#21: BCCS28, #25: CCCS2, #26: YBCCS4). While #25 was found out-of-context, it stylistically fits the form of a Cody point base.

Points #22 and #24 might be Eden because the general lack of a shoulder. Point #24 is made of chert (BCCS4). Its asymmetrical tip is a result of extensive resharpening. The piece likely broke while hafted from impact, then the hafted remnant was rejuvenated. It was subsequently removed from its haft and discarded at MacHaffie. The margins were examined under low magnification and show no signs of polish, striations, or other use-wear. Point #22 is

Table 27. Metric, Nonmetric, and Provenience Data for Cody Projectile Points.

Record Number	Excavation Unit	Excavation Level	Excavated Level Depth	CMU	Lithic Material Code	Condition	Preform	Type
13	98-South Block	18	170-180 cm BS	5	BCCS27	body-tip	biface	indeterminate
21	S1/W3	5	72 cm BS	11	BCCS38	base	biface	Scottsbluff
22	S1/W2	6	79 cm BS	11	DAC1	complete	biface	Eden
23	S1/W4	5	73 cm BS	11	YBCCS30	complete	biface	Scottsbluff
24	S1/W3	5	64 cm BS	11	YBCCS4	complete	biface	Eden
25		0	surface	1	CCCS2	base	biface	Scottsbluff
26	S1/W4	5	73 cm BS	11	YBCCS4	base	biface	Scottsbluff
29			Surface	1		complete	biface	Alberta/Nezu Knife?
30	S1/W4	4	58 cm BS	11		complete	biface	Scottsbluff
31	S1/W4	4	58 cm BS	11		complete	biface	Scottsbluff

Flaking Pattern	Cross Section	Outline Symmetry	Basal Edge Shape	Fracture Type	Base Height	Base Width	Shoulder Height
double diagonal	bi-convex	symmetrical		transverse			
parallel	bi-convex	N/A	straight	transverse		17.23	
parallel	bi-convex	symmetrical	straight	N/A	21.3	19.42	21.45
parallel	bi-convex	symmetrical	straight	N/A	15.83	18.67	15.97
parallel	bi-convex	asymmetrical	straight	N/A	15.35	18.91	17.51
parallel	bi-convex	N/A	straight	transverse		18.22	
parallel	bi-convex	symmetrical	straight	transverse		19	
irregular	bi-convex	symmetrical	straight	N/A	14.8	25	14.3
parallel	bi-convex	symmetrical	straight	N/A	18.6	18.2	19
parallel	bi-convex	symmetrical	straight	N/A	16	18	20.2

Shoulder Width	Neck Width	Neck Thickness	Body Length	Max. Body Thickness	Max. Length	Hafted Retouch Index	Weight (grams)
				6.29			2.8
		3.95					1.26
21.93	21.35	5.51	41.86	4.7	62.24	0	8.2
21.67	19.27	4.48	31.21	6.82	46.65	0.937	6.84
19.28	18.54	5.85	26.14	5.56	42.33	0.625	5.23
		4.5					1.68
		4					1.19
28	23.5		33		48	0.5	0
23	19.8		36		56	0.687	0
24.4	20.8		40		56	0.937	0

Comments
Recovered from 180 cm BS (sub-Scottsbluff Component as defined by Davis). Probably broke during manufacture.
Forbis artifact #1204. Basal edges are lightly ground.
Forbis artifact #1203. Basal edges are lightly ground.
Forbis artifact #1200. Basal edges are lightly ground.
Forbis artifact #1209. Basal edges are lightly ground.
Forbis artifact #1735. Basal edges are lightly ground.
Forbis artifact #1207. Basal edges are lightly ground.
Forbis artifact #1212. Found by Edmund MacHaffie. Artifact is missing from UM collection. A scaled photographic image was used for metric observations.
Forbis artifact #1201. Artifact is missing from UM collection. A scaled photographic image was used for metric observations.
Forbis artifact #1202. Artifact is missing from UM collection. A scaled photographic image was used for metric observations.

projectile point measurements are in millimeters

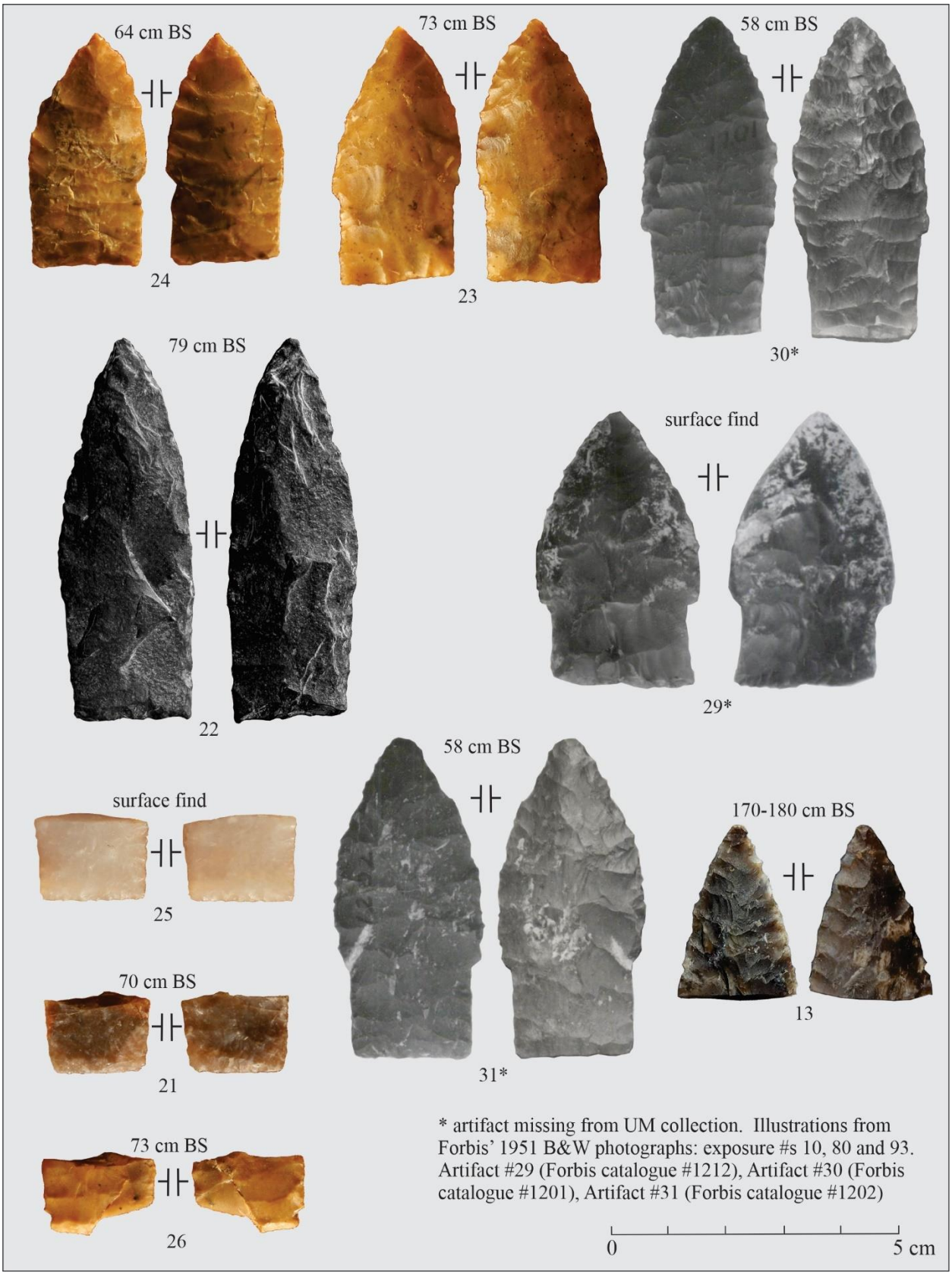


Figure 79. Projectile Points and Fragments Assigned to the Cody Component.

complete and bifacially flaked, albeit poorly so, a consequence of the dacite (DAC1) material used. Dacite consistently produces step fractures during pressure flake removal. This piece represents one of the earliest recognized uses of dacite in projectile point manufacture in Montana. It was likely never used as a projectile point, and the lack of dacite debitage suggests that it was produced off-site. It is inexplicable why this artifact was transported to MacHaffie, then discarded there.

Points #23 (YBCCS30), #29, #30, and #31 are all of chert, points #29 through #31 are missing from the UM collection. Limited metric data were obtained from scaled, high resolution photographs of the latter three points and lithic material descriptions provided by Forbis (1951 field notes and photographic record log: bin A) indicated that #29 is of "flint", #30 is of "Dark-brown, translucent, glossy flint", and #31 is of "Dull, opaque, brown flint". Based on minor shoulders and a recognizable stem with a straight basal margin, points #23, #30, and #31 are all classified here as Scottsbluff. Most colleagues suggest that #29 is best classified as an Alberta point based on its wider stem and more irregular flaking (Edward Knell, Craig Lee, Trevor Peck pers. comm. 2019).

In addition to patterns of high-quality brown and yellow chert selection, biconvex cross-sections, and slightly shouldered pieces with straight sided stems and straight basal margins, there is a general asymmetry to most of the intact pieces (#22 through #24, and #29). Whether this pattern is intentional or coincidental is uncertain. In the scenario where points #23 and #24 broke irregularly, then were reshaped (resharpened) to have functional tips, such asymmetry can occur. It is easier to understand why these two points were discarded compared to points #29-#31. These latter three pieces, while possibly having been broken and resharpened, are still fully functional pieces. Following Andrefsky's (2006) Hafted Biface Retouch Index (HRI), points #23, #24, #30, and #31 were thoroughly resharpened and now have HRI index values of 0.937, 0.625, 0.687, and 0.937. Less certain is point #29 (HRI value = 0.5) which may or may not have been reshaped. These values are predicated on the photographic images for #29 through #31 being of sufficiently high resolution to show all retouch flake scars. In contrast, point #22 indicates no post-production retouch (HRI value = 0).

Comprehensive metric data is not available for points #29 through #31. Still, scaled photographs of these pieces can provide reasonably accurate length and width measurements. The pieces for which metric data could be obtained have average base heights of 17.2 mm, base widths of 19.2 mm, shoulder heights of 18.5 mm, shoulder widths of 23.3 mm, neck widths of 20.8 mm, neck thicknesses of 4.7 mm, body lengths of 35.4 mm, body thicknesses of 5.1 mm, maximum average lengths of 52.9 mm, and an average weight of 6.76 grams.

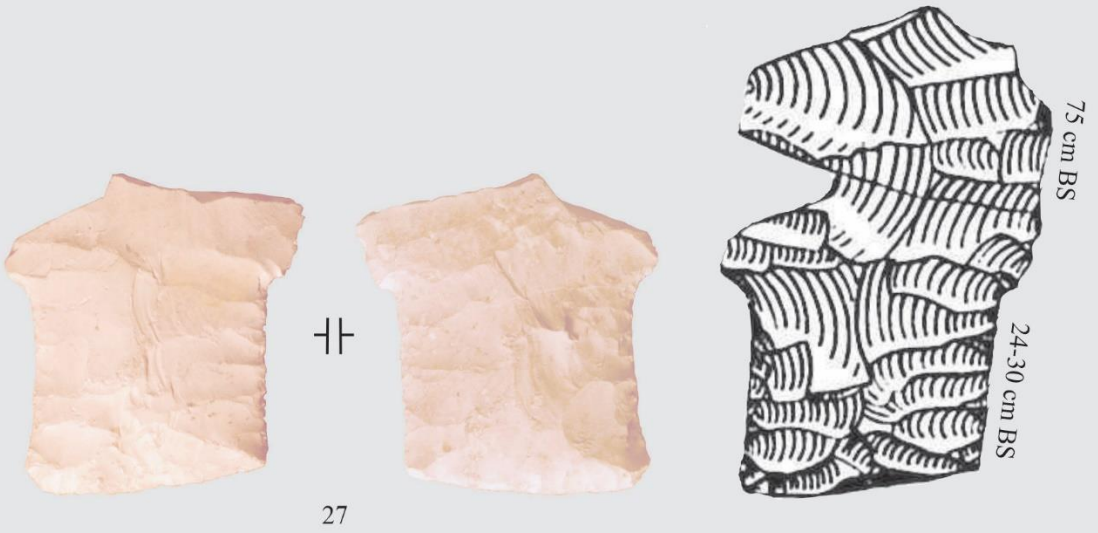
Hafted Knives (Table 26; Figure 80)

Two probable Cody Knife variants are assigned to the Cody component. Cody Knives are recognized as a diagnostic artifact of the Cody Archaeological Culture (Agenbroad 1978; Blackmar 1998; Frison and Todd 1987; Johnson et al. 2004). Although the stereotypical shape is described as "knives with transverse blades that are usually shouldered on one side but are

sometimes characterized by a parallel sided base without an inset (Wormington 1957:267)", a great deal of stylistic variability can occur around the typically asymmetrical form.

One probable Cody Knife fragment (Fig.80 .27) is the basal stem and shoulder portion. This artifact was recovered in two pieces in 1951 from different vertical levels (75 cm BS and 24-30 cm BS) in excavation unit N2/W3. The stemmed, straight sided base with minor shoulders and a slightly angled, slightly concave basal margin is consistent with Cody hafted implements. One side of the base is flaked in a vertically parallel manner and flake removals terminate at mid-line. Flaking of the opposite side is more irregular. The material is a light-yellowish to buff colored opaque chert (GBCCS10) because of its heavily weathered chalky appearance. The material is similar to weathered Avon or Bowman Chert, but the unweathered material could have been a variety of colors, textures, or opacities. Both Forbis (1955:82) and Knudson 1982:122) illustrated the rejoined artifact (Forbis artifact #1504). Today the blade fragment is missing from the UM collection. The haft is biconvex in cross-section and may have originally exhibited an asymmetrical blade. It has a base height of 24.8 mm, base width of 30.5 mm, shoulder height of 27.7 mm, shoulder width of 39.2 mm, neck width of 29.2 mm, and a neck thickness of 7.9 mm. Although incomplete, it weighs 12.07 grams. A similar artifact was recovered from the Cody affiliated Larson Cache in Wyoming (Frison 1978:190.a).

The second probable hafted knife (Fig. 80. 49) was collected from the cutbank profile by Wesley L. Bliss in 1947 at a depth of 39 cm BS. Several cultural items were recovered from a well-defined stratum exposed in the cutbank face at 39 cm BS. Bliss held that this stratum was associated with Yuma [Cody] occupants (Bliss et al. 1947). Bliss et al. (1947) assigned the piece catalogue #39 and referred to it as a Yuma point. The artifact is curated at the NMNH under accession #206347, catalogue #406712. It is also assigned catalogue #49 in the DNRC Projectile Point database. The tip of the piece was re-attached (glued) to the body to make a complete specimen. It is uncertain if the artifact was broken prior to collection. Minor chattering or pseudo-retouch along one lateral margin of the blade is damage that occurred either during or after excavation. It is not original to the piece (James Krakker pers. comm. 2019). The knife is made of a grayish-brown highly siliceous chert (BCCS38). However, it is thoroughly weathered leaving little of the unoxidized lithic material visible. Pressure flaking is random and minimal and appears to have been only applied as needed to give the piece its shape. The piece is biconvex in cross-section although it is nearly biplano. The shape is that of a modern clip point knife blade. Its basal margin is slightly angled similar to that of #27. It has a base height of 13.2 mm, base width of 20 mm, shoulder height of 13.8 mm, shoulder width of 24 mm, neck width of 20.6 mm, and a neck thickness of 8.3 mm. It weighs 13.4 grams.



27

Forbis (1955:82) and Knudson (1982:122) both show the fragmented but rejoined blade portion of #27. Today the blade fragment is missing from the UM collection. Line drawing illustration above is from Forbis (1955:82).

0 5 cm

39 cm BS

49

Item collected by Wesley L. Bliss (1947) from cutbank profile. Item curated at the Smithsonian Institution National Museum of Natural History accession # 206347, catalogue # A406712. Photos by James Krakker, 2019, archaeology collections specialist, Smithsonian Institution National Museum of Natural History.

Figure 80. Probable Hafted Knives Assigned to the Cody Component.

Bifaces (Tables 26 and 28; Figures 81-85)

Thirty-three nonhafted bifaces of chert and one of opaque black obsidian (OBS1) are associated with the Cody component. Twenty-seven (79%) of the bifaces were recovered by Dick Forbis, Edmund MacHaffie or Wesley Bliss. Only seven were recovered during the 1989 through 2018 investigations. The obsidian biface has been thin sectioned, but it is uncertain when this occurred and what data was obtained.

One biface (Fig. 83.70) is of two pieces that Forbis glued together presuming that they were originally from the same piece with one fragment showing a continued knapping history. Although the lithic materials are visually similar, these two pieces do not match and should be considered two separate biface fragments. They are catalogued here as one biface for consistency's sake. The chert bifaces are made on 15 distinctive MANA designations: BCCS4, BCCS19, BCCS23, BCCS31, CCCS1, CCCS2, CCCS3, CCCS5, CCCS7, CCCS9, GBCCS18, GBCCS20, RCCS20, YBCCS7 and YBCCS30. The BCCS23, CCCS1, CCCS2 and YBCCS30 MANA designations are represented by two bifaces each. The CCCS7 MANA designation is represented by seven pieces, and the GBCCS18 MANA designation is found among ten (30%) pieces. There appears to have been an intentional selection for the rather grainy, bluish-gray (GBCCS18) chert and for rather clear or colorless pieces (CCCS1-CCCS9) among the Cody occupants when compared to the preference for a high-quality, semi-translucent reddish brown (BCCS41) material favored by Folsom occupants. Twenty (61%) of the bifaces are complete, the others are, for the most part, distal or proximal ends. Eighteen (55%) are considered reduction stage II pieces, 15 (45%) are considered stage III bifaces, and only a single specimen is considered to represent the initial reduction stage (Fig. 81.83) (see Callahan 1979). The majority tend to be roughly ovate in shape and bi-convex (n=29 or 88%) in cross-section. Edge dulling, damage, or polish was not observed among any of these biface pieces. One interesting artifact (Fig. 82.68) is a well flaked, well thinned elongate piece that is fairly fragile and not practical for either a single projectile point preform or a durable cutting or scraping implement. It measures 12.8 cm in length, 3.1 cm in width, 0.97 cm in thickness, and weighs 47.1 grams. It may have been a flintknapper's attempt to show his skill because the tough grainy material (GBCCS18) it is made from would have been difficult to pressure flake without being heat treated. Forbis recovered this item (Forbis catalogue #1208A-1208E) in five pieces across three excavation units at approximately 79 cm BS. It appears to have been broken after manufacture and then scattered over an area measuring approximately 3 m in diameter before being buried by natural processes. Its horizontally scattered nature could have resulted from either cultural or alluvial activities.

Many of the broken pieces probably failed during end or lateral thinning and probably were subsequently discarded. Undoubtedly, some percentage were intended to be projectile point preforms, some may have been intended to be durable cutting or scraping implements, and some were probably intended to be standardized, bifacial cores. Interestingly, the Cody bifaces are less refined, far less standardized, and have greater thickness to width ratios than those of the Folsom component. Some were discarded because of obvious internal fractures or other anomalies. Others are still suitable for small flake production. Some may have been derived from heat treated material, but it is not clear which those might be. There is no evidence of the GBCCS18 material being heat treated at MacHaffie.

Table 28. Metric, Nonmetric, and Provenience Data for Cody Non-Hafted Bifaces.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Shape	Cross-Section	Reduction Stage	Tool Condition
4	C-5	160-180 cm BS	3	indeterminate	elongate	bi-convex	III	complete
9	2000-B	80-100 cm BS	4	flake	ovate	plano-convex	II	complete
16	96-West Test	110-120 cm BS	6	flake	ovate	plano-convex	II	complete
21	2008-SBE	150-160 cm BS	3	indeterminate	ovate	bi-convex	III	distal fragment
27	2008-SBE	130-140 cm BS	3	flake	ovate	bi-convex	II	proximal-medial fragment
48	98-South Block	130-140 cm BS	5	indeterminate	indeterminate	bi-convex	III	indeterminate fragment
51	98-South Block	140-150 cm BS	5	flake	ovate	bi-convex	III	distal-medial fragment
64	N1/W4	79 cm BS	11	flake	triangular	bi-convex	III	complete
65	S1/W5	72 cm BS	11	indeterminate	triangular	bi-convex	III	complete
66	N2/W4	84 cm BS	11	indeterminate	triangular	bi-convex	III	complete
67	S1/W4	73 cm BS	11	flake	ovoid	bi-convex	III	complete
68	N1/W5	79 cm BS	11	indeterminate	ovoid	bi-convex	III	complete
69	N1/W2	82 cm BS	11	flake	ovoid	plano-convex	II	complete
70	S1/W5	64 cm BS	11	indeterminate	rectangular	bi-convex	III	complete
71	N2/W4	93 cm BS	11	indeterminate	triangular	bi-convex	III	complete
72	S1/W2	70 cm BS	11	indeterminate	ovoid	bi-convex	II	proximal fragment
73	N1/W5	73 cm BS	11	flake	ovoid	bi-convex	II	complete
74	S1/W3	73 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment

Retouch/Use-Wear	Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
none	GBCCS18	10	5	1.7	72.85	Possible transverse fracture at proximal end, but considered here to be complete.
none	GBCCS18	8	5.5	1.7	91.85	
none	GBCCS20	7.7	4.2	1.4	53.9	
none	YBCCS7	2.3	4.1	0.6	7.7	Bending fracture. Probably broke during manufacture.
none	BCCS19	2.6	4.5	1.3	13.1	Transverse fracture. Probably broke during manufacture.
none	BCCS23	3	3.5	1.2	11.5	Fractured along two intersecting 90 degree planes.
none	BCCS31	1.9	2.8	0.4	2.75	manufacture.
none	BCCS4	6.8	3.3	0.87	20.61	Forbis artifact # 1210. Probably a Cody point preform.
none	BCCS23	8.5	3.8	0.92	35.74	Forbis artifact #1206. Probably a Cody point preform.
none	CCCS5	8.4	5	1.5	64.41	Forbis artifact #3217. Probably a Cody point preform.
none	CCCS1	6.8	3.5	0.97	25.23	Forbis artifact #3220. Both faces heavily sunbleached. Found in two pieces during excavation, but rejoined. Transverse fracture probably broke during manufacture.
none	GBCCS18	12.8	3.1	0.97	47.1	Forbis artifact #1208A-1208E. Found in 5 pieces across 3 excavation units at largely the same depth. Very challenging biface to make.
none	GBCCS18	7.9	4.2	1.3	38.53	Forbis artifact #3210. Irregularities on one face would have discouraged further refinement.
none	CCCS9	11.3	4.3	1.2	63.22	Forbis artifact #3201. Two pieces conjoined by Forbis, do not appear to be from same artifact.
none	CCCS7	5.9	3.1	0.91	17.45	Forbis artifact #1211.
none	CCCS7		7.2	1.5	37.84	Forbis artifact #3218.
none	CCCS3	6.1	3.8	1.2	28.12	Forbis artifact #3213.
none	CCCS7		3.5	0.94	9.32	Forbis artifact #3219.

biface measurements are in centimeters

Table 28. Metric, Nonmetric, and Provenience Data for Cody Non-Hafted Bifaces (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Shape	Cross-Section	Reduction Stage	Tool Condition
75	N1/W5	73 cm BS	11	indeterminate	ovoid	bi-convex	II	complete
76	S1/W4	73 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment
77	N2/W5		1	indeterminate	ovoid	bi-convex	II	complete
78	N2/W3	88 cm BS	11	indeterminate	indeterminate	bi-convex	II	distal fragment
79	S1/W4	67 cm BS	11	indeterminate	ovoid	bi-convex	II	complete
80	S1/W3	79 cm BS	11	indeterminate	ovoid	bi-convex	II	proximal-medial fragment
81	N1/W2	90 cm BS	11	indeterminate	ovoid	bi-convex	II	complete
82		surface	1	flake	ovoid	bi-convex	II	distal-medial fragment
83	N1/W3	74 cm BS	11	flake	ovoid	bi-plano	I	complete
84	N2/W2	67 cm BS	11	flake	indeterminate	bi-convex	II	proximal-medial fragment
85	N2/W2	75 cm BS	11	indeterminate	indeterminate	bi-convex	III	medial fragment
86	N1/W4	82 cm BS	11	flake	ovoid	bi-convex	II	complete
87	S1/W5	70 cm BS	11	flake	indeterminate	bi-convex	II	indeterminate fragment
100	S2/W2	67-82 cm BS	11	flake	amorphous	irregular	II	complete
145	S2/W3	60-75 cm BS	11	indeterminate	indeterminate	bi-convex	II	distal fragment
147	S1/W4	70 cm BS	11	flake	ovoid	bi-convex	III	complete

Retouch/Use-Wear	Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
none	GBCCS18	7.7	4.7	1.8	72.55	Forbis artifact #3209 and #6016. Found in two pieces, now conjoined. Travsverse fracture broke the original biface.
none	CCCS7	5.7	4.4	1.2	34.75	Forbis artifact #3207. Found by Edmund MacHaffie in cutbank profile.
none	GBCCS18	9.2	4.6	1.5	64.3	Forbis artifact #10007. Carling Malouf find: unknown date. Depth of artifact unknown, only the excavation unit listed in notes. Either Forbis or Malouf placed this biface with the Cody Component for unknown reasons.
none	CCCS2		3.5	1.2	10.03	Forbis artifact #3215.
none	GBCCS18	7.3	4.5	1.8	46.34	Forbis artifact #3216.
none	GBCCS18		4.5	1.3	36.55	Forbis artifact #3200.
none	YBCCS30	12.1	6.6	3.2	274	Forbis artifact #4202.
none	CCCS7		4.2	1.9	24.81	Forbis artifact #3202. Found by Edmund MacHaffie. Forbis placed the artifact with the Cody Component for unknown reasons.
none	CCCS1	5.8	2.9	1.1	18.47	Forbis artifact #3208.
none	CCCS7		3.1	1	12.25	Forbis artifact #3204.
none	YBCCS30		3.7	0.75	7.58	
none	CCCS2	6.7	4.3	1.4	35.98	Forbis artifact #3221.
none	GBCCS18		3.2	0.64	7.21	Forbis artifact #3205.
bifacial pressure flaking	OBS1	2.3	3.8	1.1	8.6	Knudson artifact # 6005 (12-425, K2185); XRF Sample # O-14. Misidentified by Knudson as a graver. The projection is incidental. It is a minimally bifacially pressure flaked, thick, broken flake.
none	GBCCS18		5.9	1.4	22.81	Knudson artifact #6010. One surface is heavily sunbleached/weathered.
none	RCCS20	4.9	3.1	0.89	17.48	Forbis artifact #3212. Found in cutbank by Edmund MacHaffie. Probably a medium-size projectile point preform.

biface measurements are in centimeters

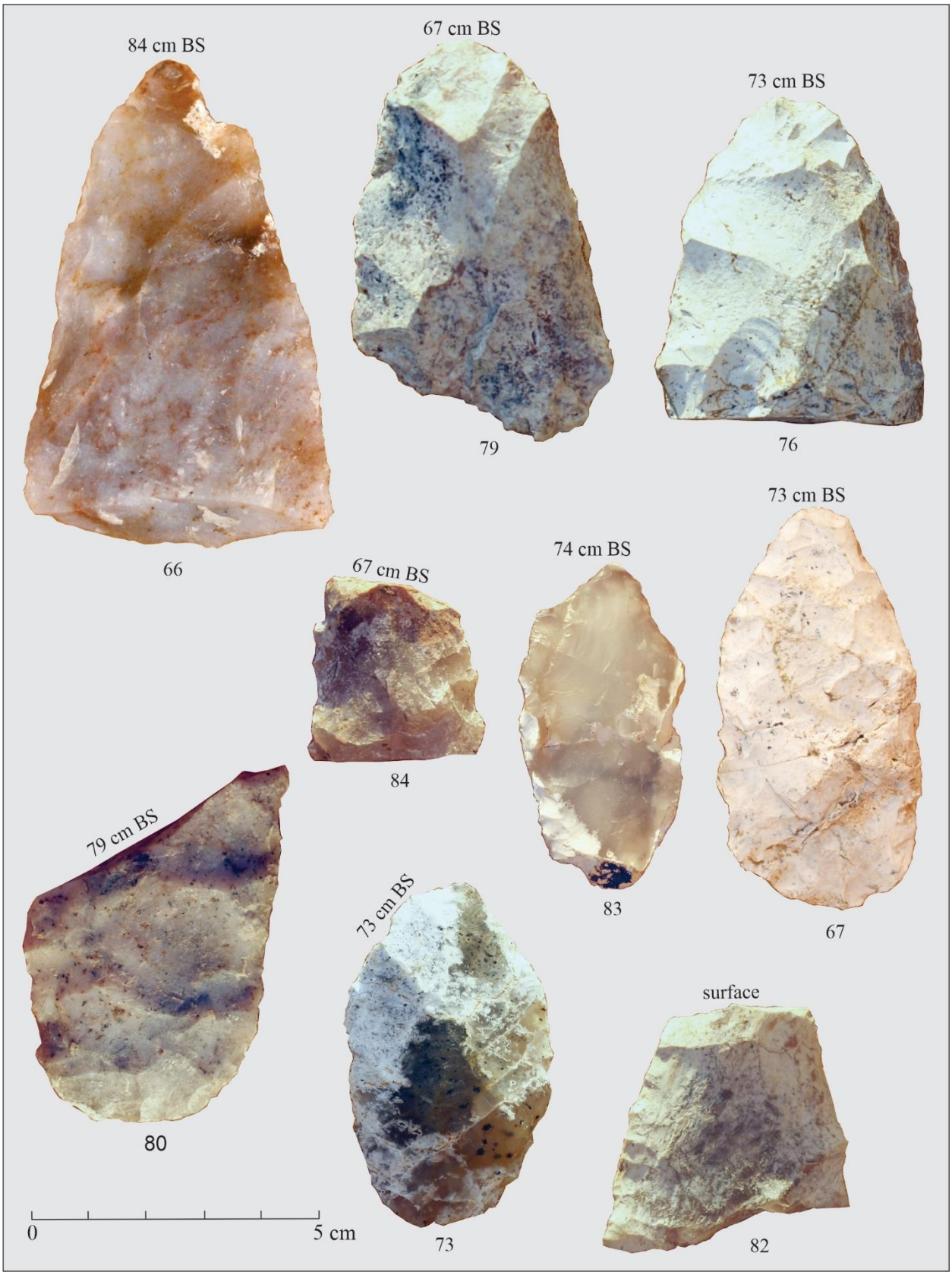


Figure 81. Non-Hafted Bifaces Assigned to the Cody Component (1).

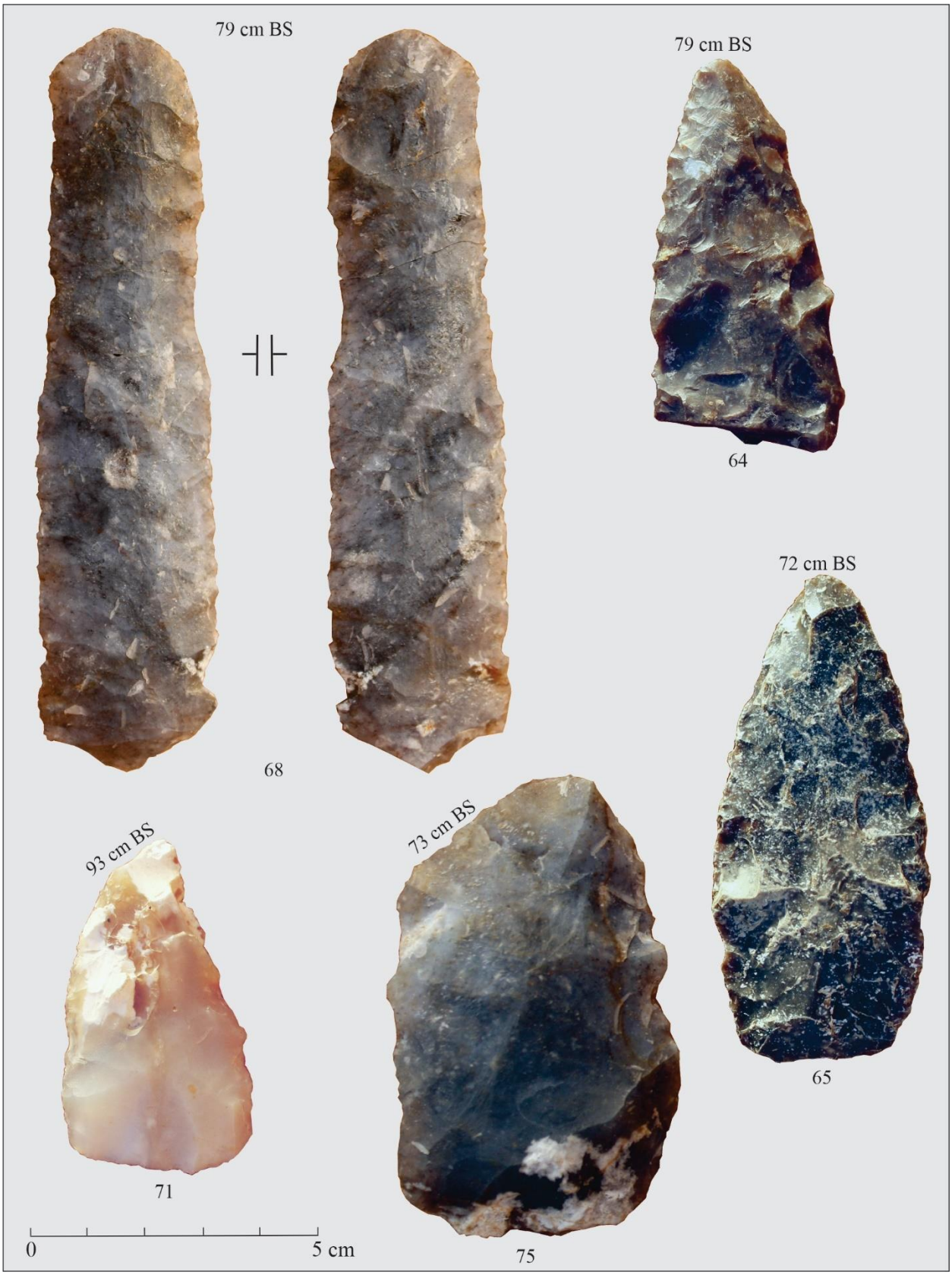


Figure 82. Non-Hafted Bifaces Assigned to the Cody Component (2).

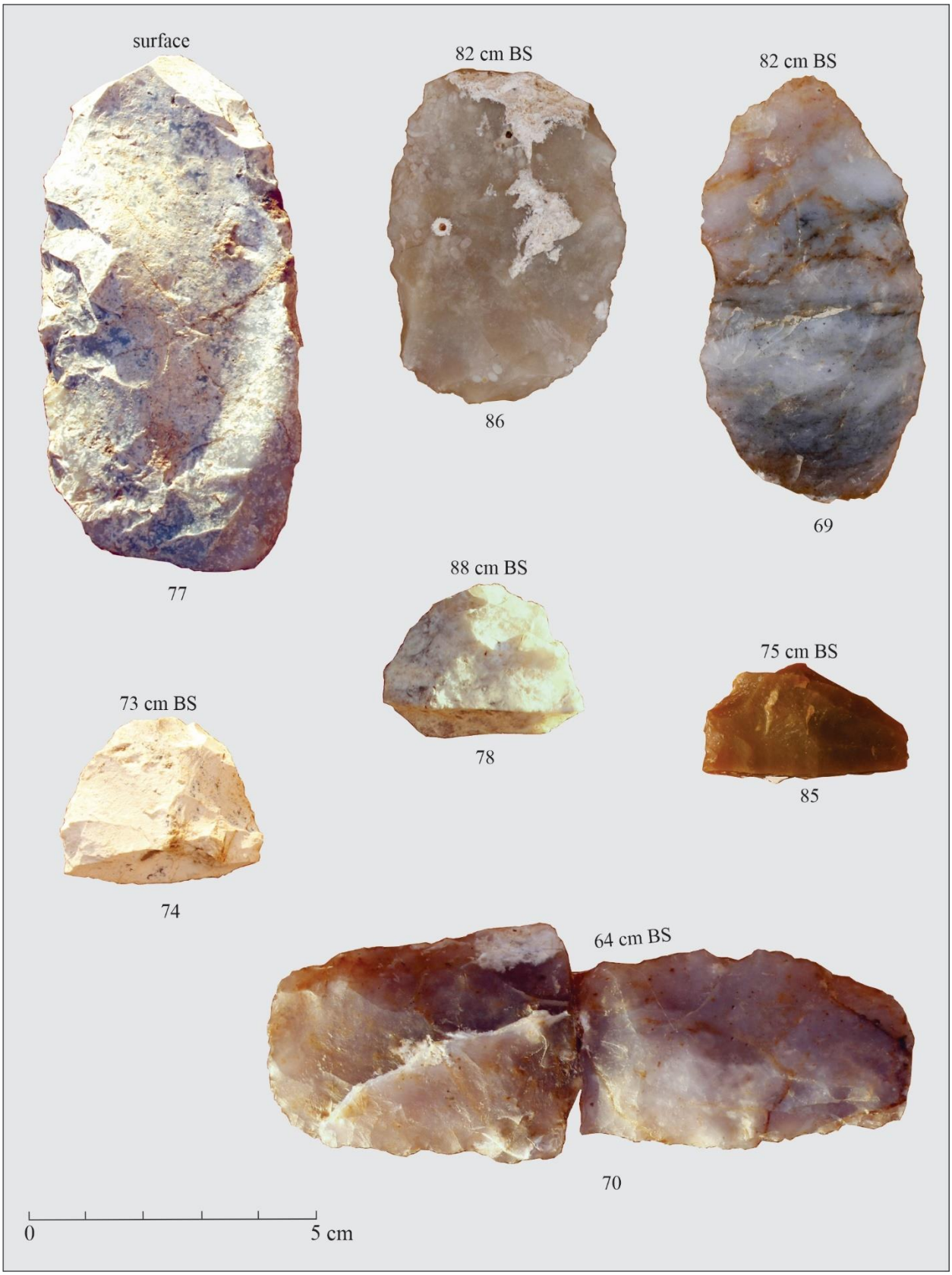


Figure 83. Non-Hafted Bifaces Assigned to the Cody Component (3).

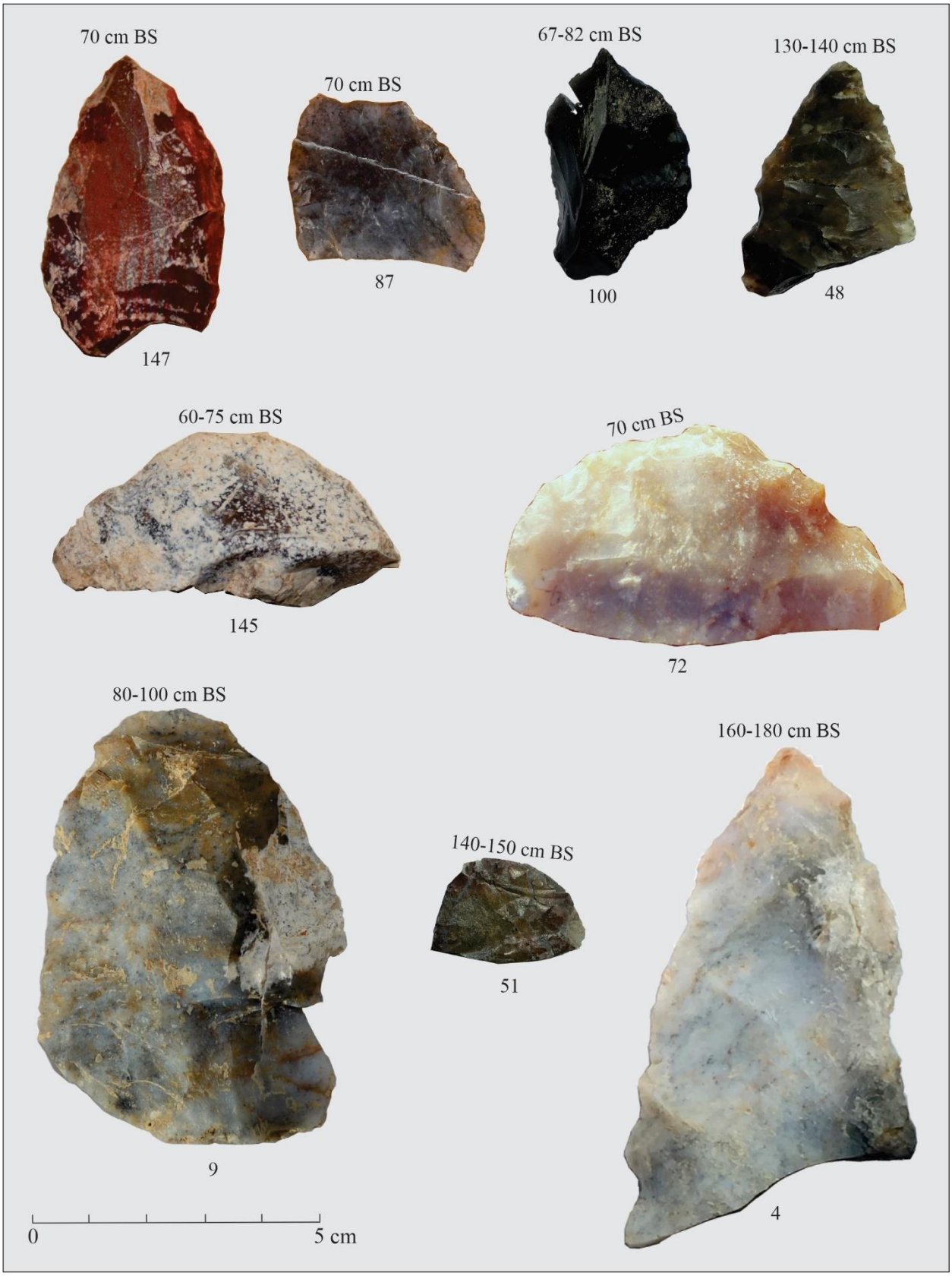


Figure 84. Non-Hafted Bifaces Assigned to the Cody Component (4).

Figure 85. Non-Hafted Bifaces Assigned to the Cody Component (5).

Excluding the fragments, the complete bifaces average 7.8 cm in length, 4.2 cm in width, 1.4 cm in thickness, and 55 grams in weight. Compared to Middle and possibly Late precontact bifaces from the Helena Component, the Cody pieces average two to three times greater mass.

Endscrapers (Tables 26 and 29; Figures 86-90)

Endscrapers are an interesting artifact because some flintknappers view their preforms as flake removal mistakes; flakes that inadvertently terminated in an overshoot (*outrepasse'*) then were utilized as endscrapers (Melvin Beattie pers. comm. 2017). Whereas traditionally these artifacts are assumed to have been intentional, they may have typically been produced after an unintentional consequence in the knapping process. None-the-less when the mistake was made the resulting flake was edge pressure flaked and turned into a formal tool.

In 1947, Wesley L. Bliss collected from the cutbank profile, at a reported depth of 39 cm BS, a complete endscraper of a brown chalcedony visually similar to Knife River Flint (Fig. 89.19). As noted previously, the stratum from which the endscraper was recovered was assigned a Cody Complex [Yuma] affiliation by Bliss (Bliss et al. 1947) although this depth is higher in the soil profile than the stratigraphic position of Cody as defined by either Forbis or Davis. Bliss et al. (1947) assigned the piece catalogue #41. The artifact is curated at the NMNH under accession #206347, catalogue #406715. It is also assigned catalogue #19 in the DNRC Endscraper database.

Dick Forbis recovered eight chert endscrapers (#5-#12) in 1951 from excavation units S1/E1, S1/W1, S1/W3, S1/W5, N1/W1 and N1/W2. Unit N1/W1 produced three specimens (#8, #10, #11) at a depth of 93 or 94 cm BS. Inexplicably, Forbis assigned these three pieces and #12 to the Cody component even though their depths below ground surface are more consistent with the Folsom component in Forbis' 1951 excavation block. They are presented here as part of the Cody component for consistency. Three additional chert endscrapers (#10, #4, #2) were recovered by Les Davis in 1989, 1990, and 1998 from excavation units 3S/0E, 8S/2W and 98 South Block respectively (Figure 8). All three pieces were recovered at a depth of 150 to 160 cm BS which is consistent with the Cody component depth in this portion of the site.

The endscrapers are made on secondary reduction stage flakes. Eleven are plano-convex in cross section and one (#19) is biplano. Eight are complete and three are distal-medial fragments. Presumably, the incomplete endscrapers broke during use. One piece (#1) exhibits extensive unifacial retouch along its distal margin, while only two pieces (#7, #10) show minimal unifacial retouch to the scraping end. The remainder (n=8) show moderate retouch. All appear to have been minimally to moderately used, presumably for scraping soft tissues from hides. This is deduced from numerous, unintentional micro-flake removals that intermingle with the intentional retouch flake scars. These micro-flake removals tend to terminate in micro-step fractures. Additionally, the exterior surfaces of the distal ends are noticeably smoother and more rounded than the immediately adjoining edges.

Table 29. Metric, Nonmetric, and Provenience Data for Cody Endscrapers.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Style	Tool Condition	Retouch
1	3S/0E	150-160 cm BS	10	flake	plano-convex	complete	extensive
2	98 South Block	150-160 cm BS	5	flake	plano-convex	complete	moderate
4	8S/2W	150-160 cm BS	9	flake	plano-convex	complete	moderate
5	S1/E1	78 cm BS	11	flake	plano-convex	distal-medial fragment	moderate
6	S1/W1	79 cm BS	11	flake	plano-convex	complete	moderate
7	S1/W5	58 cm BS	11	flake	plano-convex	complete	minimal
8	N1/W1	93 cm BS	11	flake	plano-convex	complete	moderate
9	N1/W2	88 cm BS	11	flake	plano-convex	complete	moderate
10	N1/W1	93 cm BS	11	flake	plano-convex	distal-medial fragment	minimal
11	N1/W1	94 cm BS	11	flake	plano-convex	complete	moderate
12	S1/W3	85-97 cm BS	11	flake	plano-convex	distal-medial fragment	moderate
19	cutbank profile	39 cm BS	1	flake	bi-plano	complete	moderate

Scraping Edge Condition	Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
moderately used	BCCS29	6.72	3.68	1.61	35.55	Large endscraper with patterned unifacial retouch along exterior surfaces of both lateral margins and distal (scraping) edge.
moderately used	BCCS38	5.93	3.91	2.9	41.25	Large endscraper with patterned unifacial retouch along exterior surfaces of one lateral margin and distal (scraping) edge.
minimally used	BCCS4	2.8	2.6	0.7	7.1	Made on a flake fragment.
minimally used	BCCS21		2.5	0.7	4	Forbis artifact #2200. Bending fracture removed proximal end.
moderately used	CCCS9	2.9	2.1	0.77	4.77	Forbis artifact #2001.
minimally used	BCCS38	9.2	5	2.5	104	Forbis artifact #2206. Very large piece.
moderately used	BCCS39	6	3.8	1.4	37.1	Forbis artifact #2203.
moderately used	CCCS1	4.2	3.3	1.3	16.03	Forbis artifact #2202.
minimally used	BCCS47		3.9	7.9	26.86	Forbis artifact #2003.
minimally used	YBCCS22	3.1	2.2	0.6	4.4	Forbis artifact #2204. Small piece of distal margin missing.
minimally used	BCCS6	2.1	2.4	0.72	3.46	Forbis artifact #2000.
moderately used	BCCS6	6.03	3.05	0.83	24	Bliss and Hughes (1947) artifact #41; Smithsonian Institution National Museum of Natural History Accession #206347, Catalogue #406715.

endscraper measurements are in centimeters

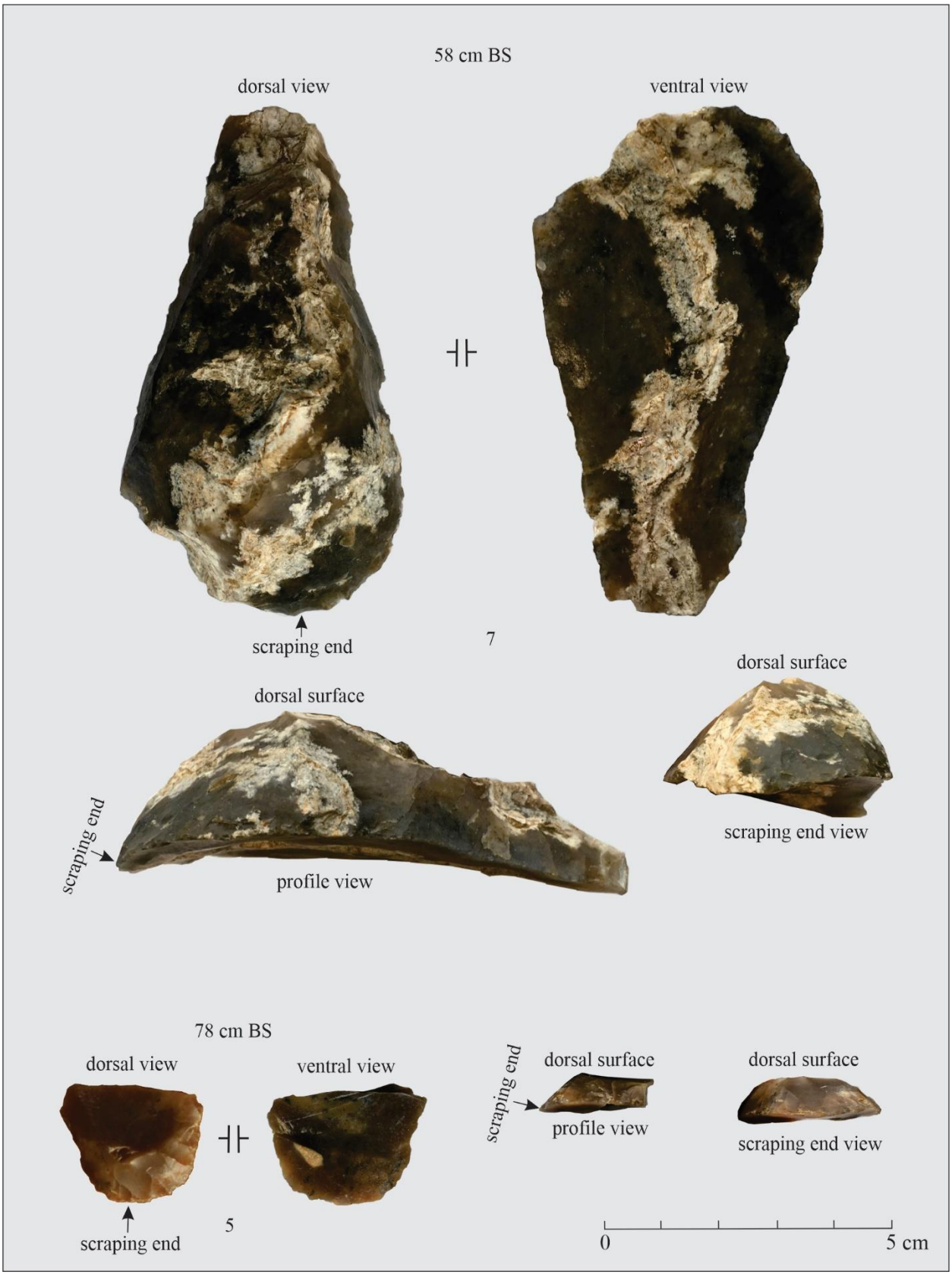


Figure 86. Endscrapers Assigned to the Cody Component (1).

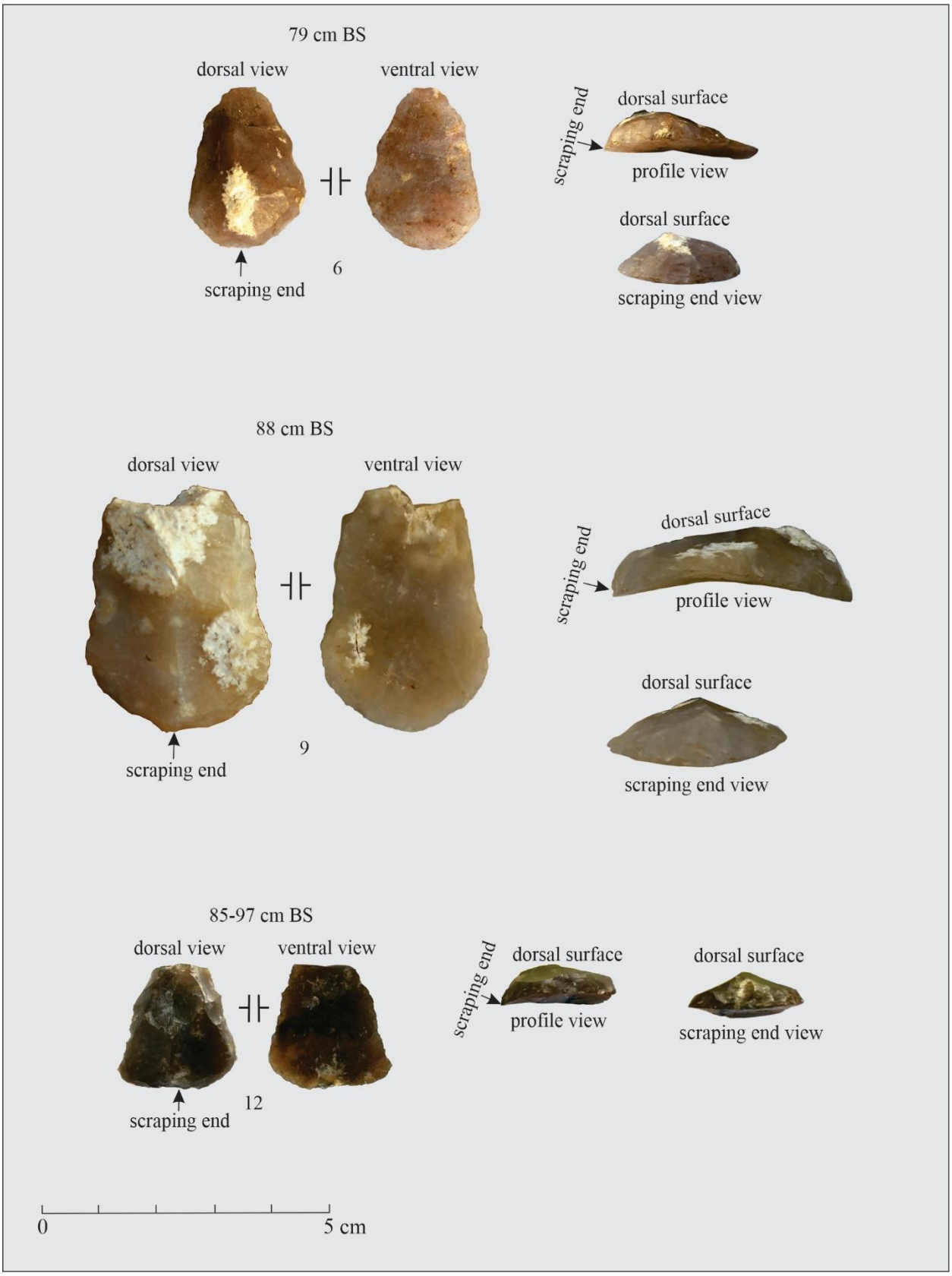


Figure 87. Endscrapers Assigned to the Cody Component (2).

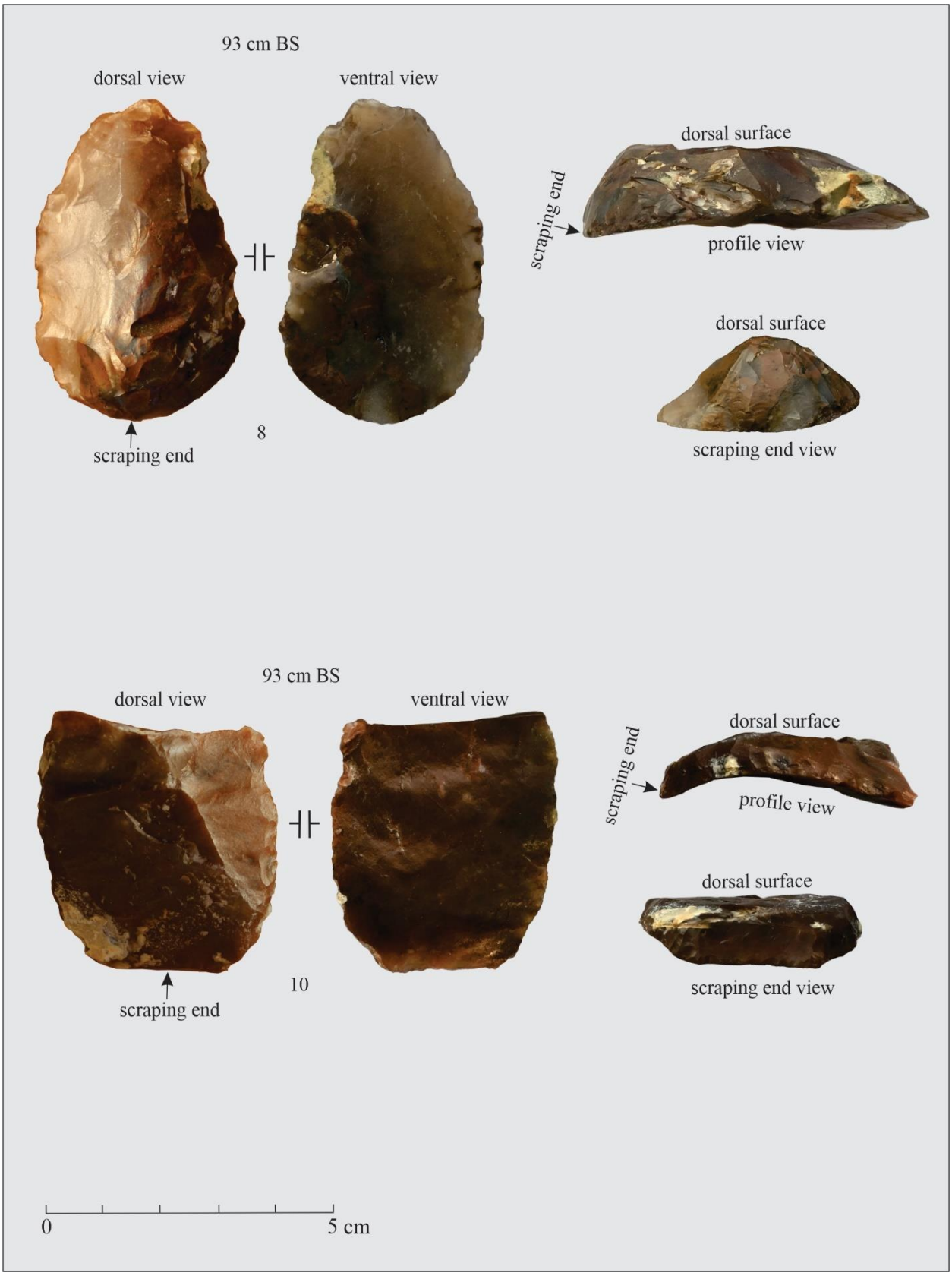


Figure 88. Endscrapers Assigned to the Cody Component (3).

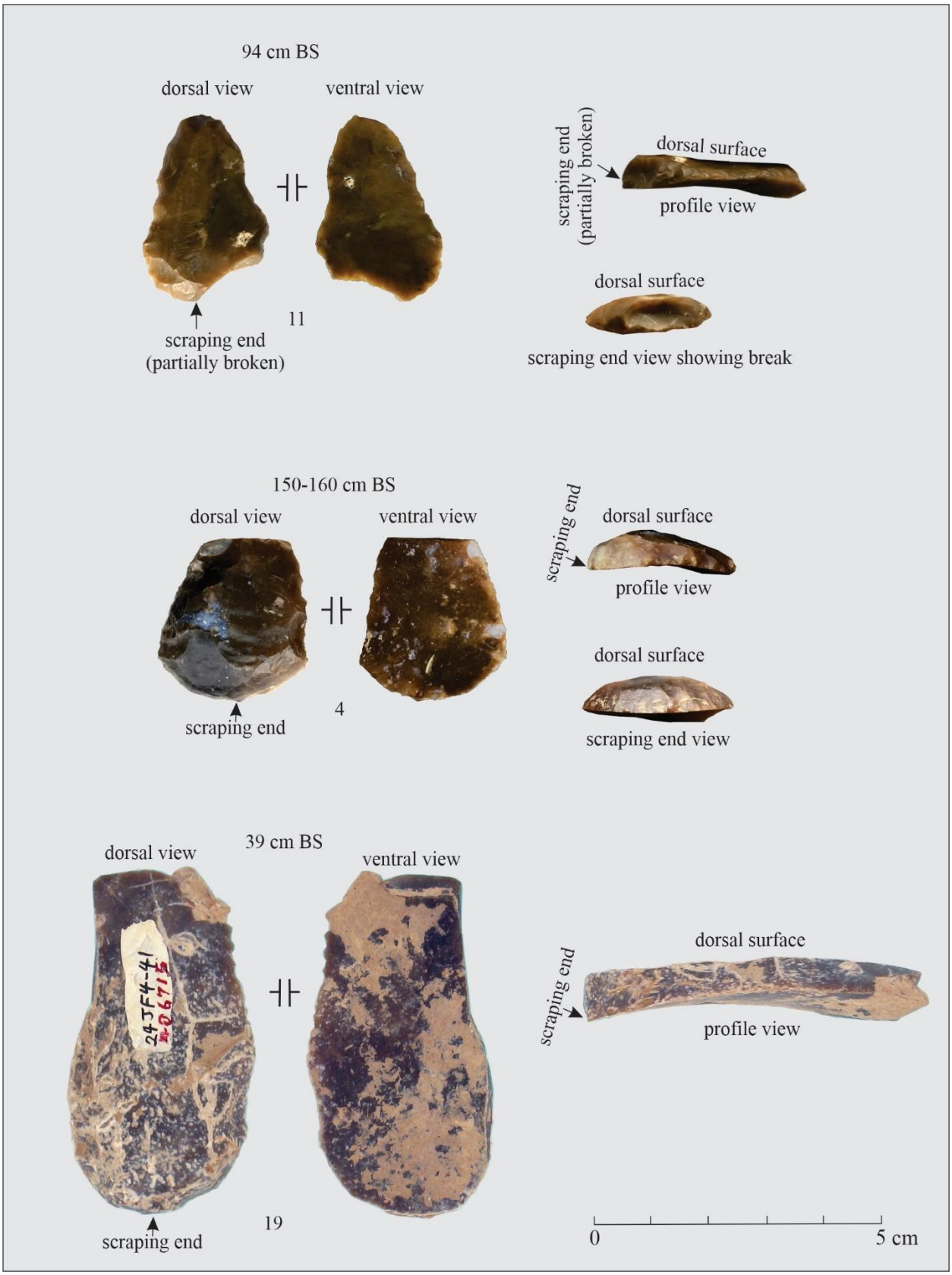


Figure 89. Endscrapers Assigned to the Cody Component (4).

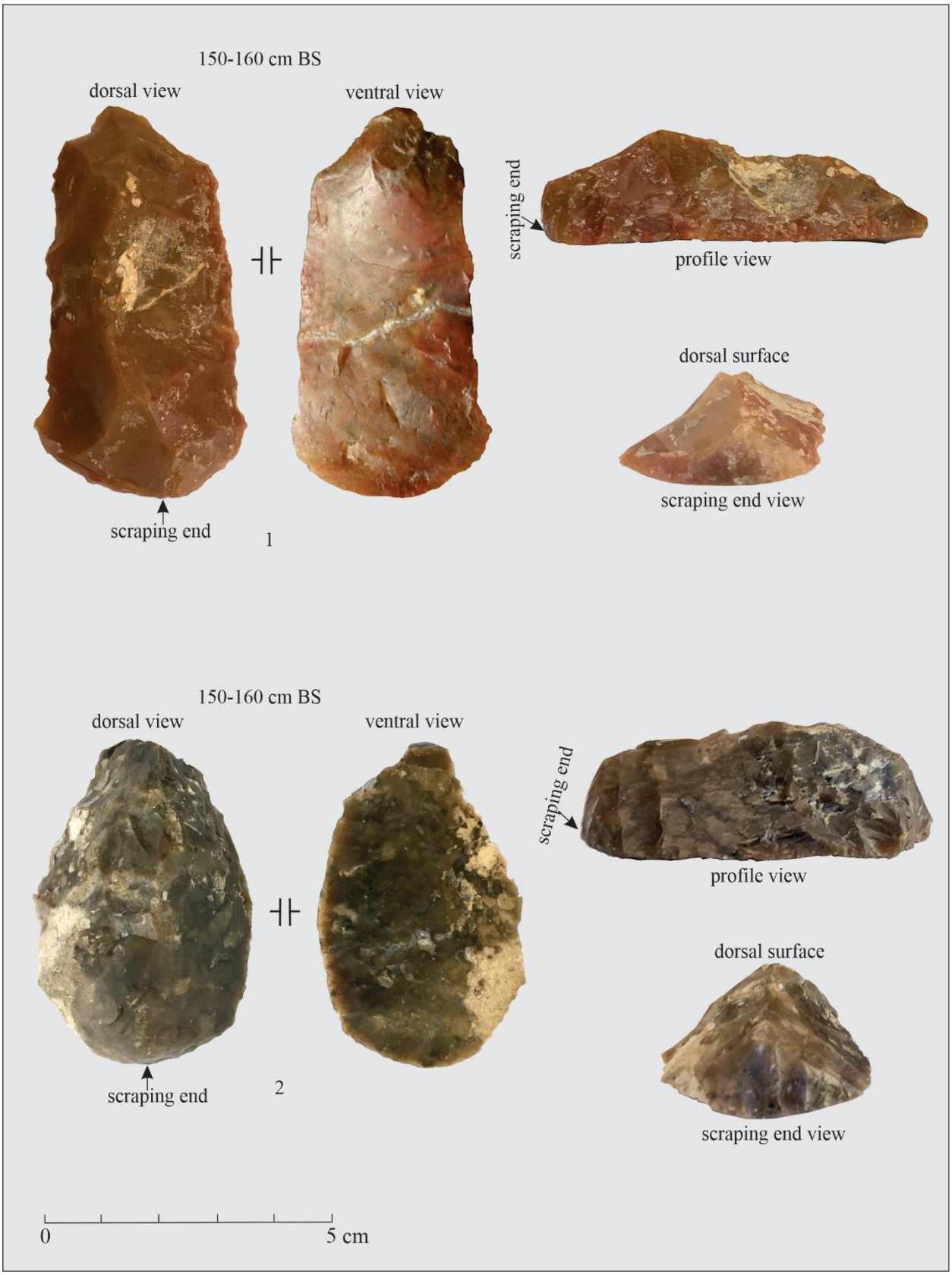


Figure 90. Endscrapers Assigned to the Cody Component (5).

Ten MANA designations are found among the 12 endscrapers (BCCS4, BCCS6, BCCS21, BCCS29, BCCS38, BCCS39, BCCS47, CCCS1, CCCS9 and YBCCS22). The MANA designation BCCS38 is used for items #2 and #7, and the MANA designation BCCS6 is used for items #12 and #19. The endscrapers average 4.9 cm in maximum length, 3.2 cm in maximum width, 1.8 cm in maximum thickness, and average 25.7 grams in weight. Endscrapers #1, #2, #7, #8, and #10 are noticeably large averaging 6.9 cm in maximum length, 4.1 cm in maximum width, 3.3 cm in maximum thickness, and an average weight of 48.9 grams.

Drills/awls/perforators, burins/gravers, and spokeshaves (Table 26)

No drills, awls, perforators, burins, gravers, or spokeshaves assignable to the Cody component have been recovered from the MacHaffie site.

Cores (Tables 26 and 30; Figures 91 and 92)

Nine cores are assigned to the Cody component. The cores are generally heavily utilized, but most are not fully exhausted. All are of chert and comprise nine distinct MANA designations: BCCS1, BCCS9, BCCS44, CCCS6, GBCCS20, RCCS35, YBCCS1a, YBCCS28, and YBCCS38. Approximately one-third of the cores retain some cortex.

Two cores are considered bifacial, and seven as unprepared whereby opportunistic or random flakes were removed from various edges. In reality, #8 and #30 might be bipolar cores considering their very small sizes, but #8 is so small that trying to place it in some sort of vice would be difficult even with modern equipment. Piece #8 is a very small decortication flake from which two micro-flakes were intentionally removed from its interior surface. It measures 1.8 cm in length, 1.1 cm in width, 0.6 cm in thickness, and weighs 1.35 grams

Cores #93 and #94 are made on small cobbles and core #30 is a small nodule from which three or four random flake removal scars are found on two sides. Core #92 is made on a large, thick flake. The original preform for the remainder could not be determined. As could be expected, the cores were probably discarded when flakes could no longer be easily removed. Still, small flakes were removed at the end of each core's use phase, and most of these scars have nothing to do with platform preparation for the removal of larger flakes. All indication is that small flakes were desired.

As seen with the Folsom cores, if resource conservation were an issue the Cody cores could have been subjected to bipolar reduction to fully utilize their potential. Quality of the lithic material comprising the cores is highly variable. The lithic material of cores #8, #30, #47, #77, #92, and #95 is highly siliceous, generally uniform in texture, and free of internal anomalies. Conversely, Cores #51, #93, and #94 are of poor-quality chert. Instead of always selecting the highest quality toolstone, the Cody occupants, like the Folsom occupants before them, chose a wide range of toolstone quality and size. This seems counterintuitive when surrounded, as is the case for the MacHaffie site, by easily accessible and extremely good quality chert.

Table 30. Metric, Nonmetric, and Provenience Data for Cody Cores.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Core Type	Shape	Extent of Utilization	Condition	Retouch/Use-Wear
8	6S/6W	90-100 cm BS	2	flake	unprepared	elongate flake	minimal	complete	none
77	S1/W2	70 cm BS	11	indeterminate	bifacial	ovoid	extensive	complete	none
92	N2/W4	78 cm BS	11	flake	unprepared	amorphous	extensive	complete	none
93	N2/W8	63 cm BS	11	cobble	unprepared	amorphous	moderate	complete	none
94	N2/W8	60 cm BS	11	cobble	unprepared	round	minimal	complete	none
95	N1/W3	60-75 cm BS	11	indeterminate	unprepared	amorphous	extensive	complete	none
30	2000-A	140-160 cm BS	4	small nodule	unprepared	blocky	minimal	complete	none
47	2008-SBE	100-120 cm BS	3	indeterminate	bifacial	amorphous	extensive	complete	none
51	98-South Block	110-120 cm BS	5	indeterminate	unprepared	amorphous	extensive	complete	none

Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
YBCCS28	1.8	1.1	0.6	1.35	NW quadrant (1x1 m subdivision); very small decortication flake from which two micro-flakes were intentionally removed from interior surface.
YBCCS1a	7.9	4.4	2.7	83.95	Forbis artifact #4201
GBCCS20	7.3	5.7	2.6	111	Knudson artifact #6018
YBCCS38	6.5	6.4	3.6	136	Knudson artifact #6021
BCCS1	7.8	6.7	3.6	209	Knudson artifact #6020; poor quality chert.
RCCS35	7.7	3.3	3.1	97.6	No matching debitage recovered at this level. Piece is anomolous among the GBCCS18 debitage that dominates.
BCCS9	3.7	2.5	2.1	17	Very small minimally worked core exhibiting 3-4 small and random flake removal scars from two separate sides. The piece could only reduced to any degree through bipolar reduction.
CCCS6	6.7	5	2.2	62.6	Random flake removals from both faces.
BCCS44	7	7	3.5	131	Some cortex on exterior surface.

core measurements are in centimeters

The bifacial cores (#47 and #77) average 7.3 cm in length, 4.7 cm in width, 2.45 cm in thickness, and have an average weight of 73.28 grams. The one possible bipolar core (#30) measures 3.7 cm in length, 2.5 cm in width, 2.1 cm in thickness, and weighs 17.0 grams. The unprepared or multi-directional cores (excluding #8 and #30) average 7.3 cm in length, 5.8 cm in width, 3.3 cm in thickness, and have an average weight of 136.9 grams.

Figure 91. Cores Assigned to the Cody Component (1).

Figure 92. Cores Assigned to the Cody Component (2).

Debitage with Edge-Flaking/Modification (DEF/M) (Tables 26 and 31; Figures 93-95)

Eleven secondary reduction stage chert flakes exhibit post-production edge modification (#2, #14-#16, #23-#28, #47). Two (#15 and #28) are derived from mid-reduction stage bifaces. Excluding two pieces made on primary flakes, the remainder could have been removed from early reduction stage bifaces, prepared cores, or even unprepared cores. One piece (Fig. 93.47) was collected from the cutbank profile by Wesley L. Bliss in 1947 at a depth of 39 cm BS. Bliss et al. (1947) assigned the piece catalogue #44 and referred to it as a "Large scraper". The artifact is curated at the National Museum of Natural History under accession #206347, catalogue #406714. It is also assigned catalogue #47 in the DNRC DEF/M database.

Eight distinct MANA designations (BCCS4, BCCS28, BCCS29, BCCS38, BCCS41, CCCS7, GBCCS5, and GBCCS18) are found among the chert DEF/M. Only two of the MANA designations (BCCS38 and CCCS7) are repeated (#15 and #16, and #25 and #27). The chert DEF/M have average lengths of 6.7 cm, average widths of 4.5 cm, average thicknesses of 1.08 cm, and an average weight of 35.4 grams.

Nine of the chert DEF/M (#2, #14, #16, #s23-27, #47) exhibit only unifacial flaking of one side of the flake edge. One piece (#15) exhibits unifacial flaking that alternates from one side of an edge to the next, and one shows a combination of unifacial and bifacial edge flaking. Six DEF/M show modification along a single edge (#2, #9, #16, #s25-27), two have two modified edges (#24 and #28), and three have three modified edges (#15, #23, #47). Five pieces (#14, #16, #23, #24, #47) exhibit unifacial edge modification along the exterior flake surfaces only, while four other pieces (#2, #s25-27) exhibit unifacial edge modification along the interior flake surfaces only. The nearby Quinn Creek (24JF110) and Adel (24CA1766) sites, although Middle and Late Precontact Periods in age, show much higher percentages of exterior edge surface modification among the DEF/M, but it is uncertain what this trend implies (Rennie 2017; Rennie and Hughes 1998). Post-production edge modification is characteristically shallow, broad, fine, feather-terminating micro-flake removals—generally as a series, and most of which extend less than 2 mm from the edge of the piece into the flake body. Although several pieces appear to have been intentionally retouched, some the "retouch" pattern and wear could have resulted from use as scraping or cutting implements on moderately soft material (cf. Odell and Odell-Vereeken 1980).

In addition to the chert DEF/M, three primary reduction stage quartzite spalls were assigned to the Cody component by Dick Forbis (1955: artifact #s 5204 through 5206). The quartzite DEF/M have average lengths of 6.3 cm, average widths of 10.4 cm, average thicknesses of 1.5 cm, and an average weight of 136 grams. The interior surface materials (noncortical material) are medium-grained, whitish-gray sandstone quartzite assigned to two distinct MANA designations (SDQZT2d and SDQZT4e). Although #20 was recovered from a depth consistent with the Cody component in Forbis' excavation block, the other two pieces (#21 and #22) were recovered within the same excavation unit and from a depth that correlates to the Folsom component. They are analyzed here with the Cody materials for consistency with Forbis' contention.

Table 31. Metric, Nonmetric, and Provenience Data for Cody DEF/M.

Record #	Excavation Unit	Excavated Level Depth	CMU	Debitage Type	Reduction Stage	Exterior Surface Flake Scar Count	Flake Scar Orientation	Lithic Material Code	Flake Shape	Flake Condition	Flake Termination Type	Platform Type	Flake Type
2	6S/6W	100-110 cm BS	2	flake	secondary	2	parallel	BCCS41	ovate	complete	hinge	indeterminate	shaping/thinning
14	8S/2W	150-160 cm BS	9	flake	secondary	2	intersecting	BCCS29	ovate	complete	feather	crushed	shaping/thinning
15	8S/2W	150-160 cm BS	9	flake	secondary	3	intersecting	BCCS38	elongate	complete	feather	flat-beveled	biface thinning
16	8S/2W	150-160 cm BS	9	flake	secondary	3	intersecting	BCCS38	elongate	fragment	feather		shaping/thinning
20	S1/W3	67 cm BS	11	flake	primary	0		SDQZT4e	ovate	complete	feather	point	decortication
21	N1/W2	100 cm BS	11	flake	primary	0		SDQZT2d	ovate	complete	feather	point	decortication
22	N1/W2	99 cm BS	11	flake	primary	0		SDQZT2d	ovate	complete	feather	point	decortication
23	N1/W1	99 cm BS	11	flake	secondary	3	intersecting	GBCCS5	indeterminate	fragment	feather	indeterminate	shaping/thinning
24	N1/W3	72 cm BS	11	flake	secondary	2	parallel	BCCS4	elongate	complete	feather	faceted	biface thinning
25	N1/W3	76 cm BS	11	flake	secondary	3	parallel	CCCS7	elongate	complete	feather	flat	shaping/thinning
26	S1/W4	73 cm BS	11	flake	secondary	2	intersecting	GBCCS18	ovate	complete	feather	flat	shaping/thinning
27	N1/W4	79 cm BS	11	flake	secondary	2	intersecting	CCCS7	elongate	complete	feather	flat	shaping/thinning
28	N1/W5	76 cm BS	11	flake	secondary	2	intersecting	BCCS28	ovate	complete	feather	flat	shaping/thinning
47	cutbank profile	39 cm BS	1	flake	secondary	3	intersecting	GBCCS18	ovate	complete	feather	crushed	shaping/thinning

Type of Edge Modification	Number of Retouched Edges	Size Grade	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
unifacial flaking	1	1	3.2	3.5	0.5	10.1	Steep, intentional, patterned flake removals along 1/2 the length of interior surface of lateral edge. Secondary flaking removed platform. Flake oriented on edge (vertically) when exposed in situ. Recovered from SW quadrant (1 x 1 m subdivision).
unifacial flaking	1	1	6.8	5.6	0.5	27.44	Continuous and patterned flake removals from exterior surface of one lateral margin.
alternating unifacial flaking	3	1	10.3	5.2	1.1	70.95	Shallow, continuous and patterned flake removals from exterior surface of one lateral margin and distal edge. Similar retouch along interior surface of proximal margin.
unifacial flaking	1	1	8.9	4.45	0.9	40.3	Continuous and patterned flake removals from exterior surface of one lateral margin. The flake was longitudingally split during manufacture.
indeterminate	0	1	7.2	13.1	1.3	135	Forbis artifact #5205. Does not appear to have been used as a tool although Forbis refers to it as a teshoa. Lack of associated debitage is puzzling.
indeterminate	1	1	5.9	10.4	1.7	166	Forbis artifact #5206. Edges and interior surface are heavily worn/smoothed. Forbis refers to it as a teshoa, but the wear pattern suggests another use. Lack of associated debitage is puzzling.
indeterminate	1	1	5.9	7.9	1.6	107	Forbis artifact #5204. Edges and interior surface are heavily worn/smoothed. Forbis refers to it as a teshoa, but the wear pattern suggests another use. Lack of associated debitage is puzzling.
unifacial flaking	3	1	6.8	6.3	1.8	65.98	Forbis artifact #4200. Continuous, shallow, unifacial flaking along exterior surface margins.
unifacial flaking	2	2	6.2	2.4	0.7	9.58	Forbis artifact #3206. Shallow, unifacial flaking along exterior edge surfaces.
unifacial flaking	1	2	4.8	2.3	0.68	6.39	Forbis artifact #1205. Shallow, unifacial flaking along one interior edge surface.
unifacial flaking	1	1	4.4	3.6	1.9	18.48	Forbis artifact #3203. Shallow, unifacial flaking along one short segment of interior lateral edge surface.
unifacial flaking	1	2	4.9	3.1	1.4	11.93	Forbis artifact #3214. Shallow, unifacial flaking along short segment of interior distal edge surface.
combination flaking	2	1	10.3	6.7	1.2	69.7	Forbis artifact #3222. Combination of unifacial and bifacial microflake removals along lateral edges.
unifacial flaking	3	1	7.3	5.7	1.2	58.7	Bliss and Hughes (1947) artifact #44; Smithsonian Institution National Museum of Natural History Accession #206347, Catalogue #406714. Continuous, shallow, unifacial flaking along exterior margins of one lateral edge and both ends.

DEF/M measurements are in centimeters

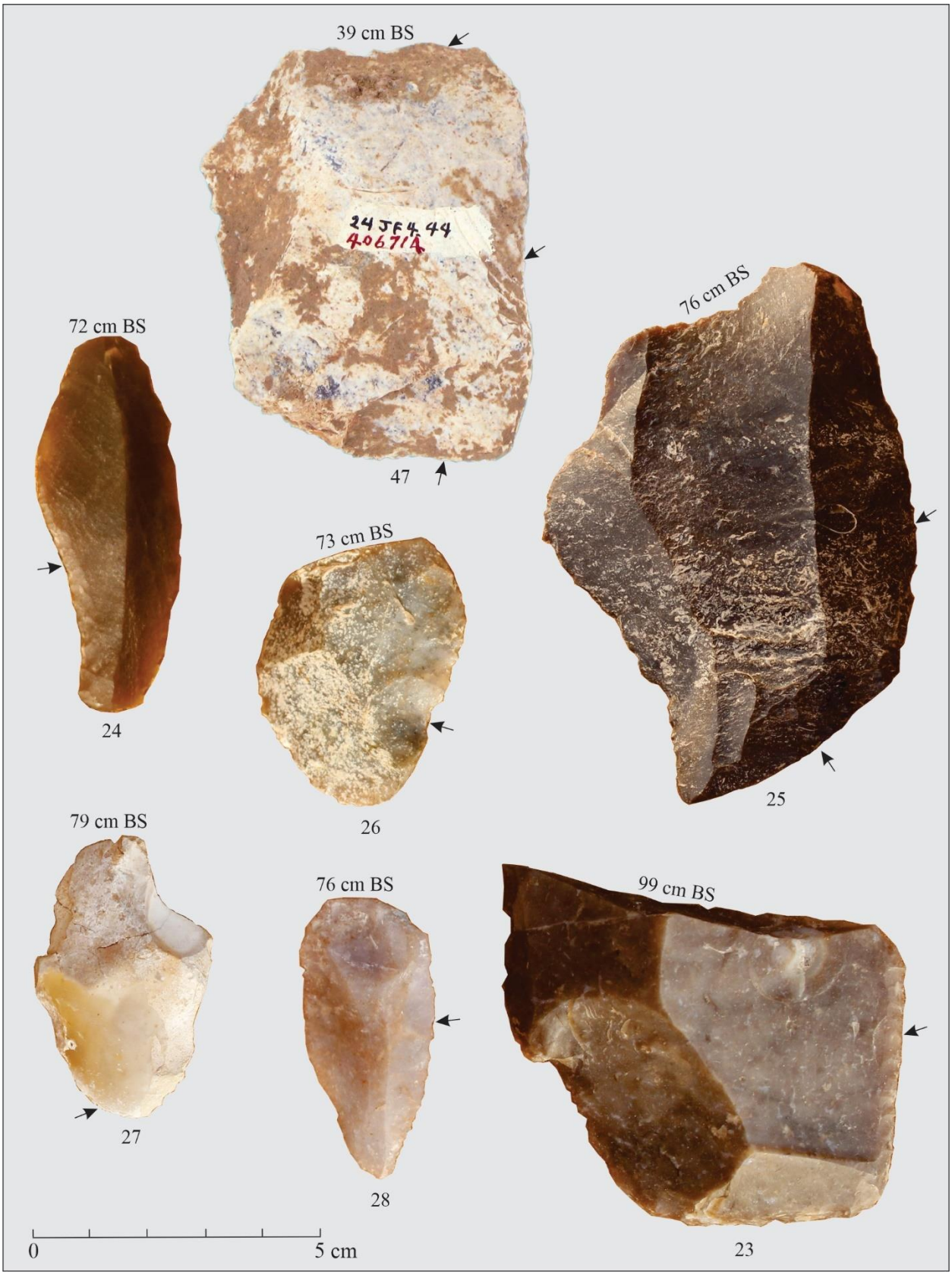


Figure 93. DEF/M Assigned to the Cody Component (1). Arrows Indicate Edge Modification.

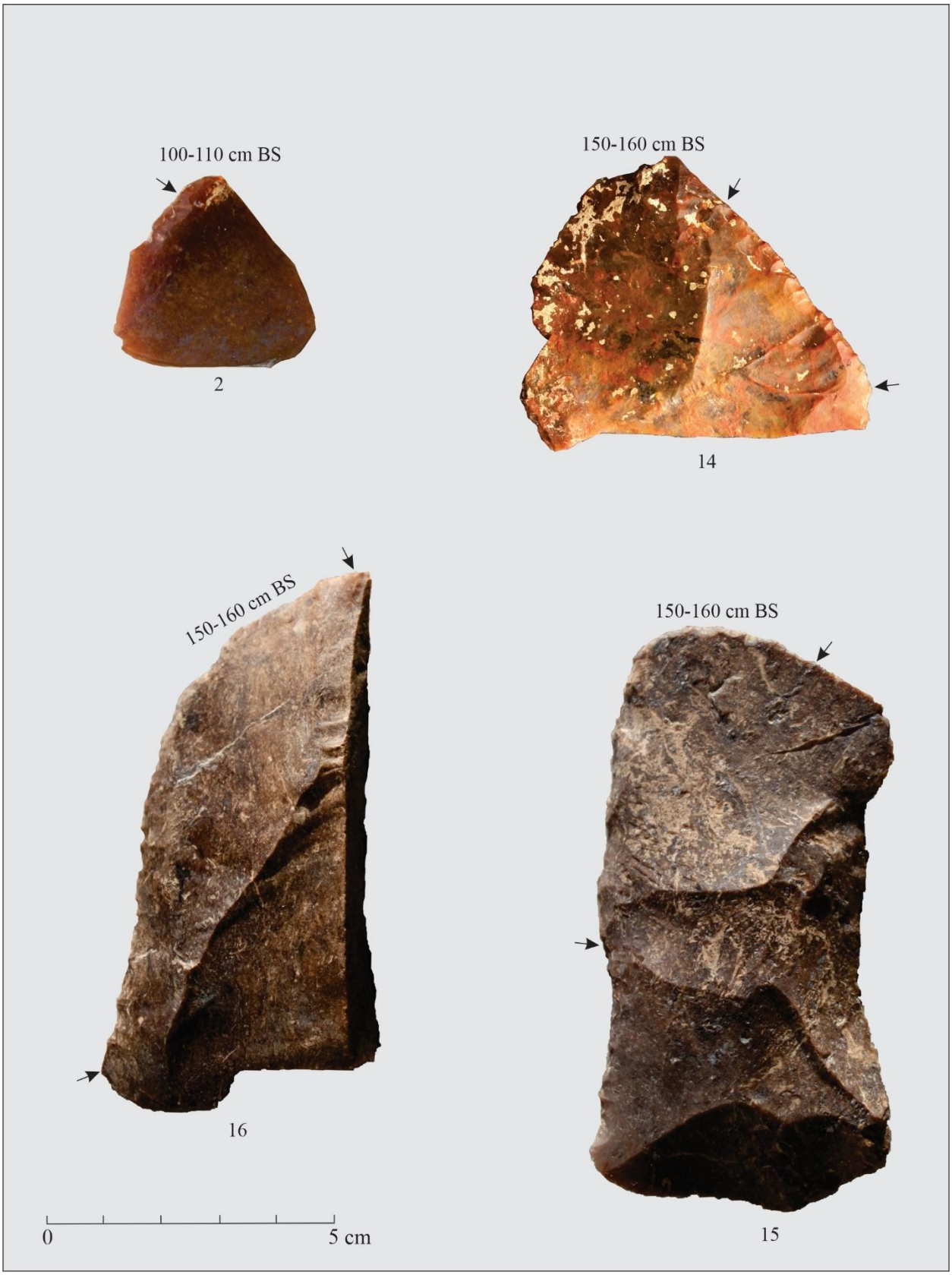


Figure 94. DEF/M Assigned to the Cody Component (2). Arrows Indicate Edge Modification.

Figure 95. DEF/M Assigned to the Cody Component (3).

Three DEF/M (#20 through #22: Fig. 95) exhibit worn and smoothed edges and interior surfaces but show no indication of retouch or secondary flake removals. Forbis (1955) referred to these three items as "teshoas", but the wear pattern (or lack thereof) suggests uses other than cutting. Considering the presence of endscrapers, perhaps they were used in hide working. High magnification microwear studies may help interpret the function of the recovered DEF/M. No associated debitage or cores were recovered suggesting the spalls were produced from cobbles off-site and transported to MacHaffie.

Unmodified Debitage (Tables 26, 32-34; Figures 96 and 97)

A total of 1,845 pieces of lithic debitage (7,284.18 g) is assigned to the Cody component and constitutes those pieces that did not correlate to a defined knapping feature. The lithic materials fall into 122 distinct MANA designations and are generally described as dacite, granite, chert, obsidian, clear quartz crystal, and sedimentary quartzite. In terms of lithic raw materials represented, 97 percent of the debitage is chert. Obsidian is first imported to MacHaffie by Cody occupants, but the quantity is limited (n=44 or 2% of total). The same is true for dacite but to an even lesser extent as it is represented by one flake and an Eden style projectile point. The obsidian debitage is small with 70 percent falling in the Size-Grade 3 range. A dominance of point and faceted platforms suggest pressure flaking of a late-reduction stage biface. All other lithic materials constitute less than 1 percent of the total. Puzzlingly, the local siliceous granite (GRAN5) was still being percussion flaked by Cody people.

Although color and texture range is great, a preference for a grainy bluish-gray chert (GBCCS18 and GBCCS20) stands out among the debitage (42% of all CCS). In contrast to the preceding Folsom occupants, Cody occupants were selecting far fewer pieces of red-toned chert for reduction work at MacHaffie. Very little of the lithic debitage appears to have been heat-treated or removed from heat-treated cores or preforms but heat-treating of the highly siliceous local chert is not always easy to recognize. Ten pieces exhibit potlids on one or more surface attesting to thermal alteration. It is unclear if this alteration was intentional.

Most of the chert was likely obtained from local sources (see Figure 3). The grayish-brown to grayish-blue chert assigned MANA units GBCCS18, GBCCS20, CCCS6, CCCS7 as well as a slightly grainy agate-like material (CCCS3) probably originated in the Palmer chert quarries (24JF226 and 24JF879) 800 meters northeast of MacHaffie (see Figure 3). Although these sources have largely been destroyed by contemporary silica mining, blocks and pieces of the chert are scattered around the open pits. Before the concrete plant began mining silica, local landowner Pamela Bompart (pers. comm. 2019) recalls riding by the Palmer Quarry and seeing numerous shallow, grassed-over pits, and tremendous volumes of debitage.

A clear quartz crystal flake was recovered from the Cody component. As noted previously for the Folsom component, the piece was likely removed through bipolar reduction considering its small-size. Bipolar shearing of one or two quartz crystals is a recurring pattern in some archaeological sites in Montana (e.g., Rennie 2017; Rennie and Hughes 1998; Rennie and Rittel 2007). The reason, from a perspective of what functional tool could be gained, is hard to explain.

Table 32. Flake Platform Morphology among Cody Unmodified Debitage.

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
BCCS2			1	1		2
BCCS3		1	1			2
BCCS4	1		8	1		10
BCCS5			1			1
BCCS6	2		2			4
BCCS8	1					1
BCCS9	4	2	10			16
BCCS12						0
BCCS15		1				1
BCCS16						0
BCCS18	1					1
BCCS19			3			3
BCCS20			1			1
BCCS21	16	2	16	1		35
BCCS23	1					1
BCCS27	1	1	3			5
BCCS28	17	2	10			29
BCCS29	2	1	9			12
BCCS31		1				1
BCCS32	1					1
BCCS33						0
BCCS34						0
BCCS37		1				1
BCCS38	3		5			8
BCCS41	21	12	23	4		60
BCCS42				1		1
BCCS43	1		1			2
BCCS44	2		2			4
BCCS46	7		1			8
BPCCS2		1				1
BPCCS5		1				1
CCCS1	6	1	2	1		10
CCCS2	12	4	16	1		33
CCCS3	15	7	32	1		55
CCCS4	1		1			2
CCCS5	1					1
CCCS6	23	22	34	3		82
CCCS7	18	6	26	2		52
CCCS8	8	1	7	2		18
CCCS9		1		1		2
DAC1				1		1
GBCCS6			2			2
GBCCS11	1					1
GBCCS14			1			1
GBCCS16				1		1
GBCCS18	70	85	183	10	3	351
GBCCS20	25	25	54	3		107
GBCCS36			1			1
GBCCS38		1				1

Table 32. Flake Platform Morphology among Cody Unmodified Debitage (continued).

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
GBCCS39	3					3
GBCCS43						0
GRAN5	6		1			7
OBS1			1			1
OBS2	1	7	10	2		20
QTZCRY1						0
RCCS3			5	2		7
RCCS4			4			4
RCCS6	6		5			11
RCCS8			1	1		2
RCCS9	1					1
RCCS11	2		2			4
RCCS12	3	2	7			12
RCCS13			1			1
RCCS14			3			3
RCCS16			1			1
RCCS19	7	2	16	1		26
RCCS20	1					1
RCCS21	1		2			3
RCCS22			3			3
RCCS26						0
RCCS27		1	3			4
RCCS29						0
RCCS31						0
RCCS32	2	2	2			6
RCCS33	2					2
RCCS47					1	1
RCCS48	2	2	9			13
SDQZT5e						0
WCCS1	1	1				2
WCCS4			1			1
WCCS5	4	3	4			11
WCCS6		1				1
WCCS8	1	1	1			3
WCCS10						0
WCCS11			2			2
WCCS12						0
WCCS15			1			1
WCCS18		1	1			2
YBCCS1a	1	2	1			4
YBCCS1b			1			1
YBCCS1d	1	2		2		5
YBCCS1e			1			1
YBCCS2	1	1	1			3
YBCCS3		1				1
YBCCS4	2	2	2	1		7
YBCCS5	1		1	1		3
YBCCS7	3					3
YBCCS8	1	1				2

Table 32. Flake Platform Morphology among Cody Unmodified Debitage (continued).

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
YBCCS11		2				2
YBCCS12	2		1			3
YBCCS15		1				1
YBCCS18	1		1			2
YBCCS21				1		1
YBCCS22				1		1
YBCCS23						0
YBCCS24		1				1
YBCCS28	1					1
YBCCS29		1				1
YBCCS30	3	1	3			7
YBCCS31			1			1
YBCCS33a	2					2
YBCCS35	2		1			3
YBCCS37		1				1
YBCCS40		1	2			3
YBCCS42						0
YBCCS44	1					1
YBCCS45	2					2
YBCCS46	1					1
YBCCS50	2		2			4
YBCCS51	2	1				3
YBCCS52	1		1			2
YBCCS53				1		1
	334	220	561	47	4	1,166

Table 33. Size Grade and Weights for Cody Unmodified Debitage.

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
BCCS2					6	3.25					6	3.25
BCCS3	1	21.76	1	1.55							2	23.31
BCCS4			1	1.13	8	2.57	1	0.05			10	3.75
BCCS5	1	14.55									1	14.55
BCCS6			1	4.7	3	1.65					4	6.35
BCCS8					2	1.05					2	1.05
BCCS9	5	173.07	10	34.67	3	1.69					18	209.43
BCCS12					1	1.91					1	1.91
BCCS15			1	3.4							1	3.4
BCCS16					1	0.38					1	0.38
BCCS18			1	6.65							1	6.65
BCCS19					3	2.05					3	2.05
BCCS20			1	5.45	1	1.45					2	6.9
BCCS21	6	154.79	12	67.22	20	7.68	6	0.95			44	230.64
BCCS23					1	0.25					1	0.25
BCCS27			1	5.1	3	1.0	2	0.2			6	6.3
BCCS28	1	28.7	13	72.04	22	10.0	1	0.15			37	110.89
BCCS29			3	4.6	14	4.7	2	0.2			19	9.5
BCCS31					1	0.7					1	0.7
BCCS32					1	0.1					1	0.1
BCCS33			1	1.6							1	1.6
BCCS34			1	1							1	1
BCCS37	1	41.6									1	41.6
BCCS38			9	22.48	9	3.9					18	26.38
BCCS41	5	101.07	26	76.03	51	23.16	1	0.05			83	200.31
BCCS42					1	0.15					1	0.15
BCCS43			1	2.4	3	2.1					4	4.5
BCCS44			2	2.95	2	1.45					4	4.4
BCCS46	1	10.3	5	14.9	4	2.3					10	27.5
BPCCS2					2	0.75					2	0.75
BPCCS5			1	6.75	2	0.55					3	7.3
CCCS1			4	11.01	17	9.9	1	0.05			22	20.96
CCCS2	2	24.43	15	48.57	19	6.54	5	0.7			41	80.24
CCCS3	3	59.3	27	59.11	54	25.35	4	0.55			88	144.31
CCCS4			1	6.75	1	0.55					2	7.3
CCCS5					1	1.05					1	1.05
CCCS6	24	568.63	59	208.09	43	20.49					126	797.21
CCCS7	7	90.01	21	218.15	43	17.17	3	0.45			74	325.78
CCCS8			7	19.95	19	7.65	2	0.15			28	27.75
CCCS9	2	28.12	1	1.84	3	2.54					6	32.5
DAC1			1	1.9							1	1.9
GBCCS6			2	1.51							2	1.51
GBCCS11			1	2.25							1	2.25
GBCCS14					2	2.0					2	2
GBCCS16					1	0.8					1	0.8
GBCCS18	81	2,070.67	191	578.43	264	145.06	13	1.15			549	2795.31
GBCCS20	33	858.35	64	185.78	100	45.2					197	1089.33
GBCCS36					1	0.1					1	0.1
GBCCS38			4	11.23							4	11.23

Table 33. Size Grade and Weights for Cody Unmodified Debitage (continued).

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
GBCCS39	1	16.45	1	2.05	3	0.8					5	19.3
GBCCS43					1	0.1					1	0.1
GRAN5	1	27.2	4	10.6	6	4.6					11	42.4
OBS1	1	3.64	1	4.53							2	8.17
OBS2			8	14.17	31	12.87	3	0.37			42	27.41
QTZCRY1					1	0.8					1	0.8
RCCS3			3	5.25	11	5.05	2	0.2			16	10.5
RCCS4			2	6.15	11	8.09	2	0.1			15	14.34
RCCS6	1	41.67	4	9.6	17	10.75	1	0.1			23	62.12
RCCS8			1	2.7	1	0.4					2	3.1
RCCS9			1	2.95							1	2.95
RCCS11			1	1.1	2	1.1	1	0.1			4	2.3
RCCS12			1	2.1	15	6.7	2	0.15			18	8.95
RCCS13	1	17.43									1	17.43
RCCS14					8	3.65	1	0.05			9	3.7
RCCS16					2	0.5					2	0.5
RCCS19			5	9.95	25	8.75	6	1.0			36	19.7
RCCS20	1	10.65									1	10.65
RCCS21			4	11.36							4	11.36
RCCS22			1	7.45	2	0.5	3	0.2			6	8.15
RCCS26			1	3.35	1	0.1					2	3.45
RCCS27			2	6.3	6	1.45					8	7.75
RCCS29			1	5.72							1	5.72
RCCS31			1	2.15							1	2.15
RCCS32			4	20.27	5	2.85	1	0.1			10	23.22
RCCS33			3	7.65							3	7.65
RCCS47					1	0.4					1	0.4
RCCS48	2	22.45	7	19.34	12	6.57	6	0.3			27	48.66
SDQZT5e					1	0.6					1	0.6
WCCS1			2	8.95			1	0.15			3	9.1
WCCS4			1	1.9	1	0.1					2	2
WCCS5	1	15.7	10	30.95	15	6.51					26	53.16
WCCS6			2	4.92							2	4.92
WCCS8	1	4.57			2	1.45					3	6.02
WCCS10					1	0.3					1	0.3
WCCS11					6	2.1	1	0.1			7	2.2
WCCS12					1	0.45					1	0.45
WCCS15					4	2.3					4	2.3
WCCS18	1	4.1	1	3.4							2	7.5
YBCCS1a			6	11.98	3	1.64					9	13.62
YBCCS1b					1	1.2					1	1.2
YBCCS1d	3	92.76	2	4.15	3	1.22					8	98.13
YBCCS1e			1	1.96							1	1.96
YBCCS2			1	1.12	2	1.7					3	2.82
YBCCS3			1	7.05							1	7.05
YBCCS4	1	6.55	5	10.53	2	0.85	2	0.25			10	18.18
YBCCS5					3	2.11	2	0.1			5	2.21
YBCCS7	2	88.7	1	1.2							3	89.9
YBCCS8					2	1.0					2	1

Table 33. Size Grade and Weights for Cody Unmodified Debitage (continued).

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
YBCCS11					2	2.33					2	2.33
YBCCS12					6	2.95					6	2.95
YBCCS15			2	3.6	1	0.05					3	3.65
YBCCS18					3	1.1					3	1.1
YBCCS21			1	2.48							1	2.48
YBCCS22					1	1.7					1	1.7
YBCCS23			1	8.55							1	8.55
YBCCS24			1	10.35							1	10.35
YBCCS28			1	1.55							1	1.55
YBCCS29			1	1.95	2	0.4					3	2.35
YBCCS30	1	27.73	2	16.9	6	2.13	1	0.1			10	46.86
YBCCS31					1	0.61					1	0.61
YBCCS33a			2	5.25							2	5.25
YBCCS35	2	80.93	2	11.85							4	92.78
YBCCS37	1	31.88									1	31.88
YBCCS40			2	2.6	1	0.1					3	2.7
YBCCS42			2	8.77							2	8.77
YBCCS44			1	3.6							1	3.6
YBCCS45			2	5.95							2	5.95
YBCCS46					1	0.65					1	0.65
YBCCS50			2	9.45	4	1.8					6	11.25
YBCCS51	1	16.28	2	8.65							3	24.93
YBCCS52			3	12.8							3	12.8
YBCCS53			1	3.21							1	3.21
	195	4,754.04	606	2,049.55	968	472.57	76	8.02	0	0	1,845	7,284.18

Table 34. Morphology by Size Grade of Cody Unmodified Debitage.

	Complete Flakes	Broken Flakes	Flake Fragments	Shatter	Count
Size-Grade 1	149	17	25	4	195
Size-Grade 2	412	38	79	77	606
Size-Grade 3	463	43	101	361	968
Size-Grade 4	40	2	3	31	76
Size-Grade 5	0	0	0	0	0
	1,064	100	208	473	1,845

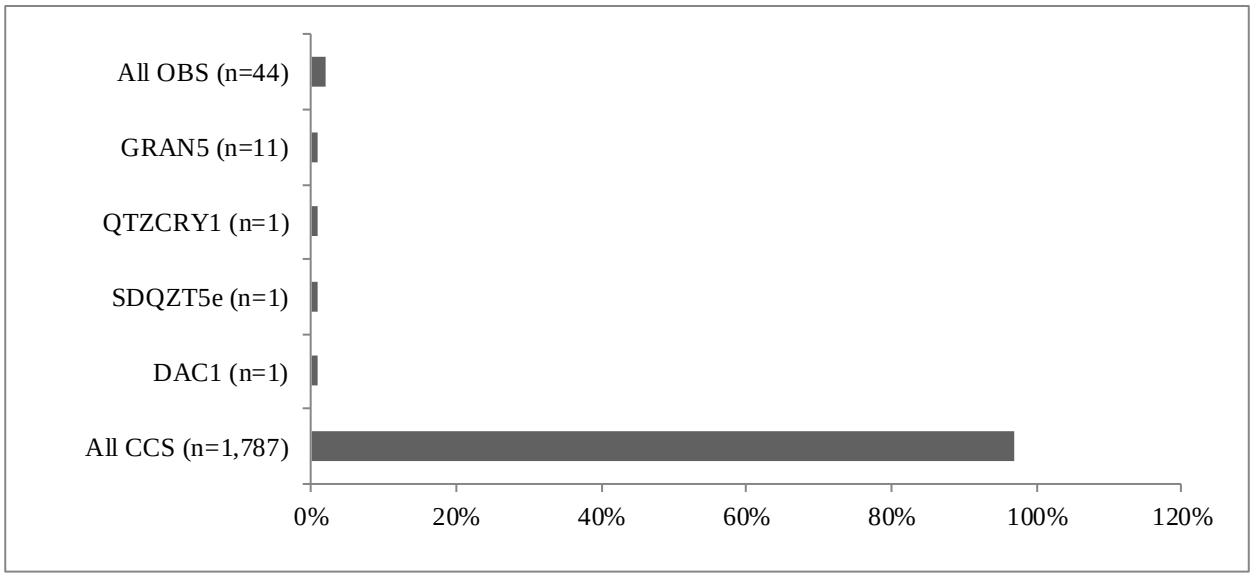


Figure 96. Count Percentages by MANA Designation for Cody Unmodified Debitage.

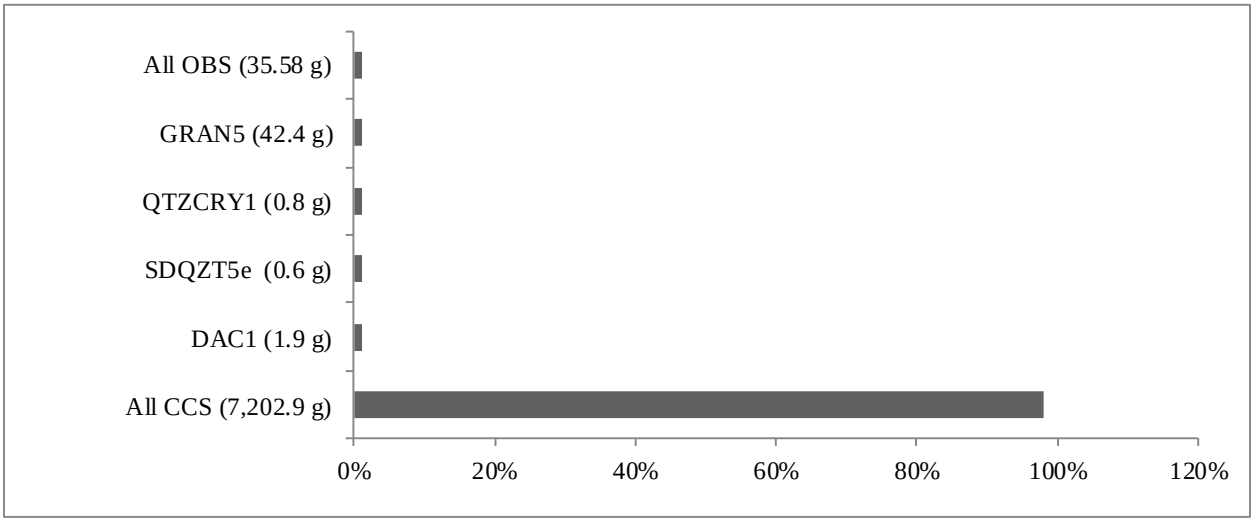


Figure 97. Weight Distribution by MANA Designation for Cody Unmodified Debitage.

Chert assigned the MANA designations of GBCCS18 and GBCCS20 is consistently represented by larger flakes than other chert materials. These larger flakes tend to be thin and straight with minor bulbs of percussion. Surprisingly, many of these large (palm-size and slightly smaller) flakes were discarded with no further consideration, even though they appear to be structurally sound. Excluding a change in chert source preference, the general approach to lithic reduction appears to parallel that described previously for Folsom occupants.

Shatter accounts for approximately 26 percent of the debitage, but very little angular shatter (n=50 or 10% of all Cody shatter) is represented, suggesting that initial edging of bifacial cores and initial preparation (cortex removal and production of large primary reduction stage flakes) of cores occurred mostly off-site. Substantiating evidence is that only 35 (2%) pieces of debitage exhibit some amount of cortex and 94 percent of the pieces with cortex are chert.

Twenty (1%) pieces of debitage are classified as primary reduction stage. All are of chert and represent 16 distinct MANA designations. One thousand five hundred twenty-eight (83%) are secondary reduction-stage pieces, and 297 (16%) are tertiary reduction-stage. Of 1,371 pieces considered to be flakes or portions of flakes, 434 (32%) exhibit only one obvious exterior surface flake scar, 911 (49%) pieces have two to three exterior surface flake scars, and only 15 pieces (1%) show four or more. Among the pieces that exhibit two or more flake scars (n=926), 833 (90%) of those flake removal scars intersect. Only 93 (10%) flakes exhibit exterior surface flake removal scars that run parallel to each other. This implies more bifacial knapping than other types of core reduction. Importantly, and as observed for the Folsom materials, there is no evidence among the debitage of polyhedral blade core preparation or reduction.

One thousand sixty-four (58%) of the debitage pieces are complete flakes, five percent (n=100) are broken flakes, and 11 percent (n=208) are flake fragments (Table 36). Among 1,259 of the pieces with intact distal ends, 1,240 (98%) exhibit a feathered termination. Hinge and step terminations occur among only one percent (n=17) of the flakes. Additionally, two overshot (outrepasse') flakes of two distinct MANA designations (BCCS3 and CCCS6) were identified among the Cody debitage. As with the Folsom knappers before them, Cody knappers exhibited a great deal of control over the stone breaking process. Three hundred seventy-six (32%) of the complete flakes are elongate in form and 786 (68%) are ovate to ovate-expanding. The shape of the remainder could not be determined because they are sufficiently incomplete pieces. It should also be noted that only seven of the flakes were inadvertently split longitudinally during the knapping process.

Complete or partial platforms (Table 34) are found on 1,166 specimens (63% of the debitage). Three hundred thirty-four (29%) exhibit flat platforms, 19 percent (n=220) exhibit faceted platforms, and 48 percent (n=561) exhibit point platforms. Forty-seven flakes (4%) exhibit crushed platforms, and four exhibit flat-beveled or flat but angled platforms. Among the faceted platform pieces, approximately 204 have platforms with maximum lengths or widths between 5 and 8 mm.

Eighteen flakes are decortication pieces while 1,320 (96%) are general shaping or thinning flakes. Later reduction stage biface-thinning flakes comprise 14 percent (n=198) of the diagnostic pieces. Only 23 percent (n=309) of the debitage are probable pressure flakes.

Two bipolar flakes represent the outer edges of sheared chert pebbles. This shows a range of knapping techniques and lithic materials selected by Cody occupants. The Cody debitage also exhibits subtle bulbs of percussion and a lack of ripple marks, although as many as ten flakes have pronounced percussion bulbs. This pattern, in conjunction with a total lack of hammerstones, continues to suggest that soft hammer reduction was far more common than hard hammer work at MacHaffie.

Among the Cody debitage, Size-Grade 3 pieces dominate (52 % or n=968), with Size-Grade 2 pieces representing a close second (33 % or n=606). Pieces in the largest size grade (SG1) makeup 11 percent of the debitage (n=195) and pieces in the smallest recovered size grade (SG4) account for only four percent (n=76) of the pieces. The latter, of course, may be an inaccurate representation because 0.25 inch mesh was used to screen most of the excavated sediments, so many small pieces could have been missed (Tables 33 and 34).

In summary, the Cody debitage emphasizes large flake and medium-size Stage II or III biface production generally beginning with initially prepared cores with minimal amounts of cortex. Surprisingly, many large, thin and straight flakes, primarily of the GBCCS18 and GBCCS20 MANA designations, were readily abandoned by Cody knappers. Most of these pieces are highly desirable by contemporary flintknappers. Pressure flaking of formal tools was limited. There is little evidence of pressure flaking among the pieces suggesting that blanks, but not finished tools, were being produced and transported elsewhere. The debitage also indicates that a range of material types was selected and reduced through percussion, but bifacial reduction likely dominated the efforts. There is a significant decrease in the use of marginal quality lithic raw materials for tool manufacture when compared to the Folsom component.

Although 1,845 pieces of debitage (excluding the knapping features) have been recovered from the Cody component, this is a minor amount for a knapping station. It suggests that neither extensive knapping nor repeated knapping events occurred at MacHaffie by Cody occupants. Like Folsom before, Cody occupation of MacHaffie likely reflects a small number of short and sporadic occupation episodes.

An interesting pattern among the most common chert debitage of the GBCCS18, GBCCS20, CCCS3, CCCS6 and CCCS7 MANA designations, is that several pieces have sunbleached to an opaque white color— sometimes both sides. This is probably related to the material being more susceptible to weathering and ultraviolet light effects than other chert materials. A similar pattern of sunbleaching was not observed among the Folsom artifacts, but the five above noted MANA designation are minimally represented in the Folsom component. It may also point to a differential sediment deposition rate that allowed the Folsom materials to be buried more quickly than the Cody artifacts.

9.2.2 Knapping Feature 3 (Tables 35 and 36, Figures 98-100; Appendix 9)

Contained in excavation unit 14S/2E at a depth of 110 to120 cm BS was a concentration of chipped stone debitage representing a portion of a knapping event through which a gray to bluish-gray chert nodule (GBCCS18) was probably reduced through soft hammer percussion. Very few of the associated flakes are pressure removed pieces. One hundred fifty-three pieces of debitage (913.95 g) constitute what is defined here as Knapping Feature 3. Little debitage recovered from the 110 to 120 cm BS depth in the excavation unit containing Feature 3 is of a MANA designation distinct from the GBCCS18 chert. This may indicate that little or no mixing of Knapping Feature 3 material occurred in this part of the site—at least at this depth. The lithic raw material was likely obtained from the Palmer chert quarries (24JF226 and 24JF879) 800 meters northeast of the MacHaffie site. These source localities contain a restricted color range of good quality chert. The colors range from opaque and somewhat grainy brown to semi-translucent and highly siliceous mottled brown/colorless, to opaque whitish-gray to bluish-gray to very dark bluish-gray (MANA designations BCCS1, BCCS38, BCCS51, CCCS5, CCCS7, CCCS9, GBCCS18, GBCCS20).

Unmodified Debitage

Only a single item weighing 53 grams is a primary reduction (decortication) flake, but no shatter was observed among the pieces representing the initial stages of hard hammer reduction work. Decortication of the original item must have occurred off-site, probably at the source, because only five pieces of debitage exhibit some cortex. One hundred forty-three pieces (93% or 859.5 g) are considered here to be secondary flakes and shatter. Shatter constitutes approximately 32 percent (n=49 pieces weighing 21.8 g) of the secondary reduction items. Four flakes are substantially concave in cross-section and probably reflect platform trimming pieces. Tertiary or final reduction stage finishing flakes account for only eight pieces (5% of total).

Mass analysis illustrates the dominance of Size-Grade 3 pieces by count (52%, n= 80), and the dominance of Size-Grade 1 pieces by weight (78% or 708.35 g). Broken flakes and flake fragments account for only 17 percent of the total and are most common among the Size-Grade 2 to 3 pieces. Complete flakes (n=78 or 51% of total) dominate the Size-Grade 1 to 3 classes. However, the ratio of Size-Grade 3 to Size-Grade 4 pieces is 26.7 demonstrating that Knapping Feature 3 is incomplete and unsuitable for mass analysis (see Baumler and Davis 2004:61).

Most of the debitage (99%) exhibit one or two exterior surface flake scars of variable orientation when two flake scars are present. This suggests core and biface shaping and thinning during early and mid-stages of the reduction sequence. Unexpectedly, obvious biface-thinning flakes account for only eight of the pieces. Flakes tend to be of moderate size and ovate in form. Fifty-two percent of the pieces have identifiable platforms. Flat platforms dominate (n=39) while point platforms are a distant second in frequency (n=26). Faceted platforms occur on only eight of the flakes, and the remainder (n=7) have been crushed. Among the faceted platform pieces, five have platforms with maximum lengths or widths between 5 and 8 mm. Feathered terminations dominate among the flakes and flake fragments (n=97 or 63%). Only two step-fractures were observed, and hinge-fractures and outrepasse' pieces are non-existent.

The evidence suggests that the debitage assigned to Knapping Feature 3 was formed when a moderate-size chert nodule was initially reduced off-site then transported to MacHaffie and secondarily reduced through soft hammer percussion. Well prepared and ground platforms coupled with precise execution of percussion work indicate a highly skilled knapper. Although the debitage indicates production of at least one Stage II or III bifacial blank, several large flakes could have also been generated and subsequently transported off-site for use, or to be heat-treated and further refined elsewhere. In comparing the Cody and Folsom Knapping Features, Cody occupants preferred the grainy, bluish-gray (GBCCS18) chert over the vitreous reddish-brown (BCCS41) material that dominates the Folsom component. Further, Cody occupants appear to have been more wasteful of the lithic resources, abandoning many large, thin and generally straight flakes.

Table 35. Flake Platform Morphology: Knapping Feature 3.

MANA designation	Flat	Faceted	Point	Crushed	Indeterminate	Count
GBCCS18	39	8	2	7	0	80

Table 36. Size Grade and Weights of Unmodified Debitage: Knapping Feature 3.

	Size Grade by Count and Weight								Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*Count*	*weight (g)*
BCCS41	24	708	46	168	80	37	3	0.5	153	914

Figure 98. Knapping Feature 3.

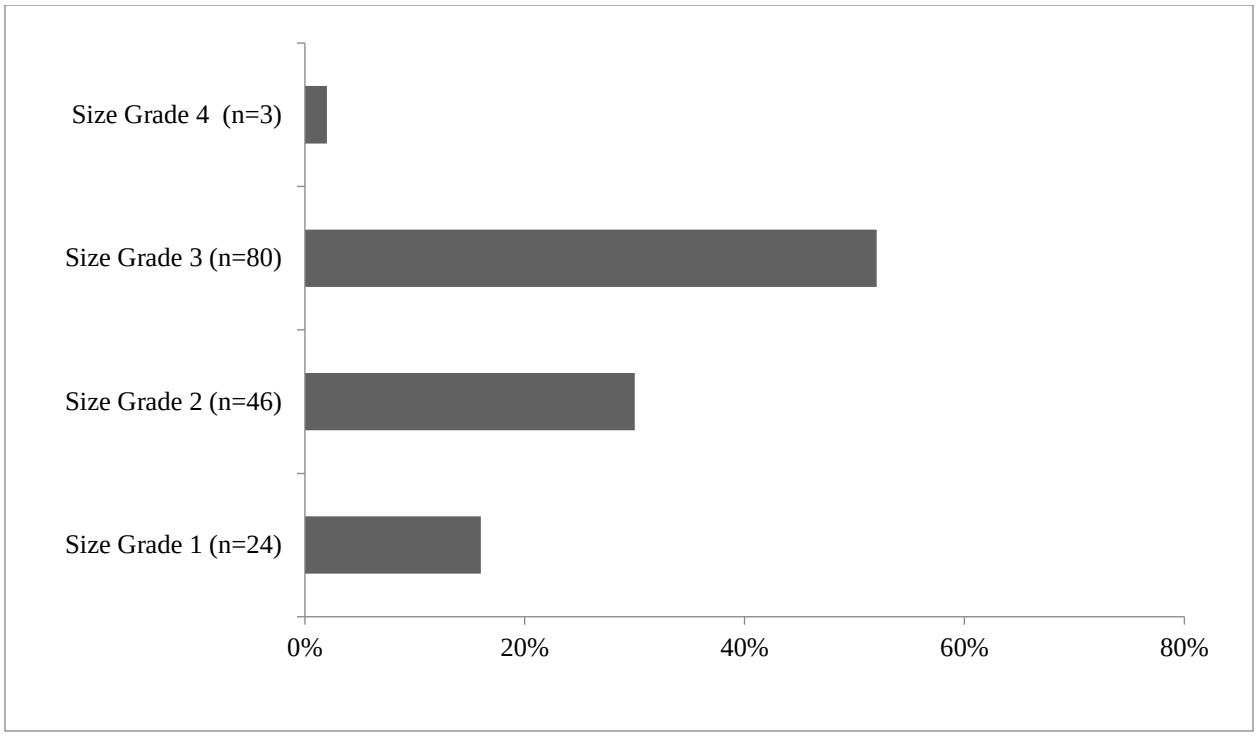


Figure 99. Unmodified Debitage Size Grade Distribution: Knapping Feature 3.

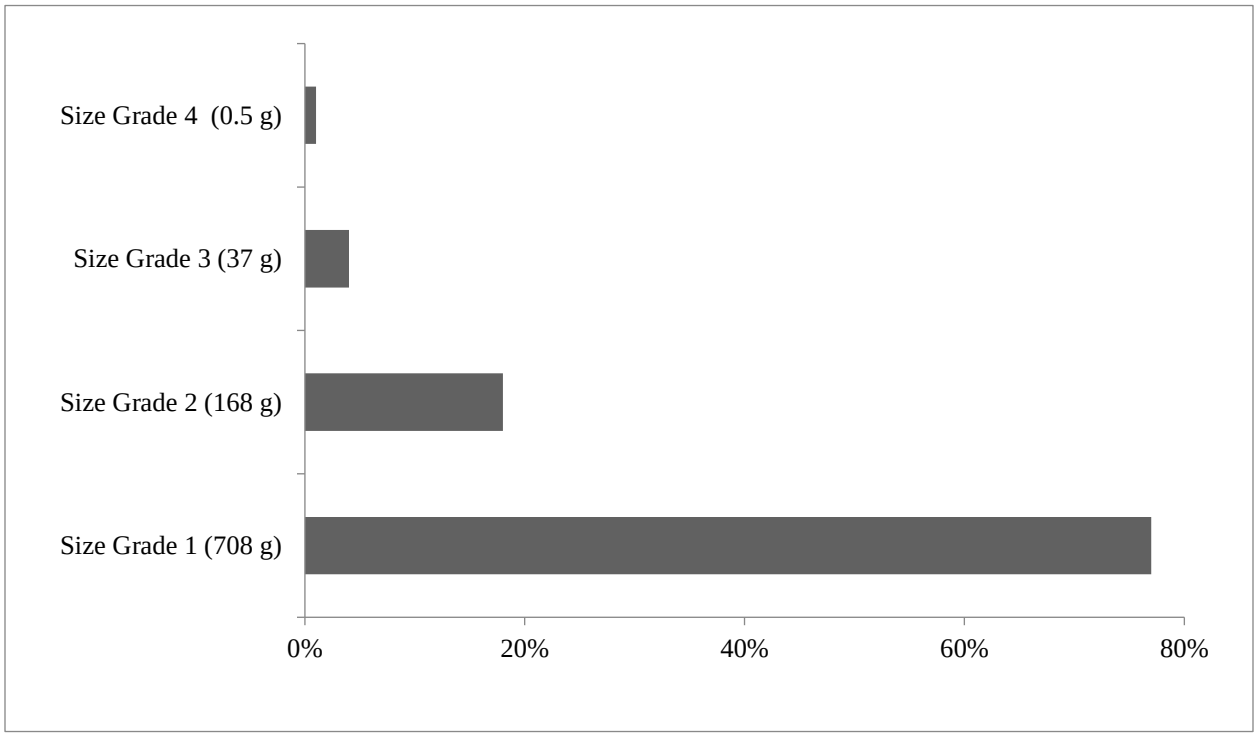


Figure 100. Unmodified Debitage Weight Distribution: Knapping Feature 3.

9.2.3 Knapping Feature 5 (Tables 37 and 38, Figures 101-105; Appendix 9)

Contained in excavation units N1/W3 and N2/W4 at a depth of 75 to 90 cm BS was a concentration of biface thinning flakes of a gray to bluish-gray chert (GBCCS18). The pieces probably resulted from soft hammer percussion. Seventy-one pieces of debitage (375.95 g) constitute Knapping Feature 5. As noted for the other knapping features, very little debitage recovered from the 75 to 90 cm BS depth in the excavation unit containing Feature 5 is of a MANA designation distinct from GBCCS18. This suggests little or no mixing of Feature 5 materials has occurred. The debitage may be incomplete but illustrates reduction of a probable stage I biface with a large amount of cortex into a Stage II or III bifacial blank. It is uncertain if the resulting biface has been recovered, presumably it was transported off-site by the knapper.

Unmodified Debitage

Although some cortex is present on the surfaces of 11 pieces, only a single item weighing 60 grams is considered here a primary reduction (decortication) flake. This suggests that decortication of the original piece must have occurred off-site, probably at the source. Shatter is represented by a Size-Grade 2 piece and a Size-Grade 3 piece. Forty-one pieces (58%) are considered here to be secondary flakes and shatter. Most of the flakes exhibit diffuse or understated bulbs of percussion. Twenty-nine (41%) possible tertiary flakes suggest some refinement through pressure flaking also occurred.

Mass analysis illustrates the dominance of Size-Grade 3 pieces by count (49% or n= 35), and the dominance of Size-Grade 1 pieces by weight (72% or 271.9 g). Broken flakes and flake fragments account for only 18 percent of the total and are only present among the Size-Grades 1 to 2 pieces. Complete flakes (n=78 or 51% of total) dominate all size-grades. However, the total lack of Size-Grade 4 debitage makes the knapping feature incomplete and unsuitable for mass analysis (see Baumler and Davis 2004:61).

Most of the debitage (94%) exhibit one or two exterior surface flake scars of variable orientation when two flake scars are present. This suggests early and mid-stages of reduction work. Surprisingly, classic biface-thinning flakes account for only 16 (23%) of the pieces. Flakes tend to be of moderate-size and ovate in form (n=35). Some of the flakes are very large with little curvature, diffuse bulbs of percussion, and few internal anomalies. It is surprising that so many of these flakes were abandoned. Fifty (70%) of the pieces have identifiable platforms. Point platforms dominate (n=32) while faceted-lipped platforms are a distant second in frequency (n=14). Among the faceted platform pieces, ten have platforms with maximum lengths or widths between 5 and 8 mm. Flat platforms occur on only eight of the pieces. Feathered terminations dominate (n=56 or 79%). Step-fractures, hinge-fractures, and outrepasse' terminations are absent. Platforms are well prepared, isolated and ground for strength. In fact, many of the platforms show nearly identical preparation. Most of the flakes are free of knapping mistakes. The absence of flake or bifacial blanks probably supports the notion that moderately refined pieces were taken off-site for heat-treatment and further refinement.

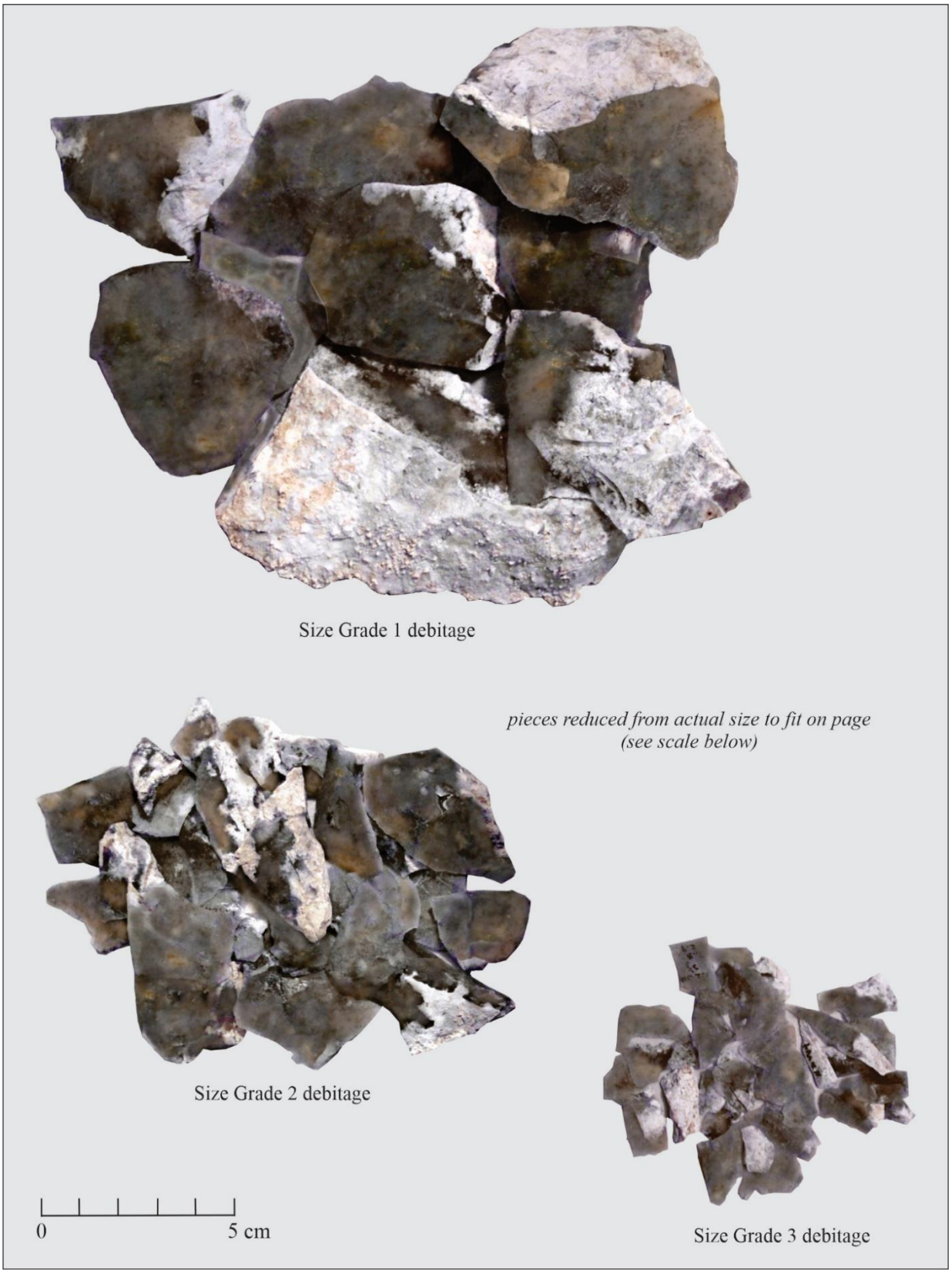


Figure 101. Knapping Feature 5.

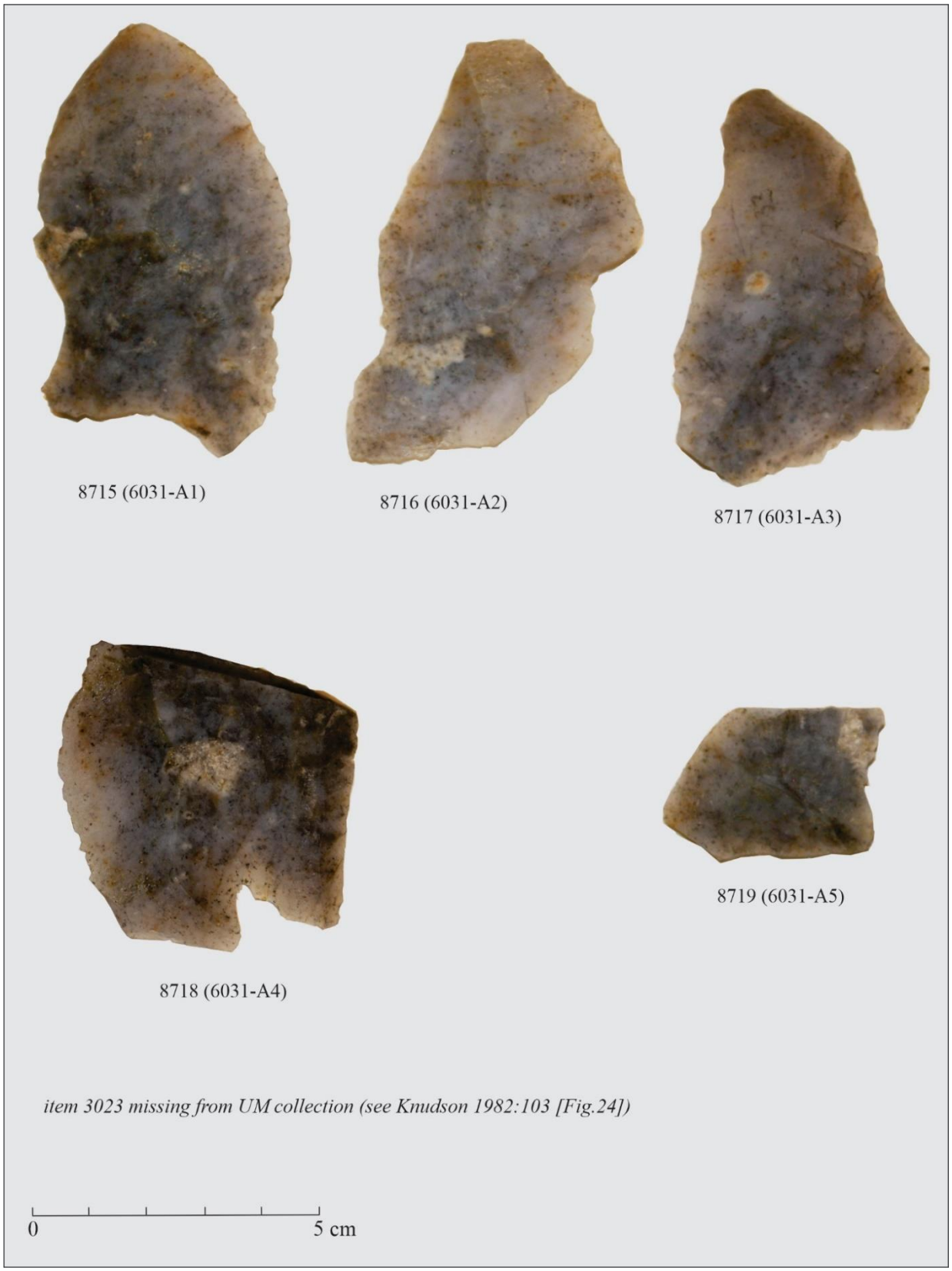
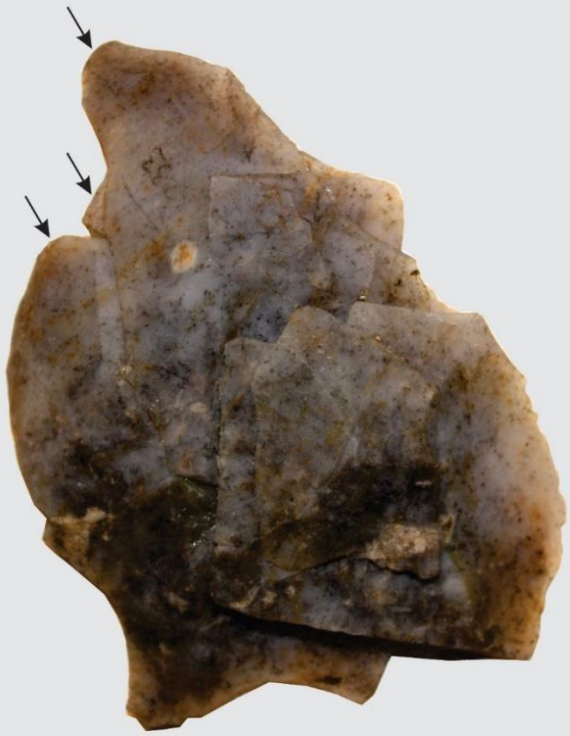


Figure 102. Knapping Feature 5 Sequentially Removed Biface Thinning Flakes before Refit.



Plan view. Arrows mark intact platforms.

Profile view of platforms.

Refit biface reduction flakes 8715-8719 (Knudson artifact #s 6031-A1through 6031-A5 (see Knudson 1982: 103 [Fig. 24]). Flake 3023 missing from refitted sequence and UM Collection.

0 5 cm

Figure 103. Knapping Feature 5 Sequentially Removed Biface Thinning Flakes (refit).

Table 37. Flake Platform Morphology: Knapping Feature 5.

MANA designation	Flat	Faceted	Point	Crushed	Indeterminate	Count
GBCCS18	4	14	32	0	0	50

Table 38. Size Grade and Weights of Unmodified Debitage: Knapping Feature 5.

	Size Grade by Count and Weight								Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*Count*	*weight (g)*
BCCS41	13	272	23	86	35	18	0	0	71	376

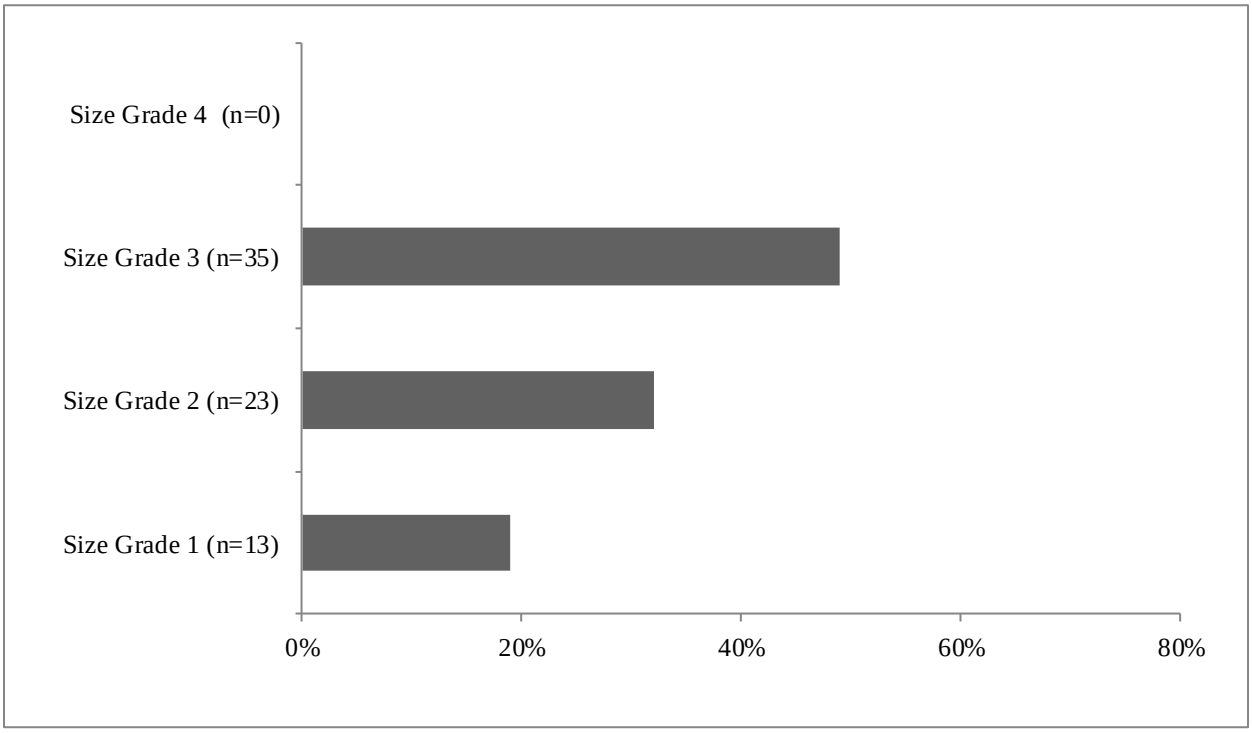


Figure 104. Unmodified Debitage Size Grade Distribution: Knapping Feature 5.

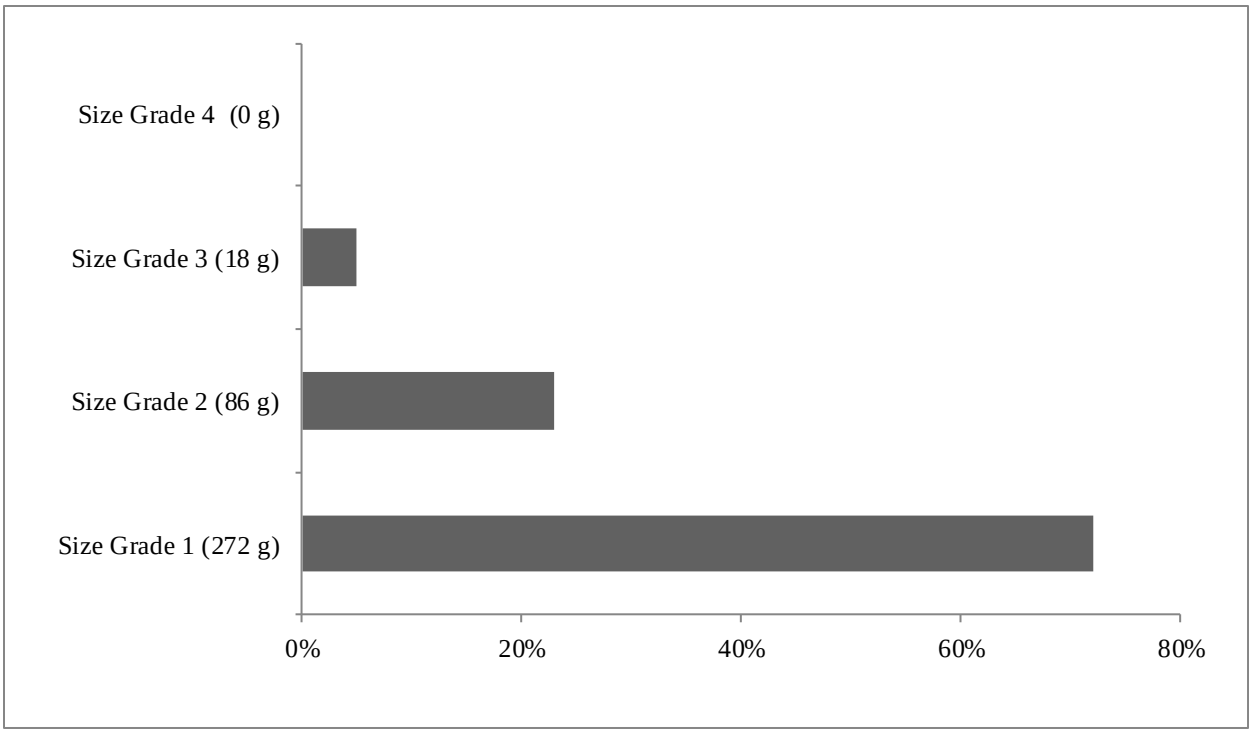


Figure 105. Unmodified Debitage Weight Distribution: Knapping Feature 5.

9.2.4 Knapping Feature 6 (Tables 39 and 40, Figures 106-108; Appendix 9)

Contained in excavation units S1/W3, S1/W4 and S1/W5 at a depth of approximately 60 to 75 cm BS was a dense concentration of chipped stone debitage representing a nearly complete knapping episode. It appears that a mottled grayish-brown to yellowish-gray opaque, slightly grainy chert (CCCS6) block was probably reduced though soft-hammer percussion. Presumably more than one resulting spall was further refined through soft hammer percussion work and a limited amount of pressure flaking. Although the debitage reflects a mixture of percussion and pressure flakes, the number of pressure flakes is insufficient to suggest that well-refined bifacial implements were produced at MacHaffie. In total 1,992 pieces of debitage weighing 1,917.37 grams constitute Knapping Feature 6.

Forbis included chipped stone materials from unit S2/W3 with the materials from S1/W3. Several pieces have this first unit designation and depth below ground surface written on them in indelible ink. Unit S2/W3 is not shown on Forbis' excavation map. Presumably this was material recovered from the original cutbank face immediately south of unit S1/W3. It may have been recovered by Forbis' team or prior to the 1951 work.

Unmodified Debitage

Although some cortex is present on the surfaces of two pieces, none represents the initial reduction stage of a core. As repeatedly observed among the Folsom and Cody components, decortication of original pieces occurred off-site, probably at the source. Shatter is represented by three Size-Grade 1 pieces, 62 Size-Grade 2 pieces, and 995 Size-Grades 3 to 4 pieces. Smaller size-grade pieces are thin and flake-like but could not be oriented to proximal or distal ends, or exterior or interior surfaces. One thousand two hundred forty-eight pieces (63%) are considered here to be secondary flakes and shatter. Most of the flakes exhibit diffuse or understated bulbs of percussion. This suggests soft hammer work and pressure flaking. Tertiary flakes account for 744 (37%) pieces showing that some blanks were being subjected to further refinement through pressure flaking. Some refined blanks were removed from the site, while other less desirable bifaces were left behind.

Mass analysis illustrates the dominance of Size-Grade 3 pieces by count (55% or n= 1,099), and the dominance of Size-Grade 2 pieces by weight (44% or 849.27 g). Broken flakes and flake fragments account for only 3 percent of the total and are largely present among Size-Grades 1 and 2. Complete flakes dominate the larger size-grades while shatter dominates the smaller size-grades. However, the ratio of Size-Grade 3 to Size-Grade 4 pieces is 2.14 demonstrating that Knapping Feature 4 is incomplete and unsuitable for mass analysis (see Baumler and Davis 2004:61).

Most of the debitage (99%) exhibit one or two exterior surface flake scars of variable orientation when two flake scars are present. Obvious biface-thinning flakes account for only 56 (3%) of the pieces suggesting that bifacial shaping and thinning was limited. However, the presence of ten stage II and III bifaces largely clustered among Knapping Feature 5 and 6 debitage imply on-site biface manufacture.

Most of the flakes are of small and ovate in form. Eight hundred seventy-nine (44%) of the pieces have identifiable platforms. Point platforms dominate (n=645) while flat platforms are a distant second in frequency (n=124). Only 75 of the pieces exhibit faceted-lipped platforms indicative of bifacial reduction. Among the faceted platform pieces, approximately 44 have platforms with maximum lengths or widths between 5 and 8 mm. Feathered terminations dominate (n=913 or 99%). Only five step-fractures and one outrepasse' flake are present. Platforms are not as well prepared as those among Knapping Features 3 and 5. In fact, the collection shows more random flake removals when compared with focused bifacial reduction work. Still, most of the flakes are free of knapping mistakes.

Figure 106. Knapping Feature 6: Debitage from Unit S1/W3.

Table 39. Flake Platform Morphology: Knapping Feature 6.

MANA designation	Flat	Faceted	Point	Crushed	Flat-Beveled	Count
CCCS6	124	75	645	35	0	879

Table 40. Size Grade and Weights of Unmodified Debitage: Knapping Feature 6.

	Size Grade by Count and Weight								Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*Count*	*weight (g)*
CCCS6	35	582.79	345	849.27	1,099	443.89	513	41.42	1,992	1,917.37

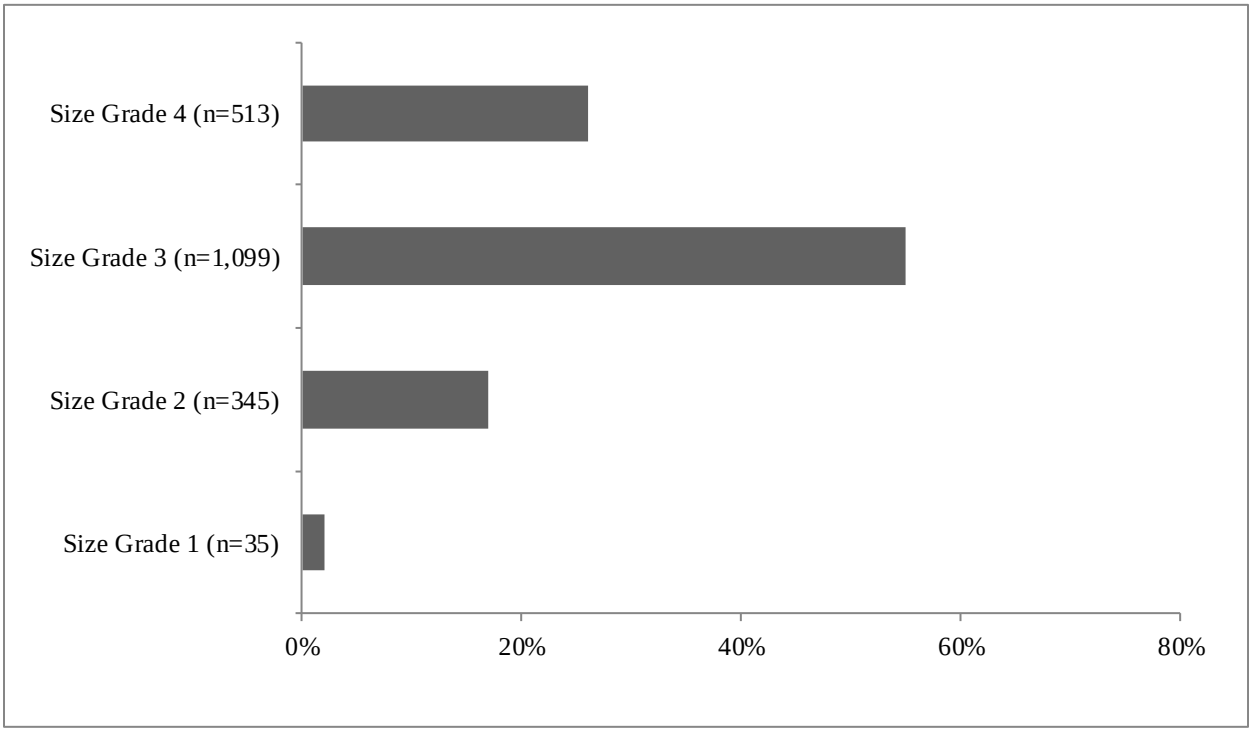


Figure 107. Unmodified Debitage Size Grade Distribution: Knapping Feature 6.

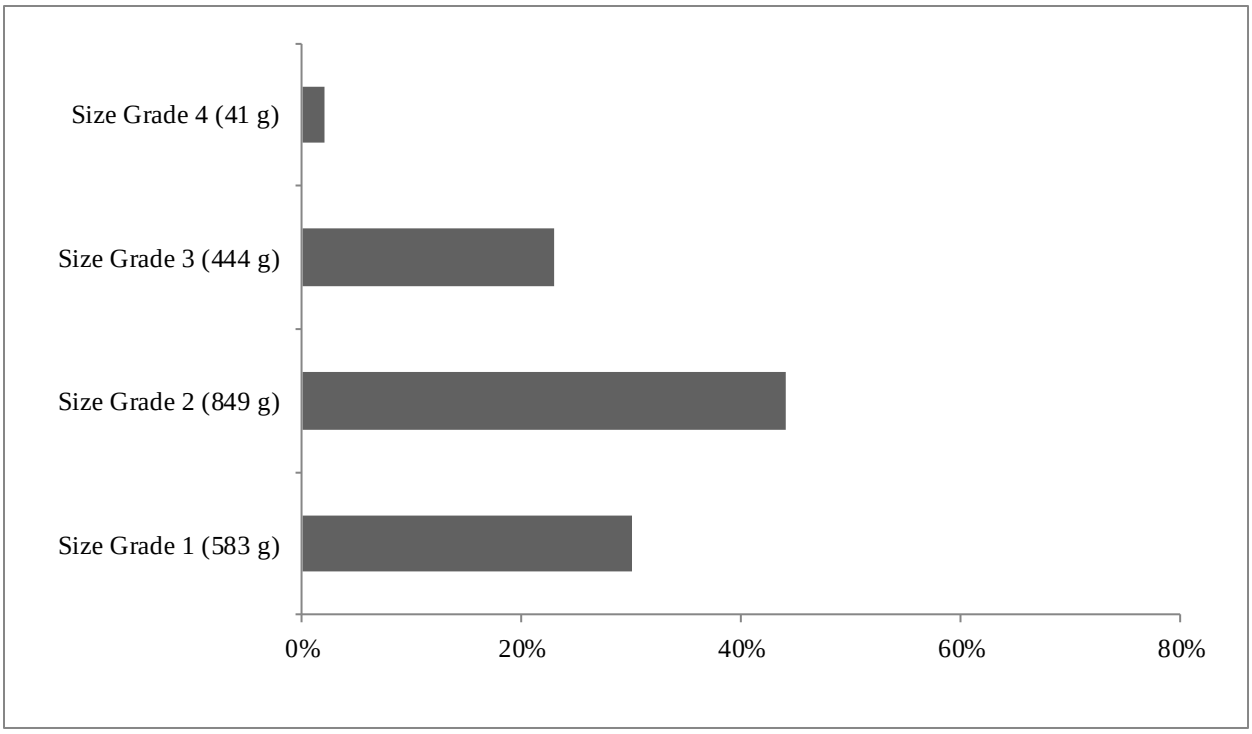


Figure 108. Unmodified Debitage Weight Distribution: Knapping Feature 6.

9.3 Minimum Analytical Nodule Analysis

Cody projectile points at MacHaffie are mostly broken and rejuvenated. These undesirable points were removed from their hafts and discarded. If fresh points were rehafted at MacHaffie, few if any were produced on-site. The projectile points and preforms assigned to MANA unit DAC1 (#22), BCCS27 (#13), and YBCCS4 (#s 24 and 26) have up to ten pieces of associated debitage, but no cores or tools (Table 41). The MANA unit designated BCCS38 (#21) has 18 associated pieces of debitage, two endscrapers, and two DEF/M. The MANA unit CCCS2 (#25) has 41 associated pieces of debitage and two bifaces. The MANA unit YBCCS30 (#23) has ten associated pieces of debitage and one biface. Because of the tremendous color and texture overlap of Madison Group cherts, identifying a source on visual characteristics is usually indefensible. It is likely that the chert comprising most of the debitage, non-hafted bifaces, and cores was largely collected from local sources. Conversely, projectile points were derived from materials collected at distant sources. Because points #s 29 through 31 are not available for study it is uncertain if they fall under any of the MANA units defined herein. Two of the three missing points (#s 30 and 31) are described by Forbis as "brown flint" which is consistent with the general pattern of brown and yellow-toned lithics among the specimens available for study. This may have been preferential, or it may reflect the dominant color texture ranges of the source. Lithic material reduced at MacHaffie, and refined elsewhere into projectile points, would trend in the bluish-gray to brown range.

Table 41. Cody Component MANA Units and Associated Artifacts.

MANA designation	projectile point/preform	cultural stone	hafted knife	endscraper	biface	core	DEF/M	debitage
BCCS1						1		0
BCCS2								6
BCCS3								2
BCCS4				1	1		1	10
BCCS5								1
BCCS6				2				4
BCCS8								2
BCCS9						1		18
BCCS12								1
BCCS15								1
BCCS16								1
BCCS18								1
BCCS19					1			3
BCCS20								2
BCCS21				1				44
BCCS23					2			1
BCCS27	1							6
BCCS28							1	37
BCCS29				1			1	19
BCCS31					1			1
BCCS32								1
BCCS33								1
BCCS34								1
BCCS37								1
BCCS38	1		1	2			2	18
BCCS39				1				0
BCCS41							1	83
BCCS42								1
BCCS43								4
BCCS44						1		4
BCCS46								10
BCCS47				1				0
BPCCS2								2
BPCCS5								3
CCCS1				1	2			22
CCCS2					2			41
CCCS3					1			88
CCCS4								2
CCCS5					1			1
CCCS6	1					1		126
CCCS7					6		2	74
CCCS8								28
CCCS9				1	1			6
DAC1	1							1
GBCCS5							1	0
GBCCS6								2
GBCCS10			1					0
GBCCS11								1
GBCCS14								2
GBCCS16								1

Table 41. Cody Component MANA Units and Associated Artifacts (continued).

MANA designation	projectile point/preform	cultural stone	hafted knife	endscraper	biface	core	DEF/M	debitage
GBCCS18					10		2	549+
GBCCS20					1	1		197
GBCCS36								1
GBCCS38								4
GBCCS39								5
GBCCS43								1
GRAN5								11
OBS1					1			2
OBS2								42
QTZCRY1								1
RCCS3								16
RCCS4								15
RCCS6								23
RCCS8								2
RCCS9								1
RCCS11								4
RCCS12								18
RCCS13								1
RCCS14								9
RCCS16								2
RCCS19								36
RCCS20					1			1
RCCS21								4
RCCS22								6
RCCS26								2
RCCS27								8
RCCS29								1
RCCS31								1
RCCS32								10
RCCS33								3
RCCS47								1
RCCS48								27
SDQZT2d							2	0
SDQZT4e							1	0
SDQZT5e								1
SLM4		1						0
WCCS1								3
WCCS4								2
WCCS5								26
WCCS6								2
WCCS8								3
WCCS10								1
WCCS11								7
WCCS12								1
WCCS15								4
WCCS18								2
YBCCS1a						1		9
YBCCS1b								1
YBCCS1d								8
YBCCS1e								1

Table 41. Cody Component MANA Units and Associated Artifacts (continued).

MANA designation	projectile point/preform	cultural stone	hafted knife	endscraper	biface	core	DEF/M	debitage
YBCCS2								3
YBCCS3								1
YBCCS4	2							10
YBCCS5								5
YBCCS7					1			3
YBCCS8								2
YBCCS11								2
YBCCS12								6
YBCCS15								3
YBCCS12								6
YBCCS15								3
YBCCS18								3
YBCCS21								1
YBCCS22				1				1
YBCCS23								1
YBCCS24								1
YBCCS28						1		1
YBCCS29								3
YBCCS30	1				2			10
YBCCS31								1
YBCCS33a								2
YBCCS35								4
YBCCS37								1
YBCCS38				1				0
YBCCS40								3
YBCCS42								2
YBCCS44								1
YBCCS45								2
YBCCS46								1
YBCCS50								6
YBCCS51								3
YBCCS52								3
YBCCS53								1
+includes Knapping Features 3, 5, and 6 debitage, sandstone abraders not included in the above counts								

Excluding the previously discussed Knapping Features 3, 5, and 6, debitage is more widely dispersed than formal tool types or cores (compare Figures 109 and 110). Cody materials were densely concentrated in the area investigated by Dick Forbis and others between 1947 and 1951. In contrast to the patterns observed among the Folsom component, more biface production was occurring. Although a wide color and texture range of chert was brought to the site, the majority is probably derived from the Palmer chert quarries ((24JF226 and 24JF879) 800 meters northeast of MacHaffie (Figure 3).

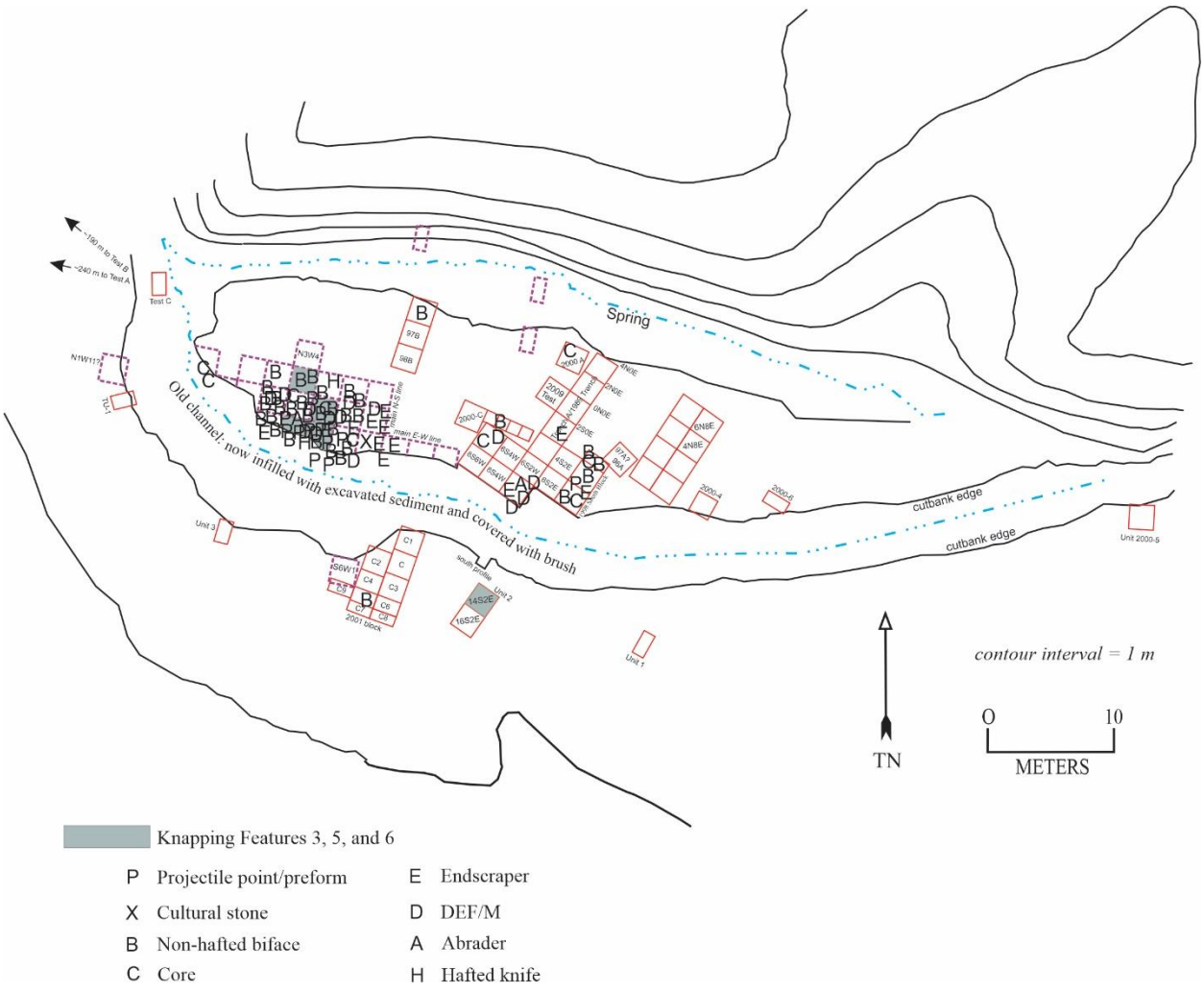


Figure 109. Distribution of Selected Cody Cultural Material in 24JF4.

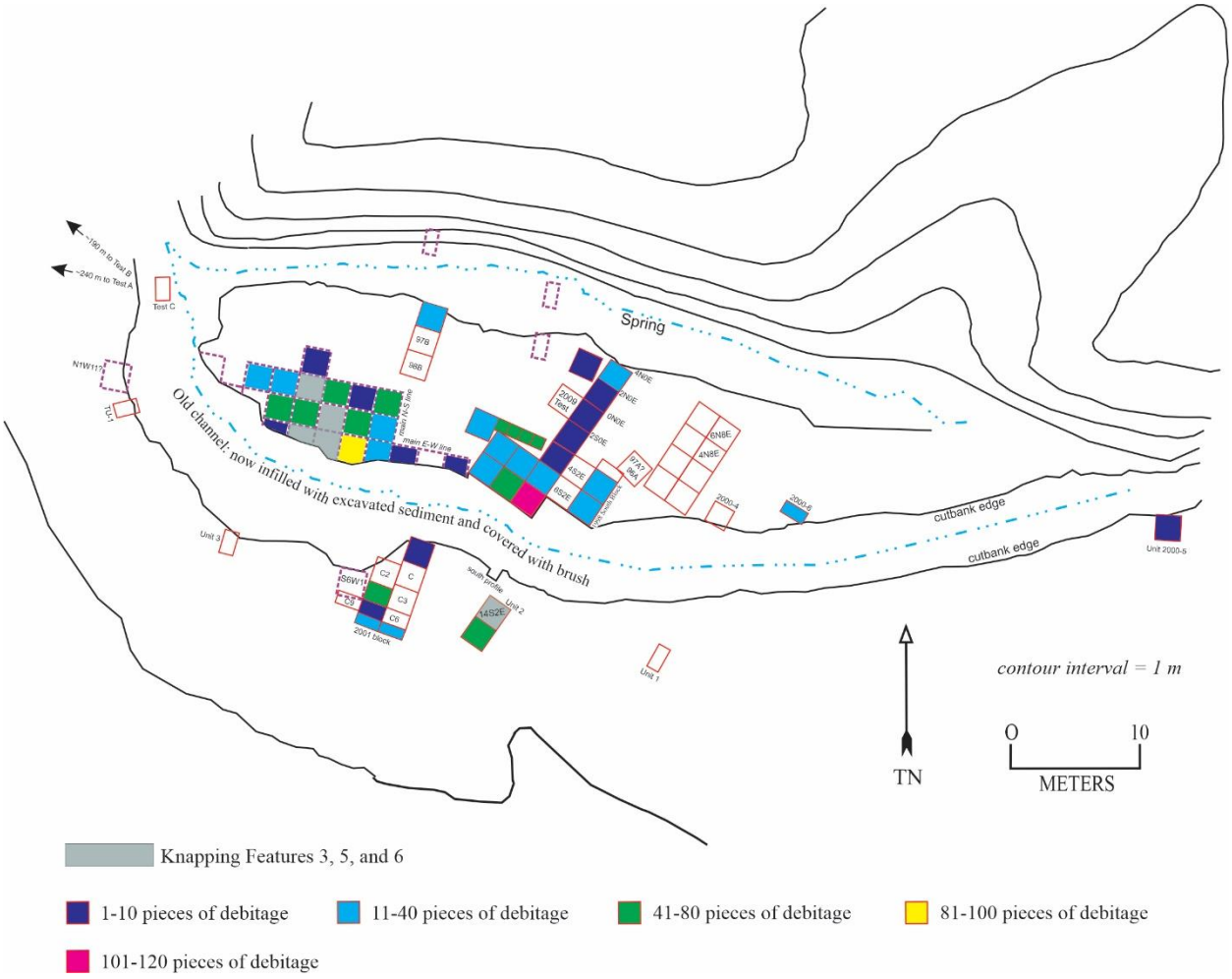


Figure 110. Distribution of Cody Debitage in 24JF4.

Non-hafted bifaces tend to cluster separately from unprepared, opportunistic (i.e., multi-directional) flake cores. Four of the unprepared cores of MANA units BCCS1, RCCS35, and YBCCS38 have no associated debitage. In contrast, all non-hafted bifaces have at least one piece of associated debitage. Eleven non-hafted bifaces and three cores are of MANA units that contain ten or fewer pieces of debitage. Two bifaces (#s 64 and 100) and one core (#8) were recovered in association with debitage of the same MANA designation. The number of non-hafted bifaces compared to debitage is greatly disproportionate. Either several of the bifaces were produced off-site and transported to MacHaffie or the Cody debitage is incomplete. In the latter instance more debitage may have been collected from 1947 to 2010 but was lost, misplaced, or discarded.

The presence of endscrapers suggests green-hide preparation or even woodworking was conducted in conjunction with flintknapping. Interestingly, neither hearth features nor FCR has been identified for the Cody component. Regional archaeological sites that contain endscrapers

often yield evidence of food processing. The Cody component at MacHaffie is an exception to the rule.

Spatial analysis of MANA units shows that non-hafted bifaces, cores, and projectile points clustered at the center of the 1951 excavation block. The majority of endscrapers (75%) and DEF/M (71%) extend easterly six meters beginning at the eastern margin of the artifact cluster (the Knapping Features 5 and 6 locality). This pattern suggests both contextual integrity of the Cody materials and a segregation of different activities.

Two endscrapers (#s 8 and 10) are of MANA units that have no associated debitage, tools, or cores suggesting that they were produced off-site and transported to MacHaffie. Similarly, there is so little debitage of the same MANA units as #s 4, 6, 11, 12, and 19 that it is unlikely these pieces were produced on-site. The remaining four endscrapers (#s 1, 2, 5, and 9) can be associated with debitage or other artifacts of the same MANA unit. This suggests they were produced on-site. None, however, was recovered from an excavation unit that produced debitage of the same MANA unit.

Six (#s 24, 14, 25, 26, 27, and 47) of the debitage with edge flaking or other modification (DEF/M) are of MANA units (BCCS4, BCCS29, CCCS7, and GBCCS18) that contain debitage and non-hafted bifaces or endscrapers. Two (#s 15-16) are of a MANA unit (BCCS38) that also contains debitage, two endscrapers, and one projectile point. The remainder of the chert DEF/M (n= 3) are of MANA units (BCCS28, BCCS41, and GBCCS5) that contain debitage but no other tool types or cores. In fact, none of the DEF/M are of the same MANA unit as an unprepared flake core. This suggests that most of the DEF/M were either derived from bifacial blanks on-site or from cores that were reduced off-site with selected flakes transported to MacHaffie. The three DEF/M of sedimentary quartzite spalls have no associated cores, tools, or debitage. These were likely produced from cobbles found off-site, then imported to MacHaffie as part of a toolkit.

A wider range and larger number of MANA units are assigned to the Cody component than the Folsom component. Still, only 25 percent (n=30) of those MANA units contain debitage and one or more tool type (including cores). Most assigned MANA units contain debitage but no associated tools or cores. In addition to a broader range of tool types, the Cody component shows a 70 percent increase in biface manufacture and a 60 percent decrease in the use of unprepared/multi-directional cores when compared to the Folsom component. Further, the Cody occupants appear more interested in bifacial quarry blank production, based on a lack of evidence for highly refined Stage III-IV bifaces. It also appears that many of the recovered bifaces were not produced on-site, and many were not refined before discard. The emphasis on mid-stage biface production among the Cody occupants is substantiated by a biface to core ratio of 3.4:1.

Off-site decortication and initial preparation of cores, as well as bifacial blank production, is further supported by the fact that 99 percent of the debitage exhibits no cortical remnants. Additionally, only three non-hafted bifaces (#s 9, 75, and 86) and three unprepared cores (#s 51, 93, and 94) exhibit a small amount of cortex.

While much of the lithic raw material associated with the Cody component is good quality toolstone, a persistent pattern is observed. Even though the MacHaffie site is surrounded by high quality chert sources, a small amount of what contemporary knappers would consider poor quality material was intentionally selected and reduced. Some of this lithic material produced little more than angular shatter. It is also worth mentioning that although the local siliceous granite (GRAN5) continued to be selected and reduced through percussion by Cody occupants, its presence is minimal (n=11 pieces of debitage) compared to that noted for the Folsom component. The GRAN5 debitage among the Cody component was not concentrated but rather uniformly spread across the site.

Of 132 assigned MANA units, only GBCCS18, GBCCS20 and CCCS6 were reduced intensively on-site. The associated tools and debitage suggest that early and mid-stages of bifacial reduction primarily occurred for these three MANA units. Knapping Feature 6, however, suggests reduction of an unprepared core. The intensive reduction work occurred in two distinct areas of the site—in similar locations as the Folsom knapping features. The three primary MANA units account for 872 pieces of random debitage (pieces not associated with Knapping Features 3, 5, and 6), three defined knapping features, 11 non-hafted bifaces, two unprepared cores, and two DEF/M. Flake blank production, a limited refinement of blanks and bifaces, removing and rehafting projectile points, shaping dart shafts, possible hide preparation or wood working, and limited food preparation (based on processed bison bone) characterized activities of the Cody occupants. Similar to that observed for the Folsom component, Cody occupation of MacHaffie was short and sporadic, likely occurring a limited number of times. So too, the Cody component suggests MacHaffie was a *location* as defined by Binford (1980:9). The evidence, when compared to available toolstone sources and regional biotic communities, do not show a distinctly *Core Area* or *nonregional land use strategy* (see Knell 2012:329). The best fit is a general nonregional strategy, at least while at 24JF4.

The overall similarity in cultural remains and represented activities between the Folsom and Cody component cannot be ignored. The observations set forth in Section 7.3 of this report are applicable here. The distinction is at a MANA level of analysis. The preferred chert source of the Cody occupants appears to be 24JF226. One or more of the nine quarries shown in Figures 3 and 68 were likely used secondarily. While popular with Folsom occupants, site 24JF881 does not appear to have been utilized by the Cody occupants.

10.0 EARLY TRANSITIONAL, MIDDLE, AND LATE PRECONTACT ARCHAEOLOGICAL CULTURES POSSIBLY RELEVANT TO THE MACHAFFIE SITE

The upper colluvial sediment block (upper 110 +/- cm of sediment) contains an unsortable mixture of Early Transitional, Middle, and presumably Late Precontact Period artifacts. Forbis (1955:8) following Witthoft (1952), defines the term “component” as “A local precisely defined unit of culture”. A unit of culture being the “remains from a set of nearly identical sites”. Based on these definitions, we are uncertain why Forbis coined the term “Helena Component” when he was aware that the colluvium contained mixed deposits

representing what he saw as "…an extension of the Woodland-like cultures of the Plains and Prairies [but] …pottery, ground stone, and bone artifacts… do not occur in the Helena component (Forbis 1955:125)". Forbis (1955:128) also contended that the overall size of the Helena Component projectile points excludes them from being arrow points. For consistency we will also use the term "Helena Component" to discuss the mixed Early Transitional, Middle, and Late Precontact remains at MacHaffie. This term is restricted to MacHaffie, however, and should not be applied to other sites where similar mixed components are present.

Mixing of Helena Component materials is partially the result of artifact seekers who visited MacHaffie after 1951. It is also related to continuous burrowing by insects and small mammals such as pocket gophers, ground squirrels, meadow voles, and rabbits. The remains of which have been recovered from MacHaffie and do not appear to be culturally utilized. Burrowing insects, root action, and the annual freeze/thaw cycle also play a part. Greater stability of the alluvium containing the Folsom and Cody materials likely reflects different environmental factors.

Chronometric dates have not been obtained for the Helena Component. The projectile point styles suggest that the archaeologically defined cultures of the Early Transitional and Middle Precontact Period known as Angostura, Bitterroot/Salmon River, Oxbow, McKean, and Pelican Lake are represented, and possibly some undifferentiated Prairie/Plains Complexes of the Late Precontact as well (Fig. 111). The colluvium is thickest in the east portion of the island investigated from 1989 through 2018. There it ranges from present ground surface downward approximately one meter to 110 cm BS. This same deposit was documented in 1951 to be shallower in the western portion of the island. There, deposits extended downward to a maximum of 60 cm BS. Forbis recognized the recovered projectile points to stylistically post-date Paleo-Indian points stating that the Helena Component represents "… a period lasting from approximately 4,500 years ago to present (Forbis 1955:128)". The mixing of chronologically distinct projectile point styles throughout the colluvium reinforces the suggestion that the culture bearing deposit has been so thoroughly churned that no contextual integrity of the various contributing cultural components remains (Forbis et al. n.d.:149). Without reliable dated contexts the time periods and archaeological cultures of the Helena Component are largely speculative and based exclusively on projectile point typology.

11.0 THE "HELENA COMPONENT" IN THE MACHAFFIE SITE

Cultural remains recovered from the colluvium are lumped together and analyzed as a single collection designated by Richard Forbis as the "Helena Component". It is characterized by inseparable "Neo-Indian" occupations (Forbis 1955). Detailed descriptions of the various artifact classes and faunal resources of the Helena Component are presented hereafter. Table 44 provides a summary by count and weight of all cultural material assigned to the Helena Component. This includes both excavated items and surface finds. In total, 10,908 items with a combined weight of 37.6 kg (83 lbs.) are documented.

Figure 111. Middle to Late Precontact Projectile Point Types Possibly Relevant to 24JF4.

Table 42: Summary by Count and Weight of Helena Component Cultural Material.

	Cultural Material Categories												
	Cultural Stone	FCR	Bone	Core	Unmodified Debitage	DEF/M	Endscraper	Biface	P.P.	Drills/ Awls	Burins/ Gravers	Spokeshave	Total
Count:	0	12	474	61	10,197	23	7	98	31	0	3	2	10,908
%Total #:	0%	<1%	4%	<1%	93%	<1%	<1%	<1%	<1%	0%	<1%	<1%	100%
Weight (gms):	0	1,253.0	1,276.5	8,894.9	24,008.2	258.4	67.2	1,779.9	92.6	0	5.3	6.2	37,642.2
%Total #:	0%	3%	3%	24%	64%	<1%	<1%	5%	<1%	0%	<1%	<1%	100%

Abbreviations: FCR- firecracked rock; DEF/M- debitage with edge-flaking or other edge modification; P.P.- Projectile point

11.1 Faunal Remains (see Appendix 7)

Forbis et al. (n.d.:161) state that "Most of the bone from the Helena layer was fragmented and highly de-composed. The only identifiable specimens were two teeth of bison, species undetermined. Some unidentifiable fragments of long bones were charred". Further, "No faunal remains other than bison have been identified for the Helena Component (Forbis 1955:140)". In addition to the occasional occurrence of small burrowing rodent remains, a largely complete snake spine was recovered at an approximate depth of 49 cm BS in unit S1/W5. This, too, appears to be a natural occurrence. Probably a snake that died inside a rodent burrow.

Greiser (2022) examined 474 complete bones and fragments weighing a combined total of 1,276.5 grams (Table 42). Identifiable species include: Bison (*Bison bison*), mountain lion (*Puma* (formerly *Felis*) *concolor*), mule or white-tailed deer (*Odocoileus* spp.), beaver (*Castor canadensis*), jack-rabbit or snowshoe hare (*Lepus* spp.), rabbit (*Sylvilagus* spp.), ground squirrel (*Urocitellus* spp.), and vole (*Arvicolinae* spp.). Whereas bison and probable bison bone pieces contribute 53 percent by count (86% by weight), medium-size ungulate bones are restricted to a deer (*Odocoileus* spp.) lower 1st molar (#272), astragalus (#211) and tibia and humerus fragments (#330, #323). The deer remains are partly or wholly from a sub-adult and may represent a single individual entirely. Definite carnivore remains are limited to a mountain lion (*Puma concolor*) patella (#159) recovered from the 98 South Block (Figure 8) by Les Davis at a depth of 10-20 cm BS. Other medium or small mammals could be represented but they could not be positively identified.

Eighty-one percent of the bone by count and 39 percent by weight is considered "scrap". Presumably these pieces formed through intensive pulverization subsequent to subjection to stone boiling. These pieces are too small to positively identify skeletal element or genus and species. To illustrate the small size of the scrap pieces, six are size-grade 1, 68 pieces are size-grade 2, and 265 are size-grade 3. The majority is probably from large or medium ungulates, and probable represent only one or two animals per species utilized by humans.

Identifiable bison skeletal elements include skull fragments (n=14), a horn core tip, an

anterior portion of mandible, an incisor, three molars, a pre-molar, a lumbar vertebra fragment, an acetabulum, a possible scapula blade fragment, tibia fragments, a metatarsal, an astragalus, a 1st phalange, and a navicular cuboid. Beyond the intentional comminution, evidence of butchering is the green breaks on only a few pieces (e.g., #s122, 240, 241). At least two individuals are represented with one being a sub-adult and the other being an adult.

More small mammal bones occur in the Helena Component perhaps because the colluvium is closer to the ground surface, or because they are not as old as the Cody and Folsom age faunal remains and preservation may be better. There is no evidence to suggest that these remains were utilized as a food source by human occupants of the MacHaffie site. The remains most likely represent individuals that occupied burrows excavated into the cultural occupation levels in which they later died.

Bones from two *Arvicolinae* rodents recovered from these levels include a right mandible with an incisor (#130), a second right mandible (#131), and right femur. A ground squirrel pelvis and femur (#214) are too deteriorated to identify species or side.

A mandible (#149) and a single metatarsal (#148) of what is likely a hare, are either from a white-tailed jackrabbit or a snowshoe hare. Remains representing as many as six either desert or mountain cottontails were recovered from the Helena levels. These include a nearly complete skeleton (#228), two mandibles (#9 and #145), and two tibias (#225 and #229), from as many as three individuals.

A large beaver incisor enamel fragment (#259) was recovered from XU S1/W4, Level 4, 50-60 cm BS. It is possible that this incisor fragment comes from the same individual as the large beaver incisor fragment (#260) recovered from XU S1/W3, Level 6, 80-90 cm BS – currently identified as a level of the Cody component. Both units were excavated by Forbis in 1951. The beaver incisor fragments may indicate their use as tools. While there is wear at the ends of the incisors, it is unclear if it is natural or cultural.

In addition to the small mammal remains, 19 snake vertebrae were located in XU S1/W5. The partial excavation unit was situated along the edge of the drainage channel in 1951 (Figure 8). A comparative skeleton was not located to help identify the snake to species.

The Helena Component shows a pattern in faunal usage at the MacHaffie site that is consistent over time. Little in the way of animal processing occurred there. The few animals probably translocated to the site for food or other resource procurement consist of selected portions of one or two bison. A similar number of smaller ungulates and small and medium-size carnivores are also represented. Green bone fractures and a large percentage of small bone fragments implies meat and soft tissue removal followed by bone comminution. Presumably these small bone pieces were subsequently subjected to stone boiling for further processing. Identifiable skeletal elements of probable or definite cultural affiliation are nearly equally represented by skull pieces (n=16) and lower leg bones (n=14) while upper leg and axial skeleton fragments are represented with six pieces total. Further, skeletal sides are equally represented.

11.2.1 Lithic Material Culture

Firecracked Rock (Table 42; Figures 112 and 113)

Although unclear if FCR was identified in 1951, Forbis (1955:45) observed:

> In squares N2/W1 and N2/W2, three groupings of granitic stones were found in no apparent order. The largest stone was 7-8 inches long. Many projected above the surface, resting on the humus level. None was stained by charcoal, but many were broken angularly, probably as a result of having been used in stone-boiling, perhaps in cooking or in sweat-bathing.

Twelve pieces of FCR weighing 1.25 kg are documented as associated with the Helena Component. In marked contrast to Folsom component granite FCR, the Helena Component FCR is sedimentary quartzite. Five pieces of heat spalled FCR and seven pieces exhibiting water fracture were recovered. Interestingly, the majority (n=11) of these pieces were recovered from the 0-20 cm BS depth in excavation units 98-South Block, 2000-C, and 6S/6W. Unit 8S/6W contained a single piece of heat spalled FCR (53 g) at the 70-80 cm BS depth. The majority of the FCR is smaller than 5 cm in maximum dimension. All were randomly scattered and none are associated with a recognized heating or cooking facility or a discrete cultural component. As noted for the Folsom and Cody components, on-site heating or cooking activities were negligible among Middle and Late Precontact occupants of MacHaffie.

Abraded Stone/Ground Stone (Table 42)

No abraded or ground stone items, including hammerstones, were recovered in association with the Helena Component.

Projectile Points (Tables 42 and 43; Figures 114 and 115)

Archaeological research in sites with good contextual integrity and dateable cultural materials provides the basis for understanding cultural continuity and change. One artifact type that does show predictable stylistic change over time is the projectile point. Discrete designations are assigned to distinct projectile point styles that fall within specific temporal parameters. Forbis (1955) and Forbis et al. (n.d.:151-154) assign terms to projectile points of the "Helena Component" that are neither used in current northern plains typological schemes (e.g., Youngs Point, Ellis Point), nor elsewhere outside of MacHaffie (i.e., Helena Styles 1-3 and Helena Forms 1-3). Forbis' designations are abandoned here in favor of contemporary projectile point types.

The oldest projectile point style recognized among the Helena Component is suggested here to be "Angostura" (Fig.116.11), but that is speculative without a dated context. The Angostura point appears in the Southern Plains ca. 9,880 to 8,880 BP (Anderson 2013:196-199) and in the northern plains ca. 8,100 to 5,500 BP (Borchert 1989: 76). The point style slightly predates and overlaps the terminal Paleo-Indian transition to the Middle Precontact Period. It is

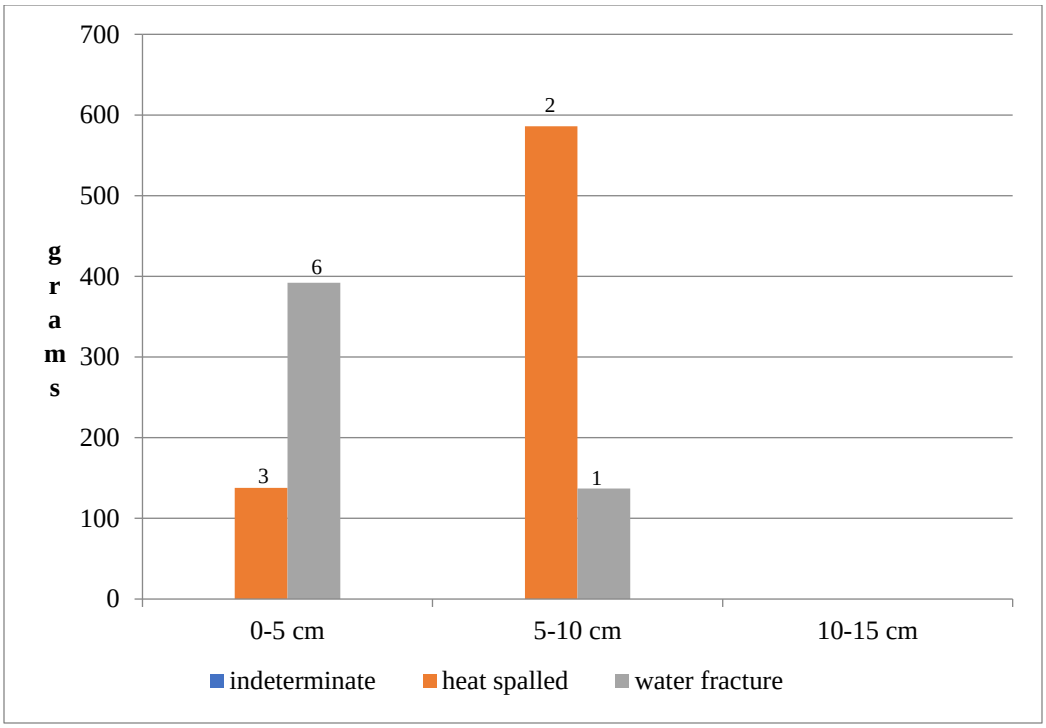


Figure 112. Counts and Weights of FCR per Size-Range and Fracture Type.

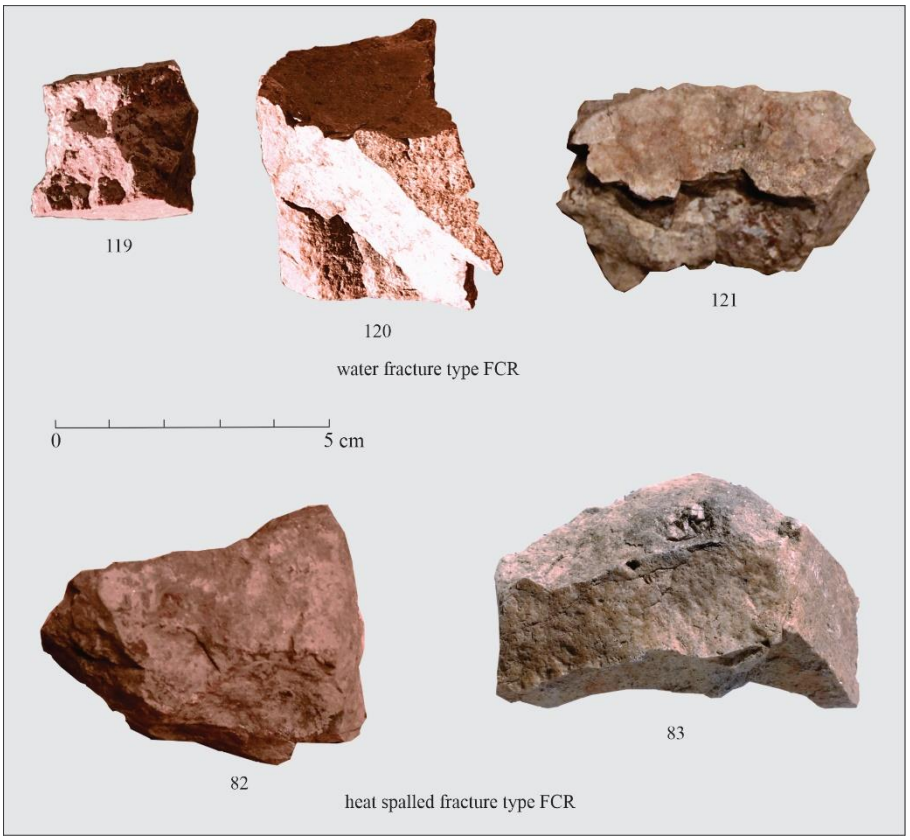


Figure 113. Water Fractured and Heat Spalled FCR Types: Helena Component.

Table 43. Metric, Nonmetric, and Provenience Data for Helena Component Projectile Points.

Record #	Excavation Unit	Excavated Level Depth	CMU	Lithic Material Code	Condition	Preform	Type	Flaking Pattern	Cross Section	Outline Symmetry
1	2000-5	0-20 cm BS	4	CCCS3	body-base	flake	small side-notched	irregular	bi-plano	indeterminate
2	2000-B	40-60 cm BS	4	YBCCS9	complete	indeterminate	Pelican Lake?	irregular	bi-convex	symmetrical
3	4S/0E	30-40 cm BS	10	CCCS3	tip	flake	indeterminate	edge modified	bi-plano	symmetrical
4	96-West Test	0-10 cm BS	6	BCCS41	complete	flake	Late Period?	edge modified	bi-plano	symmetrical
5	4S/0E	30-40 cm BS	10	OBS2	complete	indeterminate	Pelican Lake?	irregular	bi-convex	symmetrical
6	4S/0E	50-60 cm BS	10	CCCS3	complete	indeterminate	Pelican Lake?	irregular	bi-convex	symmetrical
7	Unit 1	40-50 cm BS	7	RHY2	body-base	indeterminate	Pelican Lake?	irregular	bi-convex	symmetrical
8	Unit 1	40-50 cm BS	7	YBCCS18	complete	indeterminate	Pelican Lake?	irregular	bi-convex	symmetrical
9	6S/4W	30-40 cm BS	9	BCCS15	complete	indeterminate	Hanna	irregular	bi-convex	asymmetrical
10	4S/0E	20-30 cm BS	10	BCCS19	complete	flake	indeterminate	edge modified	plano-convex	asymmetrical
11	4S/0E	60-70 cm BS	10	SDQZT5f	complete	indeterminate	Angostura	irregular	bi-convex	symmetrical
14	2N/0E	10-20 cm BS	10	BCCS27	body-tip	flake	indeterminate	irregular	bi-convex	asymmetrical
15		surface	1	YBCCS40	complete	indeterminate	Plains side-notched	irregular	bi-convex	symmetrical
16		Surface	1	BCCS1	complete	flake	Oxbow	irregular	plano-convex	symmetrical

Type of Notching	Notch Shape	Basal Edge Shape	Fracture Type	Basal Edge Height	Base Height	Base Width	Shoulder Height	Shoulder Width	Neck Width	Neck Thickness	Notch Width	Notch Depth
side	small oval expanding	concave		3	4.1		6.1			3.1	1.8	2.3
corner	small oval expanding	round-deep	N/A	2.1	5.2	2.5	6.2	6.7	10.01	3.6	5.3	2.9
N/A			transverse									
corner	small oval expanding	straight		1.87	5.87	8.52	5.29	14.16	7.93	3.46	4.74	2.48
corner	small oval expanding	convex		2.4	6.57	16.45	7.12	19.11	12.59	4.33	4.62	3.31
corner	small oval expanding	convex		2.18	6.46	12.86	6.5	17.16	9.54	3.47	3.8	3.4
corner	small oval expanding	concave	transverse	2.47	6.02	13.03	6.21	21.82	11.85	4.12	6.29	3.38
corner	small oval expanding	convex		4.18	6.81	14.02	7.14	18.79	12.8	3.1	3.7	2.95
corner-removed	large oval expanding	concave		2.34	7.69	13.65	9.17	20.6	10.97	4.25	7.4	3.96
corner	round-shallow	concave		1.9	7.46	15.96	9.2	21.89	16.09	6.83	9.72	1.54
N/A		concave			17.38	10.1	17.38	19.97	14.21	4.78		
N/A			transverse									
side	small oval expanding	straight		4.5	5.5	13.6	8	12.4	8.3	2.3	3.1	2.7
side	round-shallow	concave		5.01	11.74	23.12	13.1	28.47	20.87	6.13	8.11	2.28

Body Length	Max. Body Thickness	Max. Length	Basal Notch Depth	Basal Notch Width	Hafted Retouch Index	Weight (grams)	Comments
11.1	3.1	15.3			N/A	4.7	Partial Late Period point pressure flaked into the lateral margin of a scondary reduction stage flake (SG2) with a flat platform.
17.5	4.2	20.19			0	1.3	Probably P.Lake, but arrow point-size
					N/A	0.4	Probably arrow point-size
17.34	3.34	22.38			0	1.1	Arrow point-size, but uncertain whether it is a Prairie/Plains variant or Pelican Lake point.
23.06	4.84	30.2			0	2.35	XRF Sample O-11 (2018)
23.73	3.94	30.44			0.5	1.65	
	4.33				0	3.2	
20.02	3.85	28.36			0.375	1.55	
18.2	5.43	26.34			0.751	2.95	Appears to be heavily re-sharpened. Re-sharpening likely gave the point its asymmetry.
35.2	7.66	43.28			0	7.65	Stylistically non-descript. Uncertain if the artifact was completed. The blade curves sightly toward the tip on one side. Possibly intended as a hafted knife.
21.71	6.06	35.44			0.875	4.15	Heavily re-sharpened. Beveled base may be slightly ground along margin.
	2.47				N/A	0.7	Arrow point-size. Probably broke during manufacture. Tip is curved on one side.
16.1	2.4	22.3			0	0.75	
23.08	7.94	37.1	2.75	10.42	0.875	9.25	Heavily re-sharpened so that the tip is more rounded than pointed. Impact burination scar remnant on interior surface at distal end. Found by Pamela Bompart in 2003 on ground surface (trail surface) approx. 20 m NW of Forbis' 1951 excavation block.

projectile point measurements are in millimeters

Table 43. Metric, Nonmetric, and Provenience Data for Helena Component Projectile Points (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Lithic Material Code	Condition	Preform	Type	Flaking Pattern	Cross Section	Outline Symmetry
32	N1/W7	0-12 cm BS	11	YBCCS41	complete	flake	Hanna	irregular	plano-convex	symmetrical
33	N2/W3	0-5 cm BS	11	YBCCS4	body-base	indeterminate	Hanna	irregular	bi-convex	symmetrical
34	S1/W1	0-12 cm BS	11	RCCS2	complete	biface	indeterminate corner-notched	irregular	bi-convex	asymmetrical
35	N1/W2	0-10 cm BS	11	YBCCS4	complete	flake	Pelican Lake?	irregular	bi-convex	symmetrical
36	N2/W1	12-16 cm BS	11	YBCCS55	complete	flake	Pelican Lake?	irregular	bi-convex	symmetrical
37	N1/W1	30-32 cm BS	11	BCCS18	complete	flake	Pelican Lake?	irregular	plano-convex	asymmetrical
38	N1/W3	0-10 cm BS	11	GBCCS19	complete	biface	Pelican Lake?	irregular	bi-convex	symmetrical
39	N2/W1	15 cm BS	11	RCCS21	body-base	flake	Pelican Lake?	irregular	bi-convex	symmetrical
40	N2/W1	0-10 cm BS	11	GBCCS18	complete	flake	Pelican Lake?	irregular	plano-convex	symmetrical
41	N2/W1	10-15 cm BS	11	CCCS2	complete	flake	Pelican Lake?	irregular	bi-convex	symmetrical
42	N2/W1	6 cm BS	11	CCCS7	complete	indeterminate	Pelican Lake?	irregular	bi-convex	symmetrical
43	N2/W1	15-20 cm BS	11	GBCCS18	complete	indeterminate	Prairie/Plains side-notched	irregular	bi-convex	symmetrical
44	S1/W4	8-12 cm BS	11	OBS1	base	indeterminate	Duncan/Hanna	irregular	bi-convex	N/A
45	N5/W3	0-5 cm BS	11	DAC1	body-tip	indeterminate	indeterminate atlatl-size	irregular	bi-convex	N/A
46	S1/E4	15 cm BS	11	BCCS21	tip	biface	indeterminate atlatl-size	irregular	bi-convex	N/A
47	N2/W4	6-12 cm BS	11	YBCCS8	complete	indeterminate	Oxbow	irregular	bi-convex	symmetrical
48	S1/E2	0-15 cm BS	11	GBCCS36	body-tip	biface	indeterminate	parallel	bi-convex	indeterminate

Type of Notching	Notch Shape	Basal Edge Shape	Fracture Type	Basal Edge Height	Base Height	Base Width	Shoulder Height	Shoulder Width	Neck Width	Neck Thickness	Notch Width	Notch Depth
corner-removed	N/A	concave	N/A	2.24	10.18	17	12.29	24.83	16.14	5.85	13	2.55
corner-removed	N/A	concave	transverse	1.44	11.47	17.95	12.9	27.26	16.04	5.62	11.91	4.19
corner	indeterminate	straight	N/A	2	7.8	13.65	10.9	15.44	13.35	3.91	6.5	2.59
corner	large oval expanding	convex	N/A	3.09	7.95	17.11	8.92	21.21	12.9	3.42	4.99	4.31
corner	round-shallow	convex	N/A	2.85	7.87	13.29	9.1	16.25	11.93	3.44	5.17	2.89
corner	small oval expanding	straight	N/A	5.05	12.19	23.7	12.22	24.25	17.04	4.86	7.74	4.9
corner	small oval expanding	concave	indeterminate	5.1	6.44		8.7	23.14	12.79	3.16	5.55	2.69
corner	small oval expanding	straight	impact	3.35	5.9	16.36	6.32	19.87	13.66	2.9	3.58	2.63
corner	small oval expanding	convex	N/A	3.12	5.77	16.57	7.99	17.33	12.93	3.83	4.06	2.61
corner	large oval expanding	convex	N/A	2.39	6.09	12.72	6.37	17.87	9.71	2.89	4.41	3.15
corner	small oval expanding	convex	N/A	4.2	7.83	14.05	8.57	20.07	12.83	3.97	5.44	2.79
side	small oval expanding	concave	impact	4.16	7.81	18.98	7.46	18.26	11.13	3.86	3.76	3.76
corner-removed	N/A	concave	indeterminate	1.8	10.08	14.98	11.39		14.71	5.77		
N/A	N/A	N/A	bending									
N/A	N/A	N/A	transverse									
side	round-shallow	deeply concave	impact	4.3	7.5	18.2	8.8	18.8	16.2	3.3	6.2	1.7
N/A	N/A	N/A	transverse									

Body Length	Max. Body Thickness	Max. Length	Basal Notch Depth	Basal Notch Width	Hafted Retouch Index	Weight (grams)	Comments
24.2	5.28	36.19			0.312	6.84	Forbis artifact #1707
	5.75				N/A	8.96	Forbis artifact #1731
10.28	4.25	19.35			0.562	1.55	Forbis artifact #1718
25.14	4.64	34.13			0	2.94	Forbis artifact #1715
17.64	3.39	25.33			0.312	1.51	Forbis artifact #1728
34.76	4.91	46.85			0	6.19	Forbis artifact #1712
22.56	4.82	29.97			0.625	3.69	Forbis artifact #1714
	3				N/A	1.24	Forbis artifact #1726
13.27	3.07	21.47			0.437	1.42	Forbis artifact #1729
11.7	3.59	17.72			0.751	0.9	Forbis artifact #1727; heavily re-sharpened.
18.87	4.34	26.57			0.251	2.19	Forbis artifact #1724
17.4	5.1	23.24			0.251	2.36	Forbis artifact #1725; impact burination fracture removed portion of tip.
					N/A	1.49	Forbis artifact #1723; XRF Sample # O-15
	3.65				N/A	1.82	Forbis artifact #1711; XRF Sample # D-30
	5.93				N/A	2.62	Forbis artifact #1701; likely broke during manufacture; some cortex on both surfaces.
17.2	4.2	26.1	3.2	15.1	0.625	2.77	Forbis artifact #1732; missing distal portion of tip.
	5.1				N/A	2.41	Forbis artifact #1704

projectile point measurements are in millimeters

Figure 114. Projectile Points and Fragments Assigned to the "Helena Component" (1).

Figure 115. Projectile Points and Fragments Assigned to the "Helena Component" (2).

generally believed that climatic drying and warming began at the end of the Pleistocene reached its zenith at the time the lanceolate projectile point gives way to a series of side, corner, and side/corner-notched projectile points. This period of conjectured drought conditions is referred to as the Altithermal, Hypsithermal, or Climatic Optimum and is believed to have persisted until ca. 5,000 BP when wetter and cooler conditions were established. During the Altithermal, human occupation of the northern plains appears to have been reduced. This is inferred because of a paucity of archaeological sites from this time, and many of those occur in the mountains and foothills (Buchner 1983, Reeves 1973, 1979).

Angostura at MacHaffie is represented by a single specimen (Fig.116.11) recovered in 1989 in unit 4S/0E. This is both the oldest recognized and the most deeply buried (60 to 70 cm BS) projectile point recovered from the colluvium, but contextual integrity is lacking. Chronometric placement suggests it likely post-dates the most recent C-14 date of 7,905 ±435 BP that correlates to the upper extent of the alluvium (Figure 16). That time frame is consistent with other northern plains terminal Angosutra dates (or some variant as defined by other researchers). At MacHaffie we cannot confidently associate any other artifact with this projectile point.

The Angostura-like point is made from a beige, fine-grained sedimentary quartzite (MANA unit SDQZT5f). Flaking is parallel-oblique trending upper left to lower right on the rejuvenated blade. There the flaking travels fully across the blade. The base exhibits the original flaking pattern and shows horizontal parallel flake removals that terminate at the mid-line. The base is slightly constricted and slightly concave. The proximal margin is slightly beveled, and the basal margins may be lightly ground, but this is not certain. Detailed metric data are listed in Table 45. Visual characteristics and a HRI value of 0.875 suggest that the piece was heavily resharpened, probably in its haft after the point broke. The rejuvenated point was likely transported to MacHaffie in its haft, removed, discarded, and replaced with a freshly made projectile point. It has a base width of 15.96 mm, shoulder height of 9.2 mm, shoulder width of 21.89 mm, neck width of 16.09 mm, neck thickness of 4.78 mm, maximum thickness of 6.06 mm, an overall length of 35.44 mm, and it weighs 4.15 grams.

Although they did not distinguish among Paleo-Indian projectile point types, Deaver and Deaver (1986:81) observed that 36 percent in the Bureau of Land Management's collection from southwestern Montana that are stylistically classifiable as Late Paleo-Indian, are of chert/chalcedony, seven-percent are of obsidian, and half are of basalt (presumably very fine-grained dacite). Neither the Angostura point nor the Cody points from MacHaffie conform to that pattern. Lithic raw material preferences observed in the Deaver and Deaver (1986) study for southwest Montana Paleo-Indian projectile points are also inconsistent with that observed in SU-1 in the Myers-Hindman site in the upper Yellowstone River valley (Lahren 1976:60).

The "Angostura" name was coined by Richard Wheeler (1954a), but the type was originally designated "Long" by Jack Hughes (1949) for the point style he described from the Ray Long site (39FA65) in South Dakota. Wheeler (1995:415) and Pitblado (2003) describe the Angostura type as covering a wide range of morphological styles around a lanceolate form. They can be slender to slightly ovoid, thin or relatively thick, and they can have straight to concave bases. Some are straight sided, some exhibit constricted bases. Flaking can be parallel

oblique or collateral. Lateral margins of the bases tend to be ground. Cross-sections range from biconvex, to plano-convex, to "twisted".

Irwin (1968) named the Angostura points at the Betty Green and Hell Gap sites "Lusk", and what he deemed to be another variant in the Hell Gap site as "Frederick". Husted (n.d.) refers to Angostura points with inward tapering lateral basal margins from the Big Horn Canyon area as "Lovell Constricted". Pettipas (1985) named similar points in Saskatchewan as Late Sister's Hill (Pettipas 1985). In Manitoba they have been identified as Manitoba Points and Caribou Lake complex (Pettipas 1985; Buchner 1983). In Alberta, Cowley Stemmed and Castle River Stemmed were identified as distinct types (Pettipas 1985; Van Dyke 1994). At site 24MA171, in southwestern Montana, Davis et al. (1988) named the Alder and Hardinger complexes with their respective Ruby Valley and Metzal point types. Kelly (1983) promoted hyphenated projectile-pointism (e.g., Texas-Angostura, Victoria-Angostura, and Zella-Angostura) for minor morphological differences he observed throughout Texas collections. Other researchers focused on quantitative and chronological analysis and concluded that despite morphological variability around the general lanceolate shape, only a single Angostura type should be recognized (Borchert 1989; Kerr and Dial 1998; and Thoms 1993). Chronometric placement suggests that these point types were temporally coeval with, and slightly more recent than Cody. We are inclined to include these state and provincial "variants" under the Angostura point type and drop the other names from use. As a side note, a temporally coeval projectile point with parallel-oblique flaking and a generally deeply concave base called "James Allen" appears to us to be sufficiently distinctive from Angostura to warrant it a distinct type.

During River Basin Surveys work in the Big Horn Canyon area, Husted (1969:81-97) observed that the frequency of Pryor Stemmed and Lovell Constricted points implied a localized culture of the Pryor and Big Horn Mountains and their foothills. We concur that Pryor Stemmed is a sufficiently distinct and geographically restricted style so it deserves a type assignment. However, Lovell Constricted points share so much stylistic overlap with Angostura that we include these under the Angostura rubric. A similar notion of a "Mountain-Plains" culture had been suggested even earlier for southeastern Idaho and southwestern Montana (Swanson 1962:155). The Plains-Mountain complex was defined by Reeves (1972, 1973, 1979) following what he observed as a modification to bisoncentric subsistence strategies ca. 10,000 to 7,800 BP by at least some Plains-oriented groups. Reeves sees diversification of food economies, altitudinally structured with summer bison and sheep hunting in upper mountain valleys, then fall to spring bison and sheep hunting along the mountain front. Both hunting strategies were supplemented with smaller game animals and plant resources. Greater use of these ecotonal margins separating the plains from the mountain front presumably offered a broader range of hunting, fishing, and trapping opportunities. The complex is very similar, if not identical, to the concept of the Foothill-Mountain Complex proposed later by Frison (1991). Both complexes are largely characterized by previously mentioned lanceolate and slightly stemmed projectile point forms that constitute what we have lumped together as "Angostura" and Pryor Stemmed (Frison 1978:37; Husted n.d., 1969:13-14). Most of the data is from undated surface finds or shallowly buried deposits that lack contextual integrity. Future work may indicate the appropriateness of assigning sub-units to the Plains-Mountain/Foothill-Mountain complexes. While we do not argue against increased resource diversity exploitation during the Hipsithermal, we are not

comfortable limiting highly mobile nomads to one ecotone or another. Further, many of the sites where Angostura points occur in a stratified or dated context are on the prairies. As can be seen in Figure 34, archaeological evidence suggests Folsom and Cody peoples occupied the mountains and foothills of Montana more frequently than the open prairies where they are generally associated. Even the MacHaffie site is in a mountain foothill setting. Most Angostura or Agate Basin points found in Montana are out-of-context surface finds or found in mixed depositional contexts (Rennie 2017). Davis and Helmick (1982) and Greiser (1986) reported on a large collection of artifacts from the Canyon Ferry Reservoir area near the MacHaffie site. Several Agate Basin-like or Angostura-like points were found on lake-bed surfaces when the water levels dropped, but contextual integrity is lacking.

The relationship between Angostura and morphologically similar, but chronologically earlier and overlapping, Agate Basin points is unclear. Similarly, the relationship among Agate Basin, Angostura, and the stylistically and temporally similar Humboldt and earlier Pinto Basin points from the Great Basin and Southwest United States is also unclear. Layers 8-14 in Mummy Cave (Husted and Edgar 2002) produced Agate Basin points exclusively with corresponding dates of 8,740 ±140 BP (Layer 10), 8,100 ±130 BP (Layer 12), and 7,970 ±210 BP (Layer 14). Surprisingly, corner-notched, McKean (Duncan)-like points, and Agate Basin style points were recovered from SU-1 in Myers-Hindman. This particular "Settlement Unit" produced radiocarbon dates of 9,400 ±200 BP, 8,540 ±190 BP, and 6,740 ±240 BP (Lahren 1976). Agate Basin style points have been dated in the Alder Complex of the Barton Gulch site (24MA171) at approximately 9,400 BP (Davis et al. 1988, 1989). Similar style points recovered from Medicine Lodge Creek (48BH499) have associated radiometric dates that span from ca. 7,600-8,830 BP with an average approximate date of 8,350 BP (Frison and Walker 2007). As with most Paleo-Indian complexes of the northern plains, researchers tend to affiliate these archaeological cultures with a Plains focused and bisoncentric economy (Frison and Stanford 1982), without explaining how these traits differ from later archaeological cultures and ignoring that Paleo-Indian points appear to be more frequently found in mountain-foothill settings than on the open Plains. It is possible that Angostura is a continuation of the Agate Basin point form. Agate Basin points tend to show sequential, collateral finishing flake removal scars generally oriented 90 degrees to the biface edge. Parallel-oblique flake removals is uncommon among Agate Basin points but expected among Angostura points. As with all projectile point types, stylistic variability can be great within any sample. A knapper's skill level, artistic ability, concern for detail, physical and mental acuity, and the quality and size of the preform lithic material, recycling efforts, and size and shape of the desired implements influence the final product. Regardless, the stylistic ideal, or mental template, is readily seen among a collection of point "types" when the component retains contextual integrity. This is best observed if one looks at the projectile points assigned to the Folsom and Cody components in Sections 7.0 and 9.0 of this report.

Partially overlapping Angostura at its terminus is a broad range of side-notched, corner-notched, and side/corner-notched projectile points that are easily confused with later Middle and Late Precontact forms when found outside of a dated or stratified context. The terms "Bitterroot" and "Salmon River" were coined by Swanson et al. (1964:67) and Swanson and Sneed (1966:34) as designations for the side and corner-notched projectile points identified

during their Birch Creek, Idaho, studies that dated "younger than 8,400 yrs B.C., but older, in some measure, than 5,200 yrs. B.C. (Swanson 1972:110)." Data compiled since then places the initial appearance of the Bitterroot and Salmon River point types at or very near Swanson's estimated terminal date. It is generally held that these point types persist until approximately 5,000 BP when they are replaced by Oxbow and McKean complex materials (Husted and Edgar 2002:118-124). However, current evidence suggests that the side and corner-notched point styles persisted until at least ca. 4000 BP. The relationship of these point styles to the better recognized McKean and Oxbow Complex varieties is unclear (Frison and Walker 2007; Peterson 1999).

Many projectile point styles vertically distributed throughout the colluvium at MacHaffie (Fig.115. 4, 34 to 36, 39 to 43; Fig.116. 2, 5, 6, 7, 8, 10, 37) show stylistic similarity to some of the projectile point forms recovered from Mummy Cave Layers 16-34 (Husted and Edgar 2002:183-190). Radiometric dates obtained for these components range from 7,630 ± 170 BP (Layer 16), to 5,255 ± 140 (Layer 28), to 2,150 ±150 (Layer 34) (Husted and Edgar 2002:118-120). Husted and Edgar (2002:98-105; 118-120) and Peck (2011) identify several other archaeological properties in the western half of the United States and Canada where stylistically similar projectile points have been found and their components dated to a similar time span.

The sixteen projectile points listed above, and possibly associated with the Bitterroot/Salmon River Phase, are made on 15 distinct MANA units. Only MANA unit GBCCS18 is represented by two of the pieces (#s 40 and 43). Only one of the points (#5) is made of obsidian. All others are made of chert. Deaver and Deaver (1986:81) observed that approximately half of the projectile points in the Bureau of Land Management's collection from southwestern Montana identified as Early-Middle Precontact Period are of chert/chalcedony and the other half are of obsidian or basalt (dacite). The sample from 24JF4 is inconsistent with Deaver and Deaver's (1986:81) observation.

Points #7 and 39 are missing tips and portions of their bodies. Point #39 exhibits a bending fracture with an impact flute. Point #43 is missing a portion of its tip and also exhibits an impact flute. These specimens likely broke during use while hafted and were later removed and discarded at MacHaffie. Item #34 is stylistically non-descript. It may have been broken and rejuvenated while hafted, or it may have been a poorly-made projectile point that was later discarded. Point #41 was broken, probably during use, and subsequently resharpened before being discarded at MacHaffie. The remainder of the points (#s 2, 4, 5, 6, 8, 10, 34 to 37, 40, and 42) are complete, but points #s 2, 6, 8, 34, 36, 40, and 42 appear to be resharpened based on associated HRI values. It should be noted that #s 10 and 37 are generally larger than the other corner and side-notched pieces and may have been hafted knives.

Averaging measurements for the possible Bitterroot/Salmon River types gives average basal edge heights of 2.95 mm, base heights of 7.1 mm, base widths of 14.36 mm, notch widths of 5.23 mm, notch depths of 3.09 mm, shoulder heights of 7.84 mm, shoulder widths of 18.13 mm, neck widths of 12.26 mm, neck thicknesses of 3.87 mm, maximum thicknesses of 4.27 mm, and an average weight of 2.44 grams. The average maximum length for the most complete specimens is 27.82 mm. However, based on visual evidence and calculated HRI values, at least eight of these specimens (#s 6, 8, 34, 36, and 40 to 43) have been heavily resharpened since their manufacture.

The Boss Hill site (FdPe-4) was among the earliest archaeological resources in Alberta to produce lanceolate (Angostura) and large corner-notched points with ca. 7,800 BP dates (Doll 1982). Vivian et al. (2011) report on three Early Transitional bison kills (Everblue Springs: EgPn-700; Gooseberry kill: EgPn-625; and Snack site: EgPn-633) in southwestern Alberta that produced at least one lanceolate point and large corner-notched projectile points with associated dates between 7,000 to 8,000 BP. While some continue with the Bitterroot/Salmon River designations, other researchers have assigned names such as Maple Leaf and Country Hills (Peck 2011). Farther east, the Gowen sites (Walker 1992), Dog Child site (Cyr 2006), and Below Forks site (Meyer 2003) in Saskatchewan, and the Atkinson site (Nicholson and Playford 2009) in Manitoba all produced a series of side to corner-notched projectile points with associated dates of approximately 5,000 to 7,000 BP.

The Trappers Point site (48SU1006) in Wyoming's Green River basin is an early Middle Period pronghorn killsite with its three dated components ranging from approximately 7,880 to 4,690 BP. The associated corner and side-notched projectile points tend to be less than 4 cm in length and do not appear to have been reworked (Miller et al. 1999). The Medicine Lodge Creek site (24BH499) in the eastern Big Horn Basin of Wyoming contains a stratified sequence of cultural deposits extending from Paleo-Indian to Historic. A sequence of small and medium-size corner and corner/side-notched points are found through 4.4 m of sediment profile and have associated radiocarbon dates that span ca. 4,050 to 1,560 BP (Frison and Walker 2007). In northeastern Wyoming the Holmes Draw site (48CA2834) produced one corner-notched and one side-notched projectile point dated between approximately 6,100 to 6,500 BP (Munson 2019). In Colorado, mid to high elevation Mount Albion Complex produced corner-notched to side-notched points with a limited number of lanceolate "Angostura" style points. Associated dates range ca. 7,000 to 5,000 BP (Benedict and Olson 1978). Closer to MacHaffie, the Sheep Rock Spring site (24JF292) produced a series of corner-notched, side-notched, and corner/side-notched projectile points through a deep sediment unit with associated dates spanning ca. 7,000 to 5,400 BP (Davis and Rennie 2017). Additionally, recent work at site 24JF699 in the north end of the Whitetail Valley produced side and corner-notched points immediately above a Mazama ash layer that date to 6,068 ±34 BP with a corroborating date below the Mazama tephra of 7,760 ±30 (Ferguson and McElroy 2019).

Northwest of MacHaffie is site 24PW308 in the Helmville Valley. There, side, side/corner-notched and lanceolate (Angostura) points were recovered from dated contexts of ca. 6,600 to 6,700 BP (Beery and Herbel 2017). Near 24PW308, at the Brown's Lake Fishing Access site (24PW206), GCM Services, Inc., recently conducted limited testing. A rich cultural level at an approximate depth of 80 cm BS, and immediately overlying what appears to be Mazama Ash, produced a small, corner-notched projectile point of dacite (Ferguson 2014).

In the upper Yellowstone River valley of south-central Montana, Settlement Unit 3 at a depth of 116-135 cm BS in the Myers-Hindman site (24PA504) produced two radiocarbon dates that average ca. 5,365 ±185 BP. Associated were side and corner-notched projectile points (Lahren 1976:66-76). Farther up the Yellowstone River at Corwin Springs (24PA195) a corner-notched point was recovered from 120 to 140 cm BS, as was the base of what appears to be a Paleo-Indian projectile point tentatively classified as Agate Basin or Hell Gap (Davis et al. 2012:62). Although this stratum is not dated at 24PA195, a similar co-occurrence (catalogue #s

627 and 733) was found at Sheep Rock Spring (24JF292) in XU 94B at a depth of 140 to150 cm BS and dated to 6,143 ±25 BP. The Canyon Ferry Reservoir area has also produced several possible Bitterroot/Salmon River type points that lack contextual integrity (Davis and Helmick 1982; Greiser 1986).

Oxbow, dating from ca. 6,000-3,500 BP (Brumley and Rennie n.d.:14-16), is represented by three of the projectile points (Fig.116.16, 38, 47) at MacHaffie. All three pieces are heavily resharpened (HRI values 0.875, 0.625, and 0.625 respectively) suggesting these pieces were removed from their hafts and discarded on site. It is also possible that pieces #16 and #38 were used as hafted knives before being discarded. Each is of a distinct chert MANA designation (BCCS1, GBCCS19, YBCCS8). Averaging measurements for the three possible Oxbow specimens give basal edge heights of 4.80 mm, base heights of 8.56 mm, base widths of 20.66 mm, notch widths of 6.62 mm, notch depths of 2.22 mm, shoulder heights of 10.2 mm, shoulder widths of 23.47 mm, neck widths of 16.62 mm, neck thicknesses of 4.19 mm, maximum thicknesses of 5.65 mm, and an average weight of 5.23 grams. The average maximum length is 31.05 mm. However, based on visual evidence and calculated HRI values, all have been heavily resharpened. Deaver and Deaver (1986:81) observed that approximately half of the projectile points in the Bureau of Land Management's collection from southwestern Montana identified as Oxbow are of chert/chalcedony and the remainder are of obsidian or basalt (dacite). The sample from 24JF4 is small but is inconsistent with Deaver and Deaver's (1986:81) observation.

Oxbow projectile points generally have pronounced concave bases and shallow and comparatively broad side-notches placed low to the basal margins which give an "eared" effect (Nero and McCorqudale 1958). Oxbow type projectile points are found sporadically throughout the Northwestern Plains (Frison 1978; Hlady 1970; Melton 1988; Peck 2011). However, assemblages where the stereotypical form dominates are concentrated in southern Saskatchewan, southern Alberta and northern Montana (Aaberg et al. 1999, 2006; Brumley and Rennie 1993; Dyck 1983; Greiser et al. 1983; Meyer and Dyck 1968; Melton 1988; Peck 2011; Wettlaufer 1951). South of these areas Oxbow sites become increasingly rare (Frison 1978:45). The Sun River site (24CA74) at the confluence of the Sun and Missouri Rivers in central Montana is the most intensively, or perhaps repeatedly occupied Oxbow site in Montana (Greiser et al. 1983). From the upper Smith River drainage, Byrd (2020:27-31) reports on an Oxbow component in the Birch Creek bison killsite. Intermixed with the Oxbow materials are shallow and broadly side-notched points that Byrd dubs "Newlan" type. It is unclear if the two distinct point styles reflect mixed components, but his Newlan points share some morphological similarity to Hawken points best known from three Black Hills area bison kills dated at approximately 6,500 to 6,000 BP (Frison 1978:44). The Newlan point also stylistically falls within the Mountains-Plains (Swanson 1962:155), Plains-Mountain (Reeves 1973, 1979), and Foothill-Mountain (Frison 1991) complexes at the Late Paleoindian/Early Transitional boundary. Progressively closer to MacHaffie, a limited number of possible Oxbow points were recovered from the Canyon Ferry Reservoir but they lack contextual integrity (Davis and Helmick 1982; Greiser 1986). The Buckeye site (24CB1266) located at the west side of the Pryor Mountains contains small side-notched, corner-notched, and side/corner-notched points with associated radiocarbon dates that range ca. 5,700 to 2,400 BP. Some of the projectile points are corner-notched or side-notched while others have deeply concave to bifurcated bases and are stylistically more consistent with Oxbow or even Yonkee forms (Peterson 1999).

The McKean Complex (ca. 5,000 to 3,000 BP) is represented at 24JF4 by three Hanna points (Fig.115. 32, 33; Fig.116. 9) and the base of either a Duncan or Hanna point (Fig.115.44). Item #44 was likely broken in the haft and discarded at MacHaffie. Item #33 exhibits a bending fracture and likely broke during manufacture at MacHaffie. Points #9 and #32 are complete. Point #32 was likely discarded after manufacture but not resharpened (HRI value = 0.312). Point #9 in contrast was likely resharpened in the haft after being broken and later discarded at MacHaffie (HRI value = 0.751). Points #9, #32, and #33 are made of three distinct MANA designations (BCCS15, YBCCS41, and YBCCS4). The point base (#44) is made of opaque black obsidian (OBS1). Averaging the measurements for these four items gives average basal edge heights of 1.95 mm, base heights of 9.85 mm, base widths of 15.89 mm, notch widths of 10.77 mm, notch depths of 3.56 mm, shoulder heights of 11.43 mm, shoulder widths of 24.23 mm, neck widths of 14.46 mm, neck thicknesses of 5.37 mm, and maximum thicknesses of 5.48 mm. The average maximum length and weight for the most complete specimens (#s 9 and 32) is 31.26 mm and 4.89 grams. However, based on visual evidence and calculated HRI values, these artifacts have been extensively resharpened.

Duncan and Hanna point types are relatively short-stemmed with bases exhibiting varying degrees of concavity. An obtuse shoulder angle distinguishes Duncan from Hanna points, but this distinction is subjective and overlap is great (Mulloy 1954; Rennie 1994; Wheeler 1954b). An interesting aspect of the McKean points at MacHaffie is that three of four (75%) are made of chert, and only the basal fragment is made of obsidian. Although not quantified, a review of the literature and visual examination of various private collections across Montana leaves the senior author with the impression that approximately half of McKean style projectile points for south-central and west-central Montana east and north of the Missouri River are expected to be of chert, while obsidian and dacite combined are expected to comprise the other half (Arthur 1966:105-115; Davis et al. 2012; Greiser 1986; Griswold and Larom 1954; Huppe 1988: Appendix A; Rennie and Hughes 1998). For northwest Montana these ratios appear to change yet again. Fine-grained dark gray to black “mudstone” dominates the McKean style points from the Kootenai River drainage (Roll 1982; Thoms and Clabaugh 2006: Appendix B), but chert is the dominate lithic raw material for these point styles in Glacier and Waterton Parks (Reeves 2003). It has been demonstrated (Rennie and Hughes 1998; Rennie 2017) that McKean points in Montana west of the Missouri River and north of the Jefferson River tend to be made of obsidian or dacite (70% to 100%). Deaver and Deaver (1986:81) observed that 23 percent of the projectile points in the Bureau of Land Management’s collection from southwestern Montana, that are stylistically classifiable as Duncan or Hanna are of chert/chalcedony, 54 percent are of obsidian, and 23 percent are of basalt (dacite). The sample from 24JF4 is small but appears to be inconsistent with all previously mentioned patterns of lithic raw material selection.

McKean sites in Montana tend to be in the western and southern half of the state with emphasis on mountain-foothills and pine parkland settings. McKean in north-central and northeastern Montana is rare but the frequency increases in northwestern Montana and southern Alberta and Saskatchewan (Brumley 1975; Lahren 1976; Peck 2011; Rennie 1994, 2017; Rennie and Hughes 1998; Webster 2009). McKean is also well established in the Dakotas, Wyoming, and Colorado (Kornfeld and Todd 1985), as well as the adjoining Great Basin (Jennings 1957, 1974). However, these identical point styles can be given local designations different from

"McKean". As with other point styles, McKean style points are not unique to the northern plains. Stylistically similar Pinto Basin points, common to the Great Basin and California, may date ca. 8,400 to 2,000 BP (Aikens 1970).

Archaeological sites in the northern plains that contain an uncontaminated McKean component, show stylistic regularity around the stemmed and, to a lesser extent, lanceolate point forms (Brumley 1975; Frison 1991; Keyser and Davis 1984; Mulloy 1954; Munson 1990; Quigg 1986; Rennie 1994). Quinn Creek (24JF110) contains a rich McKean component and produced several Duncan and Hanna style points, but also contained a lesser number of corner-notched points suggesting some mixing with the Pelican Lake component. Layer 30 in 48PA201 produced Duncan and Hanna-like points in association with lanceolate and Oxbow-like points. That layer dated at 4,420 ±150 BP (Husted and Edgar 2002). It should be noted that McKean points were not recovered from earlier or later cultural layers in Mummy Cave (Husted and Edgar 2002). In site 24PA504, McKean variant points were recovered in association with corner-notched points from SU-4 and dated to ca. 3340 ±110 BP. As previously noted, points stylistically similar to those of the McKean Complex were recovered with Agate Basin or Angostura style lanceolate points and two large corner-notched points from SU-1 in 24PA504. That component was dated at 8,925 ±200 BP (Lahren 1976:42-43). At Canyon Ferry Reservoir, McKean points are second in frequency only succeeding Pelican Lake points (Davis and Helmick 1982:74).

Succeeding Oxbow and McKean is a corner-notched point form referred to as Pelican Lake or Late Archaic Corner-Notched points (ca. 3,000-1,800 BP). These are among the most common types found in the northern plains. These corner-notched points typically exhibit straight or convex bases. Concave bases are rare (Reeves 1983). Some of the corner-notched projectile points recovered from MacHaffie (Fig.115. 4, 34-36, 41-42; Fig.116. 2, 5-8, 37) are morphologically similar to points recovered from Pelican Lake components (a.k.a. Late Archaic Corner-Notched) throughout the northern Plains (Brumley and Rennie 1993; Frison 1991; Peck 2011; Reeves 1983). However, the stylistic overlap with points assigned to the Bitterroot/Salmon River Complexes is so great that it would be presumptuous to assume the distinctly corner-notched points are necessarily Pelican Lake apart from associated dates. As such, the points tentatively designated here as Pelican Lake were also used in the Bitterroot/Salmon River discussion. Ten of 12 (83%) projectile points listed previously, and possibly associated with the Pelican Lake archaeological culture are each made on a distinct chert MANA unit (BCCS18, BCCS41, CCCS2, CCCS3, CCCS7, RCCS2, YBCCS4, YBCCS9, YBCCS18, and YBCCS55). One point (#5) is made of obsidian (OBS2), and one (#7) is made of a siliceous rhyolite (RHY2). Point #7 is missing its tip. This specimen likely broke during use and was later removed from its haft and discarded at MacHaffie. Item #34 is stylistically non-descript. It may have been broken and rejuvenated while hafted, or it may have been poorly made. Point #41 was broken, probably during use, and subsequently resharpened before being discarded. The remaining points are largely complete, although projectile points #s 6, 8, 34, 36, 41, and 42 appear to be resharpened based on associated HRI values. It should be reiterated that #37 is generally larger than the other corner-notched pieces and may have been a hafted knife.

Approximately 46 percent of the Pelican Lake projectile points in the Bureau of Land Management's collection from southwestern Montana are of chert/chalcedony, 25 percent are of

obsidian, and 15 percent are of basalt (dacite) (Deaver and Deaver 1986:81). Obsidian and dacite usage as represented among the possible Pelican Lake points in 24JF4 is substantially lower than that noted by Deaver and Deaver (1986), while chert/chalcedony usage for these point types is much higher.

Averaging measurements for the 12 projectile points that could be Pelican Lake gives basal edge heights of 2.99 mm, base heights of 7.26 mm, base widths of 13.91 mm, notch widths of 11.81 mm, notch depths of 3.29mm, shoulder heights of 7.84 mm, shoulder widths of 17.77 mm, neck widths of 11.81 mm, neck thicknesses of 3.72 mm, maximum thicknesses of 4.20 mm, and an average weight of 2.21 grams. The average maximum length for the most complete specimens is 27.06 mm. However, based on visual evidence and calculated HRI values, at least seven of these specimens have been extensively resharpened.

Most of the corner and side-notched pieces lumped herein as either Bitterroot/Salmon River or Pelican Lake are smaller than expected for atlatl dart points. Thomas (1978: 467- 469) calculated a mean foreshaft diameter of 7.1 mm for historic aboriginal arrow shafts he examined. The measurement point for the foreshaft diameter was consistently taken 2 cm behind the distal end of the arrow shaft. In his study of historic aboriginal arrows from North America, Pyszczyk (1999:174; 2003) calculated a minimum shaft diameter of 6.2 mm; a maximum shaft diameter of 11.4 mm; and a mean shaft diameter of 8.8 mm. A mean neck width of 12.09 mm was calculated for 16 (#s 2, 4-7, 8, 11, 32, 34-36, 39-43) corner and side-notched points recovered from the Helena Component. Points #s 10 and 37 were not included in the study group because they may represent hafted knives.

Following Shott (1997:98), "...the shoulder-width threshold between dart and arrow [points] lies near a value of 20 mm." The same 16 corner and side-notched points used to calculate average neck widths have average shoulder widths of 18.05 mm. In conclusion, neck widths suggest that most of the study group points are atlatl-size, while shoulder widths suggest either atlatl or arrow-size pieces.

Both the Pelican Lake component at Quinn Creek (Rennie and Hughes 1998) and Layer 32 in 48PA201 (2,820±135 BP) contained corner-notched, dart-size points exclusively (Husted and Edgar 2002). A similar tendency can also be seen among the projectile points recovered from SUs 5 and 6 (ca. 2,300 BP) in site 24PA504 (Lahren 1976). Because the corner-notched projectile points associated with chronologic dates spanning ca. 7,000 to 5,400 BP stylistically overlap Pelican Lake points, chronometric dates must be associated with projectile points before putting confidence in out-of-context typology. Because of this, we are not comfortable assigning the corner-notched points from MacHaffie to any archaeologically defined culture. This circumstance has been recognized before. Frison (1991:88) notes, "It is not always possible to look at an Early Plains Archaic projectile point recovered out of context and assign it [accurately] to the proper time period". In his influential chronology of the northern plains, Reeves points out that corner-notched points dating from earlier than 3,000 BP also exist. Thus, he defines the Pelican Lake point as any corner-notched point found within the region and time period defined by the Pelican Lake Phase: 3,000 to 1,900 BP (Reeves 1983).

Yonkee (ca. 2,100 to 2,900 BP) is another Middle Precontact Period archaeological culture most commonly found in southeastern Montana. The complex is characterized by corner-notched atlatl points with bifurcate to indented bases. The complex was first identified at the Powers-Yonkee site (24PR5) in southeastern Montana (Bentzen 1962; Bump 1987). Subsequently, several other bison kills and campsites have been documented within the Powder River basin of southeastern Montana and northeastern Wyoming (Ferguson 1993; Frison 1991; Roll et al. 1992). Yonkee points are reminiscent of corner-notched Pelican Lake points but occasionally side-notched Oxbow-like points and rather non-descript side-notched atlatl points reminiscent of some Sandy Creek and Besant assemblages are present (Bentzen ibid). Insufficient data are presently available to determine Yonkee's relationship to other defined archaeological cultures. None of the points recovered from MacHaffie are identified here as Yonkee, but at least 20 possible Yonkee points were recovered from the lakebed of Canyon Ferry Reservoir (Davis and Helmick 1982:62).

Abundant in northern Montana during the latter part of the Middle Prehistoric period are materials of the Besant archaeological culture (ca. 2,100 to 1,200 BP). The primary diagnostic artifact is a projectile point with shallow and broad corner or side-notches. These points stylistically overlap with projectile points of the earlier Sandy Creek and Bitterroot/Salmon River Complexes (specifically Gowen and Hawken points). Small arrow point-size versions have been found in some late Besant assemblages and are referred to as Samantha points. The presence of Samantha points may reflect bow and arrow technology (Reeves 1983).

Sites of the Besant phase are found throughout the Northwestern Plains, and following arguments presented by both Johnson (1977) and Reeves (1983), Besant is considered synonymous with sites of the Plains Woodland Tradition, best known for sites along the Missouri River trench of the Dakotas (Wood and Johnson 1973). In the authors' perception of the current archaeological record, the frequency of Besant sites within the extended study area is greatest north of the Missouri River and east of Great Falls. No distinctly Besant projectile points have been recovered from the MacHaffie site, although 27 possible Besant points were collected out-of-context from the Canyon Ferry Reservoir area (Davis and Helmick 1982:74).

The transition to the bow and arrow from the atlatl and dart weaponry system in the northern plains is currently accepted as marked by the appearance of another distinct projectile point style referred to as "Avonlea" (ca. 1,700 to 900 BP). Avonlea is concentrated in north-central Montana and the Canadian Plains and is generally associated with bison kill sites. Although the point style is not absent from northwest Montana, it is uncommon. Researchers have assigned the designations of Akiyinek Complex, Crandell Mountain Subphase, Elk River Phase, and Warex Phase to Avonlea in the intermountain areas of western Montana/southwestern Alberta and generally without clear explanation of why (Choquette 1987; Reeves 1983, 2003; Roll 1979, 1982, 1988). Unexpectedly, a review of available radiometric dates suggest Avonlea may occur earlier and persist longer in the intermountain area than east of the Rocky Mountain Front (Rennie and Johnson 2017).

The term "Avonlea" was first used by Kehoe and McCorquodale (1961) at the type-site (Borden # EaNg-1), a Late Precontact Period bison kill and camp/processing locality near the town of Avonlea in south-central Saskatchewan. The most recognizable or aesthetically ideal

Avonlea point style is derived from a short, straight, and very thin flake that has been pressure flaked into a triangular-shaped preform. Subsequently, shallow and relatively broad notches have been removed at near 90 degree angles to the long axis of the preform. These notches are placed low on the base, and the base of the Avonlea point tends to be concave; or to a lesser extent, straight.

A variant of Avonlea is identifiable in the Big Horn, Tongue, and upper Yellowstone River drainages (Rennie and Johnson 2017). These temporally coeval side-notched and corner-notched points differ from the Head-Smashed-In variety and are most common from Wyoming and western South Dakota to the Yellowstone River (Fredlund 1988; Frison 1988; Kornfeld et al. 2010). They have been referred to as Benson's Butte-Beehive Complex points. The corner notched points exhibit straight to concave bases with relatively long and quite narrow corner-notches. Although stylistic overlap occurs, the side-notched points of the Benson's Butte-Beehive Complex look to us to have generally deeper notching and the notches may be slightly higher on the point base than the more northerly Avonlea pieces. Aaberg (2006), Meyer and Walde (2009:51), Munson (2016), and Peck (2011) argue that these points, albeit contemporary with Avonlea, should be assigned their own taxon. We concur with this assessment.

A poorly understood projectile point type assigned the term "Galt" may be most strongly represented in the general Smith River drainage. An uncalibrated C-14 date of 970 ±40 BP suggests these small, delicately made corner-notched points are at least partial contemporaries of Avonlea and may appear slightly earlier than Avonlea. They are currently only identified from a limited number of bison kill sites. At the Birch Creek site these points were recovered from a stratigraphic level beneath the layer containing Avonlea. Besant points were recovered in apparent association (Byrd 2020:28-42). More work is needed to determine if these points are a representation of the Benson's Butte-Beehive Complex or a more localized development. What can be seen with this study is that both Avonlea and Galt points representing the earliest stage of the Late Precontact Period are absent from MacHaffie. However, 16 possible Avonlea points were collected out-of-context from the nearby Canyon Ferry Reservoir area (Davis and Helmick 1982:74).

Overlapping and succeeding Avonlea are generally small side-notched or corner-notched points that can be subdivided into various archaeological cultures when specific stylistic or lithic raw material attributes, pottery, or other stylized features are associated. Terms such as Mortlach, Old Womens, Wymont, and Thunder Basin Phase are examples of these subdivisions (e.g., Brumley and Rennie n.d.; Frison 1991; Munson 2019:36; Peck 2011; Reeves 1983). Initial typological work on post-Avonlea Late Prehistoric period cultural history and projectile point typology in the region was conducted by Forbis (1960, 1962) with his work throughout southern Alberta, particularly at the Old Women's Buffalo Jump. Kehoe (1966b) builds on Forbis' scheme in proposing a Small Side-Notched Point System consisting of three primary point types (Avonlea, Prairie Side-Notched, and Plains Side-Notched), each with a number of varieties. Research in southern Montana and Wyoming has demonstrated the presence of additional Late Prehistoric arrowpoint forms and other cultural attributes not encompassed by the Small Side-Notched Point System. If a Late Period component exists at MacHaffie, it lacks contextual integrity. Possible Late Period points will therefore be referred to generically as part of the undifferentiated Prairie/Plains complexes (see Brumley and Rennie n.d.).

We suggest # 1 is a point preform and # 15 is a complete projectile point of the Late Precontact Period. Each is made on a distinct chert MANA unit (CCCS3 and YBCCS40). Because #15 is complete it is used here for metric analysis. It has a basal edge height of 4.5 mm, base height of 5.5 mm, base width of 13.6 mm, notch width of 3.1 mm, notch depth of 2.7 mm, shoulder height of 8.0 mm, shoulder width of 12.4 mm, neck width of 8.3 mm, neck thickness of 2.3 mm, maximum thickness of 2.4 mm, a maximum length of 22.3 mm, and the piece weighs 7.5 grams. It appears to be in its original form with an HRI value of 0.

Point preform #1 is an incomplete attempt to shape a small side-notched projectile point from a Size-Grade 2 secondary reduction flake. The flake preform has a flat platform and a feathered termination. The lateral half of a point has been pressure flaked into the distal lateral edge of the flake blank (Fig.115.1 and Fig.117). It has a basal edge height of 3.0 mm, base height of 4.1 mm, notch width of 1.8 mm, notch depth of 2.3 mm, a shoulder height of 6.1 mm, neck thickness of 3.1 mm, and an approximate maximum length of 15.3 mm. The piece is metrically consistent with arrow point-size projectile points. It is uncertain why the preform was not finished.

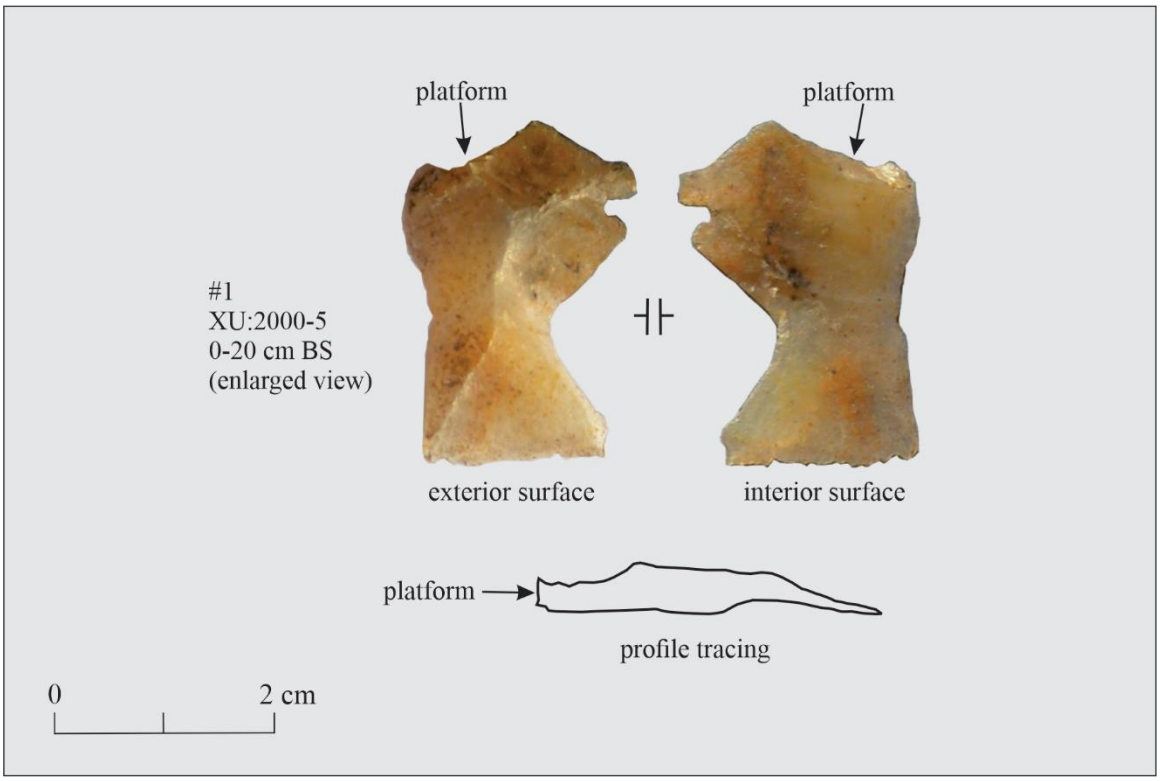


Figure 116: Enlarged view of point preform #1.

Irregular pressure flake removals typify Helena Component projectile points (87%). Thirteen (42%) were made on obvious flake blanks. All other pieces have experienced sufficient bifacial refinement to obscure the preform. Only three (10%) pieces are edge retouched without complete flaking of the body. The majority (68%) are symmetrical in outline, but four (13%) are clearly asymmetrical. Approximately 68 percent are complete, but 14 (45%) have been moderately to heavily resharpened and undoubtedly look dissimilar to their original appearance. Among 10 broken points, three (30%) exhibit impact damage, and seven (23%) exhibit transverse (bending) fractures that could have formed through impact or during manufacture. Five pieces (#s 3, 14, 45, 46, 48) are projectile point tips or tip-body fragments and cannot be assigned to an archaeological culture.

Bifaces (Tables 42 and 44; Figures 117-123)

Ninety-eight non-hafted bifaces are assigned to the Helena Component. However, six bifaces (#s 111, 129, 131, 137, 140, and 144) were not collected within the boundaries of the MacHaffie site proper and may not be affiliated with MacHaffie site occupants. It should be noted that biface #137 is neither photographed nor used in this study. It was found by Dick Forbis in 1951 among the dredge piles along Prickly Pear Creek. It is catalogued and mentioned here to allow a future researcher to track the piece.

Eighty-nine (92%) bifaces are of chert and comprise 44 distinct MANA designations. Two are of sedimentary quartzite comprising two distinct MANA units (SDQZT1b and SDQZT5a), and only one is of obsidian (OBS1). Sixty-two (69%) of the chert bifaces are represented by 16 distinct MANA designations. Thirty-five chert bifaces (39%) are represented by 12 MANA designations with each of those MANA designations represented by two to four bifaces. Twenty-seven (30%) chert bifaces account for four of the MANA designations (BCCS9, BCCS21, CCCS7, and GBCCS20) with each designation represented by five to nine bifaces. It is interesting that the dominant MANA designations found among the Folsom (BCCS41) and Cody (GBCCS18) components are minimally represented among the bifaces of the Helena Component. However, the GBCCS20 MANA designation is common among the Helena Component bifaces and is believed to have originated in the Palmer Chert Quarries 800 meters northeast of the MacHaffie site (Figure 3).

Two bifaces (Fig.120.12; Fig.121.127) found in two pieces during excavation were rejoined. Fifty-three (54%) are complete and average 4.7 cm in length, 3.2 cm in width, 1.0 cm in thickness, and 20.9 grams in weight. Twenty-two pieces are distal or distal-medial fragments, 15 are probable proximal or proximal-medial fragments, one (#118) is a medial fragment, one (#99) is the lateral half of a biface, and six pieces (#s 24, 26, 60, 149-151) are indeterminate fragments. Twenty-six pieces are probably small to medium-size projectile point preforms (#s 7, 45, 46, 56, 59, 99, 103, 104, 106, 110, 111, 114, 120, 123, 124, 128, 129, 130, 136, 137, 138, 140, 141, 143, 144, and 146). They average 4.3 cm in length, 2.8 cm in width, 0.55 cm in thickness, and 14.3 grams in weight. One proximal-medial fragment (#53) may have been a portion of a large lanceolate projectile point preform. Most could have been intended for future tool manufacture or for cutting or scraping activities. Many could be further refined although a few have obvious internal defects.

Table 44. Metric, Nonmetric, and Provenience Data for Helena Component Bifaces.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Shape	Cross-Section	Reduction Stage	Tool Condition	Retouch/Use-Wear	Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
1	6S/6W	20-30 cm BS	2	flake	ovate	bi-convex	II	complete	none	YBCCS1d	4.5	3.2	1.1	15.65	Possibly intended as a medium-size projectile point preform. Thickened area on one lateral edge.
2	6S/6W	50-60 cm BS	2	flake	ovate	wex-asymmetr	III	distal fragment	none	RCCS19	2	2.8	0.5	4.05	Transverse fracture. Probably broke during manufacture.
6	2000-A	60-80 cm BS	4	flake	ovate	bi-convex	II	proximal-medial fragment	none	YBCCS40	4.6	6.5	2.5	82.6	Possible transverse fracture suggests breakage during manufacture.
7	2000-B	60-80 cm BS	4	indeterminate	triangular	bi-convex	III	complete	none	CCCS7	4	2.8	0.8	7.25	Possible medium-size projectile point preform.
8	2000-B	60-80 cm BS	4	flake	ovate	plano-convex	II	complete	none	DAC1	5	3.7	0.6	21.55	XRF Sample D-23 (2018)
9	2000-B	80-100 cm BS	4	flake	ovate	plano-convex	II	complete	none	GBCCS18	8	5.5	1.7	91.85	
10	2000-B	80-100 cm BS	4	indeterminate	ovate	bi-convex	II	complete	none	RCCS19	4.5	2.8	1.1	15.6	
11	2000-C	0-20 cm BS	4	indeterminate	ovate	bi-convex	II	distal fragment	none	BCCS19	2.5	4	1	13.45	Transverse fracture. Probably broke during manufacture.
12	2000-C	0-20 cm BS	4	indeterminate	ovate	bi-convex	III	complete	none	CCCS7	5.7	4.3	1.1	28.6	Reconstructed from two pieces found among debitage. Transverse fracture. Probably broke during manufacture.
13	2000-C	0-20 cm BS	4	indeterminate	ovate	bi-convex	II	complete	none	YBCCS40	5.3	4.6	1.2	40.95	
14	98-South Block	0-10 cm BS	5	indeterminate	ovate	bi-plano	II	complete	none	YBCCS18	5.8	4.6	1.2	48.05	
15	98-South Block	0-10 cm BS	5	flake	ovate	plano-convex	II	complete	none	YBCCS4	6	5.5	1.2	42.05	
22	2S/0E	40-50 cm BS	10	indeterminate	ovate	bi-convex	II	complete	none	RCCS3	6.2	3.9	1.1	30.95	
24	4S/0E	10-20 cm BS	10	flake	amorphous	bi-convex	III	indeterminate fragment	none	BCCS7	4.2	3.1	0.4	11.1	
25	14S/2E	20-30 cm BS	9	flake	amorphous	bi-convex	III	complete	none	OBS1	2.9	1.2	0.4	1.85	XRF Sample O-10 (2018). Small, bifacially worked (thoroughly pressure-flaked) cutting/scraping implement.
26	0N/0E	20-30 cm BS	10	indeterminate	indeterminate	bi-convex	III	indeterminate fragment	none	YBCCS3	2	4.4	1	8.55	Probably broke during manufacture.
28	14S/2E	10-20 cm BS	9	indeterminate	ovate	bi-convex	II	proximal fragment	none	BCCS8	3.2	2.1	1	7.55	Transverse fracture. Probably broke during manufacture.
29	4S/0E	0-10 cm BS	10	indeterminate	ovate	bi-convex	II	distal-medial fragment	none	RCCS3	7	4	0.9	19.95	Transverse fracture. Probably broke during manufacture. Potlid on inferior surface.
30	4S/0E	30-40 cm BS	10	indeterminate	ovate	bi-convex	III	distal-medial fragment	none	BCCS9	3.3	4.2	0.6	13.5	Transverse fracture. Probably broke during manufacture.
31	14S/2E	30-40 cm BS	9	indeterminate	ovate	bi-convex	III	proximal fragment	none	BCCS43	1.5	3.1	0.7	3.6	Transverse fracture. Probably broke during manufacture.
34	4S/0E	10-20 cm BS	10	indeterminate	ovate	bi-convex	II	proximal-medial fragment	none	YBCCS1d	3	4.9	1.4	21.1	Transverse fracture. Probably broke during manufacture.
36	2S/0E	20-30 cm BS	10	flake	ovate	bi-convex	III	proximal-medial fragment	none	CCCS6	2.5	3.8	0.8	10.25	Transverse fracture. Probably broke during manufacture.
37	98-South Block	40-50 cm BS	5	indeterminate	ovate	bi-convex	III	complete	none	YBCCS18	4	3	0.6	11.65	
39	2000-C	0-10 cm BS	4	flake	ovate	bi-convex	III	distal-medial fragment	none	CCCS1	3	3.5	0.7	8.1	Transverse fracture. Probably broke during manufacture.
40	2000-C	0-10 cm BS	4	indeterminate	indeterminate	bi-convex	III	complete	none	YBCCS33b	5.7	4.1	0.5	20.65	
41	2000-C	0-10 cm BS	4	flake	ovate	plano-convex	II	complete	none	CCCS6	5	3.7	0.7	16.5	
42	98-South Block	70-80 cm BS	5	indeterminate	ovate	bi-convex	II	proximal-medial fragment	none	RCCS3	4.1	3.6	1.3	29.45	Transverse fracture. Probably broke during manufacture.
43	98-South Block	70-80 cm BS	5	flake	ovate	plano-convex	II	complete	none	RCCS3	4.7	3.6	0.8	20.8	Initial efforts to create a biface on a flake with a thick flat-platform and bulb of percussion.
44	98-South Block	40-50 cm BS	5	flake	ovate	plano-convex	II	complete	none	CCCS2	7.5	4.4	1.9	73.7	
45		surface	1	indeterminate	ovate	bi-convex	III	complete	none	YBCCS40	2.1	1.6	0.4	2	Possible arrow point-size preform.
46		surface	1	indeterminate	ovate	bi-convex	III	complete	none	RCCS2	2.2	1.5	0.4	1.65	Possible arrow point-size preform.
47		surface	1	indeterminate	ovate	bi-convex	III	complete	none	BCCS29	3.6	2.5	0.5	8.45	Possible Medium-size point preform.
49	6S/2W	10-20 cm BS	9	flake	ovate	plano-convex	II	complete	none	YBCCS1d	4.8	2.7	0.9	13.7	
50	6S/4W	20-30 cm BS	9	flake	ovate	bi-convex	III	distal-medial fragment	none	BCCS43	3.2	4.2	0.8	14.75	Transverse fracture. Probably broke during manufacture.

biface measurements are in centimeters

Table 44: Metric, Nonmetric, and Provenience Data for Helena Component Bifaces (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Shape	Cross-Section	Reduction Stage	Tool Condition	Retouch/Use-Wear	Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
52	98-South Block	40-50 cm BS	5	indeterminate	ovate	bi-convex	III	distal-medial fragment	none	SDQZT1b	4.7	6.7	1.4	56.45	Transverse fracture. Probably broke during manufacture.
53	98-South Block	40-50 cm BS	5	indeterminate	indeterminate	bi-convex	III	proximal-medial fragment	none	RCCS17	2.9	3	0.6	7.1	May be a large, lanceolate projectile point preform.
54	98-South Block	50-60 cm BS	5	indeterminate	ovate	bi-convex	III	complete	none	BCCS23	4.5	3.6	0.6	14.45	Transverse fracture. Probably broke during manufacture.
55	98-South Block	50-60 cm BS	5	flake	ovate	plano-convex	II	complete	none	RCCS14	5.2	3.4	0.8	20.4	
56	2N/0E	10-20 cm BS	10	flake	triangular	bi-convex	III	complete	none	RCCS19	2.65	1.5	0.28	0.7	Possible arrow point-size preform.
57	98-South Block	30-40 cm BS	5	flake	triangular	bi-convex	III	complete	none	BCCS21	2.1	1.45	0.41	2.35	Possible arrow point-size preform.
58	2N/0E	20-30 cm BS	10	flake	triangular	bi-convex	III	complete	none	RCCS32	2.1	1.8	0.6	1.55	Possible arrow point-size preform. Very tip is missing but otherwise complete.
59	6S/4W	20-30 cm BS	9	flake	ovate	plano-convex	III	complete	none	BCCS9	2.6	2	0.4	2.8	Possible arrow point-size preform.
60	98-South Block	50-60 cm BS	5	indeterminate	ovate	bi-convex	II	indeterminate fragment	none	CCCS3	2.2	4.5	1.4	14.55	Transverse fracture. Probably broke during manufacture.
61	6S/4W	20-30 cm BS	9	flake	ovate	plano-convex	II	complete	none	BCCS31	4.2	2.6	0.87	9.75	
62	6S/4W	10-20 cm BS	9	flake	ovate	bi-plano	II	complete	none	BCCS5	4.4	2.6	0.95	12.45	
63	98-South Block	40-50 cm BS	5	indeterminate	triangular	bi-convex	III	complete	none	BCCS28	5.5	3.7	1.3	26	Transverse fracture. Probably broke during manufacture.
96	N1/W5	21 cm BS	11	indeterminate	ovate	bi-convex	III	complete	none	DAC1	6.1	2.1	0.67	10.76	Forbis artifact # 1700; XRF Sample # D-26; Missing extreme portion of distal end.
97	N1/W5	15 cm BS	11	indeterminate	ovate	bi-convex	II	distal-medial fragment	none	DAC1		3.9	0.84	15.45	Forbis artifact # 3725; XRF Sample # D-27; piece likely broke during manufacture.
98	N1/W7	15-30 cm BS	11	flake	ovate	bi-convex	II	distal-medial fragment	none	DAC1		2.9	0.92	10.98	Forbis artifact # 1710; XRF Sample # D-28; piece likely broke during manufacture.
99	S2/W5	0-30 cm BS	11	indeterminate	triangular	bi-convex	III	lateral half	none	DAC1	2.8		0.43	1.47	Forbis artifact #3736. Transverse fracture. Probably broke during manufacture. Forbis artifact # 1708; XRF Sample # D-29; piece likely broke during manufacture; appears to be a arrow-point size preform.
101	S1/E6	15-30 cm BS	11	indeterminate	ovate	bi-convex	II	distal-medial fragment	none	GBCCS18		5.2	0.88	13.88	Forbis artifact #3736. Transverse fracture. Probably broke during manufacture.
102	N1/W5	9 cm BS	11	indeterminate	ovate	bi-convex	II	complete	none	BCCS29	4.7	2.8	0.72	10.26	Forbis artifact #3721. Probably a small to medium-size projectile point preform.
103	N2/W1	15 cm BS	11	indeterminate	ovate	plano-convex	II	complete	none	CCCS7	4.4	3	0.94	13.11	Forbis artifact #2710. Probably a small to medium-size projectile point preform.
104	N2/W2	21 cm BS	11	flake	ovate	plano-convex	III	complete	none	CCCS7	3.7	2.5	0.88	8.59	Forbis artifact #1717. Probably a small-size projectile point preform.
105	N2/W5	12 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal fragment	none	BCCS21		4.2	0.9	6.92	Forbis artifact #3732. Transverse fracture. Probably broke during manufacture.
106	S1/E6	15-30 cm BS	11	flake	ovate	bi-plano	III	complete	none	CCCS7	3	1.9	0.41	3.23	Forbis artifact #1733. Probably a small-size projectile point preform.
107	S1/W5	30-45 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal fragment	none	RCCS2		4.8	1.1	8.56	Forbis artifact #3702. Transverse fracture. Probably broke during manufacture.
108	N1/W5	6 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment	none	GBCCS20		2.7	0.87	7.52	Forbis artifact #3706. Transverse fracture. Probably broke during manufacture.
109	S1/E1	6-12 cm BS	11	indeterminate	ovate	bi-convex	II	distal-medial fragment	none	RCCS26		4.6	1.4	30.39	Forbis artifact #3740. Transverse fracture. Probably broke during manufacture.
110	N3/W4	30-36 cm BS	11	flake	ovate	plano-convex	II	complete	none	CCCS7	5.3	3.7	1.3	26.1	Forbis artifact #3701. Probably a medium-size projectile point preform.
111		surface	1	indeterminate	ovate	bi-convex	II	complete	none	BCCS43	4	3.3	1.1	16.61	Forbis artifact #3700. Probably a small to medium-size projectile point preform. Found 200 yards west of MacHaffie Site proper.
112	N1/W1	surface	11	indeterminate	indeterminate	bi-convex	III	proximal fragment	unifacial retouch of lateral edge and distal end	BCCS21		6.5	1.3	18.43	Forbis artifact #3738. Transverse fracture. Probably broke during manufacture.
113	N1/W7	15-30 cm BS	11	flake	ovate	bi-convex	II	distal-medial fragment	none	GBCCS20		3.9	1.2	29.57	Forbis artifact #3730. Transverse fracture. Probably broke during manufacture.
114	S1/E2	0-3 cm BS	11	flake	ovate	bi-convex	II	complete	none	CCCS7	3.9	3.5	1.2	18.39	Forbis artifact #3707. Probably a medium-size projectile point preform.

biface measurements are in centimeters

Table 44: Metric, Nonmetric, and Provenience Data for Helena Component Bifaces (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Shape	Cross-Section	Reduction Stage	Tool Condition	Retouch/Use-Wear	Lithic Material Code	Max Length	Max Width	Max Thickness	Weight (grams)	Comments
115	N1/W2	24 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment	none	BCCS7		2.7	0.8	7.13	Forbis artifact #3712. Transverse fracture. Probably broke during manufacture.
116	S1/E6	15-30 cm BS	11	flake	ovate	bi-convex	II	complete	none	BCCS21	4.2	2.8	0.8	9.99	Forbis artifact #3739. Probably a small to medium-size projectile point preform.
117	N1/W1	30 cm BS	11	indeterminate	indeterminate	bi-convex	III	proximal-medial fragment	none	BCCS9		3.2	0.67	5.89	Forbis artifact #3712. Transverse fracture. Probably broke during manufacture.
118	N1/W2	36 cm BS	11	indeterminate	indeterminate	bi-convex	III	medial fragment	none	BCCS21		3.3	0.97	12.78	Forbis artifact #1702. Transverse fractures. Probably broke during manufacture.
119	S1/E6	15-30 cm BS	11	flake	ovate	bi-convex	II	distal-medial fragment	none	GBCCS20	5.1	2.8	1	14.5	Forbis artifact #3742. Transverse fracture. Probably broke during manufacture.
120	S1/W4	9-12 cm BS	11	flake	ovate	bi-convex	II	complete	none	GBCCS20	4.5	3.3	1	19.92	Forbis artifact #3719. Probably a small to medium-size projectile point preform.
121	N2/W2	6 cm BS	11	indeterminate	ovate	bi-convex	III	complete	none	BCCS21	4.2	3.9	1.3	26.71	Forbis artifact #3703. Probably a small to medium-size projectile point preform. Some limestone cortex on both surfaces.
122	N1/W3	0-9 cm BS	11	indeterminate	ovate	bi-convex	III	distal-medial fragment	none	SDQZT5a		3.7	0.97	24.08	Forbis artifact #3711. Transverse fracture. Probably broke during manufacture.
123	N1/W1	27 cm BS	11	indeterminate	ovate	bi-convex	III	complete	none	BCCS9	4.1	2.8	0.95	13.24	Forbis artifact #3720. Probably a small-size projectile point preform.
124	S1/W2	12-15 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment	none	RCCS2		2.8	0.6	4.96	Forbis artifact #3708. Transverse fracture. Probably broke during manufacture. Probably a small to medium-size projectile point preform.
125	N2/W2	12 cm BS	11	indeterminate	indeterminate	bi-convex	III	proximal fragment	none	CCCS7		4.8	1.1	17.71	Forbis artifact #3710. Transverse fracture. Probably broke during manufacture.
126	S1/E6	15-36 cm BS	11	indeterminate	indeterminate	bi-convex	III	proximal fragment	none	BCCS21		5.6	0.89	11.15	Forbis artifact #3729. Transverse fracture. Probably broke during manufacture.
127	N1/W2	21-30	11	indeterminate	triangular	bi-convex	III	complete	none	BCCS7	4.9	2.9	0.57	9.66	Forbis artifact #1720/1721. Probably a small to medium-size projectile point preform that broke during manufacture. Found in two pieces during excavation, but rejoined.
128	N2/W5	21 cm BS	11	indeterminate	rectangular	irregular	II	complete	none	CCCS3	6.4	3	0.74	22.85	Forbis artifact #3744. Probably a medium-size projectile point preform.
129		surface	1	indeterminate	ovate	bi-convex	II	complete	none	BCCS9	5.4	3.9	1.2	26.61	Forbis artifact #3731. Probably a medium-size projectile point preform. Found 100 yards northeast of MacHaffie Site proper.
130	N1/W5	15 cm BS	11	indeterminate	ovate	bi-convex	II	complete	none	BCCS37	6.5	4.1	1	29.39	Forbis artifact #3713. Probably a medium-size projectile point preform. One side is sunbleached. Arises are worn and polished. The piece appears to have been tumbled in water.
131		surface	1	flake	ovate	bi-convex	II	proximal-medial fragment	none	YBCCS50		3.9	1.2	24.55	Forbis artifact #3717. Transverse fracture. Probably broke during manufacture. Found 500 yards west of MacHaffie Site proper.
132	N1/W3	3-6 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment	none	CCCS7		3.5	0.77	10.09	Forbis artifact #3715. Transverse fracture. Probably broke during manufacture.
133	N2/W2	15 cm BS	11	flake	indeterminate	bi-convex	II	distal-medial fragment	none	BCCS44		5.9	1.5	40.26	Forbis artifact #4702. Transverse fracture. Probably broke during manufacture.
134	N1/W2	24-30 cm BS	11	indeterminate	ovate	bi-convex	II	complete	none	YBCCS1d	4	3.6	0.74	13.18	Forbis artifact #3704. Inverted V-shaped piece missing from proximal end. Probably broke during manufacture.
135	N2/W1	9-12 cm BS	11	indeterminate	indeterminate	bi-convex	III	proximal-medial fragment	none	YBCCS43		2.6	0.73	5.15	Forbis artifact #3737. Transverse fracture. Probably broke during manufacture.
136	N1/W2	24-30 cm BS	11	flake	ovate	plano-convex	II	complete	none	YBCCS45	3.4	2.6	6.5	5.83	Forbis artifact #3709. Minimally retouched on both faces. Probably a small-size projectile point preform.
138	N1/W3	3 cm BS	11	indeterminate	ovate	irregular	II	complete	none	RCCS12	5.4	2.8	1.1	17.56	Forbis artifact #3723. Probably a medium-size projectile point preform.
139	N2/W2	15 cm BS	11	indeterminate	ovate	irregular	II	complete	none	RCCS15	7.7	6.6	1.7	83.75	Forbis artifact #3728. Small quarry blank.
140		surface	1	indeterminate	ovate	bi-convex	III	complete	none	BCCS32	5.1	3.6	0.93	17.32	Forbis artifact #3724. Probably a medium-size projectile point preform. The piece was not found at the MacHaffie Site.
141	S1/E6	15-30 cm BS	11	indeterminate	ovate	plano-convex	II	complete	none	CCCS3	4.8	3.2	1	18.98	Forbis artifact #2715. Probably a medium-size projectile point preform. Some cortex on one surface.
142	S1/E6	15-30 cm BS	11	indeterminate	indeterminate	bi-convex	III	distal-medial fragment	none	GBCCS20		4.8	0.9	13.24	Forbis artifact #3741. Transverse fracture. Probably broke during manufacture.
143	N2/W6	48 cm BS	11	flake	triangular	plano-convex	III	complete	none	BCCS38	4.8	2.1	0.66	6.52	Forbis artifact #1501. Provenienced as between Helena and Cody Components by Forbis but unclear why. Probably a medium-size point preform. Both faces fully flaked.
144		surface	1	indeterminate	triangular	bi-convex	III	proximal-medial fragment	none	BCCS9		2.1	0.35	1.88	Forbis artifact #1719. Probably a small-size point preform that broke during manufacture. Found 15 yards east of Forbis' tent.
146	N1/W1	30 cm BS	11	indeterminate	ovoid	bi-convex	III	proximal-medial fragment	none	RCCS48		2.4	0.55	4.86	Forbis artifact #1713. Probably a small or medium-size projectile point preform.

biface measurements are in centimeters

Figure 117. Non-Hafted Bifaces Assigned to the "Helena Component" (1).

Figure 118. Non-Hafted Bifaces Assigned to the "Helena Component" (2).

Figure 119. Non-Hafted Bifaces Assigned to the "Helena Component" (3).

Figure 120. Non-Hafted Bifaces Assigned to the "Helena Component" (4).

Figure 121. Non-Hafted Bifaces Assigned to the "Helena Component" (5).

Figure 122. Non-Hafted Bifaces Assigned to the "Helena Component" (6).

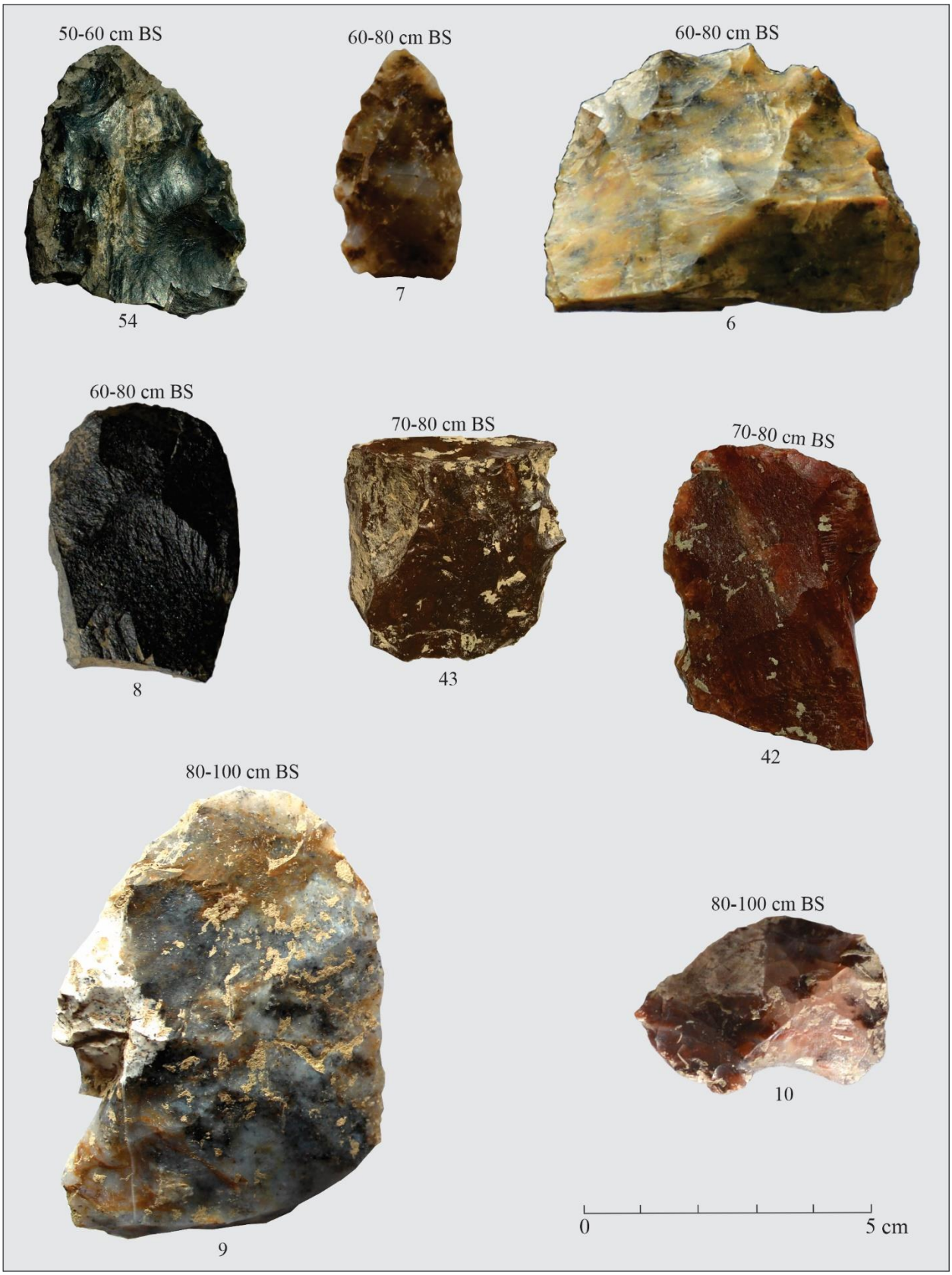


Figure 123. Non-Hafted Bifaces Assigned to the "Helena Component" (7).

Forty-six pieces (47%) are considered stage II bifaces with an average length of 5 cm, an average width of 3.85 cm, an average thickness of 1.2 cm, and an average weight of 27.28 grams. Fifty-two (53%) items are stage III bifaces with an average length of 3.6 cm, an average width of 3.2 cm, an average thickness of 0.7 cm, and an average weight of 10.71 grams. No stage I or stage IV bifaces are present (Callahan 1979). The majority (73%) of bifaces are ovate in shape and bi-convex in cross-section. Edge dulling or polish from use in cutting or scraping activities was not observed. Evidence of edge grinding for platform strengthening, however, is common. The size, shape and weights of the Helena Component bifaces are consistent with bifaces from other area Middle Precontact components (e.g., Davis and Rennie 2017; Rennie 2017; Rennie and Hughes 1998).

Most of the incomplete specimens (including the two broken bifaces now rejoined) probably broke during end or lateral thinning and were subsequently discarded. The lack of primary debitage and a disproportionate ratio of debitage to bifaces suggest that many of these artifacts were produced off-site. Some may be derived from heat-treated material, but the evidence is limited as only biface #29 exhibits a potlid.

Some of the Helena Component bifaces were intended to be projectile point preforms, some may have been intended to be cutting or scraping implements, and some were probably intended to be standardized, bifacial cores. Although smaller than the bifaces previously described for either the Folsom or Cody components, Helena Component bifaces are more similar to Cody bifaces in that they are less refined, far less standardized, and have greater thickness to width ratios than those of the Folsom component. The overall dimensions of the Helena Component bifaces are consistent with those recovered from nearby Middle and Late Precontact period components (Rennie 2017; Rennie and Hughes 1998).

Endscrapers (Tables 42 and 45; Figures 124-126)

Only one of the Helena Component endscrapers (Fig.125.3) was recovered by Les Davis' crew from excavation unit 14S/2E in 1990. The other six were recovered by Dick Forbis in 1951. Five are complete, one (#16) is a distal fragment, and one (#13) is a distal-medial fragment. The two partial endscrapers likely broke during use rather than manufacture. Excluding the two incomplete pieces, the endscrapers average 3.9 cm in maximum length and weigh 11.9 grams. All seven pieces combined average 2.68 cm in maximum width and 0.76 cm in maximum thickness. Three (#s 13-15) are plano-convex in form while all others are made on thin, flat flakes. All endscrapers are of chert (MANA designations BCCS18, BCCS46, RCCS6, WCCS5, and WCCS16). The distal edges of most of the endscrapers are noticeably sharp suggesting that they were used minimally if at all. All pieces show secondary retouch along the distal margins, and other margins to a lesser extent. These micro-flake removals tend to terminate in micro-step fractures.

One artifact (#16) is noticeably larger than the other pieces. It measures 6.4 cm in maximum length and 3.4 cm in maximum width with a maximum thickness of 1.0 cm and a weight of 28.05 grams. The other four complete endscrapers average 3.27 cm in maximum

Table 45. Metric, Nonmetric, and Provenience Data for Helena Component Endscrapers.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Style	Tool Condition	Retouch
3	14S/2E	30-40 cm BS	9	flake	thin/flat flake	complete	moderate
13	S1/W3	21-36 cm BS	11	flake	plano-convex	distal-medial fragment	moderate
14	S1/W1	39-55 cm BS	11	flake	plano-convex	complete	minimal
15	N2/W2	30 cm BS	11	flake	plano-convex	complete	minimal
16	N2/W1	3-6 cm BS	11	flake	thin/flat flake	distal fragment	moderate
17	S1/W3	9 cm BS	11	flake	thin/flat flake	complete	moderate
18	S1/E1	46-49 cm BS	11	flake	thin/flat flake	complete	moderate

Scraping Edge Condition	Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
minimally used	BCCS46	3.2	2.8	0.5	6.5	Found in two pieces. Glued together to make a complete endscraper. Cortex covers one lateral edge.
moderately used	BCCS18		2.7	0.54	5.07	Forbis artifact #2708
minimally used	WCCS5	3.8	2.3	1.4	9.56	Forbis artifact #2500. Made on heavily sunbleached material.
minimally used	BCCS18	2.6	2.4	0.87	7.83	Forbis artifact #2706
moderately used	WCCS16		2.6	0.48	2.57	Forbis artifact #2712
moderately used	WCCS5	6.4	3.4	1	28.05	Forbis artifact #2702
minimally used	RCCS6	3.5	2.6	0.56	7.65	Forbis artifact #2201

endscraper measurements are in centimeters

length, 2.52 cm in maximum width, 0.835 cm in maximum thickness, and have an average weight of 7.88 grams. The size and weight range of the Helena Component endscrapers is

consistent with the endscrapers from the nearby Quinn Creek (24JF110) and Jones Place-Adel (24CA1766) sites, both of which contain Middle and Late Period materials (Rennie 2017; Rennie and Hughes 1998). In contrast, the Helena Component endscrapers are markedly smaller on average than those assigned to the Cody component.

Drills/Awls

No drills, awls, or perforators have been recovered from the Helena Component in the MacHaffie site.

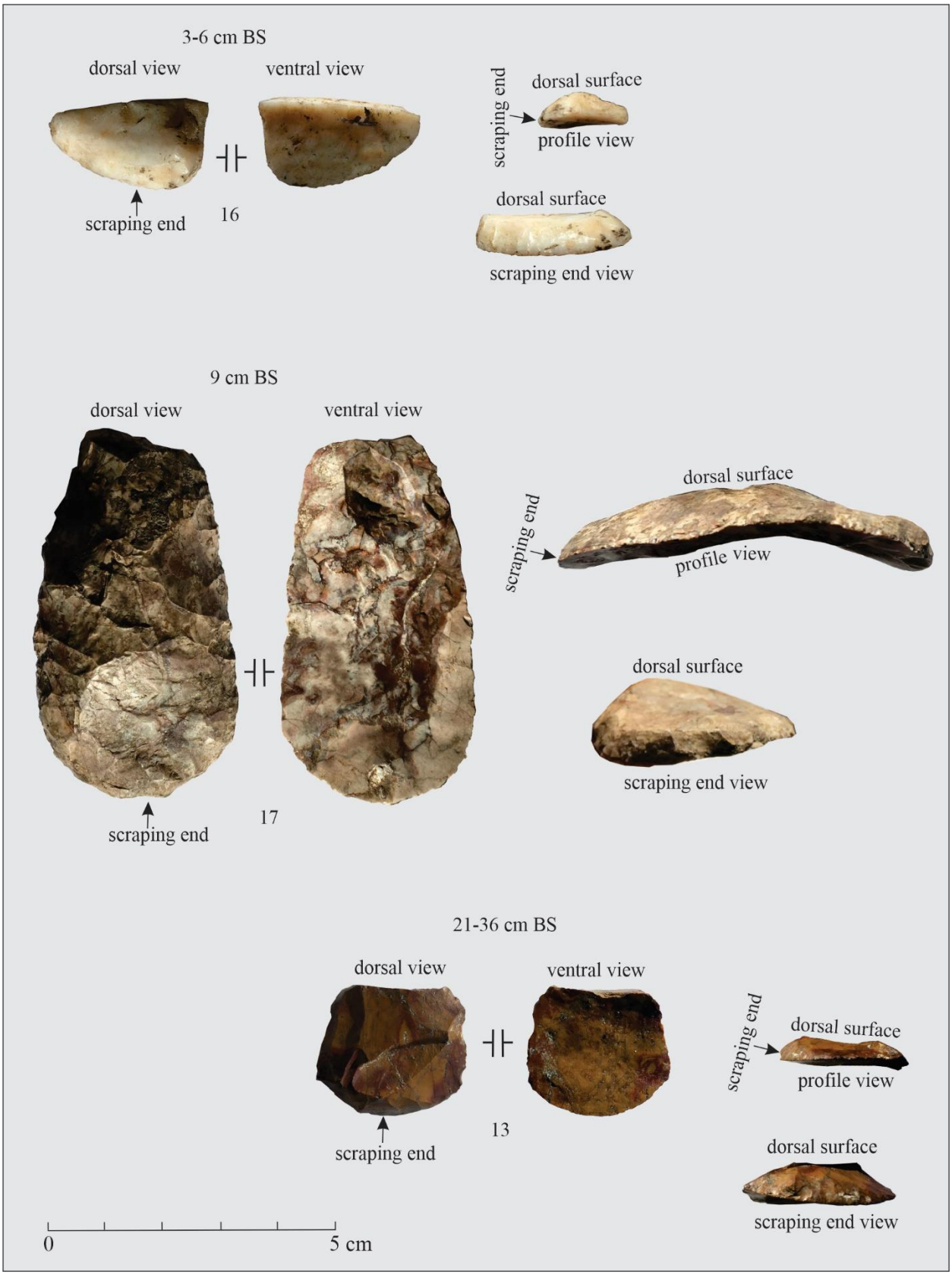


Figure 124. Endscrapers Assigned to the "Helena Component" (1).

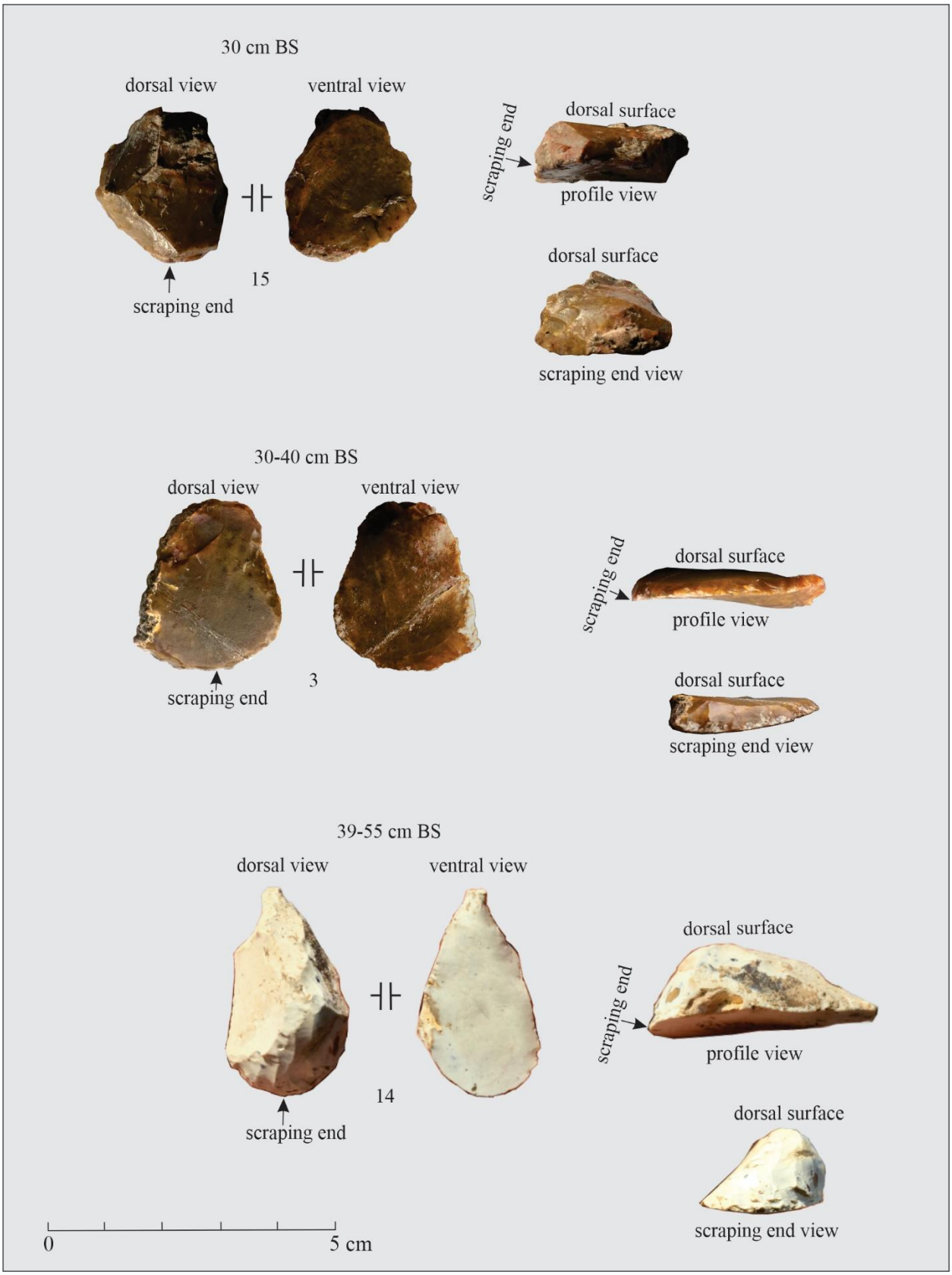


Figure 125. Endscrapers Assigned to the "Helena Component" (2).

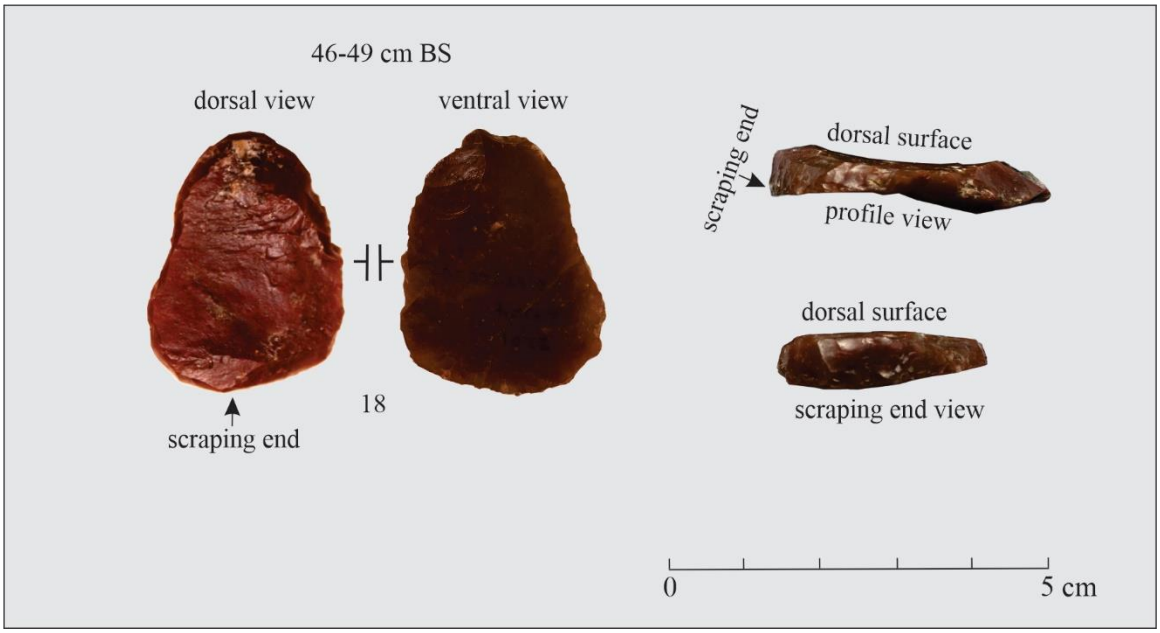


Figure 126. Endscrapers Assigned to the "Helena Component" (3).

Burins/Gravers (Tables 42 and 46; Figure 127)

Three probable gravers (Fig.127. 6, 7, 9) were recovered by Les Davis' crews from the upper 50 cm of sediment and from distinct excavation units. It is uncertain if any of the gravers were used. The chert gravers are assigned three MANA designations (BCCS21, CCCS8, and GBCCS18).

Graver #6 is made on a complete, Size-Grade 3, secondary reduction flake. The feature that distinguishes the piece as an implement is a short and thin pressure flaked projection at one lateral edge. The projection is 2 mm long, 4 mm wide at its base, and it tapers to 2 mm wide at its tip which may be slightly truncated (broken). It measures 1.4 cm in length, 1.5 cm in width, 0.25 cm in thickness, and it weighs 0.7 grams.

Graver #7 is made on a size-grade 2, secondary reduction flake fragment. The flaked projection is short and needle-like and occurs at one lateral edge. The projection is 2.04 mm long, 5 mm wide at its base and tapers to 1.1 mm wide at its tip. The piece has overall maximum dimensions of 2.04 cm in length, 2.47 cm in width, 0.31 cm in thickness, and it weighs 1.85 grams.

Graver #9 is made on a complete, size-grade 2, secondary reduction flake with a crushed platform. Shallow, steep, unifacial pressure flaking produced a short and needle-like projection along the distal edge of the flake. The projection is 2.6 mm long, 5 mm wide at its base and tapers to 1.7 mm wide at its tip. The piece has overall maximum dimensions of 2.1 cm in length, 2.9 cm in width, 0.45 cm in thickness, and it weighs 2.7 grams.

Table 46. Metric, Nonmetric, and Provenience Data for "Helena Component" Burins/Gravers.

Record #	Excavation Unit	Excavated Level Depth	CMU	Lithic Material Code	Artifact Type	Integrity	Max. Length	Max. Width	Max. Thickness/ Diameter	Weight (grams)	Comments
6	96-West Test	40-50 cm BS	6	CCCS8	graver	complete	1.4	1.5	0.25	0.7	Made on a complete secondary reduction flake. Possible graver is a short and thin flaked projection at one lateral edge. The projection is 2 mm long, 4mm wide at its base and tapers to 2 mm wide at its tip which may be slightly truncated (broken).
7	4S/0E	30-40 cm BS	10	GBCCS18	graver	complete	2.04	2.47	0.31	1.85	Made on a secondary flake fragment. Possible graver is a short and needle-like flaked projection at one lateral edge. The projection is 3.4 mm long, 5 mm wide at its base and tapers to 1.1 mm wide at its tip.
9	6S/4W	10-20 cm BS	9	BCCS21	graver	complete	2.1	2.9	0.45	2.7	Made on a ovate, secondary flake with a crushed platform. Shallow, steep, unifacial flaking produced a short and needle-like projection along distal edge. The projection is 2.6 mm long, 5 mm wide at its base and tapers to 1.7 mm wide at its tip.

graver measurements are in centimeters

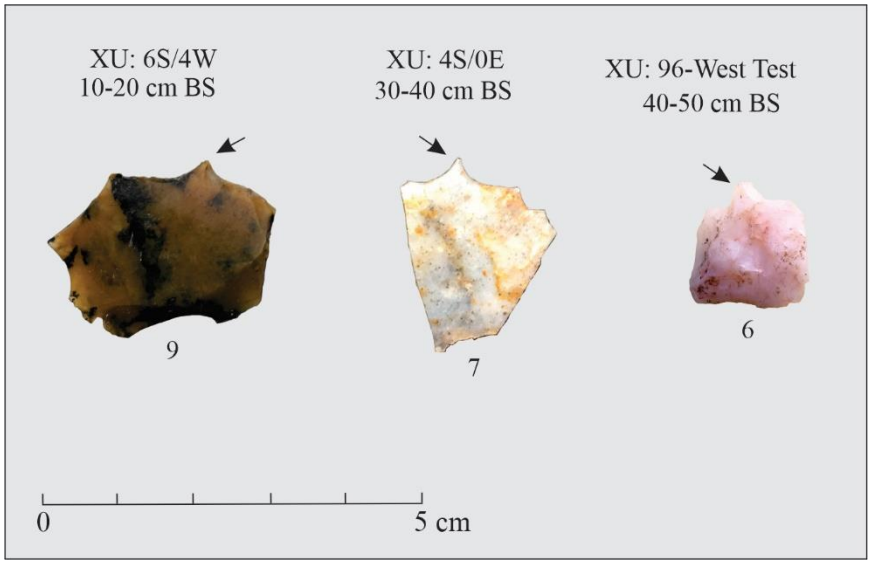


Figure 127. Burins/Gravers Assigned to the "Helena Component".

Spokeshaves (Tables 42 and 47; Figure 128)

Two artifacts (Fig.128. 12, 17) that appear to be unhafted spokeshaves were recovered by Les Davis' crews from the upper 20 cm of sediment in different excavation units. Both are made of chert secondary flakes constituting two distinct MANA designations (BCCS21 and BCCS19). Spokeshave #12 has overall dimensions of 2.3 cm in length, 1.9 cm in width, 0.56 cm in thickness, and it weighs 2.6 grams. Shallow, continuous, and patterned pressure flake removals from the exterior surface of distal margin produced a circular notch that measures 0.76 mm wide

x 0.31 mm deep. The secondary flaking is unidirectional and oriented at 80 degrees to the body of the flake, which gives a flattened appearance to the pressure modified surface.

Spokeshave #17 has overall dimensions of 2.9 cm in length, 1.4 cm in width, 0.9 cm in thickness, and it weighs 3.55 grams. Shallow, continuous, and patterned unidirectional pressure flake removals oriented at nearly 90 degrees to the body of the piece give the intentionally produced notch a flattened base. The notch measures 1.7 cm wide x 0.4 cm tall.

Table 47. Metric, Nonmetric, and Provenience Data for "Helena Component" Spokeshaves.

Record #	Excavation Unit	Excavated Level Depth	CMU	Debitage Type	Reduction Stage	Exterior Surface Flake Scar Count	Flake Scar Orientation	Lithic Material Code	Flake Shape	Flake Condition	Flake Termination Type	Platform Type	Flake Type
12	Unit 1	0-10 cm BS	7	flake	secondary	2	intersecting	BCCS29	ovate	complete	feather	point	shaping/thinning
17	2000-B	0-20 cm BS	4	flake	secondary	1		BCCS21	indeterminate	fragment			shaping/thinning

Type of Edge Modification	Number of Retouched Edges	Size Grade	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
unifacial flaking	1	2	2.3	1.91	0.56	2.6	Possible spokeshave. Shallow, continuous, and patterned flake removals from exterior surface of distal margin produced a circular notch that measures 0.76 mm wide x 0.31 mm deep.
unifacial flaking	2	1	2.9	1.4	0.9	3.55	Steep, nearly 90 degree flake removals give the notch a flattened base. Notch measures 1.7 cm wide x 0.4 cm tall.

spokeshave measurements are in centimeters

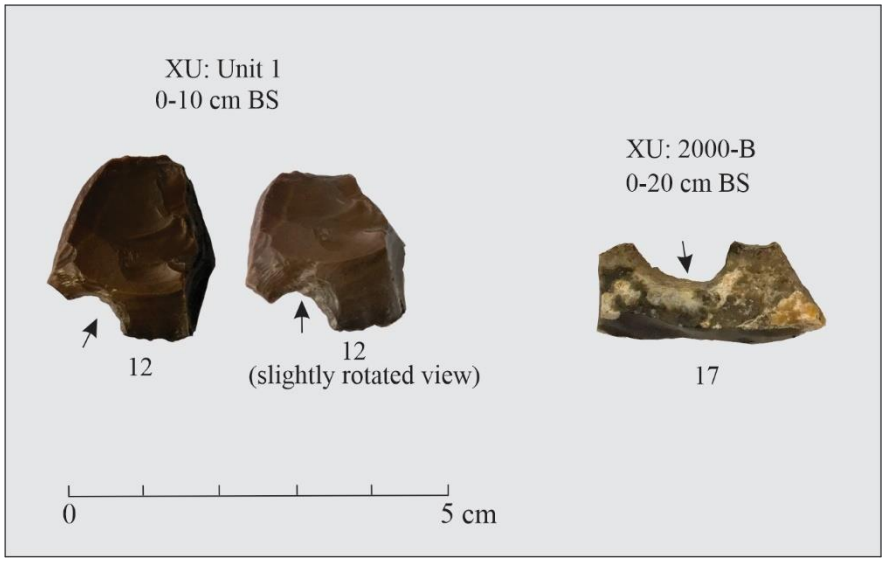


Figure 128. Spokeshaves assigned to the "Helena Component".

Cores (Tables 42 and 48; Figures 129-138)

Sixty-one cores are assigned to the Helena Component. The cores are heavily utilized, but several are not fully exhausted. Sixty are of chert and comprise 32 distinct MANA designations. Nineteen are represented by distinct MANA designations. Ten MANA designations (BCCS9, BCCS28, BCCS43, BCCS44, CCCS6, GBCCS5, GBCCS20, YBCCS1a, YBCCS4, and YBCCS18) are represented by two cores each, and MANA designations BCCS21, BCCS41, and CCCS7 have six to eight cores each. Core #2 is a sedimentary quartzite (SDQZT4b) cobble. The unprepared quartzite core is also one of the largest of the group. It measures 14 cm in length, 12.5 cm in width, 3 cm in maximum thickness, and it weighs 907.2 grams. The naturally flattened cobble with perimeter flake removals has a discoidal appearance.

Seventeen cores are bifacial (28%), seven are bipolar (11%), and 36 (59%) are unprepared or multi-directional. The bifacial cores average 6.5 cm in length, 4.8 cm in width, 2.4 cm in thickness, and have an average weight of 93.3 grams. They are considered cores not non-hafted bifaces because their greater thickness to width ratios would disallow further refinement. The bipolar cores (#3, 9, 7, 43, 62, 63, and 67) average 3.0 cm in length, 2.7 cm in width, 1.7 cm in thickness, and 15.25 grams in weight. The unprepared or multi-directional cores average 6.6 cm in length, and 5.5 cm in width, 3.3 cm in thickness. They have an average weight of 199.79 grams.

Three chert cores (#s 23, 24, and 91) are blocky pieces. Two (#s 2 and 90) are made on small cobbles. Eight (#s 8, 35, 42, 53, 61, 85, 86, and 89) are made on medium to large flakes. Seven (#s 36, 48, 49, 65, 70, 74, and 97) are made on medium to large nodules. Ten (#s 7, 9, 27, 28, 32, 37, 44, 55 62, and 67) are small nodules or pebbles. The original preform for the remainder could not be determined. Many were probably discarded when flakes could not be easily removed, but small flakes were being removed up to the end of each core's use-life.

One unique core (#64) is polyhedral, but it is sufficiently distinct from polyhedral cores of micro-blade technology. It is basically a small cone from which a sequence of flakes was removed longitudinally around its perimeter. The little core measures 1.5 cm in maximum length, 2.9 cm in maximum width, and it weighs 8.75 grams. How this piece was supported for striking is puzzling. It is too small to be supported between finger and thumb. It required a skilled knapper to strike the platform edge consistently fine and remove the very thin, straight, and constricting flakes evidenced by the scars.

Approximately 28 percent of the cores retain some cortex. Quality of the lithic material is generally good, but a few cores (#s 23, 32, 48, 55, 62, and 99) are of poor-quality chert. Instead of selecting the highest quality toolstone, the post-Cody occupants chose a wide range of toolstone quality and size. This seems counterintuitive when surrounded, as is the case for the MacHaffie site, with easily accessible and extremely good quality chert. However, this pattern was also observed among the Folsom and Cody components. In general, there seems to be more emphasis on small flake production from multi-directional cores then what was observed among the Folsom and Cody components.

Table 48. Metric, Nonmetric, and Provenience Data for "Helena Component" Cores.

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Core Type	Shape	Extent of Utilization	Condition	Retouch/Use-Wear
2	6S/6W	30-40 cm BS	2	cobble	unprepared	discoidal	moderate	complete	none
3	6S/6W	80-90 cm BS	2	indeterminate	bipolar	amorphous	extensive	fragment	none
4	6S/6W	30-40 cm BS	2	indeterminate	unprepared	amorphous	extensive	complete	none
6	6S/6W	0-10 cm BS	2	indeterminate	bifacial	bifacial	extensive	fragment	none
7	6S/6W	60-70 cm BS	2	pebble	bipolar	amorphous	minimal	complete	none
9	6S/6W	20-30 cm BS	2	pebble	bipolar	amorphous	minimal	complete	none
10	8S/6W	20-30 cm BS	2	indeterminate	unprepared	blocky	moderate	complete	none
11	TU-1	20-40 cm BS	3	indeterminate	unprepared	amorphous	extensive	complete	possible retouch or grinding along platform edge
23	2000-C	0-20 cm BS	4	block	unprepared	blocky	extensive	complete	none
24	2000-C	0-20 cm BS	4	block	unprepared	blocky	extensive	complete	none
25	2000-C	0-20 cm BS	4	indeterminate	bifacial	bifacial	extensive	complete	none
26	2000-C	0-20 cm BS	4	indeterminate	unprepared	amorphous	extensive	complete	none
27	2000-C	0-20 cm BS	4	small nodule	unprepared	amorphous	extensive	complete	none
28	2000-5	0-20 cm BS	4	small nodule	unprepared	amorphous	extensive	complete	none
32	2000-A	40-60 cm BS	4	small nodule	unprepared	amorphous	minimal	complete	none
33	2000-A	0-20 cm BS	4	indeterminate	unprepared	amorphous	moderate	complete	none

Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
SDQZT4b	14	12.5	3	907.2	SW quadrant (1x1 m subdivision); flattened cobble gives the piece a natural, roughly disc-shaped appearance. Five flake removals along margin; four removed from one face and one from opposite side.
BCCS21	2	1.8	1.1	5	NW quadrant (1x1 m subdivision); flattened cobble gives the piece a natural, roughly disc-shaped appearance. Five flake removals along margin; four removed from one face and one from opposite side.
BCCS12	3.2	3.4	2.4	23.65	SW quadrant (1x1 m subdivision); exhausted flake core.
BPCCS5	4.3	3	1.3	14.55	SW quadrant (1x1 m subdivision)
WCCS19	2.7	3.5	2.4	16	NE quadrant (1x1 m subdivision)
CCCS2	1.5	2.7	1	4.5	SW quadrant (1x1 m subdivision)
CCCS7	8	5.5	3.2	11.7	NW quadrant (1x1 m subdivision); random flake removals across surface. Piece is still viable for hard hammer reduction.
BCCS3	2	4.8	2.1	12.65	Possible bipolar core, not suitable for free-hand reduction work. Exhibits desire to produce small (short and thin) and straight flakes.
YBCCS4	13	12	8	1275.7	Many imperfections throughout the piece. Difficult to reduce into large flakes.
BCCS44	9.8	7.8	7.1	652	Still useable piece. Final series of randomly removed flakes were small (SG2) and straight.
CCCS7	8.5	5.5	4	155.9	Still useable piece. Cortex covers most of one surface.
CCCS7	6.6	6.2	2.3	128.2	Still useable piece. Final series of randomly removed flakes were small (SG2) and straight.
RCCS31	6.9	5.9	3.5	99.2	Still useable piece. Some cortex on both lateral edges on one side.
YBCCS3	4	4	2.4	28.15	Largely exhausted (too small) for free-hand reduction work.
RCCS13	5.5	5.6	3.9	149	Very poor quality material. Numerous internal vugs and fractures.
BCCS41	6.9	3	3	70.45	Some cortex remains on the core surface.

core measurements are in centimeters

Table 48: Metric, Nonmetric, and Provenience Data for "Helena Component" Cores (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Core Type	Shape	Extent of Utilization	Condition	Retouch/Use-Wear
34	2000-A	20-40 cm BS	4	indeterminate	unprepared	amorphous	moderate	complete	none
35	2000-A	20-40 cm BS	4	flake	unprepared	ovate	moderate	complete	none
36	2000-B	0-20 cm BS	4	large nodule	unprepared	blocky	moderate	complete	none
37	2000-B	0-20 cm BS	4	small nodule	bifacial	ovate	moderate	complete	none
38	2000-B	0-20 cm BS	4	indeterminate	unprepared	blocky	moderate	fragment	none
40	2000-B	20-40 cm BS	4	indeterminate	bifacial	ovate	moderate	complete	none
41	2000-B	20-40 cm BS	4	indeterminate	unprepared	amorphous	minimal	complete	none
42	2000-C	0-20 cm BS	4	flake	unprepared	ovate	moderate	complete	none
43	2000-C	0-20 cm BS	4	indeterminate	bipolar	amorphous	extensive	complete	none
44	2000-C	0-20 cm BS	4	small nodule	unprepared	amorphous	minimal	complete	none
48	98-South Block	10-20 cm BS	5	medium nodule	unprepared	nodular	minimal	complete	none
49	98-South Block	50-60 cm BS	5	medium nodule	unprepared	nodular	moderate	complete	none
50	98-South Block	60-70 cm BS	5	indeterminate	bifacial	bifacial	moderate	complete	none
52	96-West Test	60-70 cm BS	6	indeterminate	unprepared	blocky	moderate	complete	none
53	96-West Test	60-70 cm BS	6	flake	bifacial	triangular	moderate	complete	none
54	96-West Test	60-70 cm BS	6	indeterminate	bifacial	ovate	extensive	complete	none
55	Unit 1	20-30 cm BS	7	small nodule	unprepared	blocky	minimal	complete	none

Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
RCCS48	6	4	3.1	80.5	
YBCCS35	5.5	5.2	2.1	71.7	Unifacial flake core.
YBCCS18	9.6	10.7	7.4	1013	Cortex covers one end.
BCCS28	9	6.2	4.3	262	Flakes randomly removed from two opposing surfaces.
RCCS2	5.8	3.5	3.2	93.8	Still useable core of good quality material.
YBCCS1a	4.9	3	1.9	39.2	Flakes randomly (minimally) removed from two opposing surfaces.
BCCS21	4.8	3.4	2.7	36.25	
BCCS41	7	6.2	3.1	130	Random flake removals from all surfaces.
BCCS1	5.2	3.4	2.4	40	
BCCS21	4.7	3.3	2.3	35.35	Random flake removals. Some cortex on exterior surface.
YBCCS50	6.6	8.3	5.5	369	Some cortex on exterior surface. Moderate quality chert.
BCCS41	9.5	9	4.5	274	Some cortex on exterior surface.
BCCS28	4	3.5	1.5	29	Some cortex on exterior surface. Moderate quality chert.
CCCS6	7.5	4.7	3.7	216	Some cortex on exterior surface.
BCCS41	5.5	4.6	2.1	68	Some cortex on one face.
BCCS46	5	4.5	1.8	41	
BCCS9	5.5	5.5	4	196	Most flake scars (5-6 total) removed portions of the cortex, but tool quality of the piece is marginal.

core measurements are in centimeters

Table 48: Metric, Nonmetric, and Provenience Data for "Helena Component" Cores (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Core Type	Shape	Extent of Utilization	Condition	Retouch/Use-Wear
61	6S/4W	40-50 cm BS	9	flake	bifacial	ovate	moderate	complete	none
62	6S/4W	70-80 cm BS	9	pebble	bipolar	amorphous	moderate	complete	none
63	14S/2E	0-10 cm BS	9	indeterminate	bipolar	amorphous	extensive	fragment	none
64	2000-C	0-20 cm BS	4	indeterminate	polyhedral?	conical	extensive	complete	none
65	98-South Block	50-60 cm BS	5	medium nodule	unprepared	amorphous	moderate	complete	none
66	8S/4W	60-70 cm BS	9	indeterminate	bifacial	ovate	extensive	complete	none
67	14S/2E	30-40 cm BS	9	pebble	bipolar	ovate	extensive	complete	none
68	98-South Block	20-30 cm BS	5	indeterminate	unprepared	amorphous	extensive	complete	none
69	98-South Block	40-50 cm BS	5	indeterminate	unprepared	amorphous	moderate	complete	none
70	6S/4W	20-30 cm BS	9	medium nodule	unprepared	amorphous	moderate	complete	none
71	98-South Block	30-40 cm BS	5	indeterminate	unprepared	amorphous	extensive	complete	none
74	2S/0E	30-40 cm BS	10	medium nodule	unprepared	amorphous	extensive	complete	none
76	2N/0E	40-50 cm BS	10	indeterminate	unprepared	ovate	extensive	complete	none
83	S1/W4	9-12 cm BS	11	indeterminate	unprepared	amorphous	extensive	complete	none
84	S1/E6	15-30 cm BS	11	indeterminate	bifacial	ovate	moderate	complete	none
85	S1/W4	9-12 cm BS	11	flake	bifacial	ovate	moderate	complete	none

Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
BCCS21	6.5	4.5	2.5	74.85	Might be described as a Stage I biface. Cortex covers much of one surface.
BCCS41	3.5	3.2	2.4	25.2	Poor quality. Hard to tell where cortex ends and interior material begins.
BCCS9	3.2	1.8	1.2	6.7	
BCCS21	1.5	2.9		8.75	Core is difficult to describe. Something like a small cone from which very small flakes run vertically parallel. How this piece was supported for striking flakes off is a bit of a mystery. Too small to support well between finger and thumb.
CCCS7	7.8	5.1	5	219	Some cortex on one surface.
BCCS21	6.9	4.9	1.8	77	
BCCS21	3.1	2.8	1.2	9.4	
CCCS7	4.7	3.8	2.3	36	
CCCS6	6.6	4	2.2	63	
BCCS41	7.6	6.7	4.3	168	
BCCS41	4.1	4.1	2.5	44	
YBCCS51	10.2	5	3	145	Discontiguous cortex on one surface.
BCCS43	7.1	5	2.1	89.55	
GBCCS5	4.7	3.2	2	24.27	Forbis artifact #2709
GBCCS20	6.7	4.8	2.8	79.57	Forbis artifact #4708
YBCCS18	6.1	4.6	1.9	57.15	Forbis artifact #4700

core measurements are in centimeters

Table 48: Metric, Nonmetric, and Provenience Data for "Helena Component" Cores (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Preform	Core Type	Shape	Extent of Utilization	Condition	Retouch/Use-Wear
86	N1/W1	27 cm BS	11	flake	bifacial	square	minimal	complete	none
87	N2/W5	18 cm BS	11	indeterminate	bifacial	ovate	moderate	complete	none
88	N2/W2	15 cm BS	11	indeterminate	bifacial	ovate	moderate	complete	none
89	S1/E6	15-30 cm BS	11	flake	bifacial	ovate	minimal	complete	none
90	N2/W2	15 cm BS	11	cobble	unprepared	amorphous	extensive	complete	none
91	N2/W2	21 cm BS	11	block	unprepared	amorphous	minimal	complete	none
97	N2/W6	15-30 cm BS	11	nodule	unprepared	amorphous	moderate	complete	none
98	N2/W4	0-15 cm BS	11	indeterminate	bifacial	ovate	extensive	complete	none
99	N1/W2	15-30 cm BS	11	indeterminate	bifacial	ovate	extensive	complete	none
100	N1/W2	30-45 cm BS	11	indeterminate	unprepared	ovate	minimal	complete	none
101	N1/W2	15-30 cm BS	11	indeterminate	unprepared	amorphous	moderate	complete	none

Lithic Material Code	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
GBCCS36	4.1	4.3	1.3	30.46	Forbis artifact #4500
GBCCS5	4.8	4.2	1.5	32.96	Forbis artifact #3746
CCCS7	7.2	5.9	3	126	Forbis artifact #4704
GBCCS20	8.8	6.7	2.7	180	Forbis artifact #4705
BCCS44	5.8	6.5	3.8	147	Forbis artifact #4707
BCCS43	9.4	5.6	2.9	172	Forbis artifact #4706
YBCCS42	5	4.5	2.1	57	Cortex covers one face.
BCCS21	7.2	5	3.5	91	
YBCCS1a	10.6	6.9	3.5	228	Numerous vugs and cavities throughout the piece.
YBCCS4	6	4.1	2.5	88	
GBCCS11	6.3	4.5	2.8	65	

core measurements are in centimeters

Figure 129. Cores Assigned to the "Helena Component" (1).

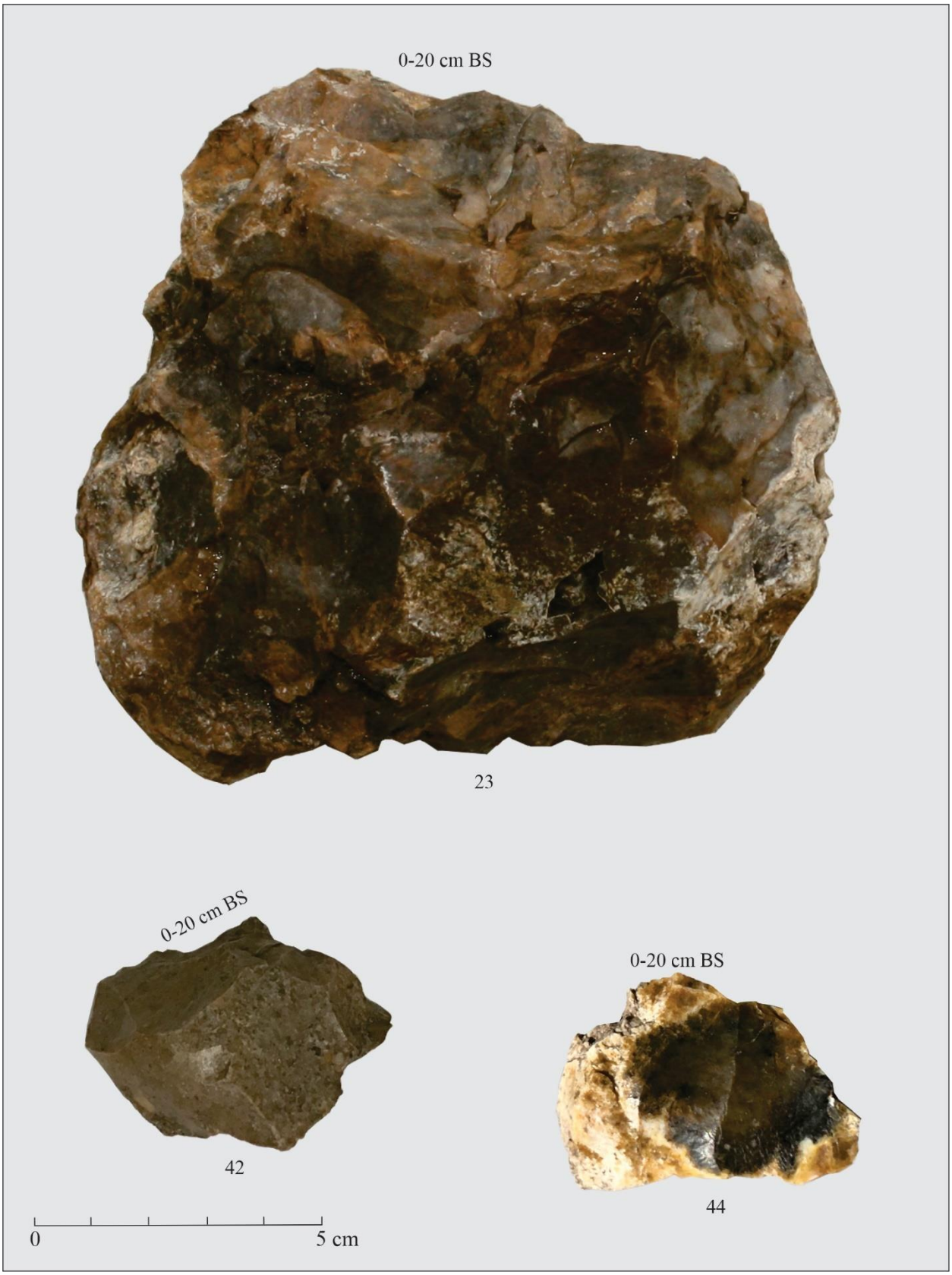


Figure 130. Cores Assigned to the "Helena Component" (2).

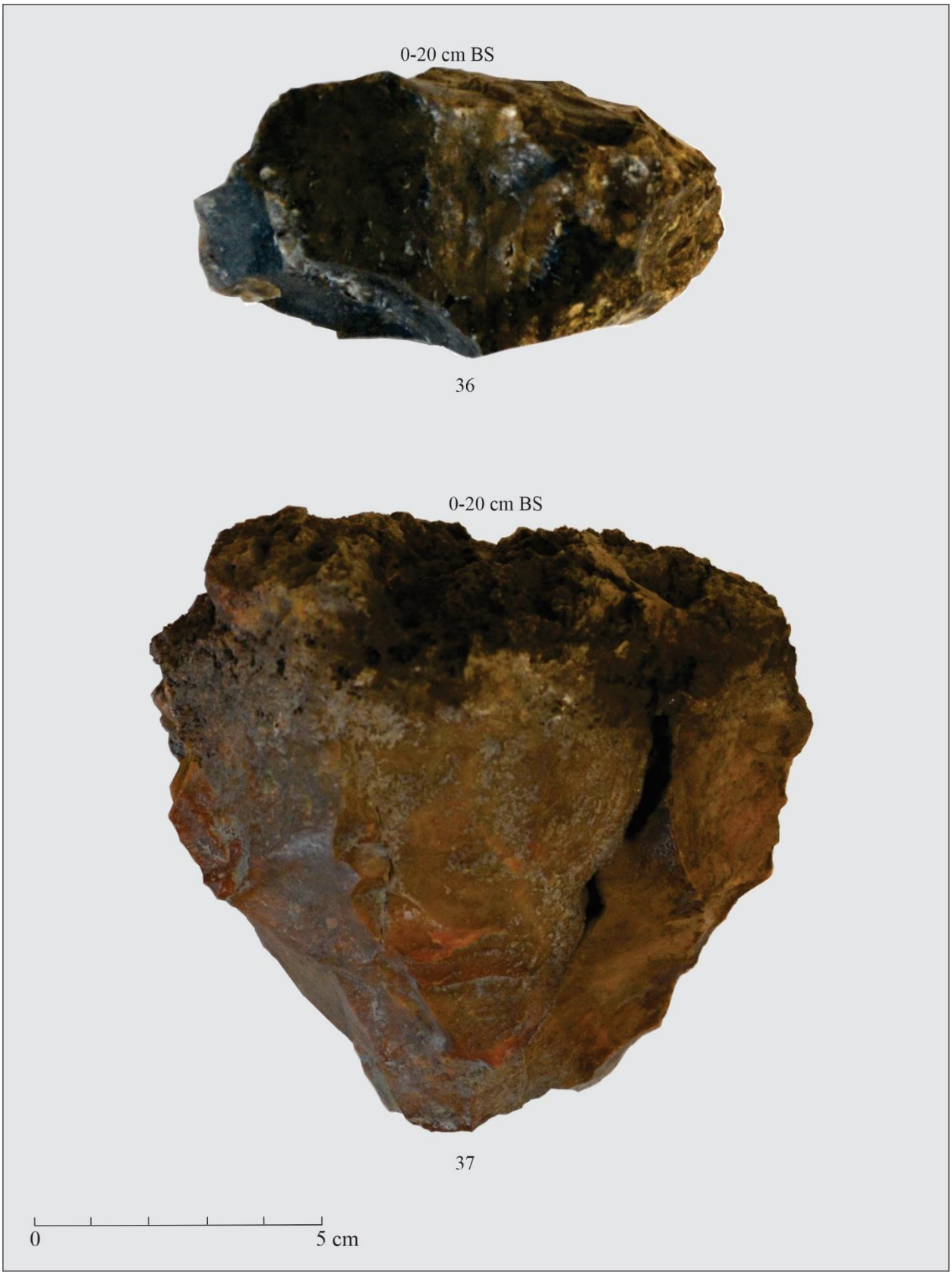


Figure 131. Cores Assigned to the “Helena Component” (3).

Figure 132. Cores Assigned to the "Helena Component" (4).

Figure 133. Cores Assigned to the "Helena Component" (5).

Figure 134. Cores Assigned to the "Helena Component" (6).

Figure 135. Cores Assigned to the "Helena Component" (7).

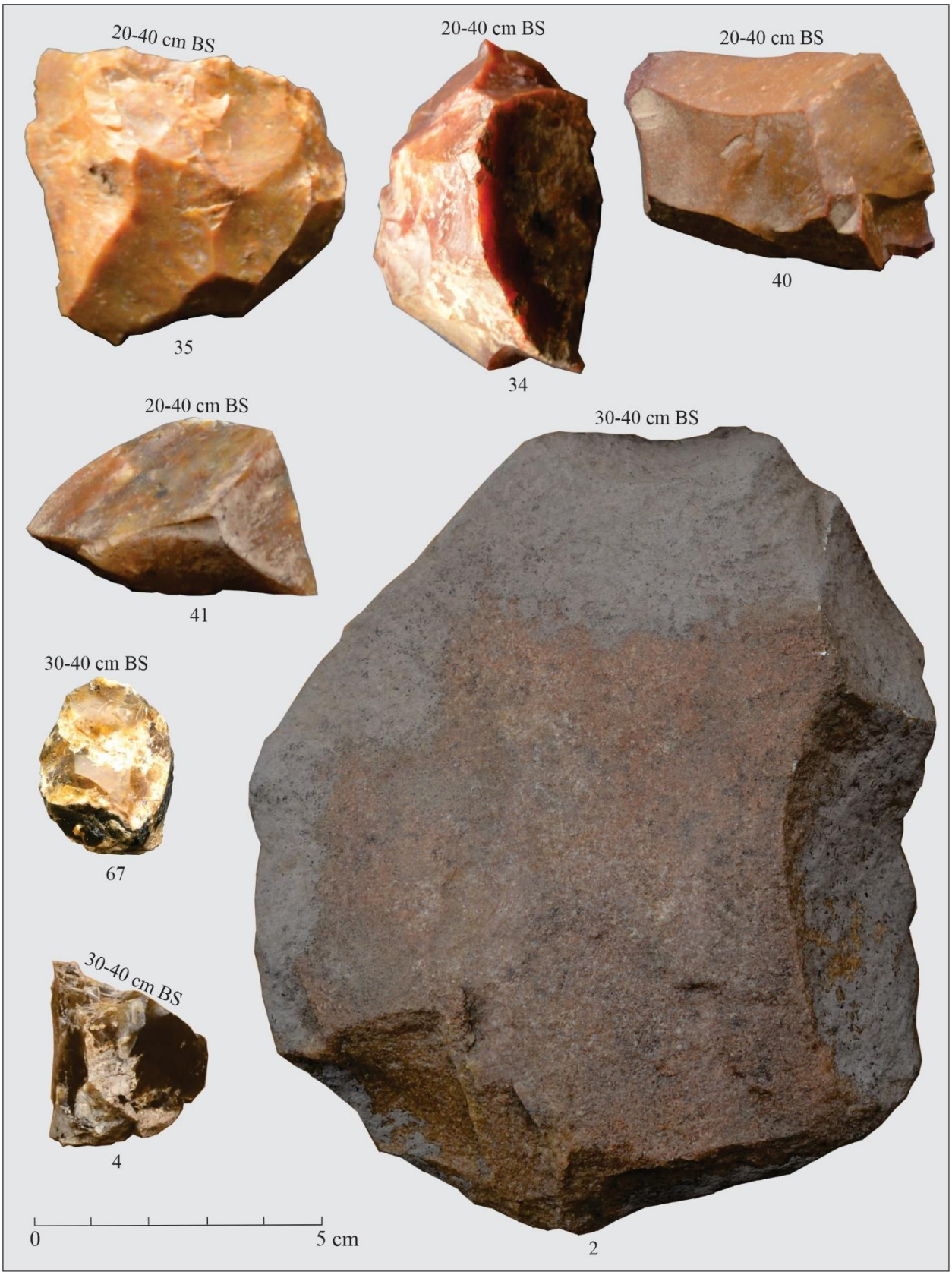


Figure 136. Cores Assigned to the "Helena Component" (8).

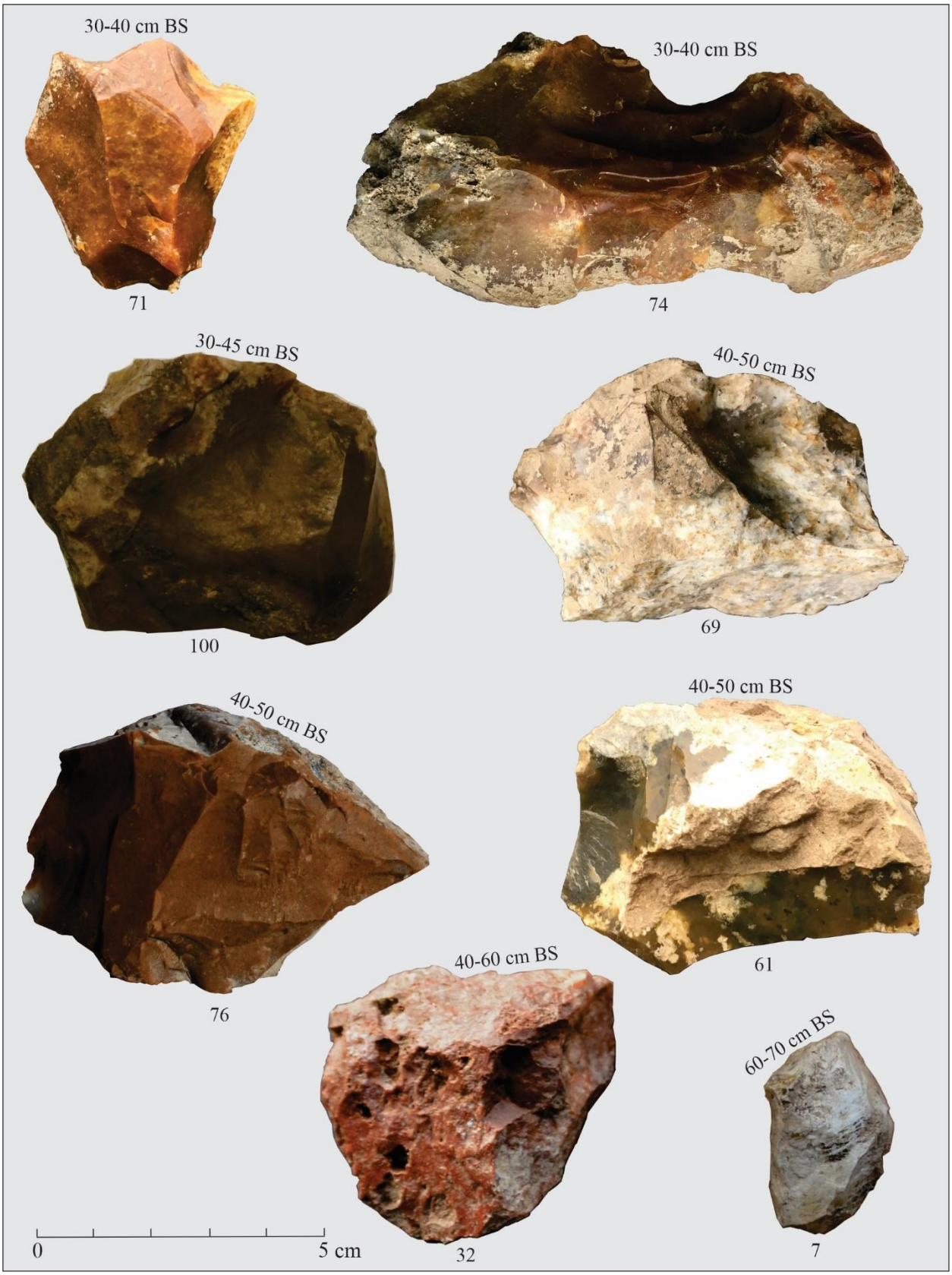


Figure 137. Cores Assigned to the "Helena Component" (9).

Figure 138. Cores Assigned to the "Helena Component" (10).

Debitage with Edge-Flaking/Modification (DEF/M) (Tables 42 and 49; Figures 139 and 140)

Assigned to the "Helena Component" are 24 secondary flakes that exhibit edge modification. Twenty are made of chert representing 16 MANA designations. Chert MANA designations BCCS41 (#s 1 and 13) and CCS2 (#s 35 and 36) are represented in two instances each and the YBCCS4 MANA designation is represented in three occurrences (#s 8, 37, and 43). In addition to chert, one DEF/M (# 39) is of sedimentary quartzite (SDQZT4m), one (#11) is of dacite (DAC1), and two (#s 33 and 34) are of opaque black obsidian (OBS1). Only three (#s 18, 33, and 36) are clearly derived from mid to late reduction stage bifaces and comprise three distinct MANA designations (GBCCS18, OBS1, and CCCS2). All other DEF/M could have been removed from early to mid reduction stage bifaces, prepared cores, or even unprepared cores. Ten of the DEF/M are Size Grade 1 pieces, 12 are Size Grade 2 pieces, and two are small size grade 3 pieces. Removing the two smallest pieces from the collection shows an average length of 3.8 cm, an average width of 3.1 cm, an average thickness of 0.8 cm, and an average weight of 11.6 grams. The largest DEF/M (#38) measures 6.3 cm in length, 3.0 cm in width, 1.8 cm in thickness, and it weighs 33.14 grams. The smallest DEF/M (#8) measures 1.4 cm in length, 1.8 cm in width, 0.4 cm in thickness, and it weighs a mere 0.85 grams.

Eleven DEF/M exhibit secondary unifacial flaking along one edge, six pieces exhibit unifacial flaking along two distinct edges of the same face, and one exhibits unifacial flaking along three distinct edges of the same face. Two DEF/M exhibit bifacial flaking of a single edge while a third piece exhibits bifacial secondary flaking of three distinct edges. One DEF/M (#37) has bifacial flaking along the proximal edge and shallow, unifacial flaking along the exterior surface of the distal edge. Another (#10) exhibits unifacial flaking along the exterior surface of the distal margin and one lateral edge. A third piece (# 34) shows alternating bifacial and unifacial flaking around the perimeter, and the unifacial flaking is not restricted to one side of the flake. Sixteen pieces (67%) exhibit unifacial edge modification along the exterior flake surfaces only. Comparable but slightly lower percentages were observed at the nearby Quinn Creek (24JF110) and the Jones Place-Adel sites (24CA1766), but it is uncertain what this trend implies.

The post-production edge-modification is largely shallow, broad, fine, feather-terminating micro-flake removals—generally as a series, most of which extend less than 2 mm from the edge of the piece into the flake body. Only the dacite piece (#11) exhibits obvious dulling and polish of the modified edge. However, high-magnification examination was not conducted for this study. While some of the secondary edge modification is no doubt intentional, much of the "retouch" pattern and polish/wear could have resulted from scraping or cutting moderately soft material (cf. Odell and Odell-Vereeken 1980).

Table 49. Metric, Nonmetric, and Provenience Data for "Helena Component" DEF/M.

Record #	Excavation Unit	Excavated Level Depth	CMU	Debitage Type	Reduction Stage	Exterior Surface Flake Scar Count	Flake Scar Orientation	Lithic Material Code	Flake Shape	Flake Condition	Flake Termination Type	Platform Type	Flake Type
1	6S/6W	0-10 cm BS	2	flake	secondary	3	intersecting	BCCS41	elongate	fragment			shaping/thinning
3	2000-6	60-80 cm BS	4	flake	secondary	2	parallel	YBCCS1d	elongate	complete	feather	flat	shaping/thinning
4	2000-6	20-40 cm BS	4	flake	secondary	1		YBCCS1a	indeterminate	fragment			shaping/thinning
7	2000-A	40-60 cm BS	4	flake	secondary	1		CCCS7	indeterminate	fragment	feather	indeterminate	shaping/thinning
8	2000-A	20-40 cm BS	4	flake	secondary	2	parallel	YBCCS4	ovate	complete	feather	flat	shaping/thinning
9	2000-C	60-80 cm BS	4	flake	secondary	5	intersecting	WCCS5	ovate	complete	feather	flat	shaping/thinning
10	98-South Block	0-10 cm BS	5	flake	secondary	5	intersecting	BCCS16	triangular	complete	feather	flat	shaping/thinning
11	96-West Test	40-50 cm BS	6	flake	secondary	1		DAC1	elongate	complete	feather	point	shaping/thinning
13	2N/0E	0-10 cm BS	10	flake	secondary	2	intersecting	BCCS41	ovate	complete	feather	flat	shaping/thinning
18	6S/2W	10-20 cm BS	9	flake	secondary	3	intersecting	GBCCS18	elongate	complete	feather	flat	biface thinning
19	98-South Block	70-80 cm BS	5	flake	secondary	2	parallel	WCCS14	elongate	broken		point	shaping/thinning
33	S1/E1	0-5 cm BS	11	flake	secondary	5	intersecting	OBS1	elongate	complete	feather	point	biface thinning
34	S1/E6	15-30 cm BS	11	flake	secondary	3	intersecting	OBS1	elongate	complete	feather	point	shaping/thinning
35	S1/E6	15-30 cm BS	11	flake	secondary	2	intersecting	CCCS2	elongate	complete	feather	flat	shaping/thinning
36	N2/W1	18-21 cm BS	11	flake	secondary	5	intersecting	CCCS2	indeterminate	fragment	feather	indeterminate	biface thinning
37	N1/W6	0-15 cm BS	11	flake	secondary	3	intersecting	YBCCS4	ovate	complete	feather	flat	shaping/thinning
38	N1/W6	0-15 cm BS	11	flake	secondary	4	intersecting	BCCS46	elongate	complete	feather	flat	shaping/thinning
39	S1/W4	9-12 cm BS	11	flake	secondary	2	intersecting	SDQZT4m	elongate	fragment	feather	indeterminate	shaping/thinning
40	N2/W2	6-9 cm BS	11	flake	secondary	4	intersecting	RCCS2	ovate	complete	feather	crushed	shaping/thinning
41	N1/E2	0-3 cm BS	11	flake	secondary	9	intersecting	RCCS5	elongate	fragment	feather	indeterminate	finishing
42	N1/W3	3-6 cm BS	11	flake	secondary	3	intersecting	BCCS47	elongate	fragment	feather	indeterminate	shaping/thinning
43	N1/W4	3-6 cm BS	11	flake	secondary	4	intersecting	YBCCS4	elongate	complete	feather	flat	shaping/thinning

Type of Edge Modification	Number of Retouched Edges	Size Grade	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
bifacial flaking	1	1	2.6	4.2	0.7	16.95	Shallow and erratic flake removals have formed a somewhat jagged edge. Probably formed through cutting or scraping hard material. Recovered from NW quadrant (1 x 1 m subdivision).
unifacial flaking	1	3	2.5	1.2	0.6	1.4	Patterned unifacial flake removals along exterior surface of distal margin.
unifacial flaking	1	2	1.8	2.5	0.5	2.2	Shallow and erratic flake removals from exterior surface of one lateral edge.
unifacial flaking	1	2	2.8	3.2	0.7	6.3	Shallow, but continuous and patterned flake removals from exterior surface of distal edge.
unifacial flaking	1	3	1.4	1.8	0.4	0.85	Shallow, steep-angled, continuous, and patterned flake removals from interior surface of one lateral edge.
unifacial flaking	2	1	4.6	2.8	1.2	15.3	A thick (plano-convex) flake with shallow, steep-angled, continuous, and patterned flake removals from exterior surfaces of both lateral edges.
combination flaking	3	2	2.9	2.6	0.3	3.35	Shallow but continuous and patterned flake removals. Unfacial flaking along exterior surface of distal margin and one lateral edge. Bifacial flaking along other lateral edge.
unifacial flaking	1	1	4.5	2.8	0.4	4.85	XRF Sample D-24 (2018). Shallow, continuous flake removals from interior surface of distal margin. The retouch exhibits a dull polish. The secondary flaking has a flattened appearance presumabaly from the degree of wear it has experienced.
unifacial flaking	1	2	2.2	3.1	0.6	5.3	Shallow, continuous, and patterned flake removals from exterior surface of distal margin.
unifacial flaking	1	1	6.3	3.1	0.9	21.9	Shallow, continuous and patterned flake removals from exterior surface of intact lateral margin. Flake is longitudinally split.
unifacial flaking	1	1	1.7	1.8	0.3	1.3	Shallow, continuous and patterned flake removals from exterior surface of one lateral margin.
unifacial flaking	2	2	5.2	1.8	0.49	4.56	Forbis artifact # 3743; XRF Sample O-12. Shallow and nearly continuous intentional flake removals from exterior surface of both lateral margins.
combination flaking	2	2	3.4	2.1	0.45	3.13	Forbis artifact #1734. Shallow, unifacial and bifacial flaking around perimeter.
unifacial flaking	2	2	5.7	2.6	1.1	16.7	Forbis artifact #2718. Shallow, unifacial flaking of exterior surface of one lateral edge and distal end.
unifacial flaking	1	2	2.4	6.2	1.3	20.14	Forbis artifact #3714. Shallow, unifacial flaking along a short segment of exterior surface of one lateral margin.
combination flaking	2	1	4.2	4.3	0.9	14.3	Forbis artifact #3734. Bifacial retouch along proximal edge, and shallow, unifacial flaking along exterior surface of distal edge.
unifacial flaking	2	1	6.3	3	1.8	33.14	Forbis artifact #2716. Shallow, unifacial flaking along exterior surfaces of both lateral edges. The piece appears to be part of a core.
unifacial flaking	2	2	3	2.8	0.57	6.56	Forbis artifact #3718. Shallow, unifacial flaking along exterior surface of one lateral edge and distal end.
unifacial flaking	1	1	5	4.7	1.4	21.84	Forbis artifact #2711. Shallow, unifacial flaking along exterior surface of distal end.
bifacial flaking	3	2	2.8	1.7	0.4	2.63	Forbis artifact #1722. Bifacial retouch along both lateral margins and distal end.
unifacial flaking	3	1	3	3.7	0.93	12.36	Forbis artifact #2704. Shallow, unifacial flaking along exterior surface of both lateral margins and distal end.
unifacial flaking	1	2	4.3	2.2	0.8	10.86	Forbis artifact #2720. Shallow, unifacial flaking along exterior surface of a rounded projection at distal end of flake.

DEF/M measurements are in centimeters

Table 49. Metric, Nonmetric, and Provenience Data for “Helena Component” DEF/M (continued).

Record #	Excavation Unit	Excavated Level Depth	CMU	Debitage Type	Reduction Stage	Exterior Surface Flake Scar Count	Flake Scar Orientation	Lithic Material Code	Flake Shape	Flake Condition	Flake Termination Type	Platform Type	Flake Type
44	N3/W4	12-15 cm BS	11	flake	secondary	3	intersecting	YBCCS35	elongate	complete	feather	flat	shaping/thinning
45	S1/E6	15-30 cm BS	11	flake	secondary	3	intersecting	RCCS8	elongate	complete	feather	flat	shaping/thinning

Type of Edge Modification	Number of Retouched Edges	Size Grade	Max. Length	Max. Width	Max. Thickness	Weight (grams)	Comments
unifacial flaking	2	1	5.1	3.7	1.1	20.2	Forbis artifact #5700. Continuous, shallow, unifacial flaking along exterior surfaces of both lateral margins.
bifacial flaking	1	2	4.4	2.6	0.87	12.24	Forbis artifact #3735. Shallow, sporadic bifacial flaking of exterior surface of one lateral edge.

DEF/M measurements are in centimeters

Figure 139. "Helena Component" DEF/M (1). Arrows Indicate Edge Modification.

Figure 140. "Helena Component" DEF/M (2). Arrows Indicate Edge Modification.

Unmodified Debitage (Tables 42, 50-52; Figures 141 and 142)

A total of 10,231 pieces of lithic debitage (24,047.48 g) is associated with the Helena Component. The lithic materials fall into 198 distinct MANA designations and are generally described as dacite, granite, chert, obsidian, orthoquartzite (siliceous sandstone), clear quartz crystal, and sedimentary quartzite. In terms of lithic raw materials represented, 98 percent (n=10,106 pieces) is chert.

Very little angular shatter (n=196 or 2%) is represented among the debitage suggesting that initial preparation took place off-site. Even this percentage seems remarkably low considering the tendency for Montana cherts to be rife with internal fractures and other anomalies. Approximately 20 of these pieces are wedge-shaped and possibly reflect bipolar core reduction debitage. Further, only 203 (2%) pieces of debitage are classified as primary reduction stage, and 184 of those pieces are decortication flakes. One hundred eleven of those pieces (1%) exhibit full cortex coverage of exterior (dorsal) surfaces, and all are chert. One hundred two pieces (1%) exhibit 50 to 99 percent cortical coverage. Those pieces are also chert. Two hundred eight pieces (2%) exhibit 1-49 percent cortical coverage. Although the majority is of chert, four of those pieces are of dacite. Most of the debitage (n=9,810 or 96%) exhibits no cortex. Not surprisingly, this includes non-chert lithic raw materials imported more than a few kilometers.

Imported lithic materials slightly increase in frequency compared to the Cody and Folsom components, but non-chert materials are still poorly represented. These consist of a fragment of a clear quartz crystal, one orthoquartzite flake, eight secondary pieces of moderately fine-grained sedimentary quartzite, 18 pieces of obsidian, and 79 pieces of dacite. Although not an imported lithic material, the local granite (GRAN1a: n=2 and GRAN5: n=16 flakes) was occasionally percussion flaked by Middle or Late Period occupants. Its presence in the Helena Component is more limited than that observed among the Folsom and Cody components.

Color and texture range is great with no obvious color patterning. However, the mixing of multiple components could skew any patterning that existed. Heat-treatment of the lithic material is not obvious but also hard to recognize among the highly siliceous local chert. Ninety-six pieces representing 35 MANA designations exhibit potlids on one or more surface, crazing fractures, or a brittle, waxy-looking, botryoidal appearance to the subsurface. These attributes suggest poorly controlled thermal alteration, but it is unclear if this alteration was intentional or even cultural.

Most of the chert was likely obtained from local sources (see Figure 3). Much of the yellow, brown, and gray-toned chert could have been obtained as close as the hillside (24JF880) at the northeast side of the MacHaffie site. Numerous other sources in the Montana City area also produce a wide range of colors and textures (Rennie n.d.). There is a good deal of chert fairly distinctive of the Palmer Chert Quarries (the agate-like and grayish-brown to grayish-blue cherts assigned MANA units CCCS3, CCCS6, CCCS7, GBCCS18, and GBCCS20). The reddish-brown and orangish-red cherts of MANA units BCCS41 and RCCS48 are distinctive (although not exclusive to) of the quarries assigned site number 24JF881 (Figure 3).

Table 50. Flake Platform Morphology: Helena Component Unmodified Debitage.

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
BCCS1		1	4			5
BCCS2	2		5			7
BCCS3	3		2			5
BCCS4	7	3	4			14
BCCS5	2	3	9	1		15
BCCS6	1	4	4			9
BCCS7	5	2	5	1		13
BCCS8	16	3	9	2		30
BCCS9	97	31	134	11	1	274
BCCS11	2		2			4
BCCS12	6	4	14	3		27
BCCS13			1			1
BCCS14	1		1			2
BCCS15	4		3			7
BCCS16	12		14	1		27
BCCS18	6	2	8			16
BCCS19	8		5	2		15
BCCS20	1	1	2	1		5
BCCS21	144	34	310	20	2	510
BCCS23	7	3	22	1		33
BCCS25		1	2			3
BCCS26	6					6
BCCS27	1	2	2			5
BCCS28	42	7	73	8		130
BCCS29	18	1	16	2		37
BCCS31	8	1	5	2		16
BCCS32		1	2	1		4
BCCS33	1		4	1		6
BCCS34	1	1				2
BCCS35	2		3			5
BCCS37	1	1	3	1		6
BCCS38	31	5	61	1		98
BCCS39	5	1		1		7
BCCS40		1	3			4
BCCS41	138	22	110	19	1	290
BCCS42	6		4	1		11
BCCS43	8		16	3		27
BCCS44	31	6	14	1		52
BCCS45	2		1	1		4
BCCS46	35	12	40	9	1	97
BCCS47	4					4
BPCCS2	1	1	1	1		4
BPCCS5	7	4	19			30
CCCS1	36	10	54	3		103
CCCS2	102	28	143	15		288
CCCS3	159	33	261	14	3	470
CCCS4	4	3	5	2		14
CCCS5	18		9			27
CCCS6	16	10	27	2		55

Table 50. Flake Platform Morphology: Helena Component Unmodified Debitage (continued).

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
CCCS7	207	45	193	19	1	465
CCCS8	39	8	51	5		103
CCCS9	5	5	28	3		41
DAC1	5	6	26	5	1	43
GBCCS3	2	1				3
GBCCS5	11	2	10	4		27
GBCCS6	1					1
GBCCS9	3	3	11	2		19
GBCCS11	1		1			2
GBCCS13	1					1
GBCCS14	3	1	1			5
GBCCS15			1			1
GBCCS16	1	1				2
GBCCS17			1			1
GBCCS18	81	54	120	13	2	270
GBCCS19			1	1		2
GBCCS20	43	6	14	4		67
GBCCS21			3			3
GBCCS26			2			2
GBCCS28			3			3
GBCCS31	2	2				4
GBCCS36	7	3	4	3		17
GBCCS38	18	8	11	2	1	40
GBCCS39	10		11			21
GBCCS41			3			3
GBCCS66	13	1	11	1		26
GRAN1a			1			1
GRAN5	8		3			11
OBS1		2		1		3
OBS2	2		5	2		9
OQTZ2			1			1
QTZCRY1						0
RCCS1	4	2				6
RCCS2	11	3	11	2		27
RCCS3	28	6	50	3		87
RCCS4	31	4	47	3	1	86
RCCS5	3	1	6			10
RCCS6	15	4	62		1	82
RCCS7	3		4			7
RCCS8	8	1	3	1		13
RCCS9	1	1	2			4
RCCS11	12	1	18	1		32
RCCS12	12	5	20	4		41
RCCS13	8	2	3			13
RCCS14	4	2	3	1		10
RCCS15						0
RCCS16	2	1	5		1	9
RCCS17			1			1
RCCS18	1		1	1		3

Table 50. Flake Platform Morphology: Helena Component Unmodified Debitage (continued).

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
RCCS19	45	8	115	11		179
RCCS20	1					1
RCCS21	4		18	2		24
RCCS22	4		3			7
RCCS23	1		1			2
RCCS24	2					2
RCCS25		1				1
RCCS26	8	1	7	1		17
RCCS27	2		4			6
RCCS29				1		1
RCCS30	2	1	4			7
RCCS31	2			1		3
RCCS32	11	2	27	3		43
RCCS33	5	1	3	2		11
RCCS34	1					1
RCCS35						0
RCCS37	1		2			3
RCCS47	7		20	2		29
RCCS48	42	4	69	6		121
RCCS56	2		3			5
SDQZT2a						0
SDQZT5k	2		1			3
WCCS1	2		2			4
WCCS2	2	1	6			9
WCCS3	1		1			2
WCCS4	3		2			5
WCCS5	51	10	68	9		138
WCCS6			1			1
WCCS7	1		2			3
WCCS8	3		2	1		6
WCCS9			1	1		2
WCCS10			1			1
WCCS11	1	1	6	1		9
WCCS12		1	1			2
WCCS13			2			2
WCCS14	1		2			3
WCCS15	9	1	9	2		21
WCCS16	2			1	1	4
WCCS17		1	1			2
WCCS18	11	2	2	1		16
WCCS19	1					1
YBCCS1a	46	16	58	4		124
YBCCS1b	3	1	4	1		9
YBCCS1c			1			1
YBCCS1d	16	4	19	5		44
YBCCS1e	5	1	2			8
YBCCS2	2		5	1		8
YBCCS3	3		6			9
YBCCS4	64	16	72	4		156

Table 50. Flake Platform Morphology: Helena Component Unmodified Debitage (continued).

MANA designation	Flat	Faceted	Point	Crushed	Flat-beveled	Count
YBCCS5	12	1	4	2		19
YBCCS6	1		5			6
YBCCS7	1	1	3			5
YBCCS8	6		2			8
YBCCS9	6	6	27			39
YBCCS11			2			2
YBCCS12		2	9			11
YBCCS14	1		1			2
YBCCS15	1	1	2	1		5
YBCCS16	1		1			2
YBCCS17	1					1
YBCCS18	8	5	13	2	2	30
YBCCS21	3		7			10
YBCCS22	3		7	3		13
YBCCS23	3	1	3			7
YBCCS24	4		3	1		8
YBCCS25						0
YBCCS27			1			1
YBCCS28			2			2
YBCCS29				2		2
YBCCS30	48	9	91	1		149
YBCCS31	14	1	10	4		29
YBCCS32			2			2
YBCCS33a	4	3	5	1		13
YBCCS33b	5	2	5	2		13
YBCCS34		1				1
YBCCS35	2		9	1		12
YBCCS36	5	1	2	2		10
YBCCS37	3			3		6
YBCCS38	11	1	6	1		19
YBCCS39	2		1			3
YBCCS40	22	4	21	4	1	52
YBCCS41	1	2	3			6
YBCCS42	2		1			3
YBCCS43	1		2			3
YBCCS44			3			3
YBCCS45	9		3			12
YBCCS46						0
YBCCS47						0
YBCCS48	2					2
YBCCS49	2		1			3
YBCCS50	39	8	33	7		87
YBCCS51	8	2	23			33
YBCCS52	6	1				7
YBCCS53	2					2
YBCCS54 YBCCS55	1 2		3	1		1 6
YBCCS56	1	1				2
	2,225	549	3,057	310	20	6,161

Table 51. Size Grade and Weights for Helena Component Unmodified Debitage.

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
BCCS1			2	10.5	1	1.0	3	0.75			6	12.25
BCCS2			6	28.12	7	5.55	1	0.15			14	33.82
BCCS3			1	3.2	6	3.22					7	6.42
BCCS4	3	50.05	11	38.87	9	6.19	2	0.3			25	95.41
BCCS5			5	17.95	14	10.48	2	0.25			21	28.68
BCCS6			6	14.71	5	3.22					11	17.93
BCCS7	1	13.4	5	10.42	14	8.69					20	32.51
BCCS8	1	12.13	21	97.3	24	13.22	2	0.2			48	122.85
BCCS9	20	438.02	179	657.91	280	214.07	19	3.76			498	1,313.76
BCCS11			3	8.25	1	0.3	1	0.1			5	8.65
BCCS12	1	9.9	15	49.61	33	24.19					49	83.7
BCCS13							1	0.25			1	0.25
BCCS14					2	2.05					2	2.05
BCCS15					8	5.15	5	0.55			13	5.7
BCCS16	2	63.07	23	103.48	14	7.95	2	0.2			41	174.7
BCCS18	2	23.95	8	17.83	11	9.57	4	0.35			25	51.7
BCCS19	2	75.85	7	21.76	16	10.95					25	108.56
BCCS20	1	23.05	8	25.26	1	1.15					10	49.46
BCCS21	17	381.39	199	630.8	587	266.22	16	2.48			819	1,280.89
BCCS23	9	239.08	10	33.47	26	13.46	8	0.95			53	286.96
BCCS25			4	7.95	3	3.22					7	11.17
BCCS26	6	123.75									6	123.75
BCCS27					7	3.15					7	3.15
BCCS28	7	186.0	36	137.12	142	65.3	24	3.2			209	391.62
BCCS29	1	16.75	17	35.58	44	29.12	4	0.6			66	82.05
BCCS31			18	72.75	3	2.2	2	0.25			23	75.2
BCCS32			2	5.59	3	1.1	1	0.15			6	6.84
BCCS33					9	3.2					9	3.2
BCCS34					2	0.95	1	0.2			3	1.15
BCCS35	1	94.0	4	12.35	1	0.7					6	107.05
BCCS37	1	9.35	5	10.9	4	2.95					10	23.2
BCCS38	12	338.92	62	235.04	84	60.0	21	1.57			179	635.53
BCCS39	1	20.2	3	14.08	4	5.78	1	0.3			9	40.36
BCCS40	1	8.01	2	3.35	1	0.4	1	0.2			5	11.96
BCCS41	29	702.6	124	406.37	237	274.6	35	4.6			425	1,388.17
BCCS42			5	14.65	9	3.05					14	17.7
BCCS43			9	27.2	32	18.98	3	0.4			44	46.58
BCCS44	7	175.31	42	162.28	50	35.29	3	0.5			102	373.38
BCCS45			3	4.51	2	2.15					5	6.66
BCCS46	8	232.23	67	274.53	89	64.23					164	570.99
BCCS47	1	15.7	3	7.53	4	1.92					8	25.15
BPCCS2			3	5.06	2	1.1					5	6.16
BPCCS5			13	42.91	35	19.91	2	0.25			50	63.07
CCCS1	5	201.37	49	169.64	116	64.8	12	1.25			182	437.06
CCCS2	12	214.68	137	471.56	387	229.41	22	2.9			558	918.55
CCCS3	14	376.66	181	464.29	491	260.8	66	8.57			752	1,110.32
CCCS4			12	26.76	5	2.86					17	29.62
CCCS5	9	209.28	19	73.69	8	6.5	1	0.15			37	289.62
CCCS6	15	310.32	25	98.21	40	15.93	3	0.36			83	424.82

Table 51. Size Grade and Weights for Helena Component Unmodified Debitage (continued).

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
CCCS7	27	619.96	267	843.2	454	259.62	35	5.35			783	1,728.13
CCCS8	4	163.55	44	191.16	112	57.22	8	1.05			168	412.98
CCCS9			35	98.19	65	41.39	2	0.35			102	139.93
DAC1	5	46.97	28	230.51	45	22.96	1	0.1			79	300.54
GBCCS3			1	2.35	4	5.57					5	7.92
GBCCS5	1	16.52	23	89.29	19	10.64					43	116.45
GBCCS6			1	8.25							1	8.25
GBCCS9	1	31.55	19	62.5	8	3.4					28	97.45
GBCCS11			1	7.92	3	2.35	1	0.1			5	10.37
GBCCS13			1	2.38	1	0.63					2	3.01
GBCCS14	1	15.32	4	9.64	1	0.35					6	25.31
GBCCS15			1	1.75							1	1.75
GBCCS16	1	20.1	1	2.4	1	0.53					3	23.03
GBCCS17					1	0.3					1	0.3
GBCCS18	26	389.66	173	501.45	251	210.69	6	1.09			456	1,102.89
GBCCS19			2	3.74			1	0.1			3	3.84
GBCCS20	15	343.27	48	209.2	52	41.74	6	0.75			121	594.96
GBCCS21			3	3.84							3	3.84
GBCCS26	1	17.6	3	5.66							4	23.26
GBCCS28					3	0.85					3	0.85
GBCCS31			4	8.19							4	8.19
GBCCS36	1	33.55	9	26.35	12	8.85					22	68.75
GBCCS38	5	139.61	36	84.65	29	16.08					70	240.34
GBCCS39	8	180.52	8	31.99	17	9.4	2	0.3			35	222.21
GBCCS41					3	0.75	2	0.5			5	1.25
GBCCS66			16	95.37	12	7.99	5	0.5			33	103.86
GRAN1a			1	2.6	1	0.95					2	3.55
GRAN5	2	103.25	5	30.42	8	6.3	1	0.05			16	140.02
OBS1			3	6.53	3	1.76					6	8.29
OBS2			1	2.45	10	3.88	1	0.05			12	6.38
OQTZ2	1	11.2									1	11.2
QTZCRY1					1	1.15					1	1.15
RCCS1			7	25.08							7	25.08
RCCS2	1	49.6	21	69.94	28	14.91	1	0.1			51	134.55
RCCS3	2	45.67	24	82.9	112	57.32	19	2.9			157	188.79
RCCS4	2	49.9	29	126.98	113	70.74	7	1.05			151	248.67
RCCS5			5	16.25	21	16.73	2	0.3			28	33.28
RCCS6	2	52.4	13	39.5	145	78.5	18	2.15			178	172.55
RCCS7			4	10.75	7	5.05					11	15.8
RCCS8	1	17.82	10	24.8	8	3.7					19	46.32
RCCS9			1	1.71	2	1.61	3	0.4			6	3.72
RCCS11			2	3.3	36	18.23	5	0.7			43	22.23
RCCS12			12	44.8	60	38.73	4	0.7			76	84.23
RCCS13			16	51.81	5	3.49	1	0.1			22	55.4
RCCS14	1	10.87	6	26.58	5	3.65					12	41.1
RCCS15			1	2.49							1	2.49
RCCS16	1	22.85	5	12.3	9	4.75					15	39.9
RCCS17					2	0.85					2	0.85
RCCS18			3	5.34	1	0.55					4	5.89

Table 51. Size Grade and Weights for Helena Component Unmodified Debitage (continued).

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
RCCS19	2	30.3	43	101.92	186	79.32	25	3.45			256	214.99
RCCS20					1	0.7					1	0.7
RCCS21			18	52.39	43	22.27					61	74.66
RCCS22	1	27.54	4	16.19	9	4.94	3	0.1			17	48.77
RCCS23			2	4.33							2	4.33
RCCS24					5	4.32					5	4.32
RCCS25			1	0.9							1	0.9
RCCS26			6	19.62	20	7.41					26	27.03
RCCS27			6	14.21	8	3.45					14	17.66
RCCS29			1	0.9							1	0.9
RCCS30			7	14.1	1	0.4					8	14.5
RCCS31			3	10.4	2	0.8					5	11.2
RCCS32	2	34.03	23	97.12	53	37.98	3	0.35			81	169.48
RCCS33	1	24.05	8	24.0	7	3.92	5	0.75			21	52.72
RCCS34			2	3.35							2	3.35
RCCS35			1	3.28							1	3.28
RCCS37			1	4.7	5	1.51					6	6.21
RCCS47			4	14.07	29	13.7	12	1.85			45	29.62
RCCS48	7	179.25	38	98.09	157	68.91	30	4.64			232	350.89
RCCS56					5	2.85					5	2.85
SDQZT2a	1	7.44			1	0.51					2	7.95
SDQZT5k			3	12.25	3	1.95					6	14.2
WCCS1	1	11.2			5	7.9					6	19.1
WCCS2	1	19.4	5	10.29	4	1.8					10	31.49
WCCS3			4	8.4			2	0.3			6	8.7
WCCS4	1	9.9	3	13.28	4	2.3	1	0.15			9	25.63
WCCS5	3	52.23	70	186.04	166	75.97	17	2.3			256	316.54
WCCS6			1	2.25	1	0.55					2	2.8
WCCS7					5	3.75					5	3.75
WCCS8			2	12.82	6	3.93					8	16.75
WCCS9			1	9.9	1	0.43					2	10.33
WCCS10			1	1.8	4	2.7					5	4.5
WCCS11			1	1.49	6	1.1	2	0.25			9	2.84
WCCS12					2	1.3					2	1.3
WCCS13					4	1.8					4	1.8
WCCS14			2	26.75	2	1.45					4	28.2
WCCS15	1	53.27	30	107.57	32	24.26	1	0.15			64	185.25
WCCS16			2	10.8	3	1.93					5	12.73
WCCS17			2	5.85	4	3.15					6	9
WCCS18			6	18.1	16	9.5	1	0.25			23	27.85
WCCS19					1	1.3					1	1.3
YBCCS1a	7	200.49	44	136.88	107	76.66	20	2.6			178	416.63
YBCCS1b	1	16.95	5	6.89	5	1.95	1	0.1			12	25.89
YBCCS1c			1	3.35							1	3.35
YBCCS1d	2	45.45	25	66.97	38	21.28	4	0.6			69	134.3
YBCCS1e			7	18.97	11	8.14					18	27.11
YBCCS2			4	15.67	8	5.91					12	21.58
YBCCS3			1	3.2	9	5.17					10	8.37
YBCCS4	9	1,163.31	80	285.07	119	68.88	24	4.05			232	1,521.31

Table 51. Size Grade and Weights for Helena Component Unmodified Debitage (continued).

	Size Grade by Count and Weight										Total	
MANA designation	*1*	*weight (g)*	*2*	*weight (g)*	*3*	*weight (g)*	*4*	*weight (g)*	*5*	*weight (g)*	*Count*	*weight (g)*
YBCCS5			5	11.74	21	15.26	1	0.25			27	27.25
YBCCS6			1	3.05	8	2.62					9	5.67
YBCCS7			2	2.7	4	1.78					6	4.48
YBCCS8			14	43.17	4	3.51					18	46.68
YBCCS9	3	45.23	9	37.03	55	27.58					67	109.84
YBCCS11			1	3.0	2	0.92					3	3.92
YBCCS12			3	8.1	14	6.13					17	14.23
YBCCS14			2	4.4							2	4.4
YBCCS15			2	5.05	5	2.0	1	0.2			8	7.25
YBCCS16	1	24.95					1	0.25			2	25.2
YBCCS17	1	25.75									1	25.75
YBCCS18	1	0.85	7	32.14	38	17.65	1	0.25			47	50.89
YBCCS21			8	24.08	11	6.89	3	0.4			22	31.37
YBCCS22	1	45.7	12	35.35	10	7.88					23	88.93
YBCCS23			9	56.11			7	1.25			16	57.36
YBCCS24	3	52.6	6	21.91	4	2.97					13	77.48
YBCCS25					1	0.2					1	0.2
YBCCS27			1	4.0	1	0.17					2	4.17
YBCCS28			3	7.7							3	7.7
YBCCS29					2	1.52					2	1.52
YBCCS30	11	200.46	61	253.82	111	37.68	14	2.1			197	494.06
YBCCS31	5	120.87	17	65.0	29	20.24	3	0.55			54	206.66
YBCCS32			2	3.65	2	1.1					4	4.75
YBCCS33a	1	24.96	8	20.56	11	5.9					20	51.42
YBCCS33b	2	30.63	4	12.81	9	4.7	3	0.5			18	48.64
YBCCS34	1	12.45									1	12.45
YBCCS35	2	50.25	6	18.4	8	5.81					16	74.46
YBCCS36	1	15.9	7	23.04	5	3.15					13	42.09
YBCCS37			5	21.35	10	5.77					15	27.12
YBCCS38	2	153.35	5	14.63	18	14.34					25	182.32
YBCCS39	1	10.9	2	1.55							3	12.45
YBCCS40	2	44.5	23	65.23	49	27.95	2	0.6			76	138.28
YBCCS41			1	5.55	8	6.05	1	0.4			10	12.0
YBCCS42			4	15.56	1	0.35					5	15.91
YBCCS43	1	19.8	1	2.7	4	2.24					6	24.74
YBCCS44							3	0.35			3	0.35
YBCCS45	3	35.85	9	38.67	2	0.9	2	0.35			16	75.77
YBCCS46					2	1.15					2	1.15
YBCCS47					1	1.2					1	1.2
YBCCS48	1	17.4	2	4.56	1	0.15					4	22.11
YBCCS49			3	19.45	1	1.35					4	20.8
YBCCS50	9	201.18	31	88.56	65	41.01	6	0.85			111	331.6
YBCCS51	1	15.02	19	68.8	31	20.79	9	1.55			60	106.16
YBCCS52	1	23.55	7	18.56	3	2.95					11	45.06
YBCCS53	2	35.84	2	12.77	2	1.44					6	50.05
YBCCS54					1	0.45					1	0.45
YBCCS55			6	13.5	2	1.15					8	14.65
YBCCS56	2	18.47	1	1.2							3	19.67
	396	10,048.03	3,031	10,199.94	6,197	3,713.34	607	86.17	0	0	10,231	24,047.48

Table 52. Morphology by Size Grade of Helena Component Unmodified Debitage.

	Complete Flakes	Broken Flakes	Flake Fragments	Shatter	Count
Size-Grade 1	306	20	33	37	396
Size-Grade 2	1,891	238	340	562	3,019
Size-Grade 3	3,148	230	648	2,173	6,175
Size-Grade 4	322	7	75	203	607
Size-Grade 5	0	0	0	0	0
	5,667	495	1,094	2,975	10,231

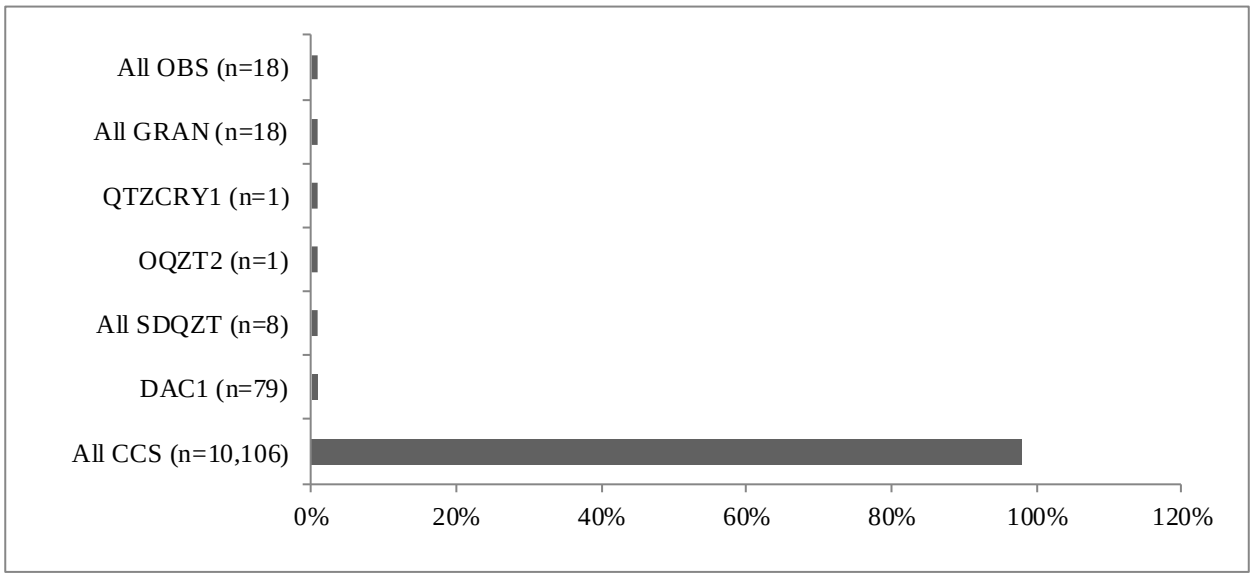


Figure 141. Count Percentages by MANA Designation: Helena Component Debitage.

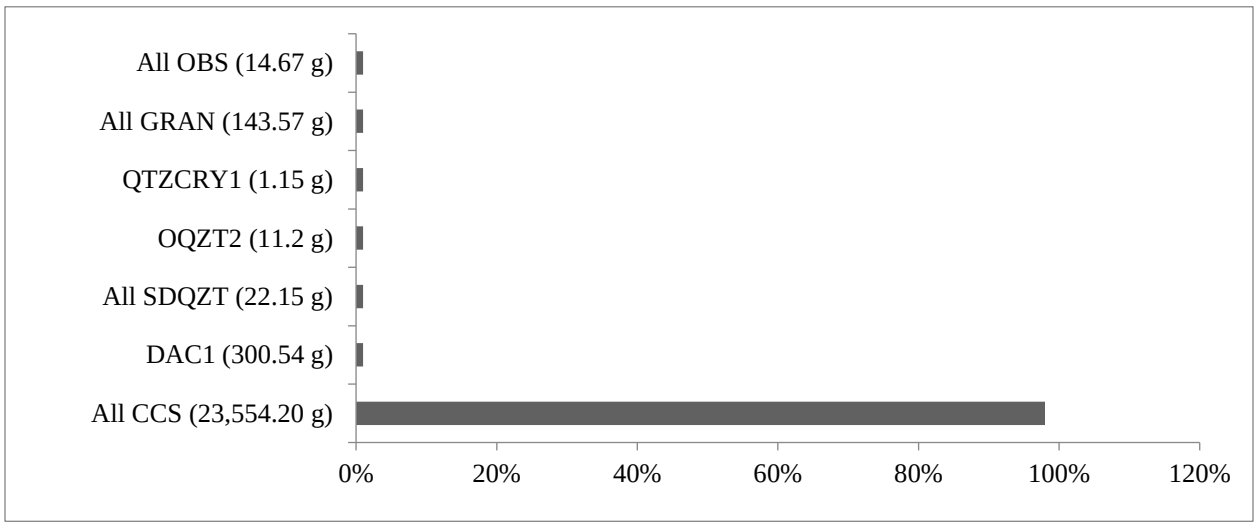


Figure 142. Weight Distribution by MANA Designation: Helena Component Debitage.

A single clear quartz crystal flake was recovered from the Helena Component. As noted previously for the Folsom and Cody components, the piece was likely removed through bipolar reduction considering its small-size.

Eight thousand two hundred twenty pieces (80%) are secondary reduction-stage, and 1,808 (18%) are tertiary reduction-stage. Of 7,293 pieces considered to be flakes or portions of flakes, 2,265 (31%) exhibit one obvious exterior surface flake scar, 4,849 (66%) pieces have two to three exterior surface flake scars, and 90 pieces (1%) show four or more. Among the pieces that exhibit two or more flake scars (n=4,943), 4,392 (89%) of those flake removal scars intersect. Only 551 (11%) flakes exhibit exterior surface flake removal scars that run parallel to each other. This implies more bifacial knapping than other types of core reduction. Importantly, and as observed for the Folsom and Cody materials, there is no evidence among the debitage of polyhedral blade core preparation or reduction.

Five thousand six hundred sixty-seven (55%) of the debitage pieces are complete flakes, five percent (n=495) are broken flakes, and 11 percent (n=1,094) are flake fragments. Shatter accounts for 29 percent (n=2,975) of the debitage (Table 61). Among 6,672 of the pieces with intact distal ends, 6,573 (98%) exhibit a feathered termination. Hinge and step terminations occur among only one percent (n=99) of the flakes. Of 6,025 complete or partial flakes sufficiently intact to determine form, 1,765 (29%) are elongate and 4,254 (71%) are ovate to ovate-expanding. Six of the pieces are wedge-like and may reflect bipolar reduction. Additionally, 87 flakes were inadvertently split longitudinally during the knapping process.

Complete or partial platforms (Table 59) are found on 6,161 specimens (60% of the debitage). Two thousand two hundred twenty-five (36%) exhibit flat platforms, nine percent (n=549) exhibit faceted platforms, and 50 percent (n=3,057) exhibit point platforms. Three hundred ten flakes (5%) exhibit crushed platforms and 20 exhibit flat-beveled or flat but angled platforms. Among the faceted platform pieces, approximately 326 have platforms with maximum lengths or widths between 5 and 8 mm.

One hundred eighty-four flakes (3%) are decortication pieces while 4,936 (68%) are considered general shaping/thinning flakes. Later reduction stage percussion biface thinning flakes comprise six percent (n=435) of the diagnostic pieces. Finishing flakes or probable pressure biface thinning flakes account for 24 percent (n=1,748) of the debitage.

Bipolar flakes representing the outer edge or surface of sheared chert pebbles (n=4) are among the debitage. This shows that whereas bifacial reduction may have dominated the knapping work by Middle or Late Precontact Period occupants, it was not exclusive and reduction of multi-direction or unprepared cores was occurring with moderate frequency. Surprisingly, bipolar reduction work, albeit minimally represented in all cultural "components" seems to be most poorly represented among the Helena Component materials when compared to the Early Precontact Period assemblages. Another similarity or persistent pattern over time at MacHaffie is a lack of obvious hammerstones and a large percentage of diagnostic flakes with understated or diffuse bulbs of percussion. This suggests soft hammer percussion and pressure flake removals rather hard hammer work.

Size Grade 3 pieces dominate (60% or n=6,175), with Size-Grade 2 pieces representing a distant second (30% or n=3,019). Pieces in the largest size grade account for only four percent of the debitage (n=396), and six percent (n=607) are Size-Grade 4. As previously noted, the low percentage of smaller than Size-Grade 3 debitage may be an inaccurate representation because 0.25 inch mesh was used to screen the bulk of all excavated sediments, and many very small pieces could have been missed (Tables 60-61).

The Helena Component debitage represents mixing of multiple assemblages over time and a bias toward artifacts that would be caught be 0.25 inch mesh. Still, some consistencies persist at the MacHaffie site. One obvious change from that observed among the Folsom and Cody debitage is an emphasis on medium and small-size flake production. This may in part be related to the quality of the chert materials available or intentionally selected by Middle or Late Period occupants. Montana's chert tends to be full of fractures and abnormalities. Finding a piece structurally uniform to remove a series of large flakes is difficult. The Paleo-Indian occupants appear to have had less difficulty finding structurally uniform toolstone because numerous large and thin flakes were abandoned instead of collected for tools or projectile point preforms. Middle and Late Period occupants were less likely to abandon large, thin, and straight flakes. Pressure flaking of formal tools increased over the knapping patterns observed for the Early Period assemblages. As before, most knapping activities involved middle reduction stage work and production of flake blanks. Also, the selection of marginal quality lithic raw materials is slightly increased over that observed among the Folsom assemblage. It is noticeably increased over the Cody assemblage.

Although 10,231 pieces of debitage have been recovered from the Helena Component, this is a minor amount considering several thousand years of intermittent human occupation represented in the upper meter of sediment. Perhaps fewer and less intensive knapping events are represented in the Helena Component when compared to the Cody and Folsom components. Overall, MacHaffie was characterized by short and sporadic occupation events where refurbishing weaponry and producing stone blanks (flake and bifacial) for off-site refinement dominated the human activities.

11.3 Minimum Analytical Nodule Analysis

Applying a MANA or any other form of aggregate analysis to the Helena Component should generate skepticism. Unlike the sediments of the Cody and Folsom components that were subject to 0.125 inch mesh or smaller screening from 1989 through 2018, only half of the Helena Component sediments were screened through 0.125 inch mesh and that applies only to the 2017 to 2018 work. Small-size debitage is probably inaccurately represented. Further, the churned nature of the colluvium has mixed cultural components over time. As could be expected with the mixed nature of the colluvium containing the Helena Component any spatial distinction between debitage and cores or tools that may have once existed is now non-existent. As expected, debitage and tool densities are rather uniform across the site (Figure 143). The reader should bear in mind that apparent breaks in the distribution of Helena Component artifacts (Figures 143-144) is the result of a lack of data for the excavation units that show no Helena Component cultural material. Some of these units may have existed only on paper but were never excavated. Some may have been excavated but were not documented. In other instances (e.g., 2001 Block,

97A?/96A, and 2000-4) the colluvium was largely removed without any examination in order to focus on the underlying Cody and Folsom components.

Still, a MANA approach is generally followed here to see if patterns in toolstone selection and reduction are present. The Helena Component points are largely considered undesirable. Most are broken or rejuvenated items removed from their hafts and discarded. If fresh points were rehafted at MacHaffie, few if any were produced on-site. This is presumed from the apparent lack of pressure flakes including notching flakes. The projectile points assigned to MANA units RHY2 (#7) and SDQZT5f (#11) have no associated debitage, tools, or cores. Projectile points of BCCS1 (#16), BCCS15 (#9), BCCS27 (#14), GBCCS19 (#38), OBS2 (#5), YBCCS8 (#47), YBCCS41 (#32), and YBCCS55 (#36) have up to18 pieces of associated debitage, but no cores or tools (Table 53). The projectile point of the MANA unit designated YBCCS9 (#2) has 67 associated pieces of debitage, but no tools or cores. All other projectile points share limited kinds and quantities of tools, cores, or debitage of the same MANA unit.

Because of the tremendous color and texture overlap of Madison Group cherts, identifying specific sources for the represented CCS lithic material is speculative at best. A reasonable assumption is that debitage, cores, early and mid-reduction stage bifaces, and flake tools or blanks matching projectile point MANA units were collected from local sources, while the projectile point fragments and other finished tools were produced elsewhere and derived from materials collected at distant sources. What can be said with certainty is that pieces refined into projectile points by Middle and Late Period occupants would generally be in the yellow to brown range, less often in gray, white, and red tones.

Based on the presence of debitage of the same MANA units, most of the non-hafted bifaces could have been produced at MacHaffie. Obsidian and sedimentary quartzite bifaces were clearly translocated by humans to the MacHaffie site. Further, two chert bifaces of MANA units YBCCS43 and YBCCS46 are associated with so little similar debitage that these pieces were likely made off-site, transported to MacHaffie, and abandoned with little or no additional refinement. The comparatively large collection of non-hafted bifaces compared to the quantities of recovered debitage is disproportionate (Table 53). This, in part, reflects exclusive use of 0.25 inch mesh. Sixteen of the defined chert MANA units include cores and bifaces. As such, a great deal of flake production would be expected among these particular MANA units. Either several of the recovered bifaces and cores were produced off-site and transported to MacHaffie with minimal to moderate subsequent reduction work, or Helena Component debitage is incorrectly represented. In the latter instance either more debitage was collected from 1947 until 2010 but has been lost, misplaced, or disposed of, or much more Helena Component debitage is still present at MacHaffie. Considering how much of the site has been excavated, the former possibility is more likely.

Although a long span of time is represented by the Helena Component, noticeably fewer endscrapers are present (n=7) when compared to the Cody component (n=11) of a much shorter duration. The presence of endscrapers suggests activities such as green hide preparation or wood debarking and shaping. Hearth features have not been identified, but a small amount of FCR suggests the presence of at least one thermal feature.

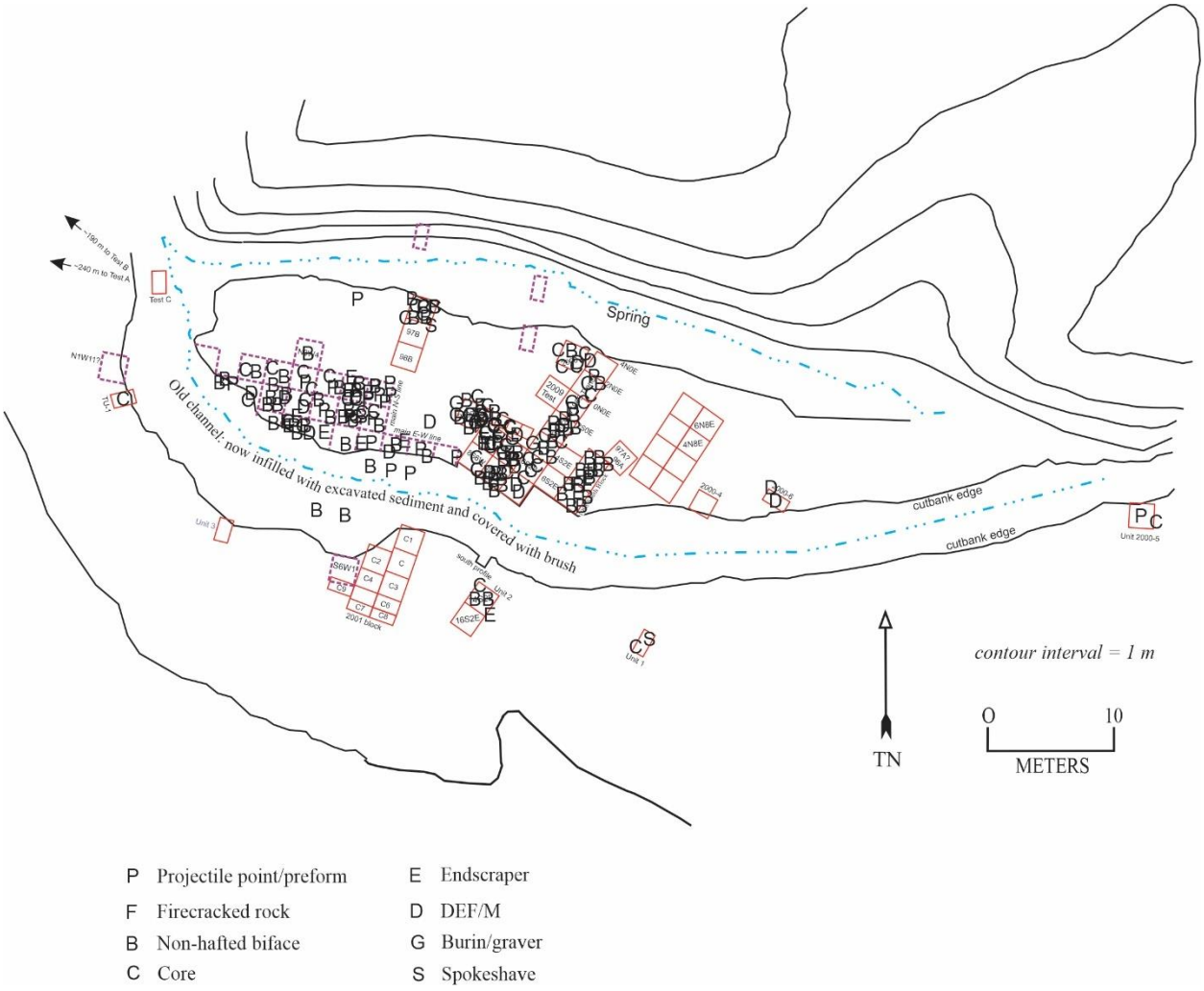


Figure 143. Distribution of Selected Helena Component Cultural Material in 24JF4.

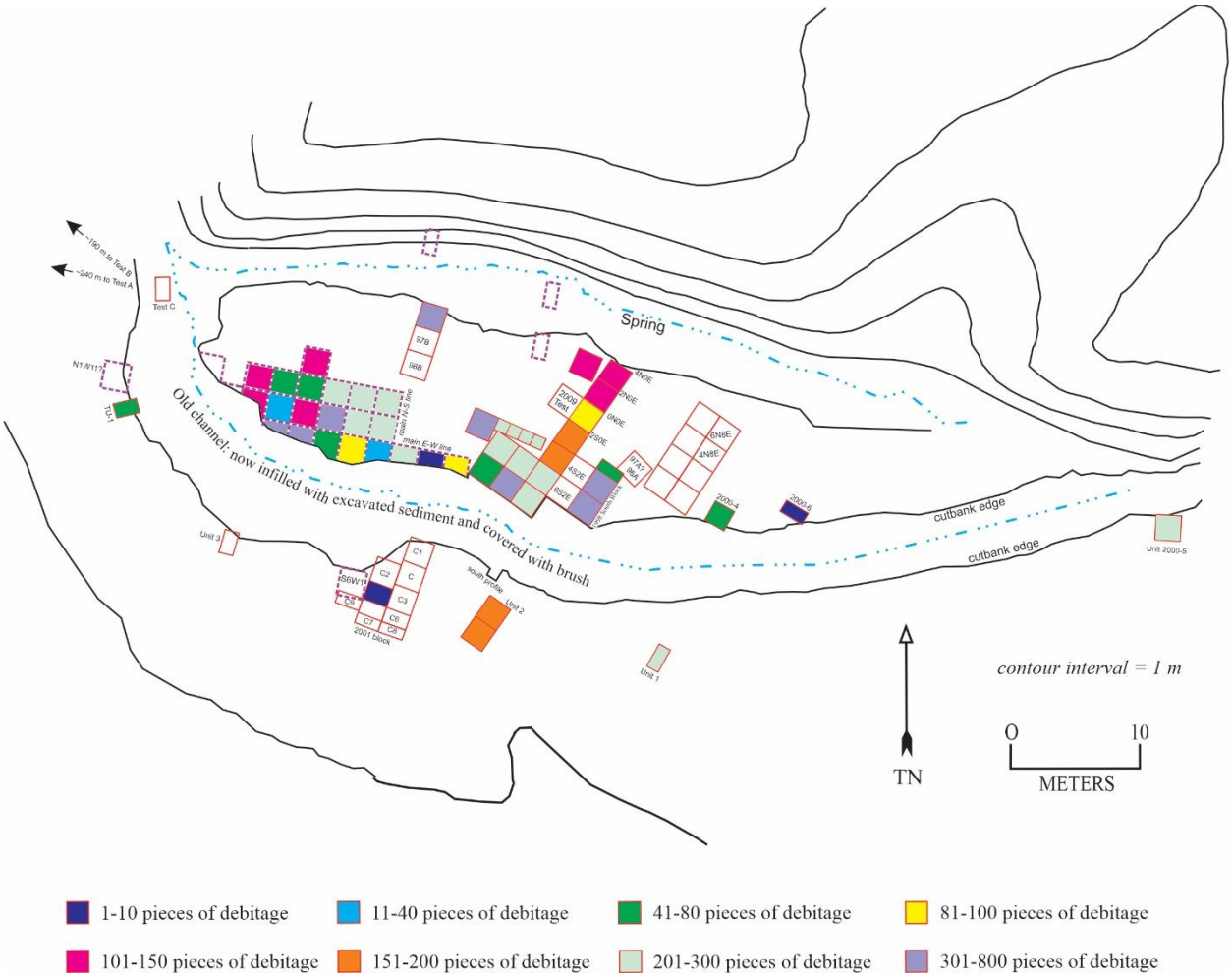


Figure 145. Distribution of Helena Component Debitage in 24JF4.

Table 53. Helena Component MANA Units and Associated Artifacts.

MANA designation	projectile point/preform	graver	spokeshave	endscraper	biface	core	DEF/M	debitage
BCCS1	1					1		6
BCCS2								14
BCCS3						1		7
BCCS4								25
BCCS5					1			21
BCCS6								11
BCCS7					3			20
BCCS8					1			48
BCCS9					6	2		498
BCCS11								5
BCCS12						1		49
BCCS13								1
BCCS14								2
BCCS15	1							13
BCCS16							1	41
BCCS18	1			2				25
BCCS19	1				1			25
BCCS20								10
BCCS21	1	1	1		7	8		819
BCCS23					1			53
BCCS25								7
BCCS26								6
BCCS27	1							7
BCCS28					1	2		209
BCCS29			1		2			66
BCCS31					1			23
BCCS32					1			6
BCCS33								9
BCCS34								3
BCCS35								6
BCCS37					1			10
BCCS38					1			179
BCCS39								9
BCCS40								5
BCCS41	1				1	7	2	425
BCCS42								14
BCCS43					3	2		44
BCCS44					1	1		102
BCCS45								5
BCCS46				1		1	1	164
BCCS47							1	8
BPCCS2								5
BPCCS5						1		50
CCCS1					1			182
CCCS2	1				1	1	2	558
CCCS3	3				4			752
CCCS4								17
CCCS5								37
CCCS6					2	2		83
CCCS7	1				9	6	1	783

Table 53. Helena Component MANA Units and Associated Artifacts (continued).

MANA designation	projectile point/preform	graver	spokeshave	endscraper	biface	core	DEF/M	debitage
CCCS8		1						168
CCCS9								102
DAC1	1				5		1	79
GBCCS3								5
GBCCS5						2		43
GBCCS6								1
GBCCS9								28
GBCCS11						1		5
GBCCS13								2
GBCCS14								6
GBCCS15								1
GBCCS16								3
GBCCS17								1
GBCCS18	2	1			2		1	456
GBCCS19	1							3
GBCCS20					5	2		121
GBCCS21								3
GBCCS26								4
GBCCS28								3
GBCCS31								4
GBCCS36	1					1		22
GBCCS38								70
GBCCS39								35
GBCCS41					1			5
GBCCS66								33
GRAN1a								2
GRAN5								16
OBS1	1				1		2	6
OBS2	1							12
OQTZ2								1
QTZCRY1								1
RCCS1								7
RCCS2	1				3	1	1	51
RCCS3					4			157
RCCS4								151
RCCS5							1	28
RCCS6				1				178
RCCS7								11
RCCS8							1	19
RCCS9								6
RCCS11								43
RCCS12					1			76
RCCS13						1		22
RCCS14					1			12
RCCS15					1			1
RCCS16								15
RCCS17					1			2
RCCS18								4
RCCS19					3			256
RCCS20								1

Table 53. Helena Component MANA Units and Associated Artifacts (continued).

MANA designation	projectile point/preform	graver	spokeshave	endscraper	biface	core	DEF/M	debitage
RCCS21								61
RCCS22								17
RCCS23								2
RCCS24								5
RCCS25								1
RCCS26					1			26
RCCS27								14
RCCS29								1
RCCS30								8
RCCS31						1		5
RCCS32					1			81
RCCS33								21
RCCS34								2
RCCS35								1
RCCS37								6
RCCS47								45
RCCS48					1	1		232
RCCS56								5
RHY2	1							0
SDQZT1b					1			0
SDQZT2a								2
SDQZT4b						1		0
SDQZT4m							1	0
SDQZT5a					1			0
SDQZT5f	1							0
SDQZT5k								6
WCCS1								6
WCCS2								10
WCCS3								6
WCCS4								9
WCCS5				2			1	256
WCCS6								2
WCCS7								5
WCCS8								8
WCCS9								2
WCCS10								5
WCCS11								9
WCCS12								2
WCCS13								4
WCCS14							1	4
WCCS15								64
WCCS16				1				5
WCCS17								6
WCCS18								23
WCCS19						1		1
YBCCS1a						2	1	178
YBCCS1b								12
YBCCS1c								1
YBCCS1d					4		1	69
YBCCS1e								18
YBCCS2								12

Table 53. Helena Component MANA Units and Associated Artifacts (continued).

MANA designation	projectile point/preform	graver	spokeshave	endscraper	biface	core	DEF/M	debitage
YBCCS3					1	1		10
YBCCS4					1	2	3	232
YBCCS5								27
YBCCS6								9
YBCCS7								6
YBCCS8	1							18
YBCCS9	1							67
YBCCS11								3
YBCCS12								17
YBCCS14								2
YBCCS15								8
YBCCS16								2
YBCCS17								1
YBCCS18	1				2	2		47
YBCCS21								22
YBCCS22								23
YBCCS23								16
YBCCS24								13
YBCCS25								1
YBCCS27								2
YBCCS28						1		3
YBCCS29								2
YBCCS30								197
YBCCS31								54
YBCCS32								4
YBCCS33a								20
YBCCS33b					1			18
YBCCS34								1
YBCCS35						1	1	16
YBCCS36								13
YBCCS37								15
YBCCS38								25
YBCCS39								3
YBCCS40	1				3			76
YBCCS41	1							10
YBCCS42						1		5
YBCCS43					1			6
YBCCS44								3
YBCCS45					1			16
YBCCS46					1			2
YBCCS47								1
YBCCS48								4
YBCCS49								4
YBCCS50					1	1		111
YBCCS51						1		60
YBCCS52								11
YBCCS53								6
YBCCS54								1
YBCCS55	1							8
YBCCS56								3

All endscrapers have MANA unit counterparts among associated debitage and other items. This pattern suggests they were produced on-site. Only #15 was recovered from an excavation unit that produced debitage of the same MANA designation.

Six (#s 1, 7, 13, 35, 36, and 40) of the debitage with edge flaking or other modification (DEF/M) are of MANA units BCCS41, CCCS2, CCCS7, and RCCS2. These MANA units also contain unmodified debitage, non-hafted bifaces, cores, and projectile points (Table 62). One (#18) is of a MANA unit (GBCCS18) that also contains debitage, a graver, two non-hafted bifaces, and two projectile points. Three MANA units (YBCCS1a, YBCCS1d, and YBCCS4) contain debitage, cores, or non-hafted bifaces. One (#38) is of a MANA unit (BCCS46) that contains debitage, a core, and an endscraper. One DEF/M (#44) is of a MANA unit (YBCCS35) that also contains unmodified debitage and a core. The dacite (DAC1) MANA unit contains one DEF/M (#11), unmodified debitage, five non-hafted bifaces, and one projectile point. The MANA unit for the obsidian DEF/M (#s 33 and 34) also contains a limited amount (n=6) of unmodified debitage, one biface, and one projectile point. Only one DEF/M (#9) is of a MANA unit (WCCS5) that contains debitage and endscrapers. The sedimentary quartzite DEF/M (#39) is of an isolated MANA unit (SDQZT4m) that does not contain any associated debitage, tools, or cores. The remainder of the chert DEF/M (n=5) are of MANA units (BCCS16, BCCS47, RCCS5, RCCS8, and WCCS14) that contain debitage but no other tool types or cores. This suggests most of the chert DEF/M were produced on-site from bifacial blanks or from multi-directional cores. A few pieces, however, were undoubtedly produced off-site and then transported to MacHaffie.

Off-site decortication and initial preparation of cores, as well as bifacial blank production, is further supported by the fact that 96 percent of the debitage exhibits no cortical remnants and only two non-hafted bifaces (#s 121 and 141) exhibit a minor amount of cortex. Further, 75 percent of the multi-directional flake cores exhibit no cortex. While much of the lithic raw material associated with the Helena Component is good quality toolstone, a persistent pattern beginning with the prior Folsom component is observed. This being that poor quality material was intentionally selected and reduced to varying extents. However, Helena Component artifacts and debitage show diminishment in attempts to knap the local siliceous granite (GRAN5).

A wider range and larger number of MANA units are assigned to the Helena Component when compared to the earlier Folsom and Cody components. Most of the MANA units (59%) consist of debitage but no associated tools or cores. The ratio of bifaces to cores (1.6:1) in the Helena Component is inverse to that observed among the Folsom component, and approximately half of that observed for the Cody component. The pieces left behind at MacHaffie suggest that the Middle and Late Period occupants were interested in production of mid-to-late reduction stage bifaces and flake blanks. In sharp contrast to Folsom and Cody occupants, the generally low quantities of debitage for any given MANA unit suggest that intensive core reduction and biface manufacture, with limited exceptions, was no longer taking place at MacHaffie.

Because of the mixed nature of the Helena Component, it is not possible to identify specific knapping events, and no defined MANA unit is confined to, or even strongly represented at a specific vertical or horizontal locus in the colluvium. Duration of occupation by Middle and

possibly Late Period occupants appears similar to that proposed for the Folsom and Cody occupants. The distinction is that more time and more short stops are represented among the Helena Component. The primary activities were limited reduction and refinement of cores and bifaces, removing undesirable projectile points from hafts and possibly rehafting fresh points, but infrequently producing projectile points. Heating or cooking and plant and animal processing activities are poorly represented. Similar to the pattern noted previously for Folsom and Cody occupants, MacHaffie can be described as a *location* following Binford's (1980) Collector model. MacHaffie was a brief stopping point for a task group visiting local chert quarries before moving on to a residential camp where refinement of stone tools and typical domestic activities took place. When compared to available toolstone sources and regional biotic communities, MacHaffie does not show a distinctly Core Area or nonregional land use strategy (see Knell 2012: 329). The evidence indicates that Middle and possibly Late Period occupants, like the prior Folsom and Cody occupants, generally followed a nonregional approach while at 24JF4.

12.0 ORIGIN OF CULTURALLY MODIFIED LITHIC RAW MATERIALS

The Folsom and Cody components are largely intact and reasonably stratified. In contrast, the "Helena Component" consists of fully mixed Early Transitional, Middle and possibly Late Precontact cultural remains. The nature of the colluvium precludes assessment if certain MANA designations were selected or preferred by one archaeological culture over another. One hundred thirty-four MANA designations are assigned to the Folsom component and 129 (96%) of those contain one or more pieces of lithic debitage. One hundred thirty-three MANA designations are assigned to the Cody component and 125 (94%) of those contain one or more pieces of lithic debitage. The Helena Component is assigned 207 MANA designations and 202 (98%) of those contain at lest one piece of lithic debitage. Most of the lithic raw materials used in stone tool production at MacHaffie are grossly lumped here under the generic term of "chert". They are chalcedonic quartz cryptocrystallines and microcrystallines. Most likely formed in the local Madison Group limestone bedrock. Processes that formed these chert deposits may have been hydrothermal activity or sedimentary precipitate or a combination thereof. Precontact chert quarries were developed to exploit these desired materials from a subsurface context. The quarries, with their resulting pock-marked ground surfaces, were once a common feature of the landscape in the Montana City area. Much of the chert brought to MacHaffie was obtained from sources a few meters distant to several kilometers away (Figures 3, 68 and 145). It is worth noting that while a wide range of chert MANA units are associated with the Folsom and Cody components, each component shows a preferred color texture range that was intensively reduced at the MacHaffie site. Dominating the Folsom component is the red to reddish-brown to honey-brown chert assigned MANA units BCCS41 and RCCSC48. It most likely came from the extensive chert quarry designated 24JF881 approximately 400 meters northwest of MacHaffie (see Figure 3) where visually and texturally similar chert dominates.

Characterizing the Cody component is a distinctively gray to bluish-gray and grayish-brown to yellow-gray (MANA units GBCCS18, GBCCS20, and CCCS6) chert. This rather distinctive lithic material dominates the Palmer chert quarries (24JF226 and 24JF879) 800 meters northeast of MacHaffie (Figure 3). This toolstone source has largely been destroyed through operations of the local concrete plant.

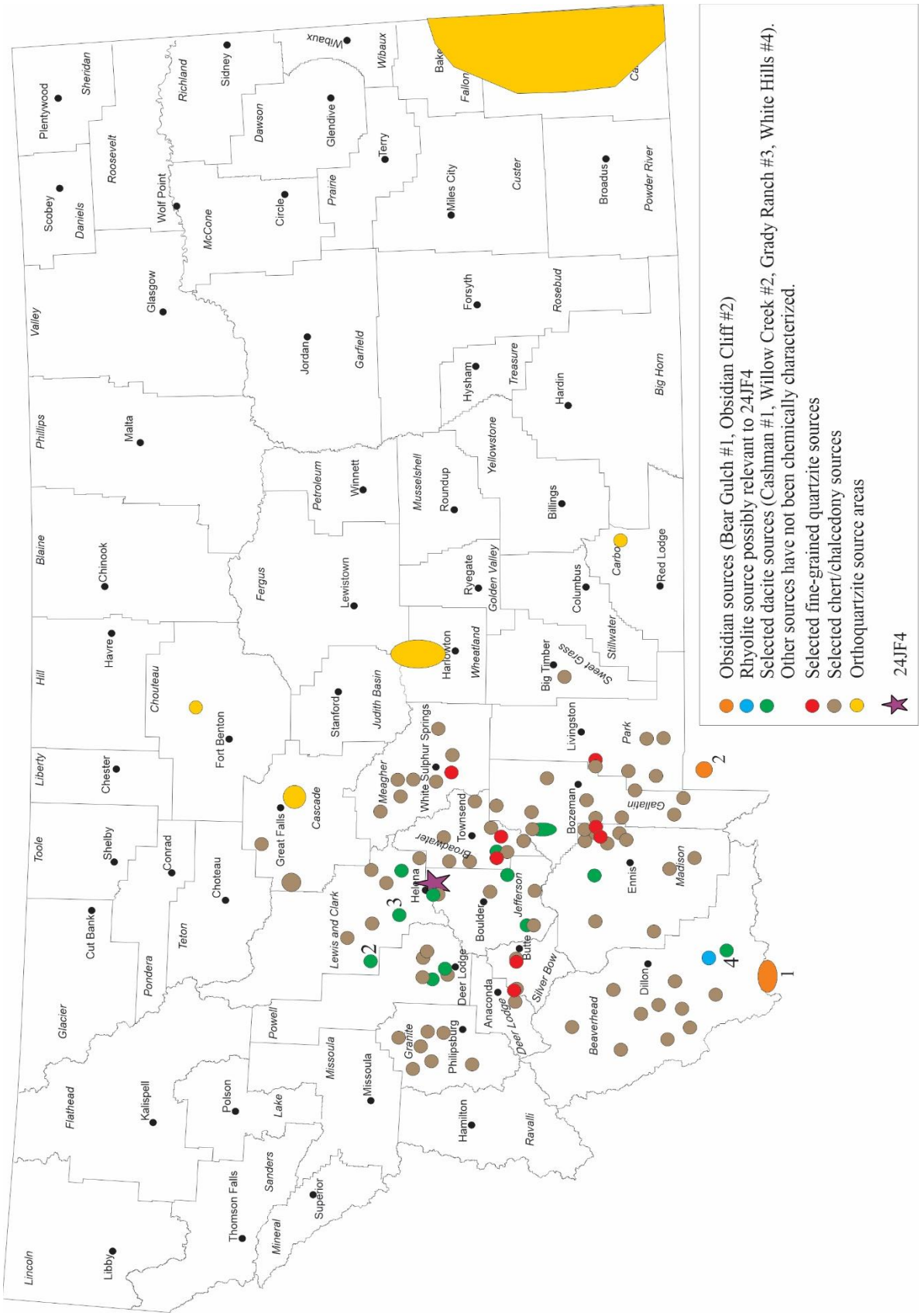


Figure 145. Selected Toolstone Source Localities in Relation to Site 24JF4.

Microcrystalline and cryptocrystalline silicates are common throughout the southern-half of Montana. Rennie's "Montana Tool Stone Database" identifies 52 documented sources (both primary and secondary) of "chert" within approximately 64 km (40 miles) of 24JF4 (Figure 145). Increasing the search area to a 161 km (100 miles) radius nearly triples the number of documented chert sources (Rennie n.d.). The source distribution map (Figure 145) gives a sense of tool quality chert sources with respect to the MacHaffie site. The range of color and texture overlap on an inter-source and intra-source basis is substantial (Davis 1987; Rennie n.d.; Roll 2003). This hinders credible source assignments of chert artifacts based on macroscopic examination.

The physical properties of chert in most Montana sources are not conducive to the frequent or consistent removal of large flakes. Most tool quality chert requires working in and around limestone inclusions, vugs, internal fractures, and bedding planes. The reduction pattern at Montana quarries is that multiple angles were worked on each core in order to retrieve as many usable flakes (generally small to medium-size) as desired for a single toolstone collection event. All cultural groups at all time periods who visited Montana chert sources in a bedrock deposit appear to have used a similar lithic reduction technique for obtaining flake and bifacial blanks. The desired pieces were used as is, edge-modified, or bifacially reduced. The larger blanks were likely heat-treated before being bifacially thinned. It is our opinion that bifacial reduction of a single raw block or nodule rarely occurred. Because many discarded pieces are still useable for the purpose of flake production, succeeding occupants of a quarry frequently reworked discards of predecessors. This further blurs knapping events represented at a quarry (e.g., Rennie and Davis 2016; Rennie and Rittel 2007).

Possible Avon or Bowman chert is assigned to the GBCCS10 MANA Unit. This distinctive marbled material is presently known from the Antelope Hill and Rhine Hill localities northwest of Avon, Montana, the Bowman and South Fork Flathead River drainages of Northwest Montana, and to a very limited extent at site 24BW70 in southwest Montana (Cameron 1984; Haseman and Rennie 2022; Reeves 2003; Rennie n.d.). Possible Avon or Bowman chert in 24JF4 is limited to a single flake among the Helena Component. Another exception is the GRCCS1 MANA unit from which the base of a Folsom point (#20) is made. Specific to Montana, dark-green, opaque material similar to that constituting #20 is currently recognized in the Tom Miner Basin and Cooke City areas of the upper Yellowstone River drainage, and the Mill Creek and Main Boulder River headwaters (Larry Lahren pers. comm. 2020; Rennie n.d.). The lithic material is a highly silicified wood as opposed to a chert that forms hydrothermally or in limestone deposits. Sources of green "chert" immediately outside Montana may occur in the Shoshone River headwaters (Ann Johnson pes. comm. 2019) of northwest Wyoming, and the Granger area of southwest Wyoming (Marcel Kornfeld pers. comm. 2020; Kornfeld et al. 2010: 590). Beyond Montana and Wyoming, green chert is found at the Illinois and Indiana border area (Attica chert), in the Hudson valley of New York (West Athens Hill), and the Mockingbird Gap source of New Mexico (Julie Morrow pers. comm. 2020). How these additional materials visually and texturally compare to projectile point fragment #20 from MacHaffie is uncertain.

Other locally obtained stone is andesite (AND2), basalt (BAS1) granite (GRAN3 and GRAN5) and some of the sedimentary quartzite (MANA units beginning with SDQZT). Most of these lithics occur as float among local sediments. Some of the quartzites brought into the site

are a very fine-grained light-gray, brown, or tan colored material. They are texturally similar to Spanish Diggings or Hartville uplift quartzites from northeast Wyoming. They are also similar to some quartzites in the White Sulphur Springs area, the Big Hole River area south of Anaconda, and the Dry Creek area at the west side of the Paradise Valley (Figure 145; Rennie n.d.). Other medium or medium-fine grained quartzites occur as cobbles across Montana.

Occasional outcrops of granite and basalt surround MacHaffie. Locally available lithic materials would have served well as hammerstones, abrading stones, in heating or cooking activities, and in stone circle and cairn construction—although little evidence for the former and no evidence for the latter has been identified at MacHaffie. The soft sandstone comprising the shaft abraders of the Cody component is not locally available but could have originated at any of several exposures in virtually any direction from the MacHaffie site. Similarly, the lithic material constituting the mudstone manuport or "cultural stone" associated with the Cody component is not available on-site but could have been collected in the Prickly Pear Creek drainage to the north, or the Missouri River drainage to the east.

Possible sources for the single orthoquartzite (OQZT2) flake are southeast of Great Falls, in the western portion of the Judith Basin, in south-central Fergus County (24FR1380), the Edgar area south of Laurel, and the southeastern corner of Montana (Figure 145; Rennie n.d., 2022a). Orthoquartzite is best described as a highly siliceous and very fine-grained sandstone. It is referred to elsewhere as Tongue River Silicified Sediment (Keyser and Fagan 1987) and Beaver River Sandstone (Kristensen et al. 2016). Initial efforts to chemically characterize this material using Energy Dispersive X-ray Fluorescence (edxrf) trace element ratio-analysis show promise for future studies (Kristensen et al. 2016).

Potential sources for the distinctively colored and textured rhyolite (RHY2) recovered from the Folsom and Helena components are found in the Sage Creek area 16 km (10 miles) east of Red Rock, Montana, and site 24GN1192 approximately 22 km (13 miles) northwest of Drummond, Montana (Figure 145; Rennie n.d., 2022b). A third, but unverified, source is reported to be 67 km (42 miles) southwest of the MacHaffie site at the head of Conrow Canyon near the south end of Bull Mountain (Rennie n.d.). Sources for clear and smoky quartz crystal (QTZCRY1 and QTZCRY2) are found throughout the Boulder Batholith of the Pipestone and Butte area 43 km southwest of MacHaffie. Another potential source is Crystal Park, approximately146 km (91 miles) to the southwest.

Current information suggests obsidian and dacite exhibit distinct trace element ratio "fingerprints" from source to source. Twenty-three pieces of obsidian and 86 pieces of dacite are from the Helena Component, forty-five pieces of obsidian and two pieces of dacite are associated with the Cody component, and none is attributable to the Folsom component. Source selection and material translocation is informative even apart from a temporal context. Thirty-one dacite and 15 obsidian pieces were submitted to Geochemical Research Laboratory for Energy Dispersive X-ray Fluorescence Analysis in order to determine geologic sources represented (Hughes 2020; Appendix 10, Volume II of this report).

The obsidian samples (Hughes 2020; Tables 54 and 55; Appendix 10 of Volume II, this report) show a pattern consistent with other archaeological sites in the upper Missouri River Table 54. Trace Element Chemistries and Source Determinations for Selected Obsidian Pieces:

Quantitative Composition Estimates.

Catalogue #	Sample #	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	Ti	Mn	Fe_2O_3T	Fe/Mn	Chemical Group	Artifact	Cultural Component
3195	O-1	nm	nm	272 ±5	4 ±2	85 ±3	170 ±4	48 ±3	nm	nm	nm	nm	75	Obsidian Cliff	debitage	Helena
1214	O-7	nm	nm	169 ±4	43 ±3	47 ±3	296 ±5	57 ±3	662 ±23	nm	nm	nm	54	Bear Gulch	debitage	Helena
2821	O-9	nm	nm	187 ±4	48 ±3	47 ±3	303 ±5	59 ±3	646 ±28	nm	nm	nm	52	Bear Gulch	debitage	Helena
25	O-10	nm	nm	182 ±4	48 ±3	47 ±3	309 ±5	54 ±3	632 ±26	nm	nm	nm	49	Bear Gulch	non-hafted biface	Helena
5	O-11	nm	nm	270 ±5	8 ±2	84 ±3	170 ±4	50 ±3	32 ±18	nm	nm	nm	68	Obsidian Cliff	projectile point	Helena
33	O-12	nm	nm	180 ±4	48 ±3	47 ±3	305 ±5	52 ±3	656 ±22	nm	nm	nm	55	Bear Gulch	DEF/M	Helena
8705	O-13	nm	nm	177 ±4	44 ±3	45 ±3	301 ±5	59 ±3	734 ±24	nm	nm	nm	54	Bear Gulch	debitage	Cody
100	O-14	nm	nm	174 ±4	44 ±3	42 ±3	290 ±5	52 ±3	736 ±24	nm	nm	nm	56	Bear Gulch	non-hafted biface	Cody
44	O-15	nm	nm	178 ±4	44 ±3	45 ±3	304 ±5	61 ±3	728 ±23	nm	nm	nm	56	Bear Gulch	projectile point	Helena

obsidian: 78% Bear Gulch, Idaho; 22% Obsidian Cliff, Wyoming (see Hughes 2020) nm = not measured

Table 55. Trace Element Chemistries and Source Determinations for Selected Obsidian Pieces: Integrated Net Count Rate Data.

Catalogue #	Sample #	Rb	Sr	Zr	Σ RB, Sr, Zr	Rb%	Sr%	Zr%	Fe/Mn	Rb/Sr	Zr/Y	Y/Nb	Zr/Nb	Sr/Y	Chemical Group	Artifact	Cultural Component
3196	O-2	424	122	1104	1650	0.257	0.074	0.669	51.6	3.5	8.5	.7	5.5	0.9	Bear Gulch	debitage	Helena
8147	O-3	274	79	746	1099	0.249	0.072	0.679	53.8	3.5	7.9	.8	6.0	0.8	Bear Gulch	debitage	Helena
2668	O-4	347	105	1017	1469	0.236	0.072	0.692	52.9	3.3	8.5	.6	5.2	0.9	Bear Gulch	debitage	Helena
2667	O-5	397	110	1084	1591	0.25	0.069	0.681	54.2	3.6	7.9	.7	5.3	0.8	Bear Gulch	debitage	Helena
122	O-6	370	10	396	776	0.477	0.013	0.51	65.7	37.0	2.6	1.4	3.7	0.1	Obsidian Cliff	debitage	Helena
2820	O-8	387	108	1063	1558	0.248	0.069	0.682	53.4	3.6	8.1	.6	4.9	0.9	Bear Gulch	debitage	Helena

obsidian: 83% Bear Gulch, Idaho; 17% Obsidian Cliff, Wyoming (see Hughes 2020)

drainage (Rennie and Davis 2016). Eighty percent were derived from the Bear Gulch source areas of the Centennial Mountains (Tables 54 and 55; Figure 145; see Willingham 1995), and only three pieces are from Obsidian Cliff (Tables 54 and 55; Figure 145; see Davis et al. 1995) in northwestern Wyoming (Yellowstone National Park). One atlatl-size corner-notched point (Fig.115.5), possibly Pelican Lake or Salmon River/Bitterroot, is made from Obsidian Cliff obsidian. The base of a probable McKean (Duncan or Hanna) point (Fig.114.44) is made from Bear Gulch obsidian (Hughes 2020).

Forbis and Sperry (1952:128) report that, "Obsidian used in the Scottsbluff and Upper levels, occurs in an outcrop about a mile to the south [of MacHaffie]". Elsewhere, Forbis et al. (n.d.:6) note a buried obsidian quarry a few miles from the MacHaffie site. These erroneous statements were based on information provided by Alfred Knopf of Yale University in 1951. Knopf based his assumption on a report prepared by Pardee and Schrader (1933) concerning metalliferous deposits in the greater Helena mining area. Knopf (1963) later observed that the presence of a "150 foot thick" bed of rhyolite caps a hill located 1.2 km southwest of MacHaffie. The lower part of the rhyolite bed is described as a perlitic obsidian that carries crystals of high-temperature plagioclase. This is the same location as the possible obsidian deposit described by Forbis and Sperry (1952:128). First-hand examination by Les Davis ruled against these geologic materials being obsidian. They are more consistent with basalt or medium-grained rhyolite (Davis 1972:45-46).

Table 56. Trace Element Chemistries and Source Determinations for Presumed Dacite Pieces: Quantitative Composition Estimates.

Catalogue #	Sample #	Zn	Ga	Rb	Sr	Y	Zr	Nb	Ba	Ti	Mn	Fe_2O_3T	Fe/Mn	Chemical Group	Artifact	Cultural Component
3958	D-2	nm	nm	63 ±3	1148 ±14	12 ±2	192 ±5	14 ±2	2515 ±31	nm	nm	4.30 ±.06	87	unknown	debitage	Helena
1287	D-4	nm	nm	3 ±2	3 ±2	1 ±2	2 ±2	1 ±2	81 ±19	nm	nm	nm	27	non-volcanic	debitage	Helena
3347	D-5	nm	nm	63 ±3	1193 ±15	10 ±2	193 ±5	12 ±2	2720 ±33	nm	nm	4.31 ±.06	94	unknown	debitage	Helena
5850	D-6	nm	nm	67 ±3	617 ±6	23 ±2	148 ±4	11 ±2	1416 ±32	nm	nm	9.10 ±.07	63	unknown	debitage	Helena
2686	D-7	nm	nm	69 ±3	1286 ±16	14 ±2	211 ±5	11 ±2	2641 ±40	nm	nm	5.04 ±.06	86	unknown	debitage	Helena
2685	D-8	nm	nm	57 ±3	1372 ±17	12 ±2	201 ±5	15 ±2	2874 ±32	nm	nm	4.74 ±.06	86	unknown	debitage	Helena
1353	D-9	nm	nm	66 ±3	1239 ±16	13 ±2	204 ±5	14 ±2	2703 ±31	nm	nm	4.72 ±.06	81	unknown	debitage	Helena
2334	D-14	nm	nm	59 ±3	1424 ±18	12 ±2	206 ±5	13 ±2	2985 ±34	nm	nm	5.15 ±.06	97	unknown	debitage	Helena
7995	D-15	nm	nm	67 ±3	1225 ±16	13 ±2	206 ±5	13 ±2	2666 ±35	nm	nm	4.57 ±.06	89	unknown	debitage	Helena
3807	D-16	nm	nm	65 ±3	1232 ±16	13 ±2	202 ±5	12 ±2	2837 ±32	nm	nm	4.51 ±.06	96	unknown	debitage	Helena
8214	D-19	nm	nm	66 ±3	1228 ±16	11 ±2	200 ±5	12 ±2	2542 ±35	nm	nm	4.84 ±.06	85	unknown	debitage	Helena
6587	D-22	nm	nm	58 ±3	1345 ±17	14 ±2	208 ±5	13 ±2	2960 ±33	nm	nm	4.84 ±.06	94	unknown	debitage	Cody
8	D-23	nm	nm	60 ±3	1194 ±16	12 ±2	195 ±5	10 ±2	2658 ±32	nm	nm	4.41 ±.06	87	unknown	non-hafted biface	Helena
11	D-24	nm	nm	65 ±3	1273 ±16	15 ±2	205 ±5	13 ±2	2708 ±32	nm	nm	4.86 ±.06	96	unknown	DEF/M	Helena
22	D-25	nm	nm	64 ±3	1153 ±15	14 ±2	200 ±4	9 ±2	2684 ±34	nm	nm	4.26 ±.05	97	unknown	Eden projectile point	Cody
96	D-26	nm	nm	61 ±3	1115 ±15	8 ±2	162 ±4	12 ±2	3623 ±32	nm	nm	3.78 ±.05	98	unknown	non-hafted biface	Helena
97	D-27	nm	nm	65 ±3	1212 ±15	12 ±2	202 ±5	12 ±2	2916 ±34	nm	nm	4.63 ±.06	92	unknown	non-hafted biface	Helena
98	D-28	nm	nm	62 ±3	1195 ±15	10 ±2	193 ±4	14 ±2	2830 ±33	nm	nm	4.37 ±.05	85	unknown	non-hafted biface	Helena
99	D-29	nm	nm	79 ±3	684 ±6	16 ±2	315 ±5	13 ±2	2195 ±29	nm	nm	3.95 ±.05	56	Cashman	non-hafted biface	Helena
45	D-30	nm	nm	63 ±3	1233 ±15	15 ±2	203 ±5	11 ±2	2524 ±30	nm	nm	4.83 ±.05	87	unknown	projectile point tip	Helena

dacite: 95% unknown source but likely the same source; 5% Cashman/Madison River valley (see Hughes 2020) nm = not measured

Table 57. Trace Element Chemistries and Source Determinations for Presumed Dacite Pieces: Integrated Net Count Rate Data.

Catalogue #	Sample #	Rb	Sr	Zr	Σ RB, Sr, Zr	Rb%	Sr%	Zr%	Fe/Mn	Rb/Sr	Zr/Y	Y/Nb	Zr/Nb	Sr/Y	Chemical Group	Artifact	Cultural Component
292	D-1	122	3214	633	3969	0.031	0.81	0.16	89	<.1	19.8	.7	13.5	100.1	unknown	debitage	Helena
8073	D-3a	124	2680	639	3443	0.036	0.778	0.186	83.6	<.1	18.8	.8	15.6	78.8	unknown	debitage	Helena
8074	D-3b	128	2560	563	3251	0.039	0.788	0.173	85.1	<.1	17.6	1.0	18.2	80	unknown	debitage	Helena
144	D-10	109	2532	622	3263	0.033	0.776	0.191	92	<.1	20.1	.8	15.6	81.7	unknown	debitage	Helena
8156	D-11	107	2395	602	3104	0.035	0.772	0.194	73.1	<.1	24.1	.7	15.8	95.8	unknown	debitage	Helena
1215	D-12	5	72	10	87	0.058	0.828	0.115	3	.1	1.0	nc	nc	5.5	non-volcanic	debitage	Helena
1173	D-13	50	1071	250	1371	0.037	0.781	0.182	62.7	<.1	20.8	.7	13.9	89.3	unknown	debitage	Helena
6122	D-17	109	2494	607	3210	0.034	0.777	0.189	88.8	<.1	18.4	1.0	19.0	75.6	unknown	debitage	Helena
1440	D-18	0	1384	52	1436	0	0.964	0.036	291.1	nc	4.3	2.0	8.7	115.3	non-volcanic	debitage	Helena
255	D-20	274	1585	936	2795	0.098	0.567	0.335	40.8	.2	11.3	1.3	14.6	19.1	unknown	debitage	Helena
6542	D-21	115	2606	629	3350	0.034	0.778	0.188	91.9	<.1	18.0	1.0	17.0	74.5	unknown	debitage	Helena

dacite: 100% unknown source but likely the same source (see Hughes 2020) nc = not computed

In contrast to the obsidian, the dacite pieces did not provide expected results (Hughes 2020; Tables 56 and 57; Appendix 10 of Volume II, this report). Only one specimen sources positively as Cashman Quarry (Baumler et al. 2001) material from the lower Madison River valley (Fig.121.99 and Fig.145; edxrf sample # D-29), although the lithic material is distributed over several known localities from Norris south to Ennis (e.g., 24MA200, 24MA1618 or 24MA1665). This is a biface from the Helena Component. All other dacite specimens (96%), including the Eden point from the Cody component (Fig.79.22; edxrf sample # D-25), are from presently undetermined sources that have chemistries similar to Willow Creek locality dacite (24LC171) south of Lincoln (Hughes 2014) and Grady Ranch dacite (24LC2013) northwest of Canyon Creek (Rennie et al. 2008). Some of the dacite pieces from 24CA1766, approximately 59 km (37 miles) northeast of MacHaffie, appear to be from the same sources as the undetermined dacite materials from 24JF4 (Hughes 2020; Rennie 2017). Chemical similarities to Willow Creek and Grady Ranch materials suggest the locality is north or northwest of MacHaffie.

Although several sources of dacite exist in Montana (Rennie n.d.; Figure 145), efforts to chemically characterize these sources have gained little traction among archaeologists. Only four sources have been adequately defined and chemically characterized in Montana (Rennie et al. 2020). Future work to identify more of these important tool stone deposits may identify a match for the undetermined source found among the sampled MacHaffie pieces. Wherever the source is, it was popular with the Middle and possibly Late Precontact occupants of MacHaffie. It also represents the first identified Cody point of this dacite source.

Three pieces of debitage presumed to be dacite were identified as “Non-Volcanic” during edxrf analysis (Hughes 2020; Appendix 10). Although no effort was made to identify the rock type, it is mentioned only to illustrate macroscopic difficulties in distinguishing volcanic dark-gray fine-grained rocks such as dacite, from metamorphic dark-gray fine-grained rocks such as hornfels (see Rennie and Brumley 2013).

Table 58 shows depths below present ground surface that the various MANA units were recovered. A few discrete MANA units appear at specific depths, or with only one of the cultural components. Most, however, are variously distributed throughout the sediments. As is typical, imported lithic raw materials in 24JF4 do not help us understand the direction people traveled to reach the site. The imported toolstones originated in multiple directions and multiple distances from 24JF4.

Table 58. MANA Units Represented and Corresponding Depths.

MANA Unit	Excavated depths below present ground surface where MANA Unit is represented	MANA Unit	Excavated depths below present ground surface where MANA Unit is represented
AND2	150-160 cm	BCCS47	0-15 cm, 30-70 cm, 180-200 cm
BAS1	105-120 cm	BPCCS2	0-20 cm, 50-60 cm, 80-100 cm, 150-160 cm
BCCS1	0-30 cm, 60-90 cm, 180-200 cm	BPCCS5	0-120 cm, 140-200 cm
BCCS2	0-110 cm, 131-160 cm, 180-200 cm	CCCS1	0-160 cm, 180-200 cm
BCCS3	0-20 cm, 40-75 cm, 160-200 cm	CCCS2	0-200 cm
BCCS4	0-110 cm, 160-200 cm	CCCS3	0-200 cm
BCCS5	0-60 cm, 80-100 cm, 95-120 cm	CCCS4	0-70 cm, 110-140 cm
BCCS6	0-90 cm, 105-160 cm	CCCS5	0-105 cm, 150-160 cm
BCCS7	0-45 cm, 60-70 cm, 160-200 cm	CCCS6	0-130 cm, 150-180 cm
BCCS8	0-100 cm, 140-160 cm	CCCS7	0-240 cm
BCCS9	0-105 cm, 140-200 cm	CCCS8	0-160 cm, 190-200 cm
BCCS11	0-10 cm, 20-40 cm, 160-200 cm	CCCS9	0-100 cm, 140-190 cm
BCCS12	0-50 cm, 160-200 cm	DAC1	0-90 cm, 120-130 cm
BCCS13	70-80 cm	GBCCS3	20-45 cm, 180-200 cm
BCCS14	0-20 cm	GBCCS5	0-60 cm
BCCS15	20-50 cm, 60-110 cm	GBCCS6	0-20 cm, 60-90 cm
BCCS16	0-45 cm, 70-80 cm, 90-100 cm, 120-140 cm, 180-200 cm	GBCCS9	20-40 cm, 60-80 cm
BCCS17	20-40 cm	GBCCS10	180-200 cm, 260-280 cm BD?
BCCS18	0-20 cm, 30-105 cm, 120-130 cm, 170-180 cm	GBCCS11	0-20 cm, 45-60 cm, 120-140 cm, 180-200 cm
BCCS19	0-90 cm, 130-200 cm	GBCCS12	Surface, 30-40 cm, 170-190 cm
BCCS20	0-50 cm, 130-140 cm, 150-160 cm	GBCCS13	0-15 cm, 30-45 cm, 180-200 cm
BCCS21	0-210 cm	GBCCS14	20-60 cm, 130-140 cm
BCCS23	0-100 cm, 120-140 cm, 160-200 cm	GBCCS15	15-30 cm
BCCS24	105-120 cm	GBCCS16	0-45 cm, 140-160 cm
BCCS25	15-40 cm, 60-80 cm, 180-200 cm	GBCCS17	0-10 cm, 180-190 cm
BCCS26	0-20 cm, 180-200 cm	GBCCS18	0-200 cm
BCCS27	0-40 cm, 60-70 cm, 100-120 cm, 140-160 cm	GBCCS19	0-60 cm
BCCS28	0-210 cm, 260-280 cm BD?	GBCCS20	0-150 cm, 180-190 cm
BCCS29	0-200 cm	GBCCS21	15-30 cm, 180-200 cm
BCCS31	0-50 cm, 60-90 cm	GBCCS26	0-30 cm
BCCS32	0-50 cm, 105-120 cm, 140-160 cm	GBCCS28	30-40 cm
BCCS33	0-10 cm, 20-30 cm, 100-110 cm	GBCCS31	0-15 cm
BCCS34	20-40 cm, 100-110 cm	GBCCS36	0-80 cm, 130-140 cm, 160-170 cm
BCCS35	20-40 cm, 60-70 cm	GBCCS38	0-90 cm
BCCS36	160-180 cm	GBCCS39	0-110 cm, 131-180 cm
BCCS37	0-40 cm, 60-90 cm	GBCCS41	20-40 cm
BCCS38	0-80 cm, 90-110 cm, 120-200 cm	GBCCS42	10-15 cm
BCCS39	0-20 cm, 30-60 cm	GBCCS43	130-140 cm, 190-200 cm
BCCS40	0-30 cm, 40-60 cm	GBCCS66	0-80 cm
BCCS41	0-200 cm	GRCCS1	128 cm
BCCS42	0-60 cm, 110-140 cm, 180-200 cm	GRAN1a	80-100 cm
BCCS43	0-140 cm, 160-180 cm	GRAN3	150-160 cm
BCCS44	0-90 cm, 100-120 cm, 140-170 cm, 190-200 cm	GRAN5	0-200 cm
BCCS45	0-40 cm	OBS1	0-100 cm
BCCS46	0-160 cm, 180-200 cm	OBS2	0-75 cm

Table 58. MANA Units Represented and Corresponding Depths (continued).

MANA Unit	Excavated depths below present ground surface where MANA Unit is represented	MANA Unit	Excavated depths below present ground surface where MANA Unit is represented
OQTZ2	30-40 cm	SDQZT4b	30-40 cm
QTZCRY1	0-15 cm, 120-130 cm	SDQZT4e	67 cm
QTZCRY2	30-45 cm, 190-200 cm	SDQZT4m	9-12 cm, 200-210 cm
RCCS1	15-80 cm	SDQZT5a	0-9 cm
RCCS2	0-105 cm, 160-200 cm	SDQZT5e	110-140 cm
RCCS3	0-200 cm	SDQZT5f	60-70 cm
RCCS4	0-200 cm	SDQZT5j	200-210 cm
RCCS5	0-100 cm, 180-200 cm	SDQZT5k	0-20 cm, 70-100 cm
RCCS6	0-130 cm, 150-200 cm	SLM1	180-190 cm
RCCS7	0-45 cm, 80-90 cm	SLM4	84 cm
RCCS8	0-100 cm, 110-140 cm, 160-180 cm	WCCS1	0-80 cm, 140-160 cm
RCCS9	15-80 BD?, 140-160 cm	WCCS2	0-45 cm, 60-80 cm
RCCS11	0-70 cm, 100-140 cm, 160-180 cm	WCCS3	0-30 cm, 160-170 cm
RCCS12	0-200 cm	WCCS4	0-60 cm, 100-110 cm, 140-200 cm
RCCS13	0-90 cm, 160-180 cm	WCCS5	0-210 cm
RCCS14	0-80 cm, 120-160 cm	WCCS6	15-30 cm, 60-80 cm
RCCS15	15-30 cm, 180-200 cm	WCCS7	0-20 cm
RCCS16	0-50 cm, 80-90 cm, 110-140 cm, 180-200 cm	WCCS8	0-40 cm, 87-90 cm, 110-140 cm
RCCS17	20-40 cm	WCCS9	60-80 BD?
RCCS18	0-30 cm	WCCS10	0-30 cm, 40-60 cm, 120-130 cm, 160-180 cm
RCCS19	0-200 cm, 180-200 cm	WCCS11	0-40 cm, 80-180 cm
RCCS20	0-10 cm, 90-105	WCCS12	90-140 cm, 180-200 cm
RCCS21	0-60 cm, 75-90 cm	WCCS13	20-60 cm
RCCS22	0-60 cm, 90-130 cm, 160-190 cm	WCCS14	10-40 cm, 80-100 cm, 160-180 cm
RCCS23	0-15 cm, 40-50 cm	WCCS15	0-80 cm, 110-140 cm, 180-200 cm
RCCS24	0-30 cm, 40-60 cm	WCCS16	0-30 cm, 50-80 cm
RCCS25	40-50 cm	WCCS17	0-30 cm, 40-60 cm
RCCS26	0-125 cm, 120-210 cm	WCCS18	0-50 cm, 70-100 cm, 120-130 cm, 140-160 cm
RCCS27	10-75 cm, 90-170 cm	WCCS19	20-30 cm
RCCS28	180-200 cm	YBCCS1a	0-105 cm, 120-140 cm, 180-200 cm
RCCS29	20-40 cm, 75-90 cm	YBCCS1b	0-40 cm, 70-100 cm, 130-200 cm
RCCS30	0-20 cm, 160-180 cm	YBCCS1c	40-60 cm
RCCS31	0-10 cm, 40-80 cm, 131-160 cm	YBCCS1d	0-140 cm, 170-200 cm
RCCS32	0-90 cm, 110-150 cm, 170-190 cm	YBCCS1e	0-90 cm
RCCS33	0-110 cm, 130-160 cm, 190-200 cm	YBCCS2	0-60 cm, 75-90 cm, 120-130 cm, 180-200 cm
RCCS34	0-20 cm, 60-70 cm	YBCCS3	15-45 cm, 60-80 cm, 140-180 cm
RCCS35	15-30 cm, 90-105 cm	YBCCS4	0-200 cm
RCCS37	10-20 cm, 45-60 cm	YBCCS5	0-90 cm, 105-120 cm, 140-160 cm
RCCS47	0-90 cm, 150-200 cm	YBCCS6	0-20 cm, 30-40 cm, 70-80 cm, 90-100 cm
RCCS48	0-200 cm	YBCCS7	15-40 cm, 50-70 cm, 90-123 cm, 150-160 cm
RCCS56	15-30 cm, 60-70 cm, 160-180 cm	YBCCS8	0-80 cm, 100-110 cm, 120-140 cm, 180-200 cm
RHY2	160-180 cm	YBCCS9	0-45 cm, 85-94 cm, 160-200 cm
SDQZT1b	40-50 cm	YBCCS11	0-15 cm, 30-50 cm, 80 cm, 170-200 cm
SDQZT2d	99-100 cm	YBCCS12	0-45 cm, 80-160 cm, 180-200 cm
SDQZT2f	149 cm	YBCCS14	30-40 cm

Table 58. MANA Units Represented and Corresponding Depths (continued).

MANA Unit	Excavated depths below present ground surface where MANA Unit is represented	MANA Unit	Excavated depths below present ground surface where MANA Unit is represented
YBCCS15	0-50 cm, 100-120 cm, 150-180 cm, 200-200 cm	YBCCS36	10-60 cm, 70-80 cm
YBCCS16	20-30 cm	YBCCS37	15-45 cm, 60-75 cm, 180-200 cm
YBCCS17	20-30 cm	YBCCS38	0-30 cm, 40-70 cm
YBCCS18	0-30 cm, 40-80 cm, 100-130 cm, 160-200 cm	YBCCS39	0-10 cm, 30-70 cm, 180-200 cm
YBCCS19	180-200 cm	YBCCS40	0-140 cm, 180-200 cm
YBCCS21	0-90 cm, 180-200 cm	YBCCS41	20-100 cm
YBCCS22	0-50 cm, 140-180 cm	YBCCS42	0-30 cm, 60-70 cm, 110-140 cm, 170-200 cm
YBCCS23	0-30 cm, 60-80 cm, 90-120 cm, 180-200 cm	YBCCS43	30-50 cm, 160-200 cm
YBCCS24	0-60 cm, 75-100 cm, 180-200 cm	YBCCS44	20-30 cm, 120-130 cm
YBCCS25	40-60 cm, 180-200 cm	YBCCS45	20-45 cm, 60-80 cm, 105-200 cm
YBCCS27	45-60 cm, 90-105 cm, 180-200 cm	YBCCS46	0-30 cm, 110-120 cm
YBCCS28	0-20 cm, 105-140 cm, 160-180 cm	YBCCS47	15-30 cm
YBCCS29	0-30 cm, 110-160 cm, 180-200 cm	YBCCS48	15-30 cm, 45-70 cm, 90-100 cm
YBCCS30	0-100 cm, 110-200 cm	YBCCS49	10-20 cm, 40-50 cm, 80-100 cm, 180-200 cm
YBCCS31	0-60 cm, 75-90 cm, 180-200 cm	YBCCS50	0-120 cm, 140-200 cm
YBCCS32	20-50 cm	YBCCS51	0-140 cm
YBCCS33a	0-60 cm, 75-90 cm, 180-200 cm	YBCCS52	0-50 cm, 70-80 cm, 90-135 cm, 150-160 cm, 180-200 cm
YBCCS33b	0-50 cm, 80-90 cm	YBCCS53	0-20 cm, 30-45 cm, 75-90 cm
YBCCS34	0-20 cm	YBCCS54	30-40 cm, 105-120 cm
YBCCS35	0-90 cm, 170-200 cm	YBCCS55	0-10 cm, 190-200 cm

13.0 HISTORIC MATERIALS

In addition to precontact cultural remains, several 20th century artifacts, and a few recent items, were recovered from 24JF4. Their presence is discussed to make the MacHaffie site record as complete as possible. It is uncertain if historic materials were recovered during Dick Forbis' investigation in 1951. Nothing is mentioned in the available fieldnotes, and none is present among the available 1947-1951 materials (UMMC 2020). In addition to the extensive small mammal burrowing, uncontrolled artifact hunting, borrowing of topsoil for local gardens, and erosive fluvial events, the presence of historic artifacts throughout the soil profile substantiate previous concerns of context problems for MacHaffie cultural materials. Table 59 and Figures 146-147 show that 81 artifacts ranging in age from approximately 100 years old to quite recent were recovered and retained during the 1989 through 2018 excavations. Fifty of those items are rusted and rotted tin fragments (Table 59; Figure 146). Based on their vertical and horizontal proveniences these likely represent only two or three sanitary cans and a larger tin container, possibly an oil or kerosene can. Eighteen items are glass fragments that are light

Table 59: Metric, Nonmetric, and Provenience Data for Historic Artifacts.

Record #	Excavation Unit	Excavated Level Depth	CMU	Material Type	Artifact Function	Integrity	Length	Width	Thickness/ Diameter	Count	Weight (grams)	Comments
1	8S/6W	40-50 cm BS	2	glass	bottle	fragment	1.2	1.1	0.4	1	0.65	Light greenish aqua colored glass fragment. No distinguishing characteristics (pre 1920 production)
2	TU-1	20-40 cm BS	3	brass	.22 long rifle cartridge case	complete	1.56	0.58	0.36	1	0.65	Union Metallic Cartridge Co. single character "U" headstamp (1888-1912 production). Rim diameter is 6.99 mm; powder chamber length is 14.69 mm; Inside diameter is 5.08 mm
3	C-8	110-140 cm BS	3	lead	.22 long rifle bullet	complete			0.55	1	2.6	Fully mushroomed, but otherwise complete .22 caliber lead bullet. Bullet base diameter is 5.56 mm/0.224 inches. Weight converts to 40 grains.
4	C-4	140-160 cm BS	3	glass	bottle	fragment	3	2.2	0.2	1	4.3	Clear glass fragment from a multi-sided bottle (possibly octagonal Heinz catsup, 1880-current).
5	C-4	180-200 cm BS	3	glass	marble	complete	1.5	1.5	1.5	1	5.2	Pale amber glass marble (5/8" diameter)
6	C-4	200-220 cm BS	3	glass	bottle	fragment	3.2	2.2	0.7	1	5.05	Clear glass fragment with a partial Maker's Mark.
7	2000-5	0-20 cm BS	4	brass	12 gauge shotgun cartridge brass	complete	1.5	2.19		1	4.6	12 gauge Remington-UMC with a Nitro Club headstamp (1911-1915 production). Primer appears to have been struck by a firing pin twice; extractor indention also on face of head. Cardboard fiber base wad is still in the brass.
8	2008-SBE	30-50 cm BS	3	glass	bottle	fragment	3.1	2	1.2	1	2.3	Light greenish aqua colored glass fragment. No distinguishing characteristics (pre 1920 production)
9	98-South Block	20-30 cm BS	5	copper	.22 long or long rifle cartridge case	complete	1.54	0.58	0.36	1	0.65	Winchester impressed single character "H" headstamp (1890-1920 production). Rim diameter is 6.99 mm; powder chamber length is 14.7 mm; Inside diameter is 5.08 mm
10	98-South Block	20-30 cm BS	5	tin	tin can	fragments				40	15.4	Rusted tin fragments presumably of small (evaporated milk-size) can. Some pieces include a portion of a seam.
11	Test C	0-20 cm BS	10	tin	flat tin pieces	fragments				6	1.55	Rusted flat tin fragments that do not appear to be part of a can.
12	Test C	0-20 cm BS	10	metal	riveted/permanent button	complete	1.1	1.6		1	2.65	Rusted metal riveted button in two pieces. Probably from denim pants or overalls.
13	Test C	0-20 cm BS	10	copper	coin	complete		1.9	0.16	1	3.15	1941 Lincoln Head "D" stamp wheat penny
14	Unit 1	0-10 cm BS	7	glass	bottle	fragments				13	4.95	Brown bottle glass fragments (small fragments).
15	8S/4W	190-200 cm BS	10	tin/lead	tin can	fragments				2	6.25	Rusted bands and lead solder from a tin can.
16	0N/0E	0-10 cm BS	10	tin	tin can	fragments				2	17.8	Rusted tin can bottom and side parts (crimped seam can).
17	8S/4W	90-100 cm BS	9	lead	.22 long rifle bullet	complete			0.55	1	2.6	Fully mushroomed, but otherwise complete .22 caliber lead bullet. Bullet base diameter is 5.56 mm/0.224 inches. Weight converts to 40 grains.
18	4S/0E	50-60 cm BS	10	fiber	string	complete	96.5		0.15	1	2.05	Braided cotton butcher block string/cord in very good condition. Knotted at cut/frayed end. Possibly from Forbis' excavation work, but uncertain why it was recovered in an area unexcavated by Forbis, and 50-60 cm BS.
19	0N/0E	50-60 cm BS	10	fiber	string	complete	26		0.07	1	0.25	Braided cotton string (light-gauge) in very good condition. Two pieces of string are knotted together to form a single strand.
20	8S/4W	170-180 cm BS	8	glass	bottle	fragment	1.6	1.1	0.2	1	0.4	Clear glass fragment. Slightly concave interior surface.
21	6S/6W & 8S/6W	160-170 cm BS, 200-220 cm BS	2	cellulose acetate	cigarette filter	complete	1.6	0.8	0.8	3	1.5	Two cigarette filters retain some of the tan-colored paper outer wrapper (probably Camel brand based on nearby partial box/pack). A third filter recovered from sterile sediment at 220 cm BS. None show nicotine staining. Hard to explain their presence at same level, and well below, Folsom preform, biface, and knapping feature.

historic artifact measurements are in centimeters unless otherwise noted

Figure 146. Metal Historic Artifacts from 24JF4.

Figure 147. Glass and Fabric Historic Artifacts from 24JF4.

greenish aqua, brown, or colorless. They likely represent three or four bottles or jars. The greenish aqua fragments (Figure 147.1, 8) suggest a pre-1920 production date, and the amber glass marble is likely of World War I era production (Jones 1965; Munsey 1970). Most of the glass fragments lack distinguishing characteristics. One piece is from a colorless, octagonal, condiment container, possibly a Heinz catsup bottle. Its octagonal pattern (Figure 147.4) has continued since its introduction in 1880. Another colorless glass fragment has a partial maker's mark of an "O" (Figure 147.6). This ovate design suggests production in the Owens Bottle-Machine Company (Illinois) in 1918 (Lockhart and Hoenig 2016).

Most of the historic artifacts were recovered from the upper 60 cm of colluvium, but some were found in and below the Paleo-Indian levels. It is easier to explain their presence in the upper 20 cm of sediment than one or two meters BS. Two .22 Long or Long Rifle cartridge cases (one of copper and one of brass) were recovered from the 20 to 40 cm BS depth in excavation units separated by a horizontal distance of approximately 25 m (Figures 146.2; 146.9, 148). The copper case was manufactured by Winchester and exhibits an impressed single character "H" headstamp (1890 through 1920 production). The brass case was manufactured by the Union Metallic Cartridge Co. and exhibits an impressed single character "U" headstamp (1888-1912 production). Each rimfire case has a single firing pin indentation on its head or face near the rim. The brass head of a 12-gauge shotgun shell was recovered from the upper 20 cm of sediment approximately 30 meters upstream of the .22 cartridge cases (Figures 146.7, 148). The shotgun shell part has a headstamp of "Remington-UMC" and "Nitro Club" placing its production date between 1911 and 1915 (Ball 1997; Barnes 2019; Boorman 2001; Marcot 2005). The primer appears to have been struck twice by the firing pin, both impacts are offset from the primer center. This suggests that a misfire occurred, the shell was extracted, slightly rotated, reinserted into the chamber, and the second strike fired the shell. There is also an indentation from the extractor which suggests a head spacing problem that allowed the case to move backward slightly upon detonation expanding the brass head outside the margins of the extractor. Both poor alignment of the firing pin and head spacing issues were relatively common among low-cost American-made, late 19th and early 20th century, single-shot shotguns (Dennis Earhardt pers. comm. 2019). The cardboard fiber base wad is still in the brass head but the paper hull has rotted away. Two .22 caliber lead bullets were recovered from 90 to 140 cm BS in excavation units separated by a horizontal distance of approximately 14 meters (Figures 146.3, 146.17, 148). They are both fully mushroomed indicating that they struck dense material. They retain their mass at 40 grains each suggesting .22 Long Rifle bullets as opposed to the lighter (29 grain) .22 Long bullets.

One excavation unit (Test C) produced rusted tin fragments, a permanent metal button from jeans or coveralls, and a copper 1941 Lincoln Head "D" stamp wheat penny at a depth of 0-20 cm BS (Figures 146.11-13, 149). At a depth of 50 to 60 cm BS in unit 4S/0E approximately one meter of braided cotton butcher block string in very good condition was recovered (Figure 147.18, 148). The strand is knotted at its cut end. Nearby in excavation unit 0S/0E and at the same depth below ground surface, a lighter gauge of braided cotton string was recovered (Figures 148.19, 149). It measures 26 cm in length and consists of two pieces of string knotted together into a single strand. It, too, is in very good condition. The string might be associated with Forbis' 1951 excavation work, but it seems to be in remarkably good condition if it was buried for almost 40 years before being recovered by Les Davis' crew in 1989.

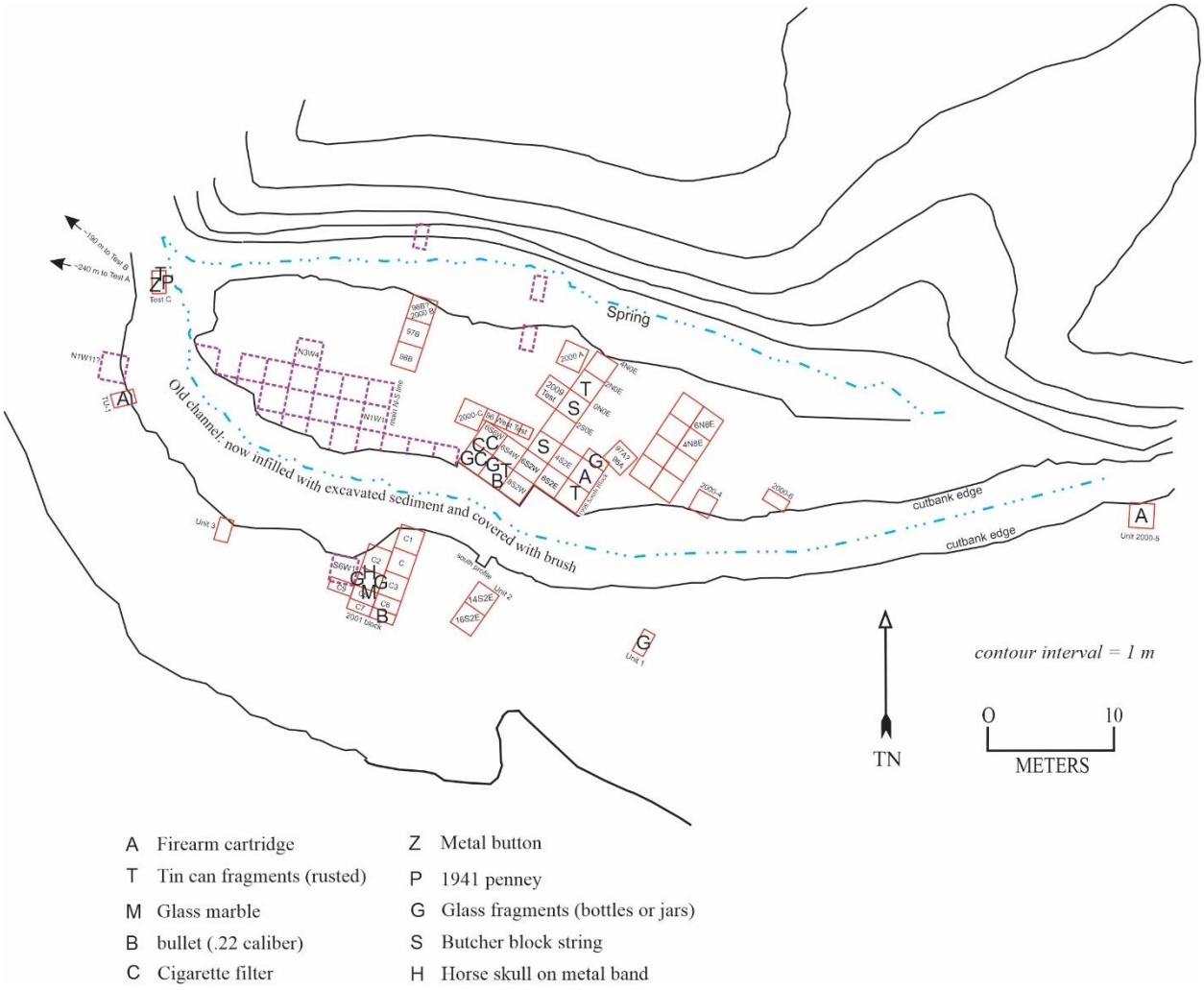


Figure 148. Distribution of Documented Historic/Modern Cultural Material in 24JF4.

In 2018 two cigarette filters were recovered from a depth of 160 to 170 cm BS (Figures 20, 147.21, 148). One was below the final excavated depth by Les Davis' crew in 1991 in the SENE corner of unit 8S/6W (possible SWNW corner of unit 8S/4W). The other was recovered from the NWSW1/4 of unit 6S/6W. They were separated by a horizontal distance of approximately two meters. The filter in unit 8S/6W could have easily been transported by small burrowing rodents as there was less than 20 cm of unexcavated sediment between where the 1991 excavation stopped and the first filter was exposed in place. The second filter could have been deposited if a small burrowing rodent had excavated laterally approximately two meters

under 1.6 meters of overburden to where it was found. A further problem is that a third filter in a more deteriorated state than the first two, was recovered at 220 cm BS in the SWcorner of unit 6S/6W. This depth is approximately 25 cm below the Folsom level in the culturally sterile basal sands. Both filters retain portions of the tan paper wrappers and neither exhibit nicotine staining which suggests that the cigarettes they once tipped were never smoked. Perhaps only coincidental, in 2018 a partial pack of Camel brand cigarettes was found 15 meters south of excavation units 6S/6W and 8S/6W. The filters and filter wrappers of the four cigarettes remaining in the partial pack look identical to those recovered during excavation. Whatever the case, the filters likely do not predate the mid-1950s when American tobacco companies introduced filtered cigarettes (Pagan 2012). The fragile paper covering the filters would not last many years in comparatively damp sediments, but no krotovinas or other disturbances were observed to explain their presence.

The most unexpected find at MacHaffie occurred in 2001 in unit C-4. Davis' crew exposed a modern horse skull atop a rusted metal band (Figures 148-150) at the depth of approximately 160 to 180 cm BS-- the Folsom/Cody transition zone in that portion of the site. From the same depth, a colorless glass fragment (#4) from what appears to be a hexagonal condiment bottle was recovered. Immediately below the skull and metal band, a pale amber glass marble (5/8 inch/16 mm diameter) was found. Deeper still in the otherwise culturally sterile sediments at 200 to 220 cm BS, the colorless glass fragment (#6) with partial maker's mark was recovered. Although no pit boundaries were identified to explain the presence of the horse skull and other historic artifacts in unit C-4, the skull and band were not of a recent occurrence. The metal band was badly rusted in the damp sediment and had stained the base of the horse skull. The band was suggested to have been part of a paint, tar, or pesticide bucket common in the 1920s through 1940s. It had been bent inward at one side but does not form any obvious shape. The band was intentionally laid flat, presumably at the bottom of a small diameter (~1 m) hand-dug pit. Presumably the marble and two glass shards were set inside the metal band. The skull was then placed atop it with the nose oriented to the east. The horse skull was uniformly stained a light-brown to reddish-brown from the iron content in the sandy silts.

Mandibles and nasal bones were missing. They were either removed prior to burial or the skull was collected after the soft tissues had decayed and the bones detached naturally. It is difficult to say much about the skull from photographs alone. Canine teeth appear to be absent. Without examining the skull, it is uncertain if these were removed or rasped flat when the horse was approximately 4 to 6 years of age, or if it is a post-mortem occurrence. Alternately, if the skull is from a mare, the canines may have never developed. It is also impossible to tell from the pictures if the molars had been floated. Bullet damage to the cranium is absent, so the horse likely died from natural causes. Excavation and subsequent infilling of the pit would have mixed cultural materials, thus the provenience of all precontact cultural remains from unit C-4 is suspect.

There are many precedents for ritual burial of animal remains. In the Nordic and Anglo-Celtic traditions, livestock skulls and body parts were buried or concealed to ward off witchcraft. When buried near a barn or in field areas, it was usually because the animal had died from some "inexplicable" cause attributed to bewitchment. To protect the rest of the livestock, the afflicted animal, or parts, were buried ritualistically to counter the curse. It was not uncommon to add other objects to the ritual assemblage. Iron, shiny and sharp objects, and amber were believed to

Figure 149. Horse Skull on Metal Band Exposed in Unit C-4 (~160 cm BS).

Figure 150. Closeup of Horse Skull on Metal Band.

wield protection against evil, specifically to counter the effects of witchcraft. Found together, these objects would amplify each other's power. Burying a horse skull with an iron band, sharp and reflective glass bottle fragments, and an amber marble fits with recorded beliefs and archaeological discoveries in Britain, Europe, and the United States (Campana et al. 2010; Hoggard 2019; Kitteridge 1972; Sofield 2015; Thilderkvist 2013; Whitlock 1992). The numbers three, five, and seven also have significance in protective magic (Augé 2020:184). The three glass objects found with the horse skull and metal band may substantiate the recognition of apotropaic magical items in the triad or quintet groupings. The evidence suggests this buried feature may be a ritualized enactment like that observed elsewhere. It is one of few currently recognized possible protective magic events identified in Montana. As an alternate consideration regarding the metal band the horse skull was set atop, area rancher, Nina Baucus, suggested it may have been intended to represent the mandibles.

Most of the historic artifacts appear to date to the early 20th century with a lesser presence of 1940s, possibly 1950s, and contemporary cultural materials. Today there is no visible evidence of a homestead or residence in or immediately adjoining the MacHaffie site. Although the original GLO Survey Plat of 1869 (Figure 151) shows no cultural features in or near the MacHaffie site, agricultural and mining settlements were beginning. The earliest homestead patent encompassing 24JF4 was received by Julius McDonald on November 10, 1919 (BLM Accession #718078, Document # 010130) and included the W1/2SE1/4 where the MacHaffie site is situated. It is unknown if Julius McDonald established a residence on his homestead. There is no surface evidence today, and Dr. Forbis made no mention of a foundation or building remains in 1951. Further, the 1947 aerial photo (Figure 152) shows no obvious disturbances or structures near the site, but the resolution is sufficiently low that only a substantial disturbance or structure would be easy to recognize. Regardless, a local homesteader of European decent might be the connection to the horse skull feature.

In addition to homesteading, numerous mining claims, one mine (Bonanza Chief), and a mill site (Bonanza Chief Mill site) are immediately north and northeast of MacHaffie, but they did not disturb 24JF4.

The presence of historic materials in the upper 20 cm of sediment is expected considering the presence of people in the area since the mid-19th century. Historic materials found deeper in the colluvium reinforces the notion that these sediments have been repeatedly churned through natural and cultural processes. The presence of historic and contemporary materials in the alluvium up to two meters BS may reflect past excavation and subsequent infilling. The data suggest that deeply buried historic materials are restricted to two locations near the center and south margin of the site (see Table 59 and Figure 148: excavation units C-4, C-8, 6S/6W, 8S/4W, and 8S/6W).

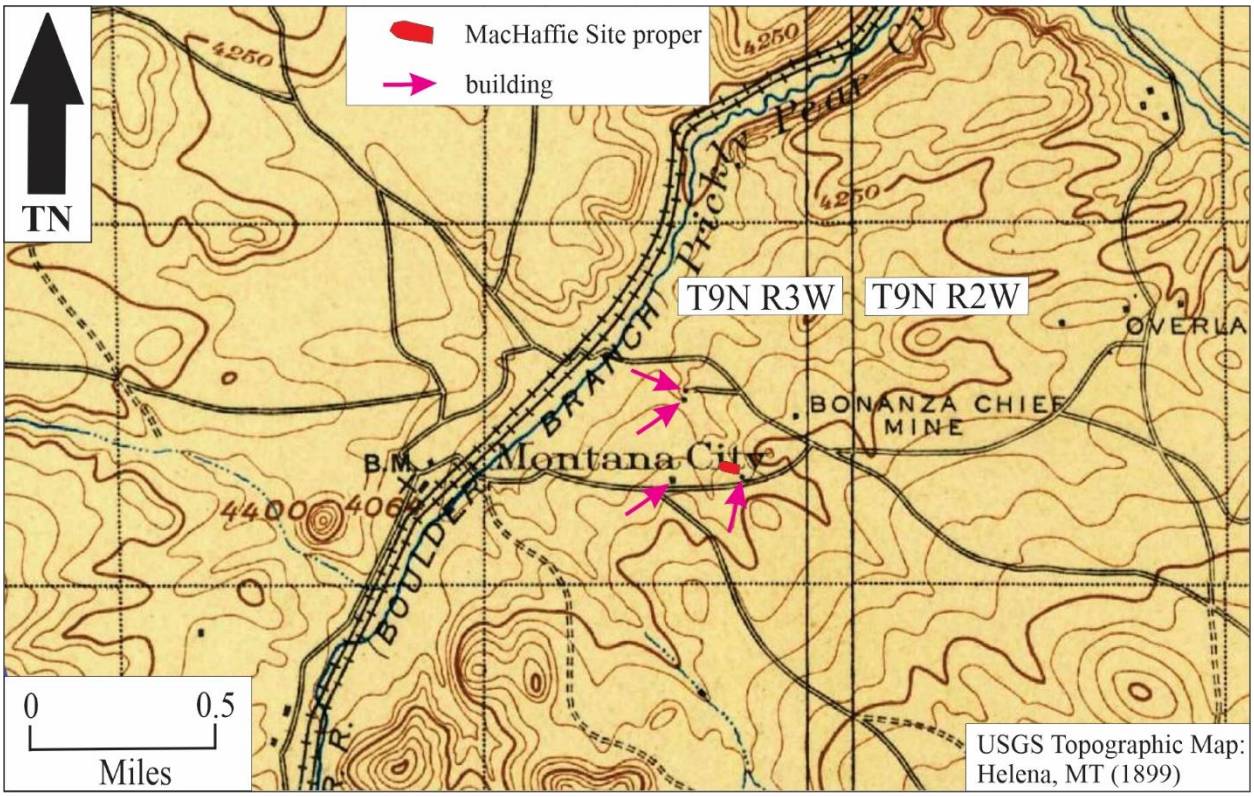


Figure 151. 1899 Topographic Map Showing Four Possible Buildings (cabins?) near 24JF4.

Figure 152. 1947 Aerial Imagery Showing the MacHaffie site Locality.

14.0 SITE CHRONOLOGY

14.1 Radiocarbon Dating

Because the so-called Helena Component (Forbis' Level III) consists of mixed cultural remains of the (presumably) Early Transitional, Middle, and possibly Late Precontact periods, no attempt has been made to date the upper meter of sediment by chronometric techniques. It is assumed that the colluvium began to form approximately 8,000 years BP based on temporally/culturally diagnostic projectile points (Figure 153).

Dick Forbis (Forbis et al. n.d.:149) obtained a solid carbon (wood charcoal flecks) radiocarbon date of 8,100 ±300 BP (L-578A) for the Cody component (Forbis' Level II). Forbis noted that "Charcoal was collected wherever possible, but only in the Scottsbluff layer was there a sufficient amount for radiocarbon dating purposes (Forbis et al. n.d.:144)". Although no record exists to shed light on the vertical or horizontal provenience of Forbis' charcoal sample, presumably it was retrieved from a depth of approximately 60 to 80 cm BS and probably from excavation units S1/W1, S1/W2, or S1/W3. We are unable to locate the Lamont-Doherty Observatory's C-14 catalogue to determine the year the Forbis' date was obtained. Strangely, the L-578A sample is not mentioned in any of Lamont's published records in early *Radiocarbon* and *Science* journals. However, Lamont Lab numbers that bracket the L-578A sample are published. Assuming these lab numbers are dated sequentially, the L-578A sample was assayed "…between July 1958 and November 1960 (Kulp et al. 1951; Olson and Broecker 1961:141)." Adding to the uncertainty is a statement by Forbis that the date was obtained in 1951 (Forbis 1992:34). Although the 1951 date is a typo, even the later estimate of 1960 makes the Forbis'date the first obtained for a Montana archaeological context. As a final note, the actual amount of charcoal collected or retained during the 1951 excavations is uncertain. No carbon sample is among the UM MacHaffie Collection.

For unknown reasons, Davis subdivided the Folsom component (Forbis' Level I) into Strata I and II and the Cody component (Forbis' Level II) into Strata III and IV (Davis et al. 1991; 2002; Figure 153). Because the chipped stone analysis, the 1989 through 2010 field notes and level records, and the 2017 through 2018 excavation work revealed no stratigraphic breaks within the Cody and Folsom components, nor even a clear separation between the Cody and Folsom components, we are inclined to view the Cody component as a single unit generally beginning at the alluvium/colluvium boundary (approximately 100 to 110 cm BS) and extending downward to the dark clay paleosol that contains the majority of the Folsom materials. This paleosol variously appears at a depth of 135 to 200 cm BS depending on location in the MacHaffie site proper. Most Folsom age materials do not extend deeper than two meters anywhere in the site and is typically found within a 20 to 25 cm thick zone that is not visibly discernable in the excavation unit profiles but fully encapsulates the dark paleosol associated with the Folsom component. Why the Cody and Folsom components tend to be higher in the soil profile where Forbis' 1951 excavation work occurred, compared to areas immediately adjacent, can only be speculated. One explanation is a trough in the early Holocene topography with the natural depression being slowly infilled with sediment over time. Forbis' work would have been carried out at the upper outside edge, or west of the presumed trough. Davis' work and the 2017 to 2018 excavations were conducted in the interior portion of the presumed depression.

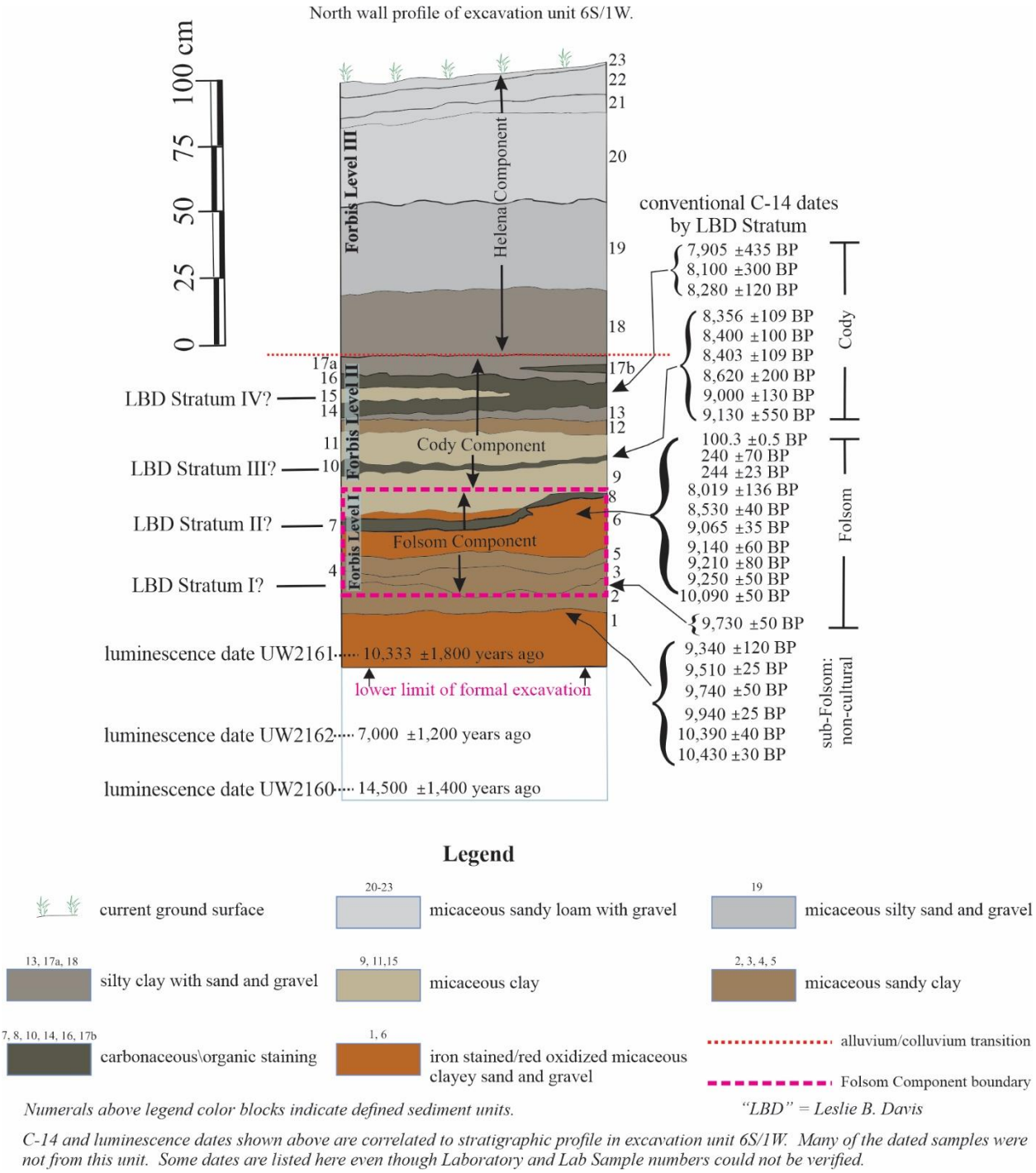


Figure 153. Sediment Units, Cultural Components, and Corresponding C-14 and Luminescence Dates by Stratigraphic Position.

Davis submitted 26 organic samples for radiometric assay over several years (e.g., Davis 1990). These samples were obtained from various locations and depths in the alluvium. Theyconsisted of bone for collagen and apatite extraction, organically rich sediments, and charcoal. To further limit bias and check for potential dating errors these samples were sent to five different laboratories for analysis (Table 60). Five handwritten dates are problematic in that we cannot confirm they are legitimate assays. Henry Abbott (pers. comm. 2020) of Beta Analytic could not locate any information on sample numbers Beta-46739 and Beta-105640. This may be due to a records loss at Beta Analytic in the 1990s. Similarly, Geochron laboratories could not locate a sample number submitted by Dr. Davis that matched the radiometric date of 8,356 ±109. These and two other dates for which no laboratory is referenced were variously plotted on notes and excavation plan maps in Les Davis' files (Table 60). They are presented here only for future reference if one or more are found to be legitimate.

In 2018, Rennie submitted 23 small fragments of non-diagnostic bison-size bone (45.7 g) to Beta Analytic for radiometric assay (DNRC sample 24JF4-2018-1; Beta-504288). The comminuted bone was collected from the Folsom level (160-170 cm BS) in excavation unit 6S/6W. It was associated with Folsom point preform #17. The bone was analyzed by Beta Analytic staff who determined that "A reliable collagen fraction could not be isolated and purified despite a careful pretreatment and it cannot be dated nor a N15/N14 measurement done (Patrick 2018)." Collagen extraction was problematic for previous samples as well (Cummings et al. 2009:3). Occasionally, the nonsoluble fraction was black and comprised a large percentage of the bone. Application of Fourier Transform Infrared Spectrometer (FTIS) suggested that the black dendritic deposits are manganese oxide and thus undatable. The next step involved the attempted extraction of bone apatite since other dates on bone apatite had been previously reported from MacHaffie. This too resulted in failure. Degradation of bone collagen can occur through many processes, natural or cultural, including water leaching. This could result from lengthy containment in naturally saturated sediments, such as the situation is at MacHaffie. It also could reflect bone that was subjected to stone boiling following its pulverization. Dateable collagen from a few sporadic small pieces of bone (*Canid* sp.) was collected from the 200 to 210 cm BS depth in unit C-5. The bone fragments were collected from sand directly below the Folsom paleosol and dated to 10,390 $\pm$40 BP (Beta-159167: see Davis et al. 2002:19). We are uncertain if the canid remains are affiliated with the Folsom component or if it represents a natural occurrence. The date is within he expected time of Folsom and it is consistent with the luminescence date for sediment sample UW2161 obtained from a similar depth and discussed in Section 14.2 of this manuscript.

Dates for the Cody component range from 7,905 $\pm$435 BP (GX-15153-A) to 9,130 $\pm$550 BP (GX-15151-A). The average of the Cody component C-14 dates is 8,399 BP with a median date of 8,400 BP. Considering the average chronometric date for Cody components elsewhere (Figure 70) is 8,898 BP (median date range of 8,950 to 8,930 BP), the Cody component at MacHaffie is at the late end of the expected Cody temporal range, but not outside expected chronologic parameters. In contrast, dates obtained for the Folsom component range from 8,019 $\pm$136 BP (UGA-6309) to 10,090 +50 BP (Beta-159058). The average is 9,299 BP with a median date range of 9,340 to 9,290 BP. Considering the average chronometric date for Folsom components elsewhere (Figure 31) is 10,247 BP (median date range of 10,470 to 10,455 BP), the Folsom component at MacHaffie appears to be unacceptably late. By way of comparison, the designated Folsom component at the nearby Indian Creek site south of MacHaffie dates within

Table 60: MacHaffie Site Radiocarbon Dates.

Sample Reference	Material Dated	Horizontal Provenience	Vertical Provenience	C-14 Conventional Age BP	C-14 Measured Age BP	C-14 Calibrated Age BP (1 Sigma)	C-14 Calibrated Age BP (2 Sigma)	delta C-13 value	Assigned Cultural Affiliation
TX-770	organically rich sediment	6S/2W	180-200 cm BS	9,730 ±50					Folsom
TX-7769	organically rich sediment	6S/2W	160-170 cm BS	9,210 ±80					Folsom
Beta-46739*				9,140 ±60					Folsom
Beta-105640*	bone apatite carbon (*bison* sp.)			9,250 ±50					Folsom
Beta-146734	charred organic material	2000-A	175 cm BS	240 ±70			470-240, 230-70, and 40-0	-25	Folsom
Beta-146735	organic material	2000-A	175 cm BS	8,530 ±40			9,560-9,510	-22.7	Folsom
Beta-159167	bone collagen (*canid* sp.)	C-5	200-210 cm BS	10,390 ±40	10,300 ±40	12,640-11960	12,790-11,940	-19.7	sub-Folsom (non-cultural?)
Beta-159168	charred material	C-5	180-200 cm BS	100.3 ±0.5 pMC	100.7 ±0.5 pMC			-23	Folsom
Beta-159058	organically rich sediment	C-5	180-200 cm BS	10,090 ±50	10,090 ±50	11,940-11,480	12,100-11,330	-25.1	Folsom
Beta-504288	bone fragments (*bison* sp.)	6S/6W	160-170 cm BS	insufficient collagen					Folsom
GX-15150-AMS	bone apatite carbon (*bison* sp.)	4S/0E	200-210 cm BS	9,340 ±120				-10.7	Folsom
GX-15151-A	bone apatite carbon (*bison* sp.)	6S/1W	160-170 cm BS	9,130 ±550				-10.1	Cody
GX-15151-G-AMS	bone apatite carbon (*bison* sp.)	8S/1W	160-170 cm BS	9,000 ±130				-19	Cody
GX-15152-AMS	wood charcoal flecks	8S/1W	160-170 cm BS	8,620 ±200				-26.8	Cody
**	organically rich sediment	6S/1W	160-170 cm BS	8,356 ±109					Cody
GX-15153-A	bone apatite carbon (*bison* sp.)	6S/1W	150-160 cm BS	7,905 ±435				-10.4	Cody
GX-15153G-AMS	bone collagen (*bison* sp.)	6S/1W	150-160 cm BS	8,280 ±120				-19.6	Cody
L-578A	wood charcoal			8,100 ±300				n/a	Cody
PRI-09-127-2MC-T1	microscopic wood charcoal	2009 Deep Test (a.k.a. 2009 Test)	230-240 cm BS	10,430 ±30		12,570-12,170	12,610-12,130	-27.2	sub-Folsom (non-cultural?)
PRI-12-033-12	bone apatite carbon (*bison* sp.)	6S/4W	170-180 cm BS	9,065 ±35		10,245-10,205	10,255-10,185	n/a	Folsom
PRI-12-033-F10	bone apatite carbon (*bison* sp.)	2008-South Block Extension (a.k.a., NE Test, South Extension)	170-180 cm BS	244 ±23		310-280; 170-150	430-410; 320-280; 180-150	-19.5	Folsom
PRI-09-127-2	Salicaceae wood charcoal	2009 Deep Test (a.k.a. 2009 Test)	210-220 cm BS	9,510 ±25		11,060-10,700	11,070-10,690	-26.2	sub-Folsom (non-cultural?)
PRI-09-127-2HU-T2	organically rich sediment	2009 Deep Test (a.k.a. 2009 Test)	210-220 cm BS	9,940 ±25		11,390-11,260	11,600-11,240	-25.5	sub-Folsom (non-cultural?)
UGA-6307	organically rich sediment	6S/1W	140-150 cm BS	8,403 ±109 (12c/13c date)				-24.67	Cody
UGA-6309	organically rich sediment	6S/1W	170-180 cm BS	8,019 ±136				-24.1	Folsom
***	organically rich sediment	6S/1W	160-170 cm BS	8,400 ±100					Cody
***	organically rich sediment	6S/1W	200-210 cm BS	9,740 ±50					sub-Folsom/Folsom?

*= Information regarding this Laboratory number not on file with Beta Analytic. Reference found on handwritten note in Les Davis' files.

**= Information regarding this date not on file with Geochron. Reference found on handwritten note in Les Davis' files.

***= Information not found regarding this sample's Laboratory number or Laboratory. Reference found on handwritten note in Les Davis' files.

the expected 10,700 to 10,400 BP age range (Baumler and Davis 2000:18). Additional dating problems are seen in three samples not included in the Folsom component chronometric average because they produced very recent dates of 100.3 ±0.5 BP (Beta-159168), 240 ±70 BP (Beta-146734), and 244 ±23 BP (PRI-12-033-F10). All three of these recent dates are associated with Les Davis' Stratum II.

The radiocarbon age series for the MacHaffie Paleo-Indian components is overall systematically younger than expected, although the relative time-stratigraphic order test is met by that array (Table 60; Figures 31, 70, 153). Considering that a variety of organic materials were assayed, and several different laboratories were used, the evidence might suggest contamination by downward movement of younger organic matter through the sediments. It might also be explained as unidentified problems that result in ages much younger than expected for the Paleo-Indian levels, and sediments underlying those cultural levels. The consistently younger than expected ages are probably not, at least not exclusively, a reflection of post-depositional pedogeneic soil development (see Reider et al. 1974) because bone and wood charcoal from the Paleo-Indian levels also produced younger than expected dates. It is possible that the dates are stratigraphically correct and reflect the latest known manifestation of the Folsom archaeological culture.

14.2 Luminescence Dating of Sediment Samples

Four sediment samples were collected by James Feathers from the vertical wall profiles of a three-meter square excavation unit designated 2009 Test or 2009 Deep Test (Figure 8). Unfortunately, level records, field notes and artifact bags applicable to this excavation unit could not be located. All that is available are field notes and photographs taken by Feathers when the samples were collected. Table 61 provides lab numbers and other information regarding the four samples. Only samples UW2160 and UW2161 were collected in stratigraphic succession from the east wall. Sample UW2159 came from the south wall and UW2162 from the north wall.

The depths given in Table 61 suggest that all the samples were collected below culture bearing sediments, given that elsewhere in the site few artifacts were found below 2 m. However, Feathers states in his field notes that UW2161 and UW2162 were taken from what appeared to be occupation layers, characterized by dark colored sediments— presumably paleosols. We cannot confirm that sampled areas of dark sediment contained cultural remains. The depths, moreover, may be misleading. Figures 154-155 show an overview of the excavation unit, the orange flag appearing in both figures for reference. Note the steep slope of the surface as followed by the fence of plywood sheeting. Such a slope is not noticed in the stratigraphic layering on the north wall in the previous figure. The depths were measured from the highest part of the surface but it could be that a lower part of the surface would have been more appropriate. That would put the luminescence samples in the range of the Folsom layers. Feathers' field notes say that the depth of the orange flag, to which all other samples were referenced, was measured from a "disturbed surface."

The fourth sample, UW2159, was drawn from the south wall, not visible in the photos, in sterile sands well below the dark staining. This sample, from the deepest part of the pit, likely predates human occupation.

Table 61. Luminescence Samples from the MacHaffie site.

Lab #	Deposit Description	Burial Depth Below Present Ground Surface (m)
UW2159	Grey-red mottled muddy sands	3.14
UW2160	Red-brown mottled sandy loam	2.65
UW2161	Clay with dark staining	2.23
UW2162	Dark brown micaceous sandy clay	2.45

Figure 154. Photo of the North and East Walls of 2009 Deep Test. The White PVC Pipes mark Locations of Luminescence Samples. Sample UW2162, near the Orange Flag is on the North Wall. Samples UW2161 (top) and UW2160 (bottom) are on the East Wall.

Figure 155. Overview of 2009 Deep Test Excavation Unit, showing mainly the East Wall. Note the Orange Flag on the North Wall is the same Flag that appears in the Previous Figure. Also Note Steep Slope of the Ground Surface as followed by the Plywood Sheeting.

Laboratory Procedures

Samples were collected in opaque cylinders and capped in the field. The sediment was removed from the cylinders under the red-orange light of the laboratory, the outer ends used for dose rate measurements and the inner portions used to measure equivalent dose (D_e). The target particles for dating were fine sand-sized single-grain (180-212 μm) potassium feldspars, after it was determined that adequate signals could not be obtained from quartz grains because of poor sensitivity. Infrared stimulated luminescence (IRSL) was used to determine equivalent dose (D_e), which is a measure of the dose absorbed since the last zeroing event and is derived by calibrating the natural signal against signals induced by laboratory irradiation. Dividing D_e (in Gy, the SI unit of absorbed dose) by the time-averaged natural dose rate (Gy per unit time) produced each age estimate (Jacobs et al. 2006).

To determine the dose rate, sample radioactivity was first measured in the lab by alpha counting in conjunction with atomic emission for ^{40}K. Samples for alpha counting were crushed in a mill to flour consistency, packed into plexiglass containers with ZnS:Ag screens, and sealed for one month before counting. The pairs technique was used to separate the U and Th decay series. For atomic emission measurements, samples were dissolved in HF and other acids and

analyzed by a Jenway flame photometer. K concentrations for each sample were determined by bracketing between standards of known concentration. Conversion to ^{40}K was by natural atomic abundance. Radioactivity was also measured, as a check, by beta counting, using a Risø low level beta GM multicounter system. About 0.5 g of crushed sample was placed on each of four plastic sample holders. All were counted for 24 hours. The average was converted to dose rate following Bøtter-Jensen and Mejdahl (1988) and compared with the beta dose rate calculated from the alpha counting and flame photometer results. Cosmic radiation was determined after Prescott and Hutton (1988). Radioactivity concentrations were translated into dose rates following Adamiec and Aitken (1998).

To make measurements for D_e, unexposed portions of each sample were first wet sieved through a 90 µm screen. The >90 µm fraction was treated with HCl and H_2O_2, and then dry-sieved to isolate the 180-212 µm fraction. These grains were density separated using lithium metatungstate set at 2.58 specific gravity. Luminescence measurements were made on the <2.58 fraction. With feldspars, correction for anomalous fading, which is athermal loss of trapped charge through time, is required.

Single-grain dating was employed for all samples (Olley et al. 2004). Single-grain measurements were made using Risø TL/OSL DA-20 reader, with an IR single-grain attachment. Stimulation used a 150 mW 830 nm IR laser, set at 30% power and passed through an RG 780 filter. Emission was collected by the photomultiplier through a blue-filter pack, allowing transmission in the 350-450 nm range. IRSL measurements were made at 50°C, and a preheat of 250°C for 1 minute at 5°C/s proceeded each measurement. Exposure for single grains was for 0.8 s, using the first 0.06 s for analysis and the last 0.15 s for background.

D_e was determined using the single-aliquot regenerative dose (SAR) protocol (Murray and Wintle 2000; Wintle and Murray 2006), as applied to feldspars by Auclair et al. (2003). The SAR method measures the natural signal and the signal from a series of regeneration doses on a single aliquot. The method uses a small test dose to monitor and correct for sensitivity changes brought about by preheating, irradiation or light stimulation. SAR consists of the following steps: 1) preheat, 2) measurement of natural signal (OSL or IRSL), L(1), 3) test dose, 4) preheat, 5) measurement of test dose signal, T(1), 6) regeneration dose, 7) preheat, 8) measurement of signal from regeneration, L(i), 9) test dose, 10) preheat, 11) measurement of test dose signal, T(i), 12) repeat of steps 6 through 11 for i regeneration doses. A growth curve is constructed from the L(i)/T(i) ratios and the equivalent dose is found by interpolation of L(1)/T(1). A zero regeneration dose and a repeated regeneration dose are employed to ensure the procedure is working properly.

Test doses for the SAR were about 5-6 Gy. Doses were delivered by a ^{90}Sr beta source, which provides about 0.11 Gy/s to 180-212 µm grains, and which was calibrated using quartz irradiated by a gamma source at Battelle Laboratory in Hanford, Washington. The dose delivered to different grains in single-grain disks varied by an order of magnitude from one end of the disk to the other. This variation was taken into account when determining doses to individual grains.

An advantage of single-grain dating is the opportunity to remove from analysis grains with unsuitable characteristics by establishing a set of criteria grains must meet. Grains are

eliminated from analysis if they (1) had poor signals (as judged from net natural signals not at least three times above the background standard deviation), (2) did not produce, within 20 percent, the same signal ratio (often called recycle ratio) from identical regeneration doses given at the beginning and end of the SAR sequence, suggesting inaccurate sensitivity correction, (3) yielded natural signals that did not intersect saturating growth curves, or (4) had a signal larger than 10 percent of the natural signal after a zero dose.

A dose recovery test was performed on some single grains (Roberts et al. 2000). The luminescence was first removed by exposure to 400 s of 875nm diodes (122 mW/cm^2) and to 1 s of the laser. A dose of known magnitude was then administered. The SAR procedure was then applied to see if the known dose could be obtained. Successful recovery was an indication that the procedures were appropriate. Anomalous fading was measured using the procedures of Auclair et al. (2003) on single grains. Age was corrected following Huntley and Lamothe (2001). Storage times after irradiation of up to 3-5 days were employed.

A fading-corrected age was obtained for each suitable grain. Because of varying precision and other factors, the same value is not obtained for each grain even if all are of the same true age. Instead, a distribution is produced. The common age model and central age model of Galbraith (Galbraith and Roberts 2012) are statistical tools that were used in evaluation of age distributions. The common age model controls for differential precision by computing a weighted average using log values. The central age model is similar except rather than assuming a single true value it assumes a natural distribution of estimated age values, even for true single-aged samples, because of non-statistical sources of variation that are not accounted for in the estimations, such as variation of luminescence properties among grains. It computes an over-dispersion parameter (σ_b) interpreted as the relative standard deviation (or coefficient of variance) of the true age estimates, or, in other words, that deviation beyond what can be accounted for by measurement error. Empirical evidence suggests that σ_b of between 10 to 20 percent for single grains are typical. Over-dispersion will be higher for samples that are not single-aged because of partial bleaching or post-depositional mixing.

For the single-grain age distributions, a finite mixture model was employed for evaluation. This model (Galbraith and Roberts 2012), which is appropriate for samples where post-depositional processes have mixed grains of different depositional age, uses maximum likelihood to separate the grains into single-aged components based on the input of a given σ_b value and the assumption of a log normal distribution of each component. The model estimates the number of components, the weighted average of each component, and the proportion of grains assigned to each component. The model provides two statistics for estimating the most likely number of components, maximum log likelihood (llik) and Bayes Information Criterion (BIC). The finite mixture model is most useful for samples that have discrete rather than continuous age populations due to mixing. A minimum age model was also employed (Galbraith and Roberts 2012). This is designed to isolate statistically well-bleached grains from a distribution that includes partially bleached grains. The method assumes a truncated normal distribution, where the truncation represents the fully bleached grains. The over-dispersion estimated to represent a single-age sample is added to the error for each grain in quadrature. Ages are determined using a laboratory spread sheet based on Aitken (1985). Ages are quoted with 1-sigma errors and using 2011 as the reference for before present designations.

Results

Dose rate. Table 62 gives the relevant concentrations as determined from alpha counting (U and Th) and flame photometry (K). The beta dose rate calculated from these concentrations is compared with that measured directly by beta counting, and this is also given in Table 62. There are no significant differences. Moisture content was estimated from current values, which were about 19% for the lowest sample and 12% for the other three. Table 63 gives the estimated dose rates, which range from 3.9 to 4 Gy/ka, and thus do not vary much within this excavated area.

Table 62. Radioactivity.

Sample	^{238}U (ppm)	^{233}Th (ppm)	K (%)	Beta dose rate (Gy/ka)	
				ß-counting	α-counting/ flame photometry
UW2159	1.05±0.17	14.33±1.44	2.84±0.10	2.63±0.23	2.76±0.09
UW2160	2.83±0.21	8.29±1.20	2.49±0.16	2.72±0.25	2.59±0.13
UW2161	2.65±0.21	10.64±1.23	2.34±0.14	2.63±0.27	2.51±0.12
UW2162	1.82±0.16	8.39±1.08	2.71±0.18	2.63±0.29	2.61±0.14

K-feldspar grains have an internal source of radioactivity – mainly beta radiation from ^{40}K. Pure orthoclase feldspar has a K content, by molecular weight, of 14%. Grains used for dating are not pure orthoclase because the 2.58 density separation does not exclude many grains with less than 14% K. K content of 18 grains from UW2159, eight which gave IRSL signals and ten which did not, were measured using an EDS attachment (energy-dispersive x-ray spectrometer) to a scanning electron microscope. The grains with signal had a median K content of 7.8% and those with no signal 6.1%. Those with signals ranged from 2.3 to 10.4%. A value of 8.5 ± 3%, which covered most grains, was used for all samples.

Table 63. Dose rates (Gy/ka)*.

Sample	alpha	beta	gamma	cosmic	total
UW2159	0.13±0.08	2.45±0.23	1.23±0.09	0.16±0.03	3.97±0.26
UW2160	0.14±0.08	2.47±0.26	1.19±0.10	0.18±0.04	3.98±0.29
UW2161	0.15±0.09	2.40±0.25	1.21±0.10	0.19±0.04	3.95±0.28
UW2162	0.11±0.07	2.50±0.27	1.11±0.09	0.18±0.04	3.91±0.29

Equivalent dose. Equivalent dose (D_e) on single grains was measured by IRSL as described earlier. Table 64 gives the number of grains measured, the number rejected using the criteria given earlier, and the number accepted. The samples showed high luminescence sensitivity to IR stimulation. The acceptance rate for signals from which a D_e could be measured ranged as high as 47% for UW2160. Other rates were lower because of large number of grains rejected for other reasons. For UW2159, 51% of the grains were rejected because the natural signal did not intersect the regeneration growth curve, either because the regeneration doses were not carried out far enough or because the grain was close to saturation and the dose was quenched somehow. There were more of these rejects for the older samples. It is possible the age for UW2159 is therefore underestimated. UW2161 had a large number of grains with recuperated signals after a zero dose and preheat. It is not clear why this sample had so many more than the others,

although the low number of recuperated signals in UW2160 and especially UW2159 may be due to strong natural signals dwarfing any recuperated signal (Table 64). UW2162 had a high number of zero doses, suggesting modern grains have contaminated the sample.

Table 64. Acceptance rates*.

Sample	N	No signal	Recycle	Too high	Recuperation	Zero dose	Accepted	Rate (%)	Median signal (counts)
UW2159	588	146	36	303	2	0	101	17.2	13802
UW2160	198	37	16	46	5	1	93	47.0	542
UW2161	386	238	45	4	43	4	52	13.5	353
UW2162	392	203	56	5	26	21	81	20.7	220
total	**1564**	**624**	**153**	**358**	**76**	**26**	**327**	**20.9**	

* N refers to the number of grains measured, no signal refers to grains that had no measurable signal, recycle refers to number of grains rejected for failing the recycle test and for no other reason, too high refers to natural signals higher than the signal from the highest regeneration point, recuperation refers to significant signal after zero dose and preheat, zero dose refers to grains rejected because the equivalent dose was not significantly different from zero. Parameters of the criteria are provided in the text.

Fading rates were highly variable, as is typical for single-grain data, although some of the variability is certainly related to precision issues. The weighted average rate, or g-value (N=327) is 7.6±0.6 %/decade (where a decade is a power of 10), which is somewhat higher than typical. Also, there is no tendency for the g-value to decrease with equivalent dose, which again is atypical (Figure 156). The large number of negative g-values are statistical artifacts. Several g-values were higher than those depicted in Figure 156. These often returned corrected ages of infinite value, indicating that the fading rate has changed through time. Of the 327 fading measures, 66 resulted in infinite corrections and these were excluded from further study.

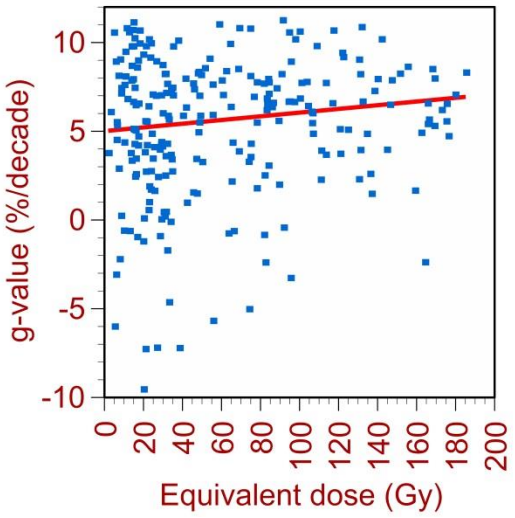


Figure 156. Relationship Between the G-Value and Equivalent Dose.

A dose recovery test was conducted on UW2160 and UW2162. About 400 grains were measured, and 115 passed the acceptance criteria. The central tendency of the derived/administered (200sß) ratio, from the central age model, is 0.93 ± 0.02, a slight underestimation. The over-dispersion of the ratio distribution is 17%, which is a measure of intrinsic variation due to machine and sample factors and which can be taken as the minimum over-dispersion expected for a single-aged sample. A value of 15% was used when evaluating age distributions.

Age. Table 65 gives the age from the central age model (Galbraith and Roberts 2012) for each sample and the over-dispersion. The over-dispersion is high for three of the samples, higher than the 17% from dose recovery. It is relatively low for UW2159. When applying the finite mixture model, the distribution of UW2160 is statistically consistent with a single age, the high over-dispersion being caused by a few high-precision grains. Almost 99% of the distribution of UW2159 is also consistent with a single age. Finally, if the over-dispersion typical of single-aged sample is set at 18% rather than 15% then UW2161 is consistent with a single age. This means that the distributions of three of the samples are consistent or near consistent with a single-age, and thus are neither partially bleached nor of otherwise mixed age. Radial graphs shown in Figure 158 confirm that most points (grains) lie within two standard errors of the central age. The central age is therefore the best estimate for the depositional age of these samples. Only UW2162, the sample with the highest over-dispersion, appears to be mixed. The finite mixture model divides this distribution into two components, one at 5.1 ± 0.6 ka with 71% of the grains and one at 18.5 ± 3.5 ka with 29% of the grains. Applying the minimum age model, appropriate if the sample is poorly bleached, results in a depositional age of 3.0 ± 0.8 ka. Looking at the radial graph, however, it can be seen that only two grains, one of relatively high precision, are driving the minimum age model. The sample also had a high number of zero-dose grains, so the younger grains could be part of this contamination. Two reference points are plotted in the radial graph, the central age at 7 ka (yellow shading) and another one at 9 ka (blue shading, the green is overlap with the yellow). Both seem to encompass most of the grains, with the 9 ka a little better, bringing in some of the older grains. The age for this sample is probably in the 7-9 ka the range.

Table 65. Corrected Age (ka) and Over-Dispersion (%) of Luminescence Samples.

Sample	N	Corrected Age (ka)	Over-dispersion (%)
UW2159	86	46.5±2.6	17.0±8.1
UW2160	67	14.5±1.4	38.1±9.6
UW2161	40	10.3±1.8	52.7±1.7
UW2162	66	7.0±1.2	88.6±14.8

The radial graphs shown in Figure 157 plot precision against the age, standardized to the number of standard errors the age value is from a reference point. The reference point is the age from the central age model for three of the samples. For UW2162, two references are shown, representing the central age and one at 9 ka. The shaded area around each reference encompasses all values within two standard errors of the reference. A line drawn from the origin

through any point intersects the right axis at the calculated age value.

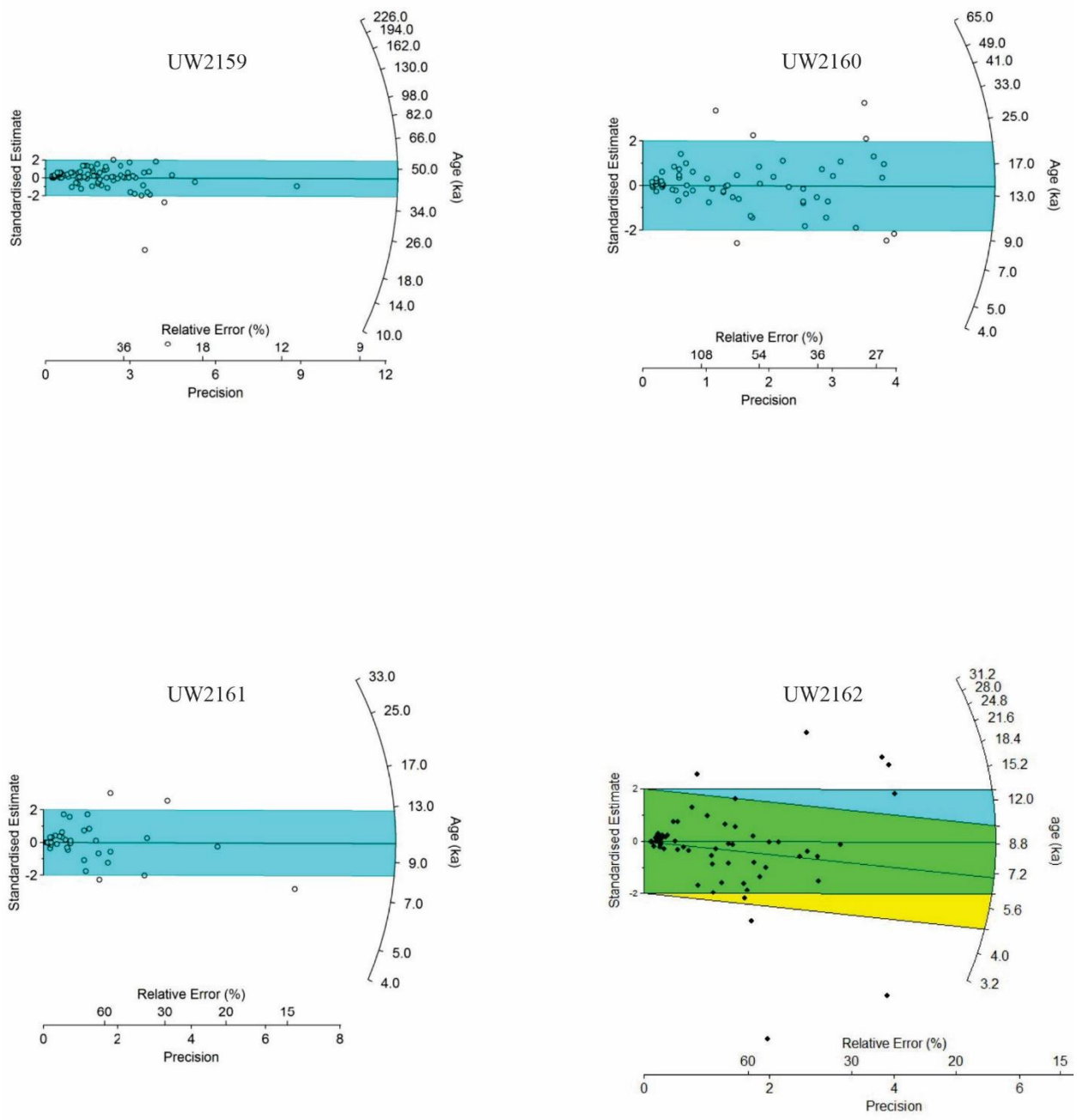


Figure 157. Radial Graphs of each Luminescence Sample.

To summarize, the lowest sample (UW2159), taken at a depth of 3.14 cm BS, is Late Pleistocene in age, but with an estimated age of ca. 46,000 years it pre-dates the last glacial maximum. Sample UW2160 is at the bottom of dark stained sediment exposed in the 2009 Deep Test excavation unit. At ca. 14,500 years it also likely predates human occupation of MacHaffie.

The upper two samples are within dark stained sediment. The date of ca. 10,300 years for UW2161 is consistent with the radiocarbon dates obtained at the base and slightly below the defined Folsom occupation at MacHaffie (Davis et al. 1991; see Figure 153). The date for UW2162 is probably just a little younger.

The C-14 and luminescence dates demonstrate general soil stability as well as increasing age with increasing depth in the soil profile. Unfortunately, the dates do not assist in distinguishing between Folsom, Cody, and other archaeologically defined cultural remains. Ultimately, the luminescence analysis supports the C-14 dates by demonstrating that Folsom deposits are younger than expected in the MacHaffie site. Scott (1998:23) quotes Leslie B. Davis who quipped that the Indian Creek and MacHaffie sites suggest the general area was the "First and Last Best Place" for Montana's Folsom groups.

15.0 SUMMARY AND CONCLUSIONS

The MacHaffie site (24JF4) in southwest Montana has long awaited an opportunity to provide a comprehensive data set for northern plains archaeological research. Beginning with the first methodic and documented investigation in 1951, Richard G. Forbis presented evidence that the Yuma (now Cody) projectile point styles post-dated Folsom projectile points. The MacHaffie site also demonstrated a long occupation sequence by past Native Americans, thus dispelling the long-held notion that the northern plains were too harsh of an environment for pedestrian nomads to have occupied with any degree of frequency. Forbis also obtained the first C-14 date for a Montana archaeological context on charcoal flecks he associated with the Cody (Yuma) component. The date is late at 8,100 $\pm$300 BP (L-578A) when compared to Cody components elsewhere but is still within the acceptable temporal range. It is also consistent with subsequent radiometric dates obtained by Leslie B. Davis from 1989 through 1991.

Misinformation and vague statements concerning the MacHaffie site are prevalent in the archaeological literature. It has been referred to as a campsite (Davis et al. 1991:17), a lithic workshop and general life maintenance campsite (Knudson 1982: 137), a Folsom bison kill site (White 2019:24), and a locality occupied by Folsom deer hunters (Daily Kos 2015). Even so, most MacHaffie references are overly generalized and limited to a few brief sentences. The most detailed works were provided by Richard G. Forbis with his doctoral dissertation (Forbis 1955), an unpublished monograph by Richard G. Forbis, William Duncan Strong and Maurice E. Kirby (Forbis et al. nd), and a section of Ruthann Knudson's doctoral dissertation that focused on a small portion of the Cody chipped stone pieces (Knudson 1982). More recently, two published short articles focused on radiometric dates for the Paleo-Indian components (Davis et al. 1991; Davis et al. 2002). With one exception (Scott 1996, 1998), previous discussion failed to accurately explain what kind of archaeological site MacHaffie is.

The MacHaffie site was originally reported to be an ideally stratified, open-air archaeological resource where cultural layers are separated by culturally sterile layers. This idealized stratification reportedly demonstrated a clear temporal demarcation between Folsom, Cody (Yuma), and a so-called "neo-indian" occupation that Forbis later referred to as the "Helena Component" (Forbis 1955:55-58; Forbis and Sperry 1952). Analysis of artifacts and

documents from Forbis' work in 1951, Davis' work from 1989 through 2010, and the follow-up work in 2017 and 2018 has demonstrated that culturally sterile sediments do not exist between the various cultural components. While there is a degree of stratification in the sense that more recent cultural materials are increasingly found upward through the alluvial sediments, a clear separation of Cody and Folsom materials does not exist. Further, the upper one meter of colluvium appears to represent thoroughly mixed sediments and cultural remains so any chronometric date obtained there would be unhelpful. The lack of contextual integrity among the Early Transitional, Middle and possibly Late Precontact cultural materials coupled with a lack of identifiable cultural features disallows attempts to address questions of intrasite dynamics such as proxemics and spatial arrangement of various activities. The Paleo-Indian levels appear to retain more contextual integrity as witnessed by the *in situ* recovery of several knapping features, and an apparent preference for lithic material from two distinct sources. The reason for more contextual integrity and an apparent distinction in use of two chert quarries among the Cody and Folsom components may be due to fewer occupation events.

Based on approximately 75 years of intermittent investigations, we conclude that the MacHaffie site is primarily a very short duration stopping point where past Native occupants brought toolstone (largely cryptocrystalline silicates) obtained from local quarries to further reduce those raw pieces into Stage II-III bifaces and flake blanks. Once the desired stone implements were crafted the occupants moved on, presumably to a formal campsite or residential base. Perhaps an appropriate moniker for MacHaffie is "Mid-Way". It may have been situated between chert quarries and a residential camp.

This generalization of site activities was occasionally interrupted, or complemented, with processing of selected animal parts, finishing of bifacial tools, and weaponry repair. Although 17% of the debitage is catalogued as tertiary reduction, we are not suggesting that these are all pressure flakes (finishing flakes). Most were likely generated during secondary percussion work. Still the low volume of assigned tertiary pieces only substantiates our contention that very few finished bifaces, and very little implement rejuvenation and pressure flaking occurred at MacHaffie. This conclusion was independently reached in a recent student paper as well (McQueen 2020).

We do not consider MacHaffie a campsite where residents spent more than one day engaged in a variety of weaponry production or maintenance, and domestic activities. The lack of heating or cooking facilities, grinding implements, bone or shell artifacts, and only a small amount of FCR further points toward activities outside of those typically associated with a campsite. The caveat to this being the scatter of FCR, small-size chipped stone debitage, and small pieces of animal bone exposed in the Folsom component near the east end of the "island" in excavation unit 4N/8E. This is a rare occurrence in Folsom sites and may suggest intact deposits are present adjacent to unit 4N/8E.

The earliest occupants at MacHaffie were those associated with the Folsom archaeological culture. Folsom at MacHaffie was succeeded by people using a Cody technology, and Cody was succeeded by archaeological cultures of the Early Transitional, Middle and possibly Late Precontact Periods (Figure 158). The alluvial deposit containing the Cody and Folsom materials has experienced the least amount of sediment mixing over time and offers reasonably segregated cultural remains. The upper meter of sediment is problematic in that we

lack the ability to credibly distinguish among the various side-notched, side and corner notched, and corner-notched projectile points. Without contextual integrity, projectile point size and morphometric attributes is generally insufficient to place them into a chronologic chart or archaeological culture. This is an insurmountable problem at MacHaffie. Still, it is accurate to say that although minor variations in tasks occurred over time, there is more consistency among precontact human activities at the MacHaffie site than dissimilarities.

Why this locality was selected over the nearby Prickly Pear Creek to the north is not easy to explain. Some have suggested that the MacHaffie site locality affords protection from wind, heat, cold, biting insects, or adversaries but we can attest from being in both settings at various times of year that there is no measurable protective difference. While the elevated setting of MacHaffie above the Prickly Pear Creek drainage could afford some thermal benefits in extreme cold, it is unlikely that chert quarrying was conducted during winter months when the ground is frozen. Even collecting rock for heating or cooking purposes from the frozen ground is a difficult task with metal tools let alone antlers and sticks. The MacHaffie site's foothills setting fits a pattern of mountain-foothill preference by Paleo-Indian and Early Middle Precontact human occupants of the region (e.g., Bonnichsen et al. 1992; Husted and Edgar 2002; Lahren 1976; Peck 2011; Peterson 1999; Rennie 2017). Our impression is that MacHaffie was a stopping point between quarry and residential base. So why not reduce the quarried pieces at the quarries then move directly to the main campsite? Why the desire to go from a quarry to a mid-reduction lithic workshop (i.e., MacHaffie), then on to a formal campsite where bifaces and flake blanks produced at MacHaffie were presumably taken? Perhaps some quality of the local environment was more influential on group behavior than strictly social or cultural elements.

Local and regional pollen and phytolith studies demonstrate that the climate going back to Folsom time was similar to today with a qualitatively similar plant community. Although droughts and periods of increased precipitation occurred at various times, these climatic changes do not appear to have been sufficient to change the character of the regional plant regime.

Some researchers contend that Folsom and Cody peoples are distinct from later Great Plains hunter-gatherers in that they were highly specialized and highly mobile bison hunters (Amick 1994, 2013; Bamforth 2002, 2011; Knell and Muñiz 2013; LaBelle 2012). We, however, see little difference over time among Great Plains precontact archaeological cultures regarding mobility. If anything, the Avonlea archaeological culture (ca. 1600-900 BP) north of the Missouri River shows more evidence for being highly specialized bison hunters than any of the Paleo-Indian groups (Rennie and Johnson 2017). At MacHaffie, and typical of regional foothills sites, (Davis and Rennie 2017; Kornfeld et al. 2010; Lahren 1976, 2006; Rennie 2017; Rennie and Hughes 1998) a broad spectrum of animal resources are represented, albeit minimally.

Goodyear (1979); Kelly and Todd (1988); and Wittoft (1952) suggest that early Paleo-Indians, lacking an adequate knowledge of toolstone resource distribution in the Americas, thoroughly used and recycled lithic implements. Such a conservationist approach developed a

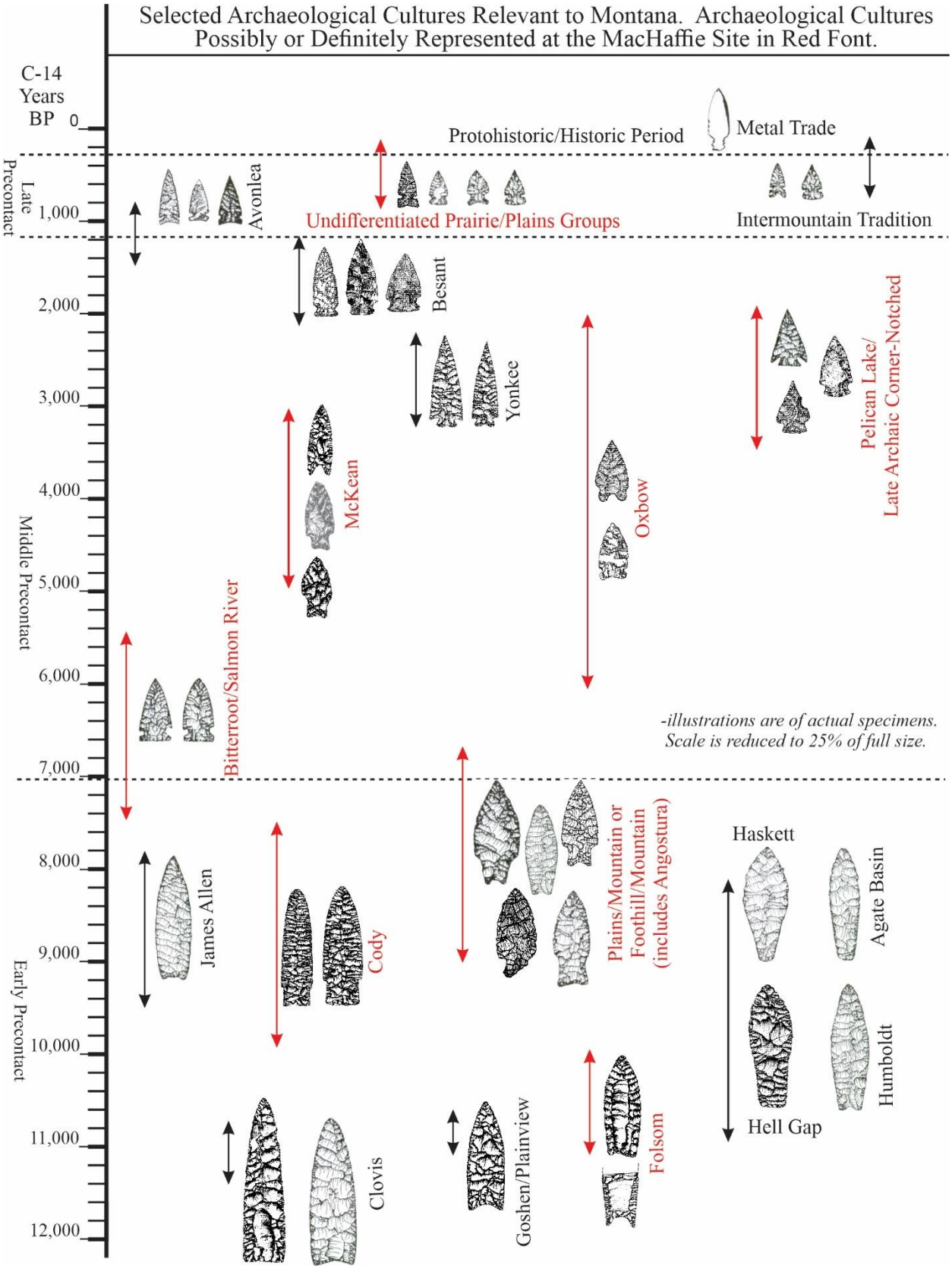


Figure 158. Projectile Point Chronologic Sequence Relevant to the MacHaffie site.

"flexible" lithic material transport and tool manufacture strategy to ensure a toolstone reserve across a long spatial and temporal span. Our inference of the use of the term "flexibility" is that bifacial cores were of utmost importance and were standardized in such a manner that repeated production of morphologically consistent flakes could be accomplished with little waste. The resulting flakes could be transformed into other tool types. Thinning flakes were only removed as needed when cutting or scraping tasks arose, or when a projectile point preform was desired. Eventually the bifacial core became too small and thin to continue to percuss. It then became a projectile point preform as the final stage in its reductive transformation. This conceptual ideal is inoffensive to a current world view, but is it realistic? We offer three points for consideration:

1) We lack understanding on how to design a bifacial core that produces more desired flakes than waste.

2) We are unclear how a flake removed from a standardized core is functionally distinct from any medium-size, reasonably thin and straight flake. We speak from experience when we state that a simple flake of any type of fine-grained material is as adaptable and functional a tool as a Stage IV biface of high-quality chert. It is certainly more flexible and durable than obsidian pieces. As an example, a quartzite flake and a chert projectile point can both be used for cutting, scraping, etching, and scoring without further modification. This is likely the reason quartzite cobble cores with one or two flake removals are ubiquitous among the glacial tills east of the Continental Divide in Montana. Similarly, naturally occurring chert nodules and pebbles among the sediments outside of primary geologic contexts show a high frequency of a limited number of flake removals. The accepted explanation is that the raw piece was tested for material quality. It is more probable that material quality was adequately understood by the Precontact inhabitants, so random chert pebbles and nodules, and the more common quartzite cobbles, were opportunistically used to generate a couple of sufficiently sharp-edged durable flakes with little more thought put into it. The flakes were then collected and taken elsewhere for future use. We are admittedly ignorant of the kinds and availability of toolstone outside Montana. What we do know is that the southern-half of Montana offers a toolstone smorgasboard. It is generally difficult to travel more than 20 miles in that area and not come across lithic material that breaks with a conchoidal fracture—even if that material is difficult to pressure flake.

3) The lithic materials recovered among the Folsom and Cody components in MacHaffie show enormous waste and little effort to recycle or conserve.

Another uncertainty we have with the flexible core concept is what happened if a Paleo-Indian hunter left a toolstone collection site with three or four standardized bifacial cores and two days later destroyed four projectile points when he encounters a herd of bison? Does he then reduce the cores into projectile points to replace the broken ones? If so, he would be left with several useful flakes for cutting or scraping implements, but he would likely have insufficient material for additional projectile point preforms. Does he spend two days returning to the toolstone quarry to obtain more bifacial cores? This seems to defeat the strategy of hauling flexible cores into an area where toolstone sources are unknown.

Early Paleo-Indians are suggested to have largely selected "high-quality" toolstone to craft standardized cores and flake implements. We have no good explanation for why Folsom and Cody occupants in other sites are reported to have focused on the highest quality toolstone yet at MacHaffie these groups used more poor-quality lithics than their Middle and possibly Late Period counterparts. This is especially curious considering the proximity and common occurrence of what contemporary knappers would consider high-quality chert in an accessible context. Perhaps the common occurrence of toolstone over a large geographic area partly shapes the manner in which toolstone is utilized.

We agree that highly siliceous and structurally sound toolstone affords greater control over flake morphology and consistent flake removal patterning. However, the amount of waste generated, even from prepared cores, is substantial regardless of material "quality". Aesthetically pleasing cores are not tantamount to lithic material conservation. Many undesired pieces of debitage could be utilized as expedient cutting or scraping implements if conservation strategies were in place. If resource conservation was truly at the forefront, it seems unlikely so much debitage, useable core pieces, and preforms would have been abandoned at quarry sites, residential bases, or task sites like MacHaffie. When compared to the Paleo-Indian components, the Helena Component shows decreased abandonment of what contemporary flintknappers consider high-quality pieces.

Excluding projectile point styles, we are uncertain how the associated cultural remains from most northern plains site types, regardless of temporal placement, differ to a significant degree. In fact, the evidence that we have reviewed indicates a more broad-spectrum subsistence with bison likely the common prey species among all northern plains archaeological cultures. Such a lifeway is characterized by Precontact peoples who visited the MacHaffie site and most frequently occupied the plains and foothills. Forbis did not comprehensively analyze the cultural remains from MacHaffie but his general conclusion stands, "…functionally each component manifests a similar if not identical mode of life—namely of bison-hunting foot-nomads (Forbis et al. n.d.:180). Forbis also observed that, "In all, the predominant theme of the history of the Great Plains in native times is cultural uniformity. From Folsom down to historic times, it has been a region inhabited by buffalo hunters (whenever it was possible to live in the Plains at all). The three components of the MacHaffie site, covering 8,000 years, clearly fall into the pattern of uniformity (Forbis 1955:194)".

Although only a small sample of the Cody component material was analyzed as part of her study, we generally concur with Dr. Knudson's conclusion and, again, extrapolate this observation across the MacHaffie site cultural components:

> In summary, tool and flake information from MacHaffie II indicates a fairly coherent, relatively invariable lithic production system was used by all the knappers, whether with tough, often flawed chalcedonies from local quarries, or with more workable, homogeneous cherts and chalcedonies from other resource areas. Platform preparation, occurrence of platform dorsal edge modification, and percussor or amount of force may have varied among materials, but the techniques used seem remarkably consistent over the entire assemblage. Primary production of local chalcedony blanks, preforms, and a few finished implements was carried out at the site, and modification of more exotic materials was limited to edge retouch or tool re-shaping. Presumably, a significant number of newly produced lithic tools and tool preforms were removed from the site, leaving only broken or flawed tools and manufacturing debris behind (Knudson 1982:87).

We take issue with two suggestions in her general site summary. First, it is incorrect that cherts from areas outside of Montana City are less tough and flawed. Also, color and texture overlap among Madison Group chert is so great that making positive visual identification from one source to the next is folly (Rennie n.d.). Further, most raw chert pieces suffer from internal flaws. When reduced through percussion, a large block of Madison Group chert generally produces a handful of large workable spalls. Even greater are the number of chunks from which smaller flakes can be removed. In our experience, because of internal fractures or other structural anomalies, a large block of chert results in an estimated 80% waste and 20% useable pieces. Second, while we concur that the evidence suggests numerous flake blanks, and mid-reduction stage bifaces were produced at MacHaffie and subsequently removed, we see no evidence that a "significant number" of formal or finalized tools requiring focused pressure flaking was produced there.

To summarize:

1) MacHaffie is a secondary chert reduction site where people stopped briefly between local chert quarries and the residential base. At various times, beginning with Folsom groups, people intermittently brought chert nodules, pebbles, and blocks collected from adjoining chert exposures to the MacHaffie site for further refinement. This opinion is based on large amounts of flaking debris, 60 flake cores (largely unprepared), the types of flakes represented, and the percentage of pieces that retain cortex. Secondary refinement largely consisted of bifacial blank (Stage II and III bifaces) and unmodified flake production. Manufacture of formal tools was less frequent, and site occupants generally did not stay longer than needed to produce Stage II-III bifaces and flake blanks. All Knapping Features reflect highly skilled knappers who could complete early and late reduction sequences, probably using soft hammer percussion.

2) It appears that the MacHaffie debitage collection is incomplete. Experimental percussion and pressure reduction of a 12 cm x 20 cm block of obsidian produced 7,967 pieces of debitage from Size-Grade 1 through approximately Size-Grade 5 (Tuohy 1987). While much of the size-grades 4 and 5 debitage could have passed through the 0.25 inch wire mesh in use at MacHaffie, there also appears to be a lack of debitage of size-grades 1 through 3. Excavations at the Cattle Guard No. 3 locality in site 24BE559 recovered approximately 50,000 pieces of debitage from a 9.6 square meter area (Davis et al. 1997). Site 24BE559 is similar in many respects to MacHaffie. It is surrounded by chert deposits, and it is along a minor stream. Selected chert pieces were translocated to the Cattleguard No. 3 area and reduced much the same as at MacHaffie. However, whereas approximately 20,000 pieces of debitage are available for study from roughly 90 square meters of excavation (65% of the MacHaffie site area), excavations from an area one-tenth the size of that examined at MacHafffie and constituting an estimated 0.015 percent of the total site area and artifacts for 24BE559 suggest far less intensive or repeated occupation and chert core reduction at MacHaffie.

3) Domestic activities are minimally represented based on the lack of thermal features, grinding stones, and bone tools as well as limited quantities of FCR, processed animal

bone, and endscrapers. The Folsom activity area exposed in excavation unit 4N/8E is a valuable attribute to Folsom studies. More of this activity area may be intact adjacent to unit 4N/8E.

4) Clean, stratigraphic separation of the constituent components does not exist at MacHaffie, although the Paleo-Indian components (Cody and Folsom) appear to contain sufficiently distinct lithic raw materials to lend confidence in segregating much of the associated cultural remains. Further, the presence of knapping features suggests stability in the culture bearing sediments of the Folsom and Cody components.

5) A series of C-14 dates obtained by Richard G. Forbis and Leslie B. Davis illustrate increasing age with depth through the soil profile for the Paleo-Indian components. These dates, supported by the sediment luminescence dates, suggest that the Paleoindian deposits are much younger than expected. Either the dates are too recent and reflect contamination, or the Folsom occupation reflects the most recent on record.

6) At approximately one meter BS to the base of cultural materials (Cody and Folsom components), size-grade 1 and 2 flakes of very good quality chert are common. Some of these are 6 or 7 cm in diameter and appear free of material flaws or knapping problems. From approximately one meter BS to ground surface, flakes are smaller and MANA units are more diversified with more broken flakes, flake fragments and shatter. The flakes wasted or abandoned at MacHaffie at depths exceeding 1 m BS would have been fully utilized by later occupants. Even by today's standards, many of the abandoned flakes of the Paleo-Indian components are highly desirable. The debitage from approximately 1 m BS to ground surface more closely resembles what modern flintknappers regularly produce because better, larger, more uniform chert is very hard to find today.

7) The MacHaffie site evidence contradicts an accepted notion that Folsom groups used only the best quality toolstone. This notion might be correct for projectile point manufacture because of the requirements for making a Folsom point. At MacHaffie both very good toolstone and lithic materials that are so poor for stone tool manufacture that their presence is both unexpected and inexplicable. In an area rich in good quality toolstone the reasons for resorting to pieces that are difficult to fracture conchoidally are hard to rationalize. It has been suggested that the poor quality lithics were relegated to beginners to learn the art of knapping without damaging valued toolstone. Based on our experience, this is unlikely. Different types of toolstone have their own problems and intricacies. Starting a novice on a piece of less than desirable lithic material will not achieve the result of learning to set platforms, or effectively observing how flakes are removed.

8) Cultural deposits in MacHaffie have been continuously disturbed and redistributed through natural processes related to accelerated water flow rates, plant root growth, and insect and small mammal burrowing. The sediments have also been disturbed by gardeners and relic hunters. These disturbances appear to be greatest among the

upper meter thick colluvium block. The use of the MacHaffie site for protective magic purposes presumably by a European immigrant homesteader in the early 20th century is represented by a modern horse skull placed on a metal band with three glass items at a depth of approximately 1.5 meters BS. Excavation needed to place the skull and sundry items at that depth would have cut through and mixed materials of the Paleo-Indian and latter archaeological cultures.

The reader will notice that we did not address sex or gender of the MacHaffie site occupants. From our perspective, males or females could have made or used most of the recovered cultural material even though some formal tool classes such as endscrapers and projectile points are typically viewed as female and male oriented. It seems unlikely and risky for group survival that only a handful of males, or even males only, engaged in stone tool production. While grip strength affords advantage in pressure flaking, hand-eye coordination and understanding angles is the most important attribute in percussion knapping. Thus, physical strength is not a dominate factor in stone tool manufacture. Given notions of division of labor in band societies (Williams 1974), women likely quarried and collected most of the lithic raw material toolstone. It stands to reason that the quarriers would also have reduced the selected toolstone pieces at the collection site. Even if we assume that projectile point production may have been largely men's work, production of simple flake tools, endscrapers, flake blanks, and non-hafted bifaces were likely created by all from at least pre-teens through adults. It seems equally probable that if both sexes are adept at percussion flaking, they are equally adept at pressure flaking.

While the focus of this manuscript has been the Native American heritage revealed at MacHaffie, the most unexpected discovery is evidence for use of the site locality by an early 20th century practitioner of protective magic. This find makes the MacHaffie site one of the few documented examples for Montana and adds yet another aspect to the historical anthropology of the Montana City area. It is our intention, with this study, to leave a well-organized and comprehensive dataset useful in comparative archaeological studies. With technological advances we believe the MacHaffie site can continue to improve our understanding of precontact societies at a universal level. At the very least, MacHaffie has demonstrated its significance in northern plains archaeology.

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