THESIS

RUNNING OF THE BUFFALO: INVESTIGATIONS OF THE ROBERTS RANCH BUFFALO JUMP (5LR100), NORTHERN COLORADO

Submitted by

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ABSTRACT

RUNNING OF THE BUFFALO: INVESTIGATIONS OF THE ROBERTS RANCH BUFFALO JUMP (5LR100), NORTHERN COLORADO

Since the Roberts Ranch Buffalo Jump (5LR100) was first reported on in 1971, there has been a great deal of research on bison kills and faunal analysis, as well as advancements in analytic techniques, that can now be applied to the collection from the site. Much of the collection was reported in a thesis by Max Witkind in 1971; however, some of these data are being presented here for the first time.

The site is dated to approximately between A.D. 1660-1750 and consists of the remains of at minimum 19 bison adult and sub-adult bison, as well as at minimum eight fetal bison. This thesis examines the collection from three different perspectives. It starts by analyzing the non-bone artifact assemblage, which includes different styles of arrow points, at least two different ceramic traditions, and a modified bone assemblage. These data show that much of the past site activities focused on butchery and processing of bison, but other activities were also carried out at the site. The next section utilizes faunal analysis methods not yet developed when the site was first reported to explore the bison assemblage in more detail. This analysis shows some non-cultural impacts to the collection, but largely documents that the bonebed is the result of human butchery and processing decisions. These two data sets are then analyzed spatially. The results show patterned clusters of artifacts around the main bone concentrations, offering new insights on how to incorporate a site structure approach at mass kill sites. Lastly, this thesis illustrates the value of applying new methods to older archaeological collections.

ACKNOWLEDGEMENTS

I have been surrounded by an amazing group of people over the past few years who have offered their support, love, and encouragement to get to this point. First and foremost among these is my advisor, Jason LaBelle. The seed for this thesis was planted on my first of many memorable CMPA-sponsored conference tours across the Plains, to the Rocky Mountain Anthropological Conference in Missoula, Montana. When Jason made mention of the Roberts site and its need to be re-analyzed, I jumped at the opportunity. This project has gone through many different versions over the years, but all of it is a direct outgrowth of hours and hours spent sharing ideas, talking archaeology, and most of all, the mentorship of someone I am pleased to call my friend. Thank you, Jason, for everything.

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

CHAPTER 1: INTORDUCTION

Bison kill sites have shaped archaeological research on the Great Plains for the past fifty plus years (e.g., Bamforth 2011; Brink 2008; Davis and Wilson 1978; Forbis 1962; Frison 1970, 1973; Kehoe 1967; Malouf and Conner 1962; Reher and Frison 1980). Kill sites, and large kills in particular, offer a glimpse or snapshot of time where human behavior can be readily visualized if the proper methods are employed during excavation and laboratory analysis. Unlike camp sites, kill and butchery sites are not clouded by long term occupations where many different activities take place, often over an extended period. Kill sites, while sometimes used on more than one occasion (e.g., Brink 2008; Reher and Frison 1980), allow for a variety of methodological approaches to capture and explore one temporally isolated activity.

The Roberts Buffalo Jump (5LR100), located in northern Larimer County, about 15 miles south of the Wyoming border, is one such site (Figure 1.1). The site is located on the Roberts Ranch, a privately held Colorado Centennial Ranch in Livermore, having been owned and operated by the Roberts family for over 100 years (Livermore Woman's Club 2009). Since the site was first excavated over forty years ago (Witkind 1971), many advances have been made in archaeological inquiry related to the investigations of mass kill sites and faunal analysis.

For instance, zooarchaeologists have taken the approach of trying to better understand butchery decisions at the individual animal level (e.g., Binford 1978a; Emerson 1990; Speth 1983). This involves making decisions about the overall economic utility of an animal, like when Speth (1983) observed that the season of the kill might dictate how male and female bison could be selectively processed based on the quality of the meat. Other analysts have shifted the focus to examine the different factors that contribute to site formation processes which can hinder the

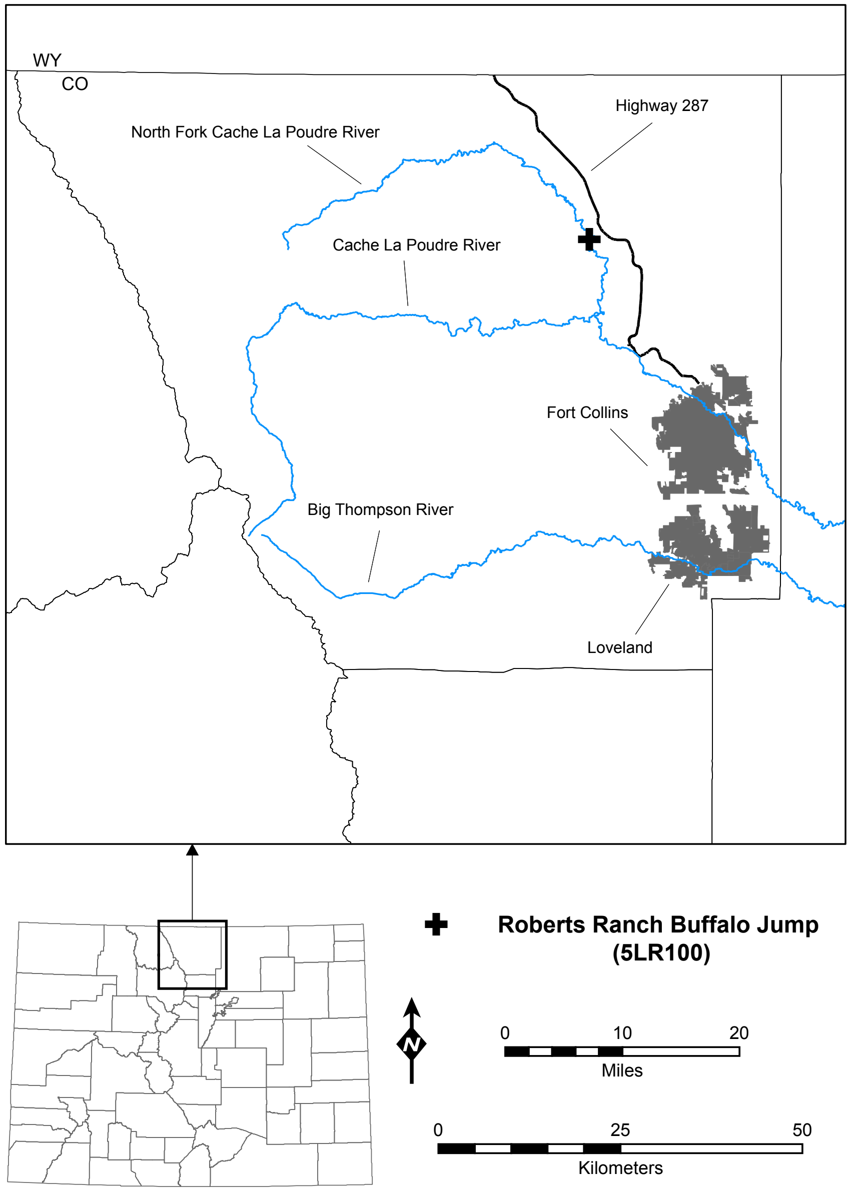

Figure 1.1. Site location map in relation to major political boundaries.

cultural interpretation (Todd 1987; Todd and Rapson 1999). Yet others have argued that ritual behavior, and not purely economic factors, were the driving force behind large bison kills (Fawcett 1987; Oetelaar 2014; Zedeño et al. 2014), and that mass bison kills do not necessarily follow one prescribed pattern (Bamforth 2011; Cooper 2008). Clearly there is more than *one* way to analyze and interpret large scale bison kills. Therefore, implementing some of these new methods and ideas on old archaeological collections can reveal important discoveries about a site and the activities that took place in the past.

The questions presented in this thesis utilize new methodology and ideas not available at the time of the original investigation to make the Roberts site data more comparable to other bison kills in the region. Although a component of this thesis is to test previous interpretations of the site, this is not the primary goal. This thesis will discuss the Roberts site from three different perspectives, moving from a macro scale of investigation of the site (and the associated assemblage) to a micro scale. The first question highlights the site as a whole unit of analysis which will be imperative in setting up the final two questions. The second question will move to the topic of just the bison bonebed as a unit of analysis. This will be followed by a focus on the micro scale of investigation by utilizing the data discussed in the first two questions to examine spatial patterns within the site.

The results of this analysis first and foremost show the value of applying new research methods, analytic tools, and ideas to older collections. As will be seen throughout this analysis, there is a remarkable level of detail and data still retained in the collection. In large part, the results mostly confirm previous interpretations of the site (Witkind 1971). It is a kill, butchery and processing locale that resulted from a herd of at least 19 bison being driven over the edge of a cliff, making the site one of the southern-most known examples of bison jumping (Frison 1991) (the overwhelming majority of bison jump sites are further to the north in Wyoming, Montana, and Alberta [Cooper 2008]). There is clear evidence for spatial segregation within the bonebed, interpreted to be primary and secondary butchery areas. And, there is evidence that other activities not directly related to processing bison took place.

There are, however, many new pieces of data which were either not reported in the original documentation, or that are gathered here as a result of this thesis. For instance, when Witkind (1971) wrote his thesis, radiocarbon dating on bone was not nearly as refined as it is now, and no date was reported for the site. Additionally, summary information was presented on portions of the artifact assemblage, such as bison bone, flaking debris and stone tools, but those data were only minimally presented and are more thoroughly discussed here. There are also portions of the assemblage that were not mentioned at all, such as a relatively large fetal bison bone collection which, owing to more recent studies of bison behavior and fetal development, offer new and interesting insights. Finally, there have been many advances in spatial analytic tools such as geographic information systems (GIS). These tools allow for efficient mapping of artifacts. The results of using these methods show patterned distributions of different artifact classes that have never been seen or discussed prior to this thesis.

The following presents the three main questions addressed in this thesis. Each question is structured so that other detailed questions about the Roberts assemblage can be addressed. The questions are followed by a brief summary outlining the remainder of this thesis.

Question 1

Chapter 4 presents the first question addressed in this thesis, which starts at the macro scale of analysis by asking: what is the non-bison bone material culture at the Roberts Buffalo Jump? This question more broadly deals with the general nature of the entire assemblage from the Roberts site at an assemblage scale of analysis. First, I present basic summary tables of the site artifacts, including stone tools, debitage, bone beads, ceramics and bone tools. These data provide a context for the rest of the thesis, but also help determine if the site is a single component as originally thought, or if there is evidence to suggest multiple temporal components. In the previous analysis, Witkind (1971) suggests that "the major bone layer leads directly into the habitation site" (1971:52) and thus the two areas of the site are contemporaneous with each other. The data from this question are used to examine this statement.

One way to do this is to identify temporally diagnostic artifacts and compare them to the radiocarbon age of the site. Therefore, an ancillary question addressed in this chapter pertains to the antiquity of the Roberts Buffalo Jump. In order to link multiple areas of the site together, a series of five radiocarbon dates were processed for this thesis. These suggest the site is likely one occupation focused mainly on, but not entirely, the butchery and processing of bison.

Question 2

The second question shifts the focus from the entire assemblage to just the bison bone. This questions asks what is the composition of the bison bonebed at the site? I will use advancements in bone coding and methodology to gather quantitative data to illustrate the composition of the bone assemblage. This question discusses two separate, yet related, issues: the basic makeup of the bison assemblage (e.g., MNI, MNE, MAU) and the factors that led to site formation (e.g., taphonomic or natural, and cultural processes).

I discuss the number of individual specimens (NISP), the minimum number of individuals (MNI), the minimum number of elements (MNE) and the minimum number of animal units (MAU). These data are crucial to understanding the overall makeup of the bone assemblage. These data can then be used to interpret the site function (kill vs. camp/processing area), processing intensity, age cohort, sex, season of death, and the fetal bone assemblage.

The second piece of this question addresses the larger issue of modification and taphonomic processes that may have impacted the makeup of the bone assemblage. To do this, data gathered from the first part of the analysis are used to examine natural attrition and degradation of the bone, carnivore modification of the bone, as well as cultural modifications such as spiral fractures and cutmarks. I use these data to discuss some of the trends that other faunal researchers have identified to assess the "intactness" of the Roberts bonebed. This shows that the bone distributions across the site are largely a reflection of human behavioral decisions, a pattern that becomes most evident in the third and final research question addressed in this thesis.

Question 3

Data collected in the previous two questions are used to ask the third and final question: how is the bonebed spatially organized and can any distinct site structure patterns be determined from the available data? Advancements in spatial analytic techniques allow for a large amount of spatial data to be efficiently analyzed. These analyses, rarely employed at mass kill sites, offer a bevy of smaller and more specific research questions.

The first focus of this question details the spatial distribution of bison bone across the site. While the excavations occured over 40 years ago, a remarkable level of spatial data was gathered during this work. By mapping the overall pattern of bone distribution, a detailed look at the site structure can be realized. Site structure research (Binford 1978b) is typically employed at camp and residential sites. This is generally for the simple reason that comparable ethnographic data are available for researchers to use in such settings. Mass kill sites like bison jumps, however, are lacking in the ethnographic record or only offer limited details for comparisons.

Because comparative ethnographic data from mass kill sites are largely unavailable, units of analysis often used in site structure approaches must be modified for mass kill sites and bonebeds. For instance, site structure analysis has identified that people tend to organize themselves around a central locus such as a hearth feature, denoted by the term "hearth-centered activity area" (Binford

1983). At a mass kill site, the central locus of activity would likely be the bonebed or toss piles. Therefore, if people are organized around the bonebed then certain classes of non-bone artifacts should also be patterned around the bonebed. This will be the focus of the second part of this question.

Lastly, once it has been established that there are patterns organized around the bonebed, the focus of the spatial analysis goes back to the bonebed itself. This will focus on patterns within the bonebed by utilizing some gross measures of butchery and processing behaviors to see if some portions of the bonebed differ compared to others. This, in some ways, is testing Witkind's original interpretation that there are divisions represented within the bonebed. All of these analyses are then used to illustrate how the Roberts Buffalo Jump operated, showing that mass bison kills really do represent one snapshot of time in the life of a hunter-gatherer on the Great Plains.

Organization of Thesis

The remainder of this thesis is presented in six additional chapters. Chapter 2 provides a summary of bison kill research on the Great Plains. This overview shows that much has been discussed on the topic since Witkind's thesis on the Roberts site. These new methods and ideas form the foundation of the analyses presented in this thesis. This chapter concludes with a summary of the three summers of excavations at 5LR100 (1966, 1969-1970), as well as discussions on fieldwork in 2013. Chapter 3 outlines the laboratory methods, offering detailed summaries used for each phase of the analysis.

The three questions posed earlier in this chapter are addressed in chapters 4-6. Chapter 4 focuses on the non-bison bone artifact assemblage, including modified stone, ceramics, and bone tools. Some of these data are compared to relevant sites in the region to establish a chronology and discussion of site type and function. Recently obtained radiocarbon dates on five bone elements from the site are also discussed. Chapter 5 focuses entirely on the bison bone assemblage. The analysis presents both the adult and fetal bison specimens, as well as a discussion on the overall makeup of the assemblage. Chapter 6 uses data from chapters 4 and 5 to discuss the spatial distribution of artifacts at the site, as well potential butchery patterns that can be spatially observed. This chapter concludes with a brief summary of how the site likely operated. Chapter 7 summarizes the results presented in this thesis, and includes additional research questions that can now be addressed using the data generated herein.

CHAPTER 2: COMMUNAL BISON HUNTING ON THE GREAT PLAINS AND RESEARCH AT THE ROBERTS BUFFALO JUMP

For as long as humans have lived on the Great Plains, they have hunted bison. Communal hunting events are documented since some of the earliest peoples inhabited the Plains and surrounding areas at sites like the Folsom site in New Mexico (Meltzer 2006), to the plains of eastern Colorado at the Olsen-Chubbuck site (Wheat 1972), and to the Horner site in northern Wyoming (Frison and Todd 1987). While the degree and frequency of mass kills over the ensuing millennia changed, (at least partially based on the diminished presence of bison during certain periods [e.g. McKetta 2014]), communal bison hunting continued more or less consistently until bison were extirpated from the Great Plains in the nineteenth century (Bamforth 2011).

Communal hunting relies on the coordinated efforts of two or more individuals who participate in an exercise with well-defined roles and an explicit plan of action (Bamforth 2011; Driver 1990). The archaeological signature of these events is highly visible deposits of bone and stone (among other materials) that offer the opportunity to observe a snapshot in time about a particular human behavior. Mass kill sites, generally, revolve around a limited suite of activities which, unlike camp or residential sites, can make observing patterned behavior less ambiguous.

In the Great Plains, hunters employed a few different methods to carry out mass kill events. Some took advantage of landscape features such as arroyos that created natural traps for which the bison had no escape (e.g., Wheat 1972). In other instances, constructed trap features (aka pounds) were used to funnel and ultimately trap bison (e.g., Bupp 1981; Frison 1971a). Perhaps the most notable communal bison hunting method employed in the Great Plains is the buffalo jump (e.g., Brink 2008; Forbis 1962; Frison 1970; Malouf and Conner 1962; Reher and Frison 1980).

Conner (1962) describes several main components that virtually all communal hunting sites contain (although Conner presented this for just jump sites, the ideas apply to other types of communal kills like traps and pounds). These components are: (1) a gathering basin where the animals are congregated; (2) drive lanes that lead from the gathering basin to the kill point; (3) the precipice of the cliff (or funnel/trap); (4) a bonebed where the animals were dispatched and at least partially butchered; and (5) an associated camp site. While some of these features are not always easily recognized, they do outline the fact that these communal kills are not haphazard events. Rather, they are well-coordinated events requiring the work and cooperation of many individuals that involve many different factors including the overall landscape and terrain, and wind direction. These key components also provide a series of expectations that can be tested at communal kill sites to help confirm the site is in fact a kill site and also to help direct the course of fieldwork investigations.

A Summary of Bison Hunting Research on the Great Plains

At the time the work on the Roberts Buffalo Jump was first reported (Witkind 1971), there were very few scholarly works on communal hunting, let alone bison jumping. Barnum Brown (1932) published the earliest descriptive piece on investigative efforts at a buffalo jump, the Emigrant buffalo jump in Montana. Brown's work, of course, was preceded by some earlier descriptions of communal hunting by European and American explorers travelling the Plains in the eighteenth and nineteenth centuries (c.f. Frison [1967:28-36). It was not until the early 1960s that more descriptive and detailed publications on jumps appeared, including Forbis' (1962) work at the Old Woman's Buffalo Jump, Kehoe's (1967) work with the Boarding School drives, and a dedicated symposium on bison jumps in the northern Plains by Carling Malouf and Stuart Conner (1962). Most of the early research on bison kill sites was focused on reconstructing chronology via projectile point typologies, as well as reconstructing cultural history (e.g., Forbis 1962; Kehoe 1967).

As Oetellar (2014:12-13) succinctly summarizes, the ensuing decades saw a bevy of different research approaches to the archaeology of communal bison hunting. Over the next few decades, researchers like Frison (1970, 1971a, 1973) and others (Arthur 1975; Barsh and Marlor 2003; Davis and Wilson 1978; Emerson 1990; Frison and Todd 1987; Reher and Frison 1980; Speth 1983; Wheat 1972) focused more on reconstructing the events around the kill, such as season of death, butchery practices, the economic and nutritional utility of the kill, and bison ecology that pertained directly to the kill events. This research suggested that kills tended to occur in the late fall to early winter season and that bison were butchered in predictable and meaningful ways based on the sex, season of kill, and the overall utility of certain carcass portions.

More recent work on communal bison hunting on the Great Plains has attempted to synthesize the mass of excavations to look at broader trends and patterns (Bamforth 2011; Cooper 2008). Some of this research challenged or tested interpretations presented earlier, such as the consistency and seasonal timing of mass kill events. For instance, Bamforth (2011) argues that the pattern of communal bison hunting seen during Paleoindian times persists for the next few millennia (with some minor differences). The one exception to this is dramatic increase in frequency of kills and processing intensity seen at bison kills on the northern Plains over the last 2000-3000 years. Bamforth (2011:32-33) echoes a sentiment first noted by Kehoe (1973:195) that bison hunting during this time reflects near "industrial" levels of frequency and processing intensity. Bamforth argues that most of this can be attributed to expanding exchange networks from the east onto the Plains, with the northern Plains groups contributing subsistence goods to participate in this network of trade and exchange.

Within the last few years, additional research (Amundsen-Meyer 2015; Oetelaar 2014; Zedeño et al. 2014) has attempted to move away from an ecological focused approach. Instead, human agency, management of the land, and the importance of the kill complex are viewed as the driving factors behind bison kills, particularly those during the last few thousand years. Oetelaar (2014), for instance, argues that spiritual beliefs, including the relationship between humans, animals, and the land, dictated processes to carry out a successful hunt. While communal bison hunting certainly employed some level of spiritual or ritual significance, the results of these behaviors are often nearly impossible to detect archaeologically. This does not mean that these interactions should be discounted. Instead, it is most likely that all of these factors (ecology, economy, and ritual) were at play and displayed at communal hunting sites; some of these behaviors are just easier to identify archaeologically than others.

As the above summary shows, communal bison hunting, perhaps more than any other topic of archaeological investigation on the Great Plains, has had a great deal of ideas, arguments, and research laid out for investigators to ponder. Much of this research is on sites from the northern and northwestern Plains (and in particular kill sites dating to the last 3000 years or so), where the concentration of communal bison hunting activity is seen (Cooper 2008). In fact, Frison (1991:233) states : "Very likely, one could stand at the Roberts Buffalo Jump in northern Colorado and look from one Late Prehistoric bison jump to another all the way to the northern tip of the Plains in Canada."

This quote reveals two important facts. First, it implies that Roberts jump is one of the southern most known Late Prehistoric bison jumps in the Great Plains (arguments have been made for a Paleoindian-aged jump kill at Bonfire Shelter in Texas, which would predate the next earliest known example of jumping at Head-Smashed-In in Alberta by thousands of years and is separated by nearly an entire continent, but see Byerly et al. [2005] that refutes this idea). Second, Frison acknowledges that the mass of known communal kill sites lay further to the north in Wyoming, Montana, and Alberta. However, communal bison hunting, while most prevalent on the northern Plains, is not restricted to this area.

For instance, Clark Wissler (1910:49) noted in a footnote from a letter by a Mr. Reese Kincaide to T. R. Davis: "In talking to Washee, one of the Arapaho chiefs, about this matter [driving bison over a cliff], he said that he remembers seeing the Arapaho hunters drive a herd of buffalo over a bluff in Colorado". What this site is, or its exact location, is unknown. But, it shows that communal bison hunting, while concentrated in the northern Plains, is not restricted to this area. Aside from the Roberts jump, there are other examples of Late Prehistoric bison kills in northern Colorado and southern Wyoming, most of which likely date to around the same time as the Roberts site. For instance, Byerly et al. (2015) document the Coffin bison kill (5JA7), located in North Park near Walden, Colorado. The Willow Springs bison pound (48AB130) is just across the Colorado-Wyoming border west of Highway 287 (Bupp 1981). The site likely represents at least three different kill components, with at least one component containing side-notched arrow points and thus roughly contemporaneous with the Roberts site.

Other sites near Roberts and dating to about the same age include the Upper and Lower Boxelder Creek kill sites (Meeker et al. 2012; Smith 2013). Both of these sites are on private land and exist only as collections by the Coffin family (since donated to the Fort Collins Museum of Discovery). The museum loaned these collections to the Center for Mountain and Plains Archaeology at CSU for analysis by CSU undergraduate students under the direction of myself and Dr. Jason LaBelle. The Upper Boxelder Creek site appears to have a mass of bison bone, some of which is burned, at the base of a small precipice. The Lower Boxelder Creek site has not been visited by professional archaeologists. Therefore, data is limited from both sites to chipped stone collections consisting primarily of side- and tri-notched arrow points. The artifact styles are very similar to the point assemblage from the Roberts site, but little else is known about them. This underscores the importance of the Roberts site in understanding the record of Late Prehistoric period bison hunting in northern Colorado prehistory.

The Lykins Valley site (5LR263) is a historic-era Native American occupation about 17 km northeast of the Roberts jump (Newton 2008). The site dates to the early A. D. 1800s and contains both European manufactured artifacts as well as artifacts indicative of pre-contact indigenous technologies like chipped stone tools. While slightly more recent than the Roberts jump, the site shows the rapid change in technology occurring over a short period between when the Roberts jump was utilized and when contact between Native American groups and Europeans became more widespread. The artifact assemblage from Lykins Valley also offers clues to help refine the age of the Roberts jump which is discussed more fully in chapter 4.

Another site near Roberts is Killdeer Canyon (5LR289) which is a residential stone ring site about 6 km northeast of the Roberts jump. The site has two recent AMS bone dates that are roughly contemporaneous with the Roberts jump (Hallie Meeker, personal communication 2016). How, and if the site is related to the Roberts jump is unknown. Brief attempts at refits between the two sites have been unsuccessful. Collections from the site are currently being investigated by Hallie Meeker as part of her master's thesis work at CSU which should be completed in later 2016.

Roberts Buffalo Jump Investigations: 1966-1971

Witkind (1971) describes the excavations at the Roberts Buffalo Jump in more detail, but a discussion is warranted here for review as some of the details bear heavily on the current state of the collection used in this thesis. In 1957, the landowner, Mr. Evan Roberts, first noticed exposures of bone along the banks of the North Fork of the Poudre River when he used a bulldozer to open the river channel. This possibly removed a portion of the site, among other impacts like increased erosion. However, it was Mr. Roberts who notified archaeologists of the presence of the site and without his encouragement for the site to be excavated and documented it likely would have been lost to time.

The first excavations occurred in 1966 led by Raymond Barker, an amateur archaeologist from Denver (Figure 2.1). Mr. Barker was joined by a crew consisting of his two sons (one whom is named Lawrence), Larry Nelson, Charles Nelson (no relation to Larry Nelson), Ralph Roberts (no relation to the Roberts Ranch family) and others associated with a Colorado Archaeological Society group from Denver. Mr. Barker is now deceased, and efforts to contact his family, including his sons, have been unsuccessful. However, Larry Nelson had been in contact with Dr. Charles Reher of the University of Wyoming regarding other projects in southern Wyoming. Dr. Reher facilitated contact with Mr. Nelson, who has graciously shared photos and stories of their excavations in 1966 (on file at the CSU Archaeological Repository).

The 1966 excavations focused only at the base of the cliff, upslope from the main bonebed. Witkind refers to this as the "habitation area". The total area excavated is unknown, but based on pictures and limited data from these collections, at least three units (labeled as TT1, TT2, and TT3) were dug, appearing to measure approximately three feet by three feet in size. Aside from what is listed in Witkind's thesis, no other notes or documentation exist for this collection. Additionally,

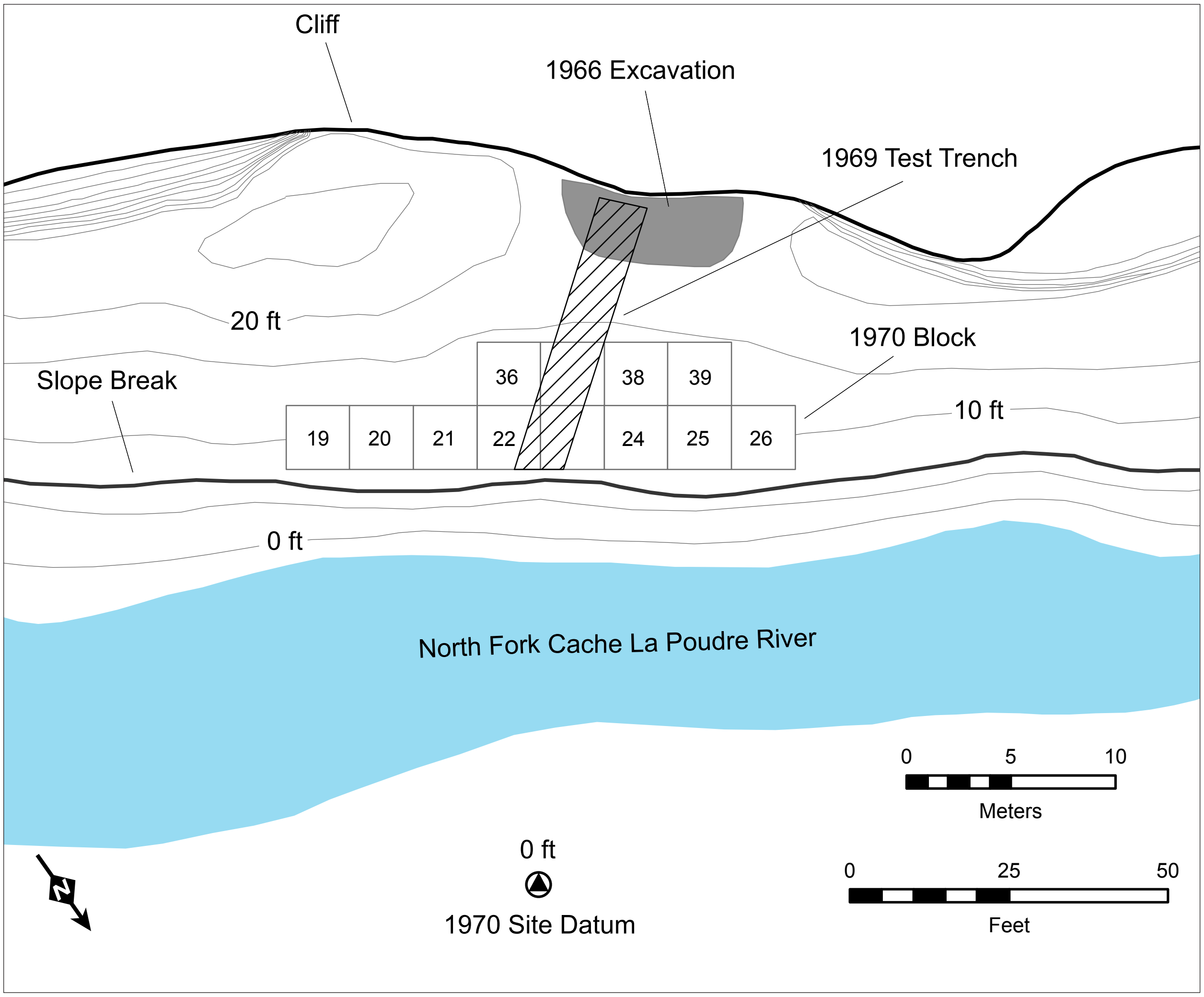

Figure 2.1. Plan map of the Roberts Ranch Buffalo Jump showing the topography, major landforms, and the locations of the three excavations at the site.

as will be more thoroughly discussed in chapter 4, it appears that at least some portions of this excavation are not part of the collection housed at the CSU Archaeological Repository.

Many artifacts were recovered from these excavations, with a complete inventory discussed by Witkind (1971:36-46). Perhaps the most notable pieces of this collection includes a partially complete flat-bottomed ceramic vessel (Figure 2.2). Unfortunately, this vessel is not with the collection and its present location is unknown. Other portions of the 1966 collection are still curated with the site assemblage, all of which are discussed in chapters 4 and 5.

Figure 2.2. Partially complete Intermountain Ware vessel recovered during the 1966 excavations at the site. Photo courtesy of Max Witkind.

In 1969 CSU began excavations at the site with a test trench running perpendicular to the river bank and the base of the cliff (Figure 2.3), extending to the northeast edge of the 1966 excavation (Witkind 1971:14). These excavations were under the supervision of Dr. James Judge, then a professor at CSU. The trench showed a significant deposit of bone and cut through the middle of what later was realized to be the main bonebed. Artifacts from this excavation are still

Figure 2.3. Photograph of the 1970 excavation. Opened units on the left are grids 19-21, and units on the right are 24-25. Note the disturbed sediment in the center of the frame, showing the location of the 1969 test trench.

curated with the collection and labeled as coming from Grids 1-7. The exact location of these grids is unknown, but using Witkind's data as well as one sketch drawing from the field notes, an approximate location of the test trench was determined (as depicted in Figure 2.1). The lower grid numbers from the 1969 testing (Grids 1-4) were within or very near the 1970 excavation block, and Grids 5-7 were up slope from this and to the edge of the 1966 excavation area.

In 1970, again under the direction of Dr. Judge, CSU students and staff with the archaeological field school returned to the site to conduct more formal excavations (Figures 2.4 through 2.6). Technical details of the excavation startegy are lacking in Witkind's documentation as well as from field notes from the two CSU projects. The following is the result of piecing together

Figure 2.4. (Top): View of the site from across the river during the 1970 excavation, with people standing in grids 24-25. (Bottom): Photo of the crew prior to excavation in 1970. Wheelbarrow and other tools are roughly where the 1966 excavation occured. Photos courtesy of Max Witkind.

Figure 2.5. (Top): Overview of the 1970 excavation of grids 24 (back) and 38 (foreground). (Bottom): Close-up of the 1970 excavation of grid 24 main bone layer. Photos courtesy of Max Witkind.

Figure 2.6. View of the 1970 excavation of grid 24 from the top of the cliff. Note that grid 25 appears to be backfilled, and grid 26 is open. Photo courtesy of Max Witkind.

various documents that listed different aspects of the excavation strategy employed in 1970. These documents included student notebooks with sketches, loose-leaf notes in a file of documents about the site, a surveyors map showing the original grid numbers that were abandoned prior to the start of work in 1970, and most useful, a series of level maps for each excavated unit. These level maps mostly depict bone and are keyed to a section of the page that lists the provenience data for each specimen. These maps were critical for interpreting the 1970 excavation grid system.

At least nine, 10 x 10 ft squares were opened up in 1970. Each square was given a number (e.g., 24; also see Figure 2.1 for all grid numbers), then divided into quarters (Figure 2.7). Each 5 x 5 ft square was labeled as 1 through 4 (e.g., 24.1, 24.2, etc.). Then, each quarter was divided in to 1 x 1 ft squares, and labeled with a letter A through Y (e.g., 24.1A). Each letter was then divided into

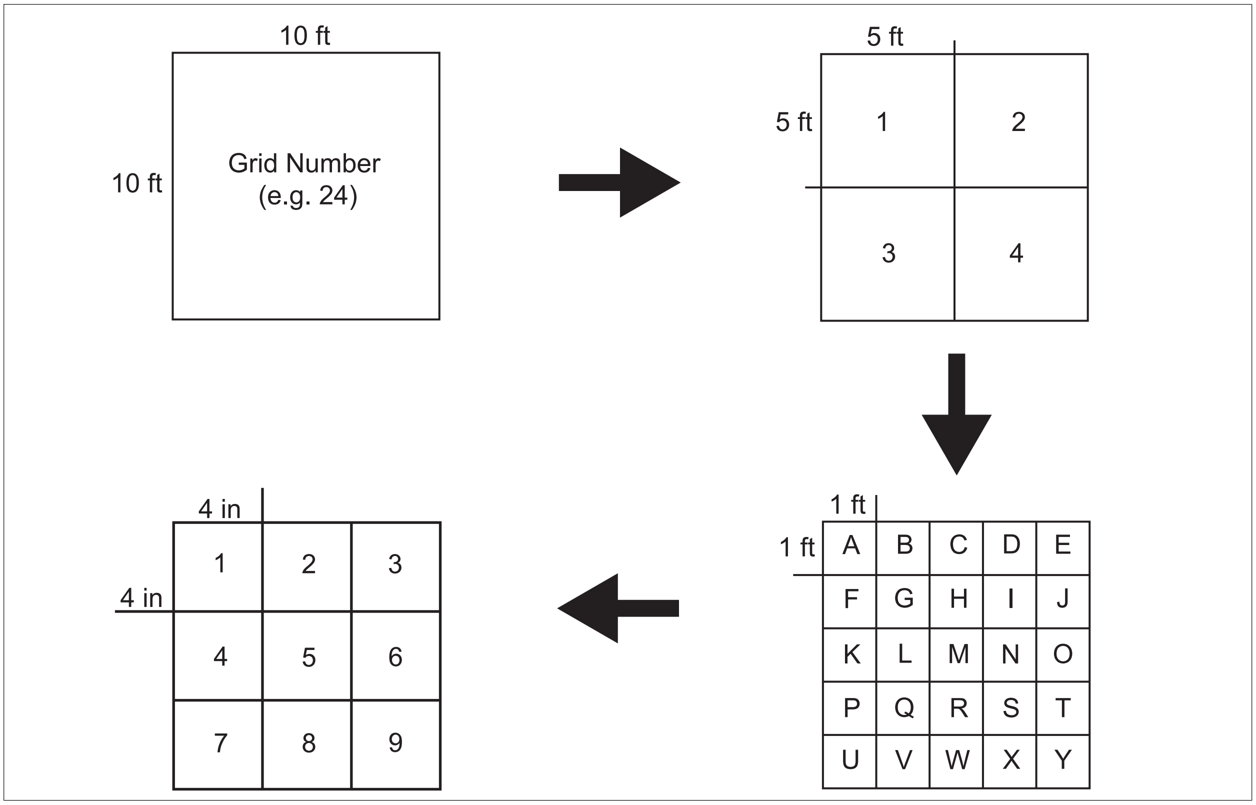

Figure 2.7. Flow chart showing the provenience plotting system used in 1970.

a series of 4 in squares, and labeled with a number 1 through 9 (e.g., 24.1A1). Artifacts such as long bones that spanned multiple sections of the grid, could contain two or more points to map the provenience information (e.g., 24.2C8-H9-N2). This remarkable level of provenience control allows artifacts to be mapped to a 4 inch square across an area roughly 80 feet wide by 20 feet long.

Depth information was recorded for each artifact (e.g. 24.1A1:32"). It is unclear if depth was recorded from a main site datum or if it was from the surface level of each unit but was most likely from each unit. Additionally, once the main bone layer was reached in each quarter unit, the entire bone layer was recorded as one depth which does not account for the roughly north trending slope of the site. For example, bones in unit 24.1 are upslope of those on the river side of that unit (the .1 and .2 units are on the cliffside and the .3 and .4 units are on the river-side), yet their depths are all stated as 32 inches. Each quarter unit was plotted in this same manner for the bone layer. However, non-bone artifacts were not recorded in this manner, and individual depths were taken on at least some of these artifacts which helps illuminate the sloping nature of the bone layer (Figure 2.8).

The 1970 investigations resulted in the identification of two cultural layers that merge towards the base of the cliff (Figure 2.8). The lowest layer is the most concentrated with artifacts, and is where the large majority of the collection comes from. The profile depicts the east walls of grids 24-38 (along with a grid 52 that was not plotted on Witkind's original plan map but was likely part of the test trench that cut through south of grid 38). As shown in the profile, the lowest layer is overlain by a thin clay deposit which is capped by a red sandy unit. Above this is a thin layer of

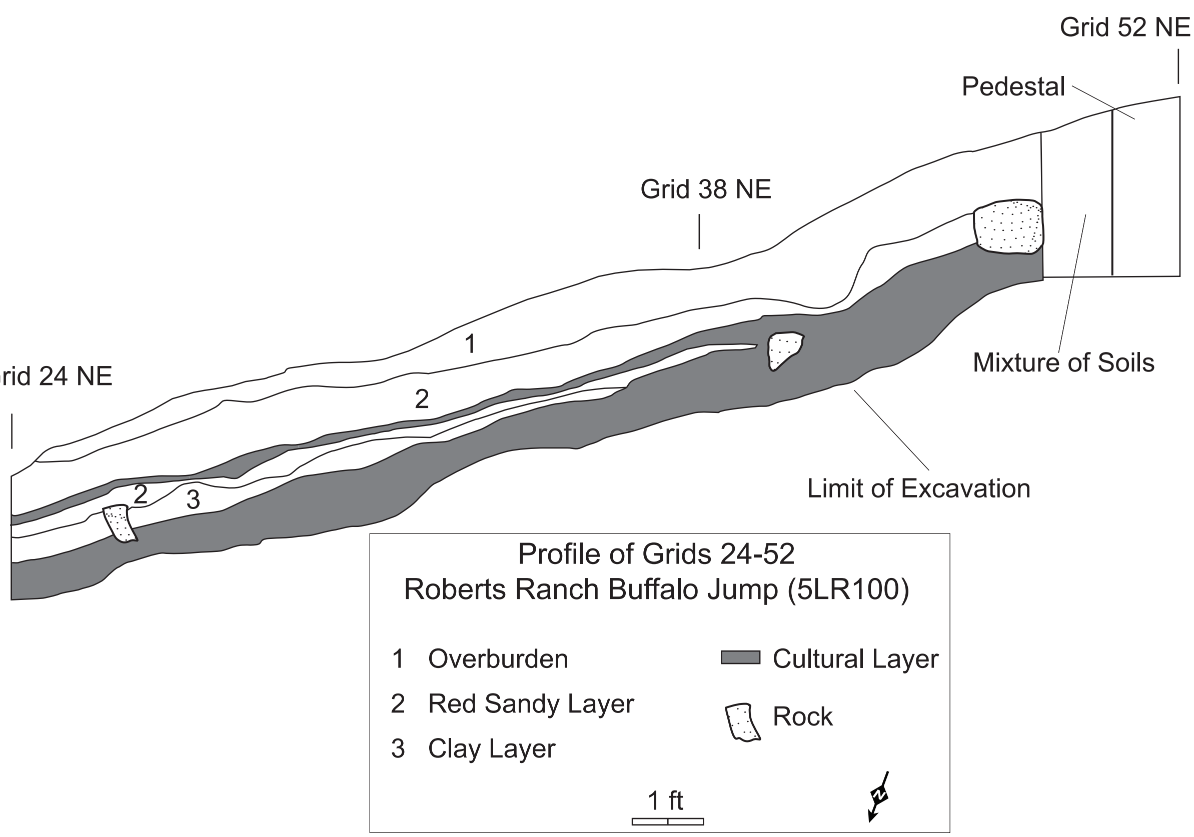

Figure 2.8. Profile drawing of grids 24-52. Adapted from Witkind (1971:Figure 12).

cultural material that appears to merge with the lower cultural layer near the grid38-52 border. This suggests that the lowest layer was more rapidly buried, followed by slight erosive activity that moved cultural materials from upslope (near the 1966 excavation area) over the main cultural layer, giving the impression of two components. This is overlain by another red sandy unit, which is capped by what Witkind calls "overburden". As I will show in chapters 4 and 6, the cultural materials appear to only represent one occupation, supporting the above stratigraphic interpretation.

The 1969 CSU test trench cut through the middle of site and the 1970 grids were placed around this trench. No exact depth or area for the trench is known, but it appears to be approximately five feet wide and dug up to about two and a half feet deep in arbitrary 6 in levels.

Combined, the 1969 and 1970 CSU excavations spanned approximately 1,200 square feet (roughly 110 square meters). As Figure 2.1 shows, eight 10 by 10 foot squares were dug on the river side, and four on the cliff side, adjacent to the northern (river side) squares. It is impossible to know exactly how deep some units went, or if certain quarter squares (5 x 5 ft blocks) were not opened. However, based on the level maps created during the 1970 excavation as well as plotted artifacts shown in chapter 6, it appears that most of the 10 by 10 ft squares were opened up to their horizontal entirety. Photographs of the site during excavation show screens and screened backdirt piles, indicating that more than likely all sediments were screened. It is assumed that quarter-inch mesh screens were used based on the maximum diameter of flaking debris recovered from the site as well as standard field methods for the time. When the 1970 excavations began, the site was completely overgrown with vegetation (Figure 2.4, bottom), which in the ensuing 40 years has come back (Figure 2.9).

Max Witkind (1971) wrote up the results of the three seasons of field work as his Master's thesis. His work represented one of the earliest scholarly documents on bison jump investigations

Figure 2.9. Site overview photo from 2013 showing the extensive overgrowth.

in the Great Plains. With little to draw on for reference points, Witkind used the data to interpret the site as a kill-processing locale and associated camp site. While his interpretations remain largely correct, some of these interpretations will be tested in this thesis using more recent methods and data from kill sites that have been excavated since the early 1970s. Additionally, technological advances in radiocarbon dating and computer software packages allow for a more refined look at the age and spatial structure of the site, both of which will be presented in this thesis. Finally, at a time when so little was actually known about communal hunting and the associated features of a communal kill site like the Roberts Buffalo Jump, new insights have allowed for additional fieldwork to be completed to examine how the site would have likely functioned.

Recent Investigations at the Roberts Buffalo Jump: 2013 Summer Fieldwork

During the summer of 2013, students from the CSU Archaeological Field School, under the direction of Jason LaBelle, returned to the site to investigate the potential of further work and also to get an up-close view of the site as no research had been done there since 1970. As the Senior Teaching Assistant on the field school, I organized a research design focused on two goals: 1) testing the site to examine stratigraphy and to see if intact deposits still remained, and 2) to survey the landscape above the cliff in search of drive line markers or cairns.

With permission from the Roberts family, we visited the site in early June 2013 to establish a temporary site datum and explore the logistics of accessing the site. Upon reaching the site, it became clear that our goal of testing the site with the short time we had available would not be possible due to extensive overgrowth. Additionally, safety concerns, including the steep slope, the presence of rattlesnakes, and the inability to quickly exit the site if needed further prohibited us from doing extensive work at the site.

In lieu of testing, the crew used the time making a map of the surface topography and relevant landforms. The data collected mirrored that recorded in 1970 (which is depicted in Figure 2.1), indicating that there have been few, if any, impacts to the site since the 1970 excavations. The data also showed it is approximately 14 meters (46 feet) from the top of the cliff to the base.

A survey in 1970 did not find any cairns. However, at the time, little was known about the size and nature of cairns. The assumption was they should be large enough for a person to crouch behind and spook the bison during the final drive (Max Witkind, personal communication 2012). We now know that drive line cairns are typically just a small pile of rocks that likely supported a wooden cross piece or something similar to give the illusion of a more permanent barrier, and are rarely large or tall rock piles or boulders (e.g., Brink 2013; Brink and Rollans 1989; Carlson 2011).

The 2013 field crew conducted a reconnaissance level survey on the land south of the jump point with the gracious permission of the Greenwood family. The survey crew started close to the cliff doing transect surveys roughly east-west across the cliff edge and south approximately 150 m, looking for the typical v-shaped funnel lines seen at many jump sites in the northwest Plains. No such features were observed in this section. The crew then continued surveying south of this point, still in a roughly east-west direction. Approximately 250 m south of the cliff, a small stack of angular to sub angular cobble bedrock pieces was noted. The crew then noted additional similar rock piles both north and south of the initial discovery.

Fourteen cairns of what appear to be deliberately stacked rocks were recorded (Figure 2.10). On average, the cairns are about 8 m apart (standard deviation of 3 m), with the largest gap being 14.3 m and the smallest 3.8 m. The cairns form a slightly sinuous line running approximately 110 m north-south. The north end is about 230 m southeast of the jump point (Figure 2.11). They are

Figure 2.10. One of the cairns, representative of the other cairns documented at the site.

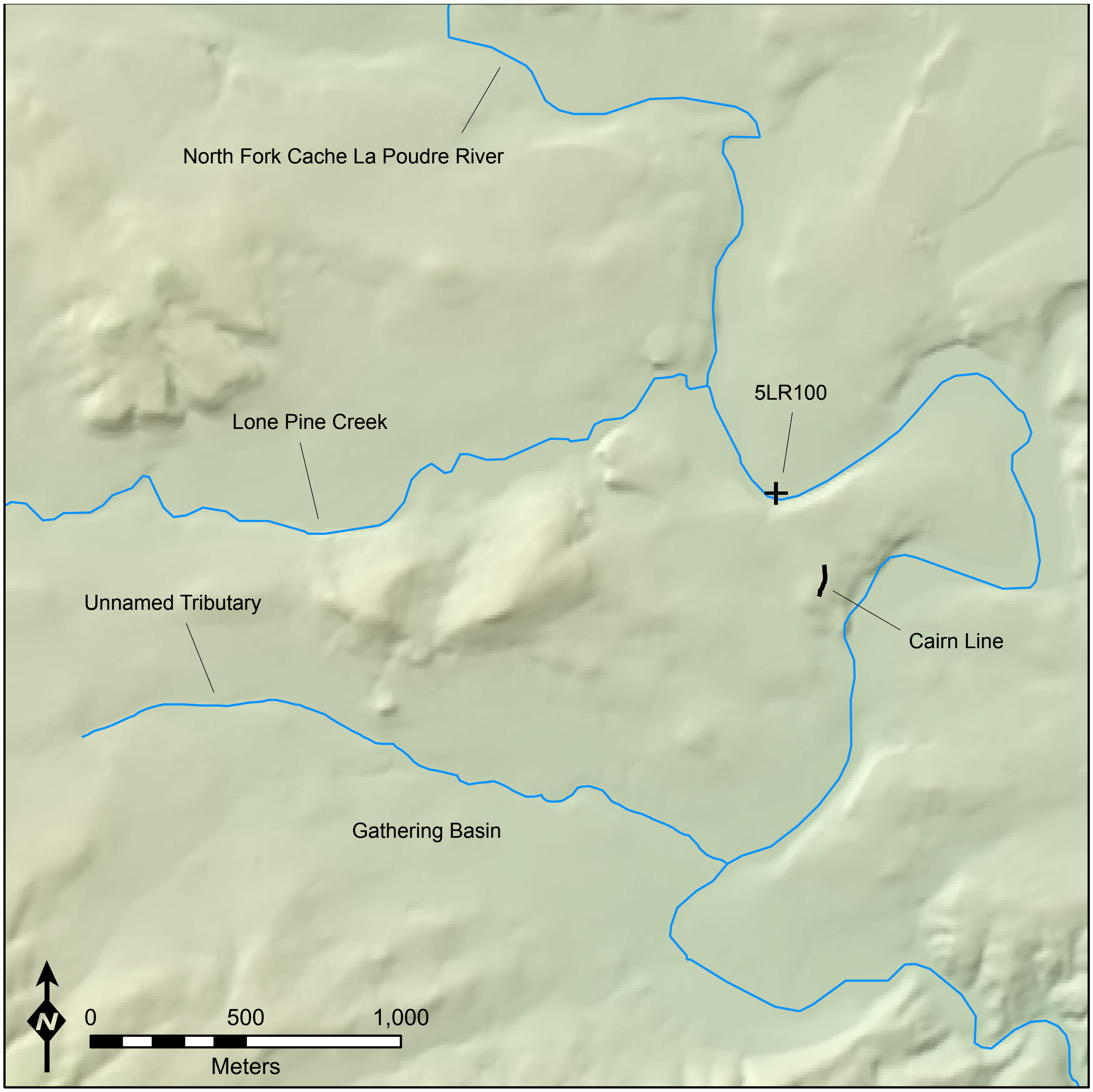

Figure 2.11. Hillshade relief map showing the location of the cairn lines relative to the jump point and the general location of the probable grazing area.

all situated along the crest of gentle slope break. The cairns appear to have been in place for some time based on the presence of lichens on exposed surfaces, and the lack of lichens on the underside of the rocks. Lichens have also grown between adjoining rocks, further confirming their relative antiquity. No corresponding wall or cairn lines to the west were noted; however, access to the adjacent property 250 m to the west was not granted.

Considering the probable gathering basin and drive corridor, the cairns are nearly perfectly placed to turn the stampeding herd north towards the jump point (Figure 2.11). Further, the cairns are downwind of the prevailing wind direction, which in this area is generally from the west. If the bison were being driven from a gathering area south and slightly west of the jump point, they would be heading in a roughly northeast direction. In order to hit the intended jump point, the herd would need to be turned slightly east. The topography where the cairns are found, marked by a gentle slope break, would be the perfect spot to reduce the momentum and shift the herd in a more northerly direction. They are slightly east of the jump point, but if they were much further west they may have caused the herd to turn north too far west and miss the intended jump point. Dogs may also have been used to drive or herd the bison, as evidenced by the two dog skeletons found in the main bonebed (Witkind 1971). (These skeletons are still curated with the collection but were not studied for this thesis; see Future Research section in chapter 7 for more information.)

The path leading to the jump point is a gentle, uphill slope, similar to what is seen at many other jump sites. As the herd was heading north, they would have only seen an endless vista (Figure 2.12), typical of many other jump sites. Then, about 20 m south of the jump point, the slope begins to sharply decline towards the cliff edge. Still, however, the cliff edge is not visible, and would especially be hard for a stampeding bison herd to sense. The forward momentum of the herd would have created a nearly impossible situation to pull out of until it was too late.

Figure 2.12. Photo of the view towards the jump point. Note the person standing approximately 30 m away, at the edge of the cliff.

Summary

The remainder of this thesis utilizes data collected from the three field investigations. When available, data on specific years of excavation are noted, but in general, the collection is considered as a whole. Aside from data and Witkind (1971) and bag labels, no records remain from the 1966 excavation. However, data reported by Witkind still allows for these collections to be useful in interpreting the site function and the spatial distribution of artifacts on the site.

A great deal of work has been completed on bison kills, and bison jumps in particular, since the Roberts Buffalo Jump was first reported in 1971. This research has created a number of new insights, methods, and theories. Using these new modes of investigation, I will argue that there is still much to be learned from previously reported collections. These methods are described in more detail in the following chapter, followed then by the results of these analyses.

CHAPTER 3: METHODS OF ANALYSIS

This chapter describes the methods used to gather data for the questions addressed in the following three chapters. I begin by describing the state of the collection at the outset of analysis, followed by a detailed analysis methods discussion. This chapter focuses almost entirely on the methodological components of each analysis presented in this thesis. In the following chapters I provide the theoretical context that guided the analyses to answer the particular chapter questions.

Condition of the Collection and Summary of Analysis

The artifact analysis began during the Spring of 2012 and was completed by the author with the assistance of multiple CSU undergraduate, graduate students and volunteers. The collection had been stored in the Archaeological Repository at CSU since the excavation. Artifacts from the 1966 excavation were stored in paper bags inside two cardboard boxes, both labeled "Habitation". Chipped stone tools and debitage from the CSU excavations were stored in two cardboard boxes identifying them as lithics from 5LR100. Most pieces of debitage and stone tools had the provenience data written on them in black ink and covered with a clear protective coating. All appear to have been rinsed free of dirt and debris. The debitage was stored loosely in a smaller cardboard box, a small cigar box, plastic sandwich bags, and letter-size paper envelopes, including some that were sealed.

At some point in the past, the bison bone from the CSU excavations had been roughly organized and stored in cardboard boxes. Some of the bone had been labeled with the provenience information in black pen but some pieces retained no provenience data. Smaller bones (e.g. carpals and tarsals) were stored in small paper bags, somw of which were labeled with the provenience data.

Small pieces of bone were found at the bottom of many of the boxes, mostly with no provenience data written on them and a few with fresh breaks suggesting they were broken fragments from larger elements within the box. Attempts were made to refit these pieces when possible but were not always successful. Additionally, it appeared that some elements, particularly the mandibles, had been removed from the collection, boxed together, and individually packaged in aluminum foil.

Only 23 percent of the bones were labeled with provenience information relating to the 1970 grid. My initial thought was that the un-labeled bones from boxes with a grid number written on the box were from that particular unit. However, it was realized that there was no correlation after comparing certain elements contained in boxes with the unit number designations to the field maps. It was determined that the provenience information for unlabeled elements had been lost. Box labels were abandoned owing to a likely relict curatorial error, and bones were sorted by element and coded.

Artifacts were first removed from their original storage container and organized to streamline the data coding process. After analysis, artifacts were stored in individual 2 mm polyethylene bags with any relevant data, such as provenience, written directly on the bag. The exception to this is much of the bison bone which remained in cardboard boxes but had an identifying catalog number written in black ink directly on the bone. Bison bone was organized and re-boxed by element. Multiple items that came from the same original storage container, such as the paper envelopes with debitage, were each bagged separately with the same data from the original storage container appearing on each new bag.

Data were collected using handwritten forms along with a coding sheet designed specifically for different stages and types of analysis (see Appendix A for all codes). The data were randomly checked by the author throughout the analysis for quality and consistency. The data were then entered into a Microsoft Access database table designed to mirror the handwritten form. The only exception was the bison bone data which was entered directly into a Microsoft Excel spreadsheet and then transferred at the end of each day to a master Access table and checked to ensure no data were lost during the transfer.

In most instances, individual items were given unique catalog numbers that were linked on each line within the database and the specimen bag. The catalog system starts at 1001 and each artifact class (e.g., debitage, tools, ceramics, and bone) begins a new series of catalog numbers at the thousand breaks (e.g., 3000, 4000, etc.) (Table 3.1). This was designed to ensure no numbers were repeated but enough numbers were available to maintain a standard within the system. Some items were recorded in bulk under one catalog number, such as unidentifiable bone fragments from unknown provenience and a portion of the debitage. Specific methods for each analysis are described in the following sections.

Table 3.1. Starting catalog numbers (CN) and number of assigned catalogs for each artifact class.

Artifact Class	Catalog Number Start	Number of Assigned Catalog Numbers
Debitage (CSFD)	1001	1,013
Stone Tools	3000	66
Ceramics	4001	28
Modified Bone	4100	31
Animal Bone	5001	990
"Habitation" (1966 collection) and Fetal Bone	7001	320

Modified Stone

Modified stone data collection includes both tools and debitage, or chipped stone flaking debris (CSFD), as well as ground stone tools. The thesis research design regarding chipped stone analysis allowed for only basic data recovery, which included raw material, heat treatment, burning, cortex, the maximum length, mass, size grade, and provenience data, when applicable.

Raw material identification followed standard criteria used in chipped stone artifact analysis. Chert includes all opaque cryptocrystalline materials. Chalcedony includes all transparent/translucent cryptocrystalline materials. Quartzite includes all silicified sandstone materials, including both ortho- and meta-quartzite varieties. When possible, source locations of some artifacts were noted in the comments, but actual source locations were not identified for every artifact.

Early in the sorting and organizing process it was noted that many pieces of debitage showed evidence of being heavily burned and it was deemed necessary to establish criteria to identify and properly classify burned items. Burning was only coded for cryptocrystalline materials. The criteria include potlids or irregular fractures, crazing or cracking, and translucent cryptocrystalline materials (chalcedony) that have turned a deep white color. It was also observed on some obviously burned pieces that some cherts, primarly a dark maroon colored chert, tended to turn a speckled white and maroon after being burned. These artifacts were coded as being burned even if other indicators such as potlids were absent. In rare instances when burning could be confidently identified on quartzite it was coded as such, but due to the nature of the raw material and the lack of key burning identifiers on quartzite most are coded as "NA" as opposed to "Not Burned". This allows for an accurate ratio of definitely burned versus unburned artifacts. It is probable that some of the quartzite materials not coded as burned are in fact burned, but doing it this way allows for the most secure level of baseline data on burning.

Heat treatment differs from burning in that it is an intentional process to improve the flaking quality of the toolstone (Domanski and Webb 2007). This can show advanced preparation of stone, possibly in order to carry out specific tasks that heat-treated materials may be better suited for. Heat-treated materials can be difficult to identify, especially in assemblages with many burned chipped stone artifacts. For this reason, all items coded as heat-treated or possibly heat-treated were double checked by the author to ensure consistency and accuracy. Characteristics of heat-treatment include a change in color from the post and pre heat treated surfaces (e.g., yellow cherts tend to develop a red rind post heat-treatment and when the red surface is flaked it is yellow underneath), and a change in the luster with flaked heat-treated surfaces being much more lustrous than non-flaked heat-treated surfaces and/or materials that have not been heat-treated. Burning can often destroy, or make hard to observe, evidence of heat-treatment.

Cortex was noted only as either present or absent; the amount or percentage of dorsal surface covered in cortex was not coded. The presence of many items with cortex can be a proxy to identifying the stage of lithic reduction, access to raw material sources giving indications of mobility and planning strategies, and the type of tool manufacture taking place at a site.

Some of the flaking debris assemblage was coded in a slightly different manner and uses methods known as mass analysis (Ahler 1989). Mass analysis of flaking debris was used on portions of the assemblage from unknown provenience or where tight provenience control was lacking (such as in the test units or from the 1966 excavations). This analysis follows similar conventions as described above. However, items were only size-graded using standard metal sieve screens, then counted as groups showing the same variable attributes (e.g. all burned size grade 3 cherts were counted and given a single catalog number). Size sorting of the assemblage includes four size grades: grade 1 (items retained in a 1-inch square mesh screen; grade 2 (1/2-inch mesh); grade 3 (1/4-inch mesh); and grade 4 which includes all items that passed through the 1/4-inch mesh screen.

Stone Tools

The same variables were used to code chipped stone tools with some additions including maximum width and thickness, portion of the tool (e.g., complete, proximal end, etc.), and two variables to describe the tool, a technological class and a functional class. A technological analysis of stone tools focuses primarily on how the items were manufactured rather than their intended use (Ahler et al. 1994). Each technological class identifies a sequence of production steps and techniques ranging from simple and expedient to multi-stage and complex (Table 3.2). For example, large patterned bifaces are produced by a series of staged flake removals via soft-hammer percussion on a large flake or biface, likely produced via hard-hammer percussion. These tools may also exhibit evidence of pressure flake removal along the tool margins. A key component in technological analysis rests on the concept of "patternedness" resulting in bilateral symmetry. By contrast, unpatterned tools are asymmetrical and their shape primarily determined by the original flake blank used to make the tool.

A functional class uses morphological characteristics of the tool to describe their intended (or assumed) function. For example, tools coded as small patterned bifaces for technological class

Table 3.2. Technological tool class descriptions for tools that were coded for in the analysis. Tool codes from Ahler et al (1994).

Technological Class	Description
Small patterned biface	Produced by controlled and sequenced pressure flaking on small, thin flake blanks. When finished, artifacts in this class exhibit continuous bifacial retouch and are symmetrical in plan and cross section. Includes arrowpoints, drills, and small cutting tools.
Large patterned biface	Produced by controlled and sequenced percussion flaking on various blank types. Symmetrical in plan view and cross section. Pressure flaking also is used, which sometimes obliterates evidence of earlier manufacturing stages. Includes dart points and hafted and unhafted bifacial cutting tools.
Unpatterned biface	Produced by hard hammer percussion on tabular, pebble or flake blanks; pressure flaking is used only rarely. Tools in this class are not symmetrical and often exhibit discontinuous bifacial edging.
Patterned flake tool	Produced by pressure flaking on flake or tabular banks. Patterned flake tools exhibit plano-convex cross sections, but are bilaterally symmetrical in plan view. Includes hide scrapers.
Unpatterned flake tool	Produced by use-flaking or pressure-flaking on a flake blank. Edge modification is highly variable and may be discontinuous. Unpatterned flake tools lack symmetry. Includes a wide variety of tools used for many different tasks.
Unpatterned bifacial core	Produced by application of bifacially directed, freehand percussion to the edge of a large chunk or cobble. Flakes are often removed from only a portion of the tool perimeter, and edge outlines are often very sinuous in plan view.
Patterned pecked or ground tool	Produced by pecking or grinding on various blank types. Includes abrading tools.

are often coded as projectile points for functional class and are most often arrow points. For this assemblage, multiple functional classes were recognized including arrow points, end and side scrapers, cores, and bifacial knives or processing tools. Arrow points were further classified based on their morphology and include side-notched, tri-notched (side and basal notches), and un-notched.

Ceramics and Modified Bone

Basic descriptive data, along with basic metric measurements, were recorded for the ceramic and modified bone assemblage. Provenience data were noted, when applicable, for both artifact classes. Data collected for ceramic sherds included surface treatment (e.g., finger-nail impressed or plain ware), portion of the sherd (body or rim), maximum length, width and thickness, and mass.

The collection also contains an assortment of modified bone including bone beads and bead manufacturing debris, and bone tools. Descriptive class categories were created and include bone bead, awl, flaker and unknown modified bone. I developed an additional level of analysis to capture data on bone bead production debris. These categories relate to the production sequence of bone bead manufacuting and include score only, snap only, score and snap, polished, and finished. Score means the item has been scored but not yet snapped, while snap means the item has been snapped but no score marks are visible. Score and snap mean the item has been scored and snapped with score marks still visible. Polish indicates some further surface treatment but the ends are not completely rounded. Finished beads show a high degree of polish on the surface and the ends are polished and rounded. Species identification, when known, was coded for each specimen. Items were also measured to the nearest tenth of a millimeter for maximum length and weighed to the nearest tenth of a gram. Maximum width and thickness was also recorded for finished and polished beads.

Bison Bone

The methods for the bison bone analysis are broken out in sections because multiple modes of investigation were used in this analysis. It will become clear, however, that many of the methods build upon each other and thus are linked together in many instances throughout the analysis and discussion sections. Technical aspects of the methods used in this analysis are discussed here. Discussion of the analytical components of these methods are presented in chapter 5.

Bones were coded following methods developed by Todd (1983, 1987) which categorize each bone in a three part system by first noting the element, then the portion of that element, followed by the segment of that portion (see Appendix A for bone codes). Such a system can allow for comprehensive counts of element frequency, especially in assemblages that are complete or nearly complete (Hill 2001:21-22). While potentially excluding fragmentary elements from the analysis, which can impact frequency or other element distributions, this system was deemed the most appropriate method for the Roberts bone analysis because it maximizes the amount of data that can be efficiently collected and also allows for the Roberts assemblage to be compared to many other assemblages that utilize this method.

The analysis presented in chapter 5 first attempts to understand the basic characteristics of the bison bone assemblage, such as minimum number of individuals (MNI), minimum number of elements (MNE) and minimum animal units (MAU). A detailed analysis of bone fragments is unlikely to increase these numbers in a meaningful way. Second, it came to my attention early in the analysis that some portions of the bone assemblage, in particular fragmentary elements, had likely been discarded as a space saving measure (Max Witkind 2012, personal communication). Complete or partially complete elements therefore represent the most practical way to understand the composition of the bone assemblage.

Individual elements were coded for side (left or right) when applicable, along with the degree of fusion (proximal and distal) for relevant elements. Fused radius-ulna elements were counted as individual elements. A maximum length (from proximal to distal ends) and a weight were recorded for each specimen. Additionally, each specimen was examined for indicators suggesting cultural modifications and the presence of carnivore modification. Cultural modifications include burning, cutmarks and green-bone, or spiral, fractures. Carnivore modifications include tooth puncture marks, furrowing of articular ends, or the complete absence of articular ends with furrowing. Burning and cutmarks were recorded as either present or absent.

NISP, MNI, MNE, MAU

The element-portion-segment coding method allows for straightforward quantifications of the bone assemblage. The number of individual specimens (NISP) counts the total number of specimens in an assemblage by element. Such a count is useful to see the overall extent of the assemblage. When NISP is compared to the counts derived for MNE and MAU values, it can be used to examine the degree of fragmentation in the assemblage. However, more specific measurements are needed to examine the questions proposed in this research.

Three such indices are referred to as minimum number of individuals (MNI), minimum number of elements (MNE) and minimum animal units (MAU). MNE values use both the element and portion codes to quantify the highest number of individual elements represented in the assemblage (Lyman 1994:102). MNI uses the most represented element in an assemblage to determine the base minimum for the numbers of animals. In this analysis, MNE by side was used to determine the MNI value. Using the portion codes and sides allow for the maximum number of elements to be used as it accounts for both complete elements as well as a subset of incomplete elements. For example, because many elements are fragmented, only using complete humeri would discount the overall number of elements represented in the assemblage. Similarly, using all instances of complete and incomplete humeri would inflate the MNE values as it would count proximal and distal segments as two when they could be from the same animal. Therefore, using both the complete and then the most-represented portion (e.g., complete humeri and the distal articular end) allows for the most justifiable value for the number of elements.

MAU refers to the minimum number of animal units needed to account for the total number of specimens represented in an assemblage (Lyman 1994:105). Binford (1978:70-71) recognized the utility of doing such an analysis to better understand processing and transport decisions at kill sites. Thus, assuming non-cultural factors have not impacted the assemblage (discussed later in this section), MAU values can be considered a potential measurement of behavioral choices made by the butcher which can then be used to examine differential spatial patterning of elements in an assemblage (Hill 2001:31).

To calculate MAU, the MNE values are totaled then divided by the number of elements that would be present in a complete specimen. For example, an MNE for humeri of four would have an MAU value of two, as each complete bison would contain two humeri. Then, to standardize the MAU measurement to make relevant comparisons about the abundance (or the lack of different elements in an assemblage), each element MAU value is divided by the highest MAU value then multiplied by 100 to act as a relative percentage.

Density Mediated Attrition

Density mediated attrition examines the role that natural degradation of bones can have in the composition of a bone assemblage based on their volume density. Kreutzer (1992) provides density measurements for bison bone. For this analysis, complete bones utilized the greatest density measurement for that element. In instances where both complete and portions were used for the MAU value, the density measurement most similar to the portion was used. The specific locations of density measurements used for each element are listed in chapter 5 along with the portion code or if a complete code was used. Not all bones that are present in the assemblage have density values measured. For example, carpals are not presented individually so in this instance the carpal density measurement (LUNAR in Kreutzer [1992]) was used for all individual carpals.

Utility Indices

Binford (1978a) suggests that bone distributions like MAU can be used to explore different processing and transport behaviors. For instance, sites that have an over representation of high utility elements (such as limb elements like femora and humeri) could be considered secondary processing areas away from the main kill site. One way to explore such an issue is to apply utility indices that assign a utility value to each element based on certain factors such as gross meat weight or the amount of bone marrow or fat contained in each element. To examine the potential for patterned behavior in how the carcasses were processed, data from Emerson (1990) was used to compare to the Roberts assemblage. Emerson provides many different models to examine different aspects of utility, such as total products, marrow only or bone grease only. For the analysis presented here, three models were used to compare to the MAU values from Roberts.

The three models used in this analysis are the Average Total Products (MAVGTP) which averages the data from all bison used in her sample and accounts for utility factors such as meat, fat, bone grease and marrow but does not isolate season or sex; a marrow fat model (MAVGMF) which examines only the caloric yield and utility data for marrow only; and a skeletal fat model

(MAVGSKF) which measures the utility of marrow and within-bone fat used for bone grease production. While data suggest the assemblage is fall to winter season of death comprised mostly of females (Simcox 2013; Zawasky 1971), the female only or fall killed female were deemed unsuitable models since at least one male and juvenile males or females are in the assemblage. It would be impossible to eliminate only the male elements entirely from the assemblage, thus the use of the averages derived from Emerson's study.

Each utility model has two options of data to choose from. One accounts only for the value of each individual element and the other accounts for the effect of riders and is denoted by 'M' at the beginning of the model name (e.g., AVGTP vs. MAVGTP for the Total Products model). Accounting for riders increases the utility value of certain elements (or portions of those elements) that have a lower utility value. For example, in the Averaged Total Products Model (Emerson 1990:Table 8.6), the utility value of the proximal ulna increases from 7.9 to 16.5 in the model with riders. The perceived value of this portion of the ulna is increased due to it's relationship with the distal portion of the humerus. In terms of removing meat packages, it is more economical and thus an increase in utility value to remove both the distal humerus and the proximal ulna at one time for further processing. Emerson (1990:620-623) provides a more detailed discussion between the two models. The data presented in chapter 5 uses the models which account for riders.

Like the density values presented by Kreutzer (1992), Emerson's utility values are also based on portions. For example, proximal and distal humeri have different utility values in all of the models used here. Thus, appendicular elements which utilized one portion over another to develop the MNE and MAU values also use the utility value represented by that portion in the same manner that they were used to calculate density measurements.

Fetal Bison Bone

A large collection of fetal bison bone is in the assemblage (n=181). Under my guidance, CSU undergraduate Natalie Sanford analyzed the fetal bone assemblage for her ANTH 465 Zooarchaeology class final project. In tandem, we developed methods for the analysis to gather data relevant for the analysis. The methods largely follow those designed for the main bone analysis, including NISP, MNI, MNE and MAU, along with coding for burning, cutmarks, and carnivore modifications.

We also wanted data to compare to other fetal bison assemblages of known age to attempt to analyze seasonality based on the size of certain elements. To do this, we followed methods implemented by McKee (1988) and Von den Driesch (1976) to record certain measurements on long bones. These measurements include the maximum diaphyseal length (MDL), the minimum antero-posterior diaphyseal diameter (MAPDD), and the minimum transverse diaphyseal diameter (MTDD).

Since bison rut in the fall and have about a 10 month gestation period (although see Walde [2006] and the discussion in chapter 5 about this issue), comparisons between the size of certain elements to known assemblages can help determine the season of the kill. Intra-assemblage comparisons of these measurements allow for a determination to be made on the relative consistency (or lack thereof) of the age profile at death, which is then (at least partially) used to examine season of death. Inter-assemblage comparisons are similarly used to compare to other fetal assemblages and their suggested season of death. If there is great variability of the measurements within the assemblage, then it could be posited that the fetal assemblage represents multiple kills or occupations. Conversely, if the variability is limited, it could be argued that the fetal bones likely all come from the same kill since the fetuses would be about the same age at death.

Spatial Analysis and GIS Methods

Binford (1978b; 1983) describes site structure, or the "spatial distribution of artifacts, features, and fauna on archaeological sites" as a method to analyze the archaeological record. While broad ranging in its behavioral implications, the site structure approach has rarely been used at kill sites, and bison kill sites in particular. O'Connell and others (1992) utilize this approach when examining Hadza kill and butchery sites, but their analysis more pertains to the actual butchery process, the time investment, and structure of the actual butchery of the animal. Additionally, their analysis only focused on single or few-animal kill sites and not on multi-animal kill sites like those seen in Plains bison jumps.

The majority of analyses using the site structure approach are focused on hunter-gatherer camp/residential sites (Bamforth et al. 2005; Binford 1978a, 1978b; Enloe 1983; Enloe et al. 1994; Hill et al. 2011; Rigaud and Simek 1991; Simek and Larick 1983, among others). This is primarily due to the fact that baseline ethnographic data used to compare archaeological assemblages are derived from camp or residential sites. However, as will be demonstrated in chapter 6, these general baseline data about site structure and human behavior can also be used to identify patterned behavior at mass kill sites.

Two primary methods utilizing mathematical models of spatial analysis are commonly applied in site structure studies to discern activity areas or artifact concentrations: density contour maps and the K-means clustering algorithm (also see Mills [2009] for a thorough discussion of these and other spatial analytic techniques that can be employed at a bison kill using GIS; and Chambers [2015] for other clustering methods used in archaeological GIS analysis). In short, density contour maps utilize computer programs such as Surfer and applies arbitrary grid systems, such as excavation grid blocks (or post-hoc grid layouts), overlain on data in an X, Y coordinate system (Enloe et al.

1994:107-108). Each grid is then given a relative value based on the frequency of a particular artifact class or for entire artifact assemblages from a site. Each grid unit is then combined with surrounding grids to come up with a cumulative value to show general trends of artifact distributions via smoothed contour lines.

The K-means clustering algorithm is a computer model which, like the density contour method, utilizes an X, Y coordinate system for certain classes of artifacts, or even sites (Kintigh and Ammerman 1982). Rather than looking at general distributional trends based on arbitrary grid placement, however, K-means analyzes the point locations of each individual item. The model seeks to identify logical clusters of artifacts which "minimize the intracluster variances while maximizing the intercluster distances" (Kintigh and Ammerman 1982:39). In other words, the model is designed to isolate discrete divisions between potentially different artifact groupings as well as establish discrete (and thus meaningful) relationships between closely spaced artifacts. Additionally, as Simek and Larick note (1983:166), this method can be utilized at different scales so that small-scale patterns (i.e., allowing for multiple cluster solutions) can be examined in relation to larger site-level patterns (i.e., allowing for fewer cluster solutions).

A major difference between these two methods is that when running a K-means cluster algorithm the investigator inputs the number of clusters. This, in some ways, makes the investigator already have some assumption about what the expectations are. Conversely, using a density contour method requires an arbitrary grid over the X, Y coordinates to determine the extent of the distribution of artifacts. As Enloe et al. (1994:107-108) state, the size of the squares in this grid, and consequently the sample size for each grid, change how patterns display. In other words, at larger sites with a distribution of artifacts across a broad space, this method may not be the most suitable. However, as will be seen more clearly in chapter 6, the distribution of artifacts at the Roberts site is already spatially restricted. Therefore, it was deemed that a version of the density contour method would be most suitable to help partially address the questions posed in chapter 6.

GIS Methods

To carry out the spatial analysis, all available data were plotted in ArcGIS 10.2, a geographic information system program. A GIS was built using an arbitrary grid system (i.e., not built on real-world coordinates). The first step was creating a grid system that could capture 5 x 5 ft grids. A Fishnet polygon extension was utilized to create this grid with X, Y coordinates rooted at 0, 0. Once this was complete, the original site map (Witkind:Figure 1) was georefrenced to this grid to create the individual 10 x 10 ft polygons and the major landforms and contours were traced in the GIS to create a scaled map of the surface topography and surrounding features. This map was also utilized to capture the location of the 1966 excavation as it appears on the original site map, as well as to create a rough estimate of the 1969 test trench location.

Chapter 2 already described the recovery of provenience information from the 1970 excavation. The resultant coordinates (e.g., 20.4A:9) are not conducive to working in a GIS which is structured on an X, Y, Z coordinate system. Therefore, the provenience data was translated to an X, Y coordinate system. To do this, I had the assistance of Noah Benedict, a CSU undergraduate, who created a script in MATLAB to translate each successive portion of the provenience data to a specific value based on the grid established in the GIS. For instance, 20.4 has a specific X, Y value, which is further modified by the 'A', and then further modified by the '9'. A trial was run to compare the GIS plots to the original field plot maps; this determined that the script was successful. However, as many of the artifacts (particularly the flaking debris) had the same coordinates, these data were then randomized in Microsoft Excel to place them somewhere within the confines of a 4 x 4 inch grid (the most precise measurement taken during the 1970 excavation). This allowed for a better display of the plotted artifacts without changing their actual coordinates within the site grid. The resultant X, Y data were appended to the Microsoft Access data table for all artifacts. Artifacts that do not have any provenience data associated with them cannot be plotted. As will be seen in chapter 6, however, a fairly large portion of the assemblage can be plotted, at least to some degree.

Some artifacts, such as long bones, have multiple points. Each one of these points was translated to X, Y grid coordinates, then ordered successively in the Access data table. When these points were added to the GIS, a Hawth's Tools Point-to-Polyline extension was utilized to join points based on their catalog number as well as the point order. This created two GIS shapefiles; one of bones with just a single point, and one of bones with multiple points represented by lines. All other artifacts that are plotted have only one point. A separate shapefile was added of all bones, but the multi-point bones were limited to just one point per bone. This was done so that density maps based on the bone point data would not be inflated by bones with multiple points.

Once the plotted artifacts were added to the GIS, I began to utilize some of the spatial analysis methods discussed above. Since the data were already plotted on an X, Y coordinate system much of the analysis was completed by basic visual inspection and therefore advanced spatial statistical methods were not utilized (c.f. Mills 2009). This is mainly due to the low sample size for most artifact classes. The two exceptions, as will be seen in chapter 6, are flaking debris and the bone. Based purely on deductive reasoning that becomes clear in chapter 6, there was no need to do any further spatial or statistical analysis on the flaking debris assemblage.

The bone however, created a more complex display that needed to be clarified visually to compare with other artifact classes. To do this, I utilized a density contour method in ArcGIS known as Kernel Density. This toolbox extension follows the same methods described earlier for density contour maps. Rather than using this method as a purely spatial statistic model, however, I used this to both identify clusters of bone (which can be seen visually in the plotted bone map), but more so as a visual display tool to show where the concentrations of bone are in relation to other artifact classes.

CHAPTER 4: NON-FAUNAL ARTIFACT ASSEMBLAGE

This chapter describes the non-faunal artifact assemblage from the site which includes stone tools and flaking debris, pottery, bone tools, and other artifacts associated with the site. The central question this chapter addresses is: what entails the non-faunal artifact assemblage at the site? This allows for additional questions to be addressed both in later chapters but also within this chapter. These data can also be used to ask how the artifact assemblage reflects site activities. For instance, does the non-bone artifact assemblage suggest only butchery and processing activities; or were other activities taking place that are not traditionally thought of as related to butchery and processing activities?

These data will also be used in conjunction with a series of radiocarbon dates to discuss the age of the site and examine if the diagnostic artifacts are contemporaneous with the absolute dates. These data are then used to address the number of cultural components present at the site. Lastly, the data presented in this chapter will play a pivotal role in exploring the spatial distribution of artifacts as discussed in chapter six.

At least some portion of the original assemblage is no longer curated with the present collection. Some artifacts have likely been lost over the years; portions could have been discarded by CSU, or they may have been retained in the Barker collection. Attempts have been made to locate Barker's two sons who were present at the excavation, but as of this writing they have not been located. When relevant, the numbers originally reported in Witkind will be presented along with those from the current analysis. However, the majority of this analysis will focus primarily on the portions of the collection that are currently housed at the CSU Archaeological Repository.

I begin by discussing the chipped stone assemblage, including the debitage and chipped stone tools, followed by a discussion of the modified bone and ceramic assemblages. The chapter concludes with an overview of the radiocarbon dating results of five bone samples.

Chipped Stone

A large collection of chipped stone flakes and tools were recovered from both the 1966 and the 1969-1970 CSU excavation. The stone tools were mostly reported in Witkind (1971) but the debitage has yet to be fully reported. Tool counts do not entirely match those presented by Witkind (1971:17-27; 40-43) which is likely the result of portions of the collection that are now missing.

Flaking Debris

The flaking debris assemblage is comprised of 1,904 flakes (Table 4.1). Multiple raw materials are represented but the assemblage is dominated by chert, chalcedony and quartzite. Eleven obsidian flakes are also present, along with flaked quartz, petrified wood and a few instances of rhyolite (all under the "Other" category in Table 4.1). Chalcedony is the most represented material by count, but chert materials have a higher mass, more than double that of chalcedony. This is the result of just a few large grade 1 chert flakes that skew the mass of the chert flaking debris. Grade 3 flakes are the most represented by count, whereas size grade 2 flakes have a higher mass.

Raw material source was not coded in the analysis, although some flakes were noted as coming from unique and easy to identify sources. Identification of these sources is based solely on visual inspection including color, texture and inclusions in comparison with samples from the Center for Mountain and Plains Archaeology raw material comparative collection. These sources include a small number of Flattop chalcedony flakes, a purplish opaque to translucent material from eastern

Table 4.1. Count and weight of the flaking debris assemblage by size grade and raw material.

	Count					Weight (g)				
Raw Material	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
Chert	45	236	335	51	667	912.1	572.8	292.5	4.0	1,781.4
Chalcedony	12	308	363	32	715	98.3	453.1	247.8	3.6	802.8
Quartzite	5	78	317	45	445	49.9	214.7	222.3	5.1	492.0
Obsidian	-	6	5	-	11	-	3.6	5.4	-	9.0
Other	3	16	39	8	66	140.8	53.2	34.2	0.7	228.9
Total	65	644	1,059	136	1,904	1,201.1	1,297.4	802.2	13.4	3,314.1

Colorado (Greiser 1983) and some that are similar to Table Mountain jasper, a red to maroon chert mostly found in the mountains near Middle Park (Benedict 1990:19-20). Other sources include orthoquartzites likely from the Dakota group (Benedict 1990:20) and possibly some pieces of Kremmling chert, a clear to milky white chert from the Troublesome formation in Middle Park (Benedict 1990). Some of the quartzite is almost certainly from the Campbell Mountain source just a short distance away (Pelton et al. 2013). It must be stressed that identifiable sources were not noted for the entire assemblage and those that were easily identified were the minority.

Only 190 flakes (10 percent of the assemblage) have cortex present (Table 4.2). No attempts were made to classify the amount of cortex on each individual flake (e.g., 1-25%, >75%) but cursory inspection show the majority of flakes have less than 25 percent of the dorsal surface covered with cortex.

Table 4.3 notes the frequency of burned flaking debris by size grade and raw material. Both chert and chalcedony are almost equally represented. Burning was not coded for quartzite unless it

Table 4.2. Percent of flaking debris with cortex by size grade.

Raw Material	G1	G2	G3	G4
Chert	28.8	15.3	14.3	5.9
Chalcedony	-	9.1	12.1	3.2
Quartzite	-	7.7	3.1	-
Other	-	6.3	-	-
Total	20.0	11.0	9.6	2.9

Table 4.3. Count of burned flaking debris by size grade.

Raw Material	Size Grade G1	G2	G3	G4	Total
Chert	22	125	117	4	268
Chalcedony	8	159	106	3	276
Other	2	2	2	-	6
Total	32	286	225	6	550

was completely clear that the material was burned. Only three quartzite flakes show clear evidence of being burned (included with the Other tally). Excluding quartzite, 38 percent of the flake assemblage is burned. Much of the burned flaking debris is concentrated in one area of the site, an interesting pattern that will be discussed more in chapter 6. Only five flakes show evidence of being intentionally heat treated. This may reflect the difficulty in detecting intentional heat treatment or the evidence of heat treatment being obscured or destroyed by burning. Even so, intentional heat treating does not appear to be a major component of the flaking debris assemblage.

In general, the flaking debris is reflective of the activities taking place at the site. The low frequency of flakes with cortex suggests that flake reduction was primarily on partially finished pieces that had most or all cortex removed prior to being brought to the site. This is consistent with the low frequency of larger flakes. The high frequency of grade 3 flakes indicates re-sharpening and some later stage tool production, perhaps for larger butchering tools. The low frequency of size grade 4 flakes is not surprising because most of these flakes would have been missed during the screening process, assuming quarter inch screens were used to screen the sediments. Some of these flakes were plotted and bagged on-site, while others are definitely fragments broken from larger flakes during the last 40 years. The variation in how grade 4 flakes ended up in the collection makes much interpretation of this size grade difficult.

Stone Tools

Sixty-five stone tools were identified in the collection (Table 4.4). Small patterned bifaces are the most represented technological class with 28 cases, followed by unpatterned flake tools with 12 cases. The technological classes represented in the assemblage are consistent with expectations for the site type. Thirteen tools are burned and only one has evidence of intentional heat treatment (Table 4.5). The low frequency of heat treatment is consistent with the flaking debris and indicates this was not occurring at the site or in preparation for use at the site.

As with the flaking debris, chert and chalcedony dominate the tool assemblage, especially for the patterned tool classes. Tools in nearly every technological class are made from quartzite. This may reflect a local procurement strategy from the nearby Campbell Mountain quartzite source. One obsidian tool was noted, a crude, unpatterned biface with multiple step fractures on both faces. Two quartz crystal tools were also noted. One is a small core fragment with clear flake scars on multiple faces. Some crushing exists on one end but the opposite end has no evidence of crushing or step fracturing. The crushing could be related to use as a wedge, but expectations would be to see bi-polar reduction, and none is present. The other quartz tool is a triangular, un-notched arrow point. Some quartz flakes were identified in the assemblage, indicating that at least some type of reduction of this hard material was taking place.

Table 4.4. Counts of stone tools by technological class and raw material.

	Raw Material					
Technological Class	Chert	Chalcedony	Quartzite	Obsidian	Quartz	Total
Small patterned biface	12	10	5	-	-	28
Large patterned biface	1	1	3	-	-	5
Unpatterned biface	2	-	2	1	1	5
Patterned flake tool	7	-	1	-	-	8
Unpatterned flake tool	5	4	3	-	-	12
Bifacial core-tool	-	-	1	-	-	1
Core/core-tool	4	1	-	-	1	6
Total	31	16	15	1	2	65

Table 4.5. Count of burned and heat treated tools tech class.

Technological Class	Burned	Heat Treated
Small Patterned Biface	2	1
Large Patterned Biface	1	
Unpatterned Biface	2	
Patterned Flake Tool	4	
Unpatterned Flake Tool	5	
Core/Core-Tool	4	
Total	18	1

Tools were also coded based on their morphology and typed to more descriptive functional tool categories, such as projectile points or end scrapers (Table 4.6). Eleven simple flake tools were identified. These consist mainly of larger flakes with retouch along the margins, and likely served as cutting tools. One of these is a large quartzite flake that has heavy use or retouch along one margin (Figure 4.1e). This tool could have functioned as a large chopper, a tool commonly seen at kill-butchery sites (e.g. Frison 1967:13, 1970:Figure 23; Reher and Frison 1980:24, also see Figure 23), however it's smaller size might make this improbable. Alternatively, it could have been a large, durable kinfe or cutting tool. Eleven bifaces (not including projectile points) were noted. These are bifacially flaked tools that have no morphological comparison; in other words, their intended function could not be determined in this study and were classed as general bifaces. However, it is

Table 4.6. Counts of stone tools by morphological class and raw material.

	Raw Material					
Morphological Class	Chert	Chalcedony	Quartzite	Obsidian	Quartz	Total
Biface	3	2	4	1	-	11
Core	4	1	-	-	1	6
Flake tool	5	3	3	-	-	11
End scraper	5	-	-	-	-	5
Side scraper	1	-	-	-	-	1
Scraper fragment	-	1	1	-	-	2
Alternate Bevel Knife	-	-	1	-	-	1
Graver	1	-	-	-	-	1
Projectile Point	12	9	5	-	1	27
Knife	-	-	1	-	-	1
Total	31	16	15	1	2	65

Figure 4.1. Selected stone tools from the Roberts modified stone assemblage. End scrapers (a-c); side scraper (d); quartzite chopper (e); heavily burned serrated knife (f); and burned sandstone grooved abrader fragment (g).

likely that at least some served as knives or bifacial cutting tools but use-wear analyses were not conducted to confirm this. Future work on these tools could be done to more further refine their function.

A total of eight scrapers and scraper fragments are in the collection (Figure 4.1a-d). These include five end scrapers, one side scraper, and two distal scraper fragments (both of which are burned). Frison (1967:42) suggests side scrapers may have functioned as a scraper and a cutting tool. The five end scrapers are all made of chert. One of these is made from Bridger Formation chert (often called Tiger chert) (Figure 4.1c), from northwest Colorado and southwest Wyoming (Miller 2010:589-592). Interestingly, no flakes of this material were observed in the debitage analysis.

One tool is a fragment of an alternately beveled knife (Figure 4.2h). It is made from a gray orthoquartzite. It has a transverse fracture that initiates along one margin, but it is difficult to say if the fracture occurred during use or re-sharpening. One artifact is a large, side and basally-notched hafted knife (Figure 4.1f). It has deep serrations along each margin and is burned.

Another uniquely identifiable tool is a fragment of a parallel-oblique-flaked tool made from orthoquartzite that has split along a fracture or bedding plane (Figure 4.2i). Only one face is present, but it is almost certainly from a bifacial tool. It measures 52.4 mm long by 16.7 mm wide. The fragment is incomplete, but the flaking pattern is very similar to what are often called Shoshone knives from sites like the Long Knife site (5MF5827) in northwest Colorado (Mueller and Frior 2009) and the Eden-Farson site (48SW304) in southwest Wyoming (Frison 1971b). The Coffin bison kill (5JA7) in North Park also contains a Shoshone knife (Byerly et al. 2015).

One sandstone tool is present in the collection. It is a grooved abrader that has been pecked and ground to shape (Figure 4.1g). The groove is 5.1 mm wide and is continues across the entire face. This diameter is consistent with range of arrow shaft diameters (Hare et al. 2004; Thomas 1978) and indicates the tool was likely used to smooth and shape arrow shafts.

Projectile Points

Twenty-seven projectile points, point fragments, and unfinished points are included in the collection (Figure 4.2a-e). Witkind identified 52 projectile points (Table 4.7), 35 of which came from the habitation area dug in 1966. Seventeen of the points came from the kill area excavated by CSU. It is believed that the points in the collection for the analysis presented here are these 17 points, along with either additional fragments that were not originally coded as projectile points or instead are a portion of the 1966 collection.

Eight points are triangular, un-notched arrow points (Figure 4.2d-f; Table 4.8). All of the un-notched points have the maximum width at the base, which are all concave (Table 4.9). Use-phase data (discussed later in this section) suggests all of these points were finished and not preforms waiting to be notched. Four points are tri- or basally-notched arrow points (Figure 4.2b-c) and two are side-notched arrow points (Figure 4.2a). Five broken point fragments were unclassifiable to type due to breakage; all are tips missing bases. Attempts to refit the tips to the base fragments were unsuccessful. Eight points are unfinished and will be discussed in more detail later in this section.

Ahler (1992) supplies methods for use-phase classification of Plains Village arrow points, which uses the technological trajectory of arrow point production (classified in stages) to examine

Table 4.7. Summary of tools reported by Witkind (1971).

Tool Type	Kill Area	Habitation Area	Total
Projectile Points	17	35	52
End Scrapers	5	5	10
Side Scrapers	1	2	3
Backed Knife	1	-	1
Biface	1	-	1
Utilized Flakes	10	9	19
Shaft Abraders	2	-	2
Drills	-	2	2
"Tanning Stones"	-	2	2
Total	37	55	92
Flakes	2001	unreported	2001

Table 4.8. Summary of arrow point styles by raw material.

	Raw Material				
Type	Chert	Chalcedony	Quartzite	Quartz	Total
Side-notched		1	1		2
Tri-notched	1	2	1		4
Triangular Un-notched	5	2		1	8
Fragment		3	2		5
Unfinished	6	1	1		8
Total	12	9	5	1	27

Table 4.9. Typology, metric and use-phase data on projectile point assemblage (excludes the five tip fragments). See Table 4.10 for stage and use-phase definitions.

			Measurements (mm)								
CN	Material	Type	Extant Length	Extant Width	Thickness	Base Width	Haft Width	Mass (g)	Fracture	Stage	Use-Phase
3007	quartzite	side-notched	7.0	13.7	3.3	13.1	6.5	0.3	transverse	5	4
3012	chalcedony	side-notched	18.0	13.4	3.5	broken	8.6	1.0	impact	5	4
3006	chalcedony	tri-notched	13.1	14.2	2.7	14.2	8.8	0.4	impact	5	4
3011	chalcedony	tri-notched	17.9	11.2	3.1	11.1	8.3	0.5	impact	5	4
3032	chert	tri-notched	12.5	11.4	2.8	11.3	7.9	0.4	impact	5	4
3033	quartzite	tri-notched	12.4	12.7	2.8	broken	9.1	0.4	impact	5	4
3009	chert	un-notched	23.1	16.5	3.7	16.5	16.9	1.4	impact	4	4
3008	chert	un-notched	30.6	16.3	4.4	16.3	16.3	2.2	none	4	3
3010	chert	un-notched	27.5	16.6	2.4	16.6	16.6	1.2	impact	4	4
3034	chert	un-notched	14.1	13.4	2.2	13.4	13.4	0.4	transverse	4	4
3049	chalcedony	un-notched	13.2	12.4	2.4	12.4	12.4	0.3	impact	4	4
3042	chert	un-notched	17.2	11.3	3.1	11.3	11.3	0.5	impact	4	4
3048	chalcedony	un-notched	16.6	16.0	4.2	16.0	16.0	0.8	perverse	4	2
3054	quartz	un-notched	22.7	22.4	5.3	22.4	22.4	2.2	impact	4	4
3058	chert	unfinished	21.3	14.5	2.7	11.3	na	1.0	none	3	1
3038	chalcedony	unfinished	29.7	14.6	3.1	13.9	na	1.5	none	2	1
3057	chert	unfinished	23.1	16.2	2.4	14.8	na	0.9	none	3	1
3059	chert	unfinished	30.3	23.7	4.9	na	na	3.6	none	2	1
3016	chert	unfinished	18.8	16.1	4.6	na	na	1.3	perverse	2	2
3053	quartzite	unfinished	22.3	17.7	3.1	na	na	1.0	lateral	2	2
3030	chert	unfinished	25.5	21.0	4.4	na	na	2.4	perverse	3	2
3020	chert	unfinished	19.1	20.4	4.2	na	na	1.6	perverse	2	2

the production stages of a collection (e.g., unfinished, or finished and used). The point assemblage from the Roberts site shows that both broken and complete points were discarded and/or left at the site. The data, however, indicate that arrow points were also being manufactured at the site. Table 4.10 provides a description of the five production stages of points identified in the

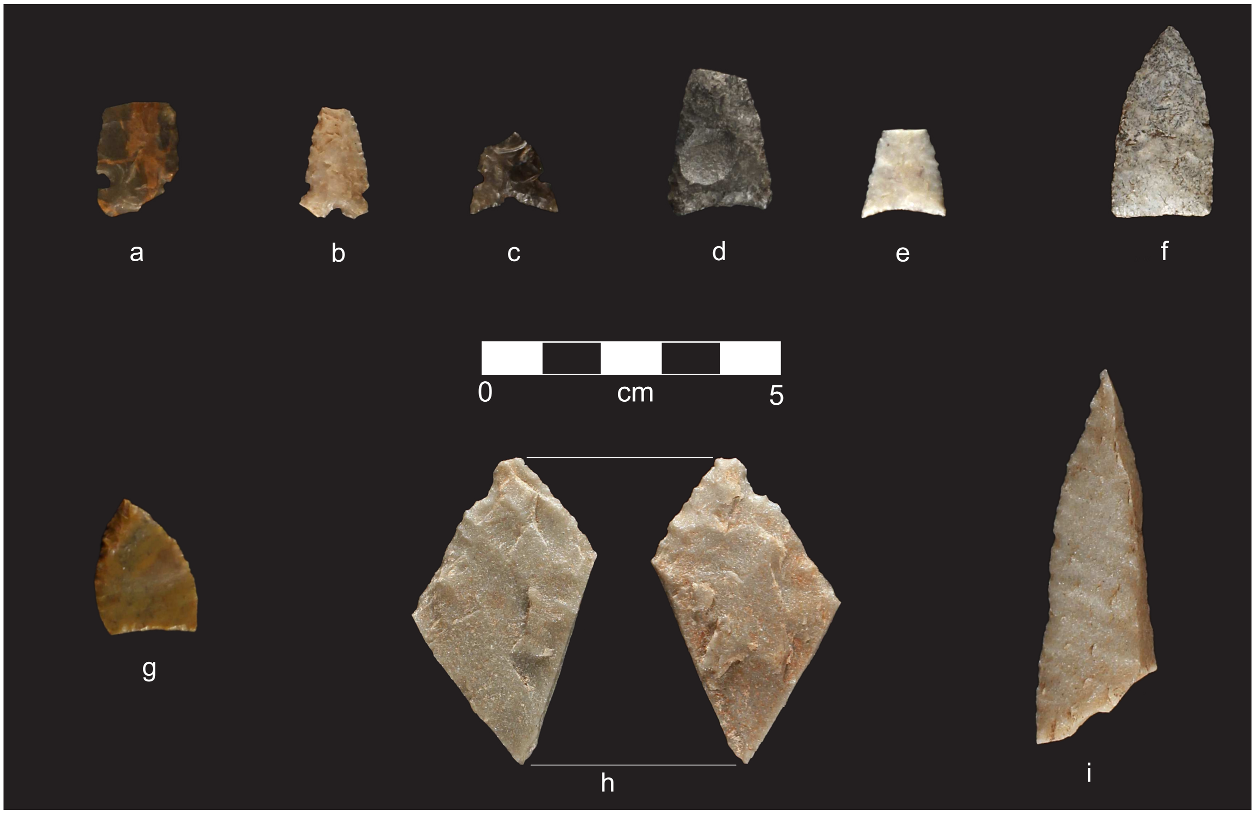

Figure 4.2. Projectile points and other tools in the Roberts modified stone assemblage. Side notched arrow point (a); tri-notched arrow points (b-c); un-notched arrow points (d-f); unfinished arrow point (g); two sides of alternate beveled knife fragment (h); and parallel-oblique "Shoshone" knife fragment (i).

assemblage, as well as a description of Ahler's four use-phase classes. In sum, stage 2 and 3 points are in the manufacturing process and are not considered complete or finished points. Finished, un-notched arrow points would be classified as stage 4, unless there is evidence for fracturing during maintenance which would make it a stage 6. Stage 5 points are either finished or broken notched points, depending on the fracture type.

A total of eight points are classified as unfinished, stage 2 or 3 points (Figure 4.2g; Table 4.11). Three have perverse or twisting fractures that occurred during pressure flake removal, one has a lateral flake break that also likely occurred during flake removal, and four are intact, unfinished points made on flake blanks.

Table 4.10. Use-phase and stage descriptions (from Ahler [1992]).

Stage	Description
2	Edging: Production of a unifacially or bifacially pressure flaked edge on a blank where there formaerly was none
3	Initial thinning: Patterned removal of long pressure flakes along all flake margins
4	Final Thinning and Shaping: Continued pressure flaking/shaping to produce a symmetrical isosceles triangular form
5	Notching: Optional step to produce hafting and basal notches.
6	Resharpening and Maintenance: Optional step to refurbish a broken or damaged point.
Use-Phase	
1	Manufacture incomplete, useful (*e.g.* unbroken preform)
2	Manufacture incomplete, non-useful (*e.g.* broken preform)
3	Manufacture complete, useful (*e.g.* complete projectile point)
4	Manufacture complete, non-useful (*e.g.* finished projectile point with impact fracture, not big enough to refurbish)

Table 4.11. Stage and use-phase by fracture type for the projectile point assemblage.

	Stage 2		Stage 3		Stage 4			Stage 5	Stage 6	
Fracture	U.P. 1	U.P. 2	U.P. 1	U.P. 2	U.P. 2	U.P. 3	U.P. 4	U.P. 4	U.P. 4	Total
Lateral	-	1	-	-	-	-	-	-	1	2
Perverse	-	2	-	1	1	-	-	-	-	4
Transverse	-	-	-	-	1	-	3	1	-	5
Impact	-	-	-	-	-	-	6	5	-	11
No fracture	2	-	2	-	-	1	-	-	-	5
Total	2	3	2	1	2	1	9	6	1	27

Twelve points are classified as stage 4, or in the final shaping and thinning stage. The majority of these are finished, un-notched triangular points (n=8), the other three are tips. Six have impact fractures, showing they were used for the kill and then discarded. Four have simple transverse fractures, which can either be caused by a bending force across a tools axis during re-sharpening or via some stress or force during use (Ahler 1992:44). One has a perverse fracture that likely occurred during the final finishing phase. One is a complete, finished un-notched point.

Six points are classified as stage 5, or the notching stage. All six are finished side- or tri-notched arrow points. Five show evidence of impact fractures, and one has a transverse fracture that could be from use. One point is in the maintenance stage 6. It is the tip of a finished projectile point that fractured via a lateral flake fracture, which occurs during flake removal and maintenance. The fracture clearly initiates at a pressure flake scar along one of the margins, further indicating a re-sharpening failure.

Only one of the nineteen finished points is complete (Figure 4.2f; Table 4.9). As noted earlier, it is an un-notched, triangular arrow point. Eleven points (58 percent of the point assemblage) have impact fractures. These include five un-notched points, four tri-notched, one side-notched, and one projectile point tip. Five have simple transverse fractures, which can occur either during use or maintenance. One lateral flake fracture is on a tip (described earlier), and one un-notched point has a perverse fracture that likely occurred during the final finishing stage.

Tool Summary and Discussion

The chipped stone assemblage is almost entirely related to kill and processing activities. Projectile points and cutting tools (including knives, bifacial cutting tools and flake tools) are the most represented tool classes. Scrapers, used for cleaning and preparing hides, are also heavily represented in the tool assemblage. Six cores, most with little remaining utility due to their diminished size,. were likely used to create sharp flakes for processing and butchery.

The projectile point assemblage includes 19 classifiable points (including tip fragments). The mere presence of these points indicates that the fall from the cliff did not kill all of the bison and at least some had to be dispatched after the fall. Thus, the tool assemblage shows evidence of kill, butchery and processing activities all taking place. Broken bases were likely removed from the arrow shaft and discarded, while tips may have been lodged in meat packages that could have been removed during butchery and processing. These assumptions will be explored more in chapter 6 in terms of their spatial location in the site.

The point assemblage is dominated by triangular, un-notched points (n=8). Tri-notched points account for 21 percent of the assemblage, and side-notched points (n=2) make up 11 percent. Many sites dating to the Late Prehistoric-Protohistoric periods have these three point styles (or some combination of the three) represented in their assemblages. The make-up of these assemblages can be instructive to determining an approximate age for the site.

Sites like the Vore site (48CK302) show that these point styles do co-occur, but often to varying degrees. For instance, Level 2 at Vore has 28 side-notched points, 11 tri-notched, and four un-notched points (Reher and Frison 1980:Table 12). Reher and Frison (1980:29) note that this level dates to approximately A.D. 1700-1800. At the Glenrock Buffalo Jump (48CO304), Frison (1970:36-39) notes that the bottom level contains no tri-notched points but the top level (most recent) is composed of 30 percent tri-notched points. The bottom level at Glenrock has a radiocarbon date of 280±100 B.P. and the lower part of the top level has a date of 210±100 B. P. (Frison 1970:7). While somewhat close in radiocarbon years, this does suggest that tri-notch points occur slightly later in time than side-notched points and thus sites with higher frequencies of tri-notched points could be considered more recent.

The Piney Creek sites (48JO311 and 48JO312) also have all three point styles represented but dominated by side- and tri-notched points. Frison (1967:27) reports two dates from the site, A. D. 1580±100 and A. D. 1610 ±100. The Coffin kill site (5JA7) has all three styles represented, but is dominated by side-notched points (Byerly et al. 2015). Four AMS radiocarbon dates on bone collagen suggest potentially three different episodes of use at the site, spanning between the fifteenth and nineteenth centuries (Byerly et al. 2015:276-278).

Non-kill sites also have some combination of the three point styles. For instance, Level 2 at Cherokee Mountain Rock Shelter (5DA1001) has all three styles represented, but the majority are side-notched (Nelson and Stewart 1973:330). The site has not been dated, but based on the point styles and other artifacts the investigators assign it an age between A.D. 1250-1590 and conclude that the site is associated with a "Shoshonean group" (1973:334). At the Long Knife site

(5MF5827) on the Western Slope, both tri-notched (what the investigators call Desert side-notched) and un-notched triangular points (termed Cottonwood triangular) were recovered (Mueller and Firor 2009:12-16). Fifteen radiocarbon dates were run from this site with most spanning between approximately 550-200 calibrated B. P. (Mueller and Firor 2009:Table 18, Figure 43), or roughly contemporaneous with the Roberts site. At Killdeer Canyon (5LR289), a stone ring site a few miles west of the Roberts jump and also on the Roberts Ranch, a small projectile point assemblage is comprised solely of side-notched points. Two recent AMS dates on bone collagen from the site are 225±25 RCYBP and 230±25 RCYBP, roughly contemporaneous with the Roberts jump (Hallie Meeker, personal communication 2016). This intriguing site, in terms of it's relationship to the Roberts jump, is currently being analyzed by Meeker for her master's thesis at CSU.

The Carter site (48NA1425), in northwestern Wyoming, has both un-notched and side-notched points, but no tri-notched (Martin 2000). A single radiocarbon sample from the site produced a date of 580±60 RCYBP (or A. D. 1280-1440).

The three styles also occur at the Eden-Farson site (48SW304) in southwestern Wyoming (Frison 1971b). The site, a residential site with the remains of some 200 antelope that Frison suggests were communally hunted, has a radiocarbon date of A.D. 1720±100. A total of 75 projectile points were recovered from Eden-Farson, including 52 tri-notched, 11 side-notched, and 10 triangular, un-notched. However, Frison (1971b:270) notes that the un-notched variety are "believed to be unfinished specimens, since some appear to have been broken while applying the notches". While this may be the case at some sites, the un-notched points from the Roberts site are clearly complete and finished points because five of the eight have impact fractures, and two others have fractures that could be associated with a force from impact.

The above summary is only a small sample of the number of sites with all three point styles represented. What this shows, however, is that the presence of one type of point cannot, on its own, be used to define a narrower temporal range than about post-A. D. 1200 or so. Sites like Vore and Long Knife show that tri-notched and un-notched points tend to date later in this range and sites dominated by side-notched points tend to date earlier in this range. Because the Roberts site has more tri- and un-notched points, a reasonable argument could be made that the site likely dates to the later end of the ranges for the sites presented above, or roughly post-A. D. 1550. Radiocarbon data presented later in this chapter will help to confirm this.

Modified Bone

Modified bone includes bones that were used as tools or modified in some other way. It does not include bones with cut-marks or carnivore modified bone; both of these will be discussed in chapter 5. Twenty-eight pieces of modified bone are in the collection (Table 4.12 and 4.13), most of which are related to bone bead manufacture. When possible, species identification was made for each modified bone. Genus and species that could be identified for modified bone specimens included Canid sp. and *Bison bison*.

Table 4.12. Descriptive data on non-bead modified bone.

Catalog Number	Tool Type/Modification	Length (mm)	Mass (g)	Species
4117	Polished	30.5	0.6	Other/Unknown
4124	Polished	29.7	1.4	Other/Unknown
4125	Polished	30.4	1.1	Other/Unknown
4126	Flaker	123.4	38.8	Most likely *B. bison*
4127	Metapodial flesher	117.1	37.9	Most likely *B. bison*
4128	Rib tool, heavy polish	227.1	42.7	Most likely *B. bison*
4129	Awl/needle tip	39.6	1.2	Other/Unknown

Bone Tools

Table 4.12 lists the non-bead related modified bone. These include three heavily polished pieces from an unknown species, which may be pieces of knapping tools; a piece of bison bone that is blunt and rounded on one end and is a knapping tool (Figure 4.3d); a heavily polished bison rib; and the tip of a bone needle or awl (Figure 4.3b).

The other bone tool is a bison metapodial that has grooves or notches on the bit end and heavy polish across the working surface (Figure 4.3a). The tool likely functioned as a flesher, similar

Figure 4.3. Modified bone from the Roberts assemblage. Metapodial flesher tool (a); awl tip (b); finished bead (c); flaking tool (d); and bone bead manufacturing debris (e-g).

to some of the metapodial tools Frison describes at the Glenrock Buffalo Jump (1970:27). The tool is also very similar to the "toothed, bison metapodial flesher" that Frison describes at the Piney Creek site (Frison 1967:19, Plate 14C). The tool has many linear striations and heavy polish on one side, and was clearly intentionally cut and shaped. The proximal end is broken, perhaps during use, suggesting the tool may have been hafted.

Bone Beads

Three finished bone beads are in the collection (Table 4.13). All have heavy polish on at least one surface and one is complete (Figure 4.3c). The others have heavy polish but are fragments of completed beads. One (CN4103) is burned.

Twenty of the bead artifacts are debris from bead manufacture and not actual beads. Nineteen have score marks along one or two sides that were then snapped (Figure 4.3e-g). It appears the pieces that were snapped off were the objective piece that would have been made into a bead. One piece has score marks, but was never snapped. Of these 20 artifacts, 15 could confidently be identified as canid bones, with most being sections of metapodials or phalanges. No other identifiable elements were noted. It should be noted that the remains of at least two domesticated dog skeletons were found during the CSU excavations (Witkind 1971:46). (These remains are cutated with the collection at the CSU Archaeological Repository but were not analyzed for this thesis.) Whether the bone beads are from these animals is unknown. The other five pieces were lacking identifiable landmarks, or were distinct enough that they could not be confidently identified to a particular species.

Bone bead manufacture appears to be an odd activity associated with a bison kill. However, Reher and Frison (1980:25) note that this is commonly seen at other kill sites, and is documented

Table 4.13. Description of the bone bead and bead manufacturing assemblage.

Catalog Number	Modification	Length (mm)	Mass (g)	Species
4100	scored and snapped	18.8	0.5	*Canid*
4101	scored and snapped	22.9	1.7	*Canid*
4102	polished, broken	17.9	0.5	*Canid*
4103	complete	17.9	0.7	Other/Unknown
4104	scored and snapped	17.3	1.3	*Canid*
4105	scored and snapped	22.3	1.0	*Canid*
4106	scored and snapped	21.7	0.6	*Canid*
4107	scored and snapped	32.3	0.7	Other/Unknown
4108	scored and snapped	18.6	1.1	*Canid*
4109	scored and snapped	13.9	0.7	*Canid*
4110	scored and snapped	13.3	0.5	*Canid*
4111	scored and snapped	17.2	0.6	*Canid*
4112	scored and snapped	24.1	1.9	*Canid*
4113	scored and snapped	18.2	0.4	*Canid*
4114	scored and snapped	22.3	1.4	*Canid*
4115	scored and snapped	52.9	2.7	Other/Unknown
4116	scored and snapped	53.9	2.5	Other/Unknown
4118	scored and snapped	26.6	0.8	Other/Unknown
4119	scored and snapped	27.8	0.9	*Canid*
4120	polished, broken	11.1	0.2	Other/Unknown
4121	scored only	28.0	0.7	Other/Unknown
4122	scored and snapped	22.4	1.9	*Canid*
4123	scored and snapped	24.8	0.4	*Canid*

by two bone beads at the Vore site. As they also note, this could be an activity directly associated with the kill, or one where carnivores that are taking advantage of the bison carcasses are killed and utilized. Frison also describes a similar bone bead assemblage from the Piney Creek processing area (Frison 1967:20, Plate 13 f-g, j-m).

Ceramics

The ceramic assemblage in the collection includes 26 vessel sherds, three pieces of fired clay that appear to be part of a broken pendant, and one broken, elongated piece of fired clay. This section first describes the vessel assemblage, including a discussion of the partially complete vessel no longer in the collection, followed by a discussion of the non-vessel ceramic assemblage.

Vessel Assemblage

The 26 vessel sherds are far fewer than the count Witkind presents (1971:27-32; 36-40), which included six sherds from the 1970 excavations, 31 sherds making up the partially complete vessel from the 1966 excavations, and 66 additional sherds from the 1966 excavations. Only one sherd from the 1970 excavations was fingernail impressed and 26 of the 97 sherds from the 1966 excavations were fingernail impressed. The other 76 sherds are described as being similar to the style represented by the partially complete vessel, which Witkind calls Intermountain Ware (1971:36-39). The location of this vessel is unknown, despite attempts to locate its whereabouts. Attempts to refit the sherds in the collection were wholly unsuccessful, and it is clear that the sherds making up the partially complete vessel are no longer with the collection.

Twenty-six sherds are still in the collection (Table 4.14). Some of these come from the 1966 excavation, and at least three come from the CSU excavations. The others do not have any provenience data. Based on decoration, surface treatment, sherd thickness, and the partially complete vessel, at least two ceramic traditions are represented: fingernail impressed, or what is commonly called Uncompahgre Brown Ware, and plain, undecorated, or Intermountain Ware (Figure 4.4). Ceramic types were identified based on descriptions provided in Ellwood (2002). The majority are Uncompahgre sherds (n=19), with only three Intermountain sherds. Four sherds are small fragments and lack any surface treatment or decoration; due to their small size these were not considered plain

Table 4.14. Count and thickness of ceramic vessel sherds by style.

Variable	Uncompahgre Brown Ware		Intermountain Ware		Indeterminate
	Rim	Body	Rim	Body	Unknown
Count	2	17	1	2	4
Range of Thickness (mm)	6.5-6.7	5.8-8.8	-	9.1-9.2	5.8-6.3
Avg. Thickness (mm)	6.6	6.4	10.40	9.15	6.12

Figure 4.4. Select ceramic artifacts from the Roberts assemblage. Plain ware sherds (a-b); punctate of finger nail impressed sherds (c-d); refit portion of a circular and smoothed pendant-like artifact (e); and heavily polished and abraded ceramic artifact (f).

wares. As Table 4.14 shows, their average thickness falls more in line with the Uncompahgre sherds, suggesting they are more likely that type than Intermountain. However, they could represent thicker base fragments of an Intermountain ware style vessel.

Three sherds with small rim fragments are represented, including two Uncompahgre and one Intermountain. All three are simple, unmodified rims and have only small portions of the rims preserved, so small that any indication of rim style or vessel size is not possible. The remaining sherds all appear to be part of the vessel body.

The Uncompahgre fingernail impressed sherds are similar in paste and inclusions. The temper is made up of single grain quartz crystals along with small flecks of mica that are likely residual of the original clay source and not additive for temper like those commonly seen in micaceous wares from the Southwest (Eiselt and Darling 2012; Eiselt and Ford 2007).

The Intermountain sherds are similar in paste and temper to the Uncompahgre sherds, and also include residual mica. The Intermountain sherds still in the collection are similar to those described by Witkind for the partially complete vessel, but it is unknown if they are from the same vessel or different ones. Based on all of these factors, a minimum of two vessels are represented at the site, one Uncompahgre Brown Ware and one Intermountain Ware.

Vessel Summary and Discussion

The two ceramic types site date to the Late Prehistoric-Protohistoric periods and are contemporaneous with the projectile point styles described previously. The partially complete vessel (see Figure 2.2) was identified as Intermountain by William Mulloy (Witkind 1971:39), who originally defined the tradition (Mulloy 1958).

The vessel has the typical flower pot shape of Intermountain Ware vessels; it is flat bottomed, with a slightly flaring shoulder and a slightly constricted to straight neck, measuring 26.1 cm from the base to the rim and an estimated rim diameter of 23.9 cm (Witkind 1971:37). Intermountain Ware is most often found in Wyoming (Finley and Boyle 2014:42-43; Frison 1971b:280), although they do appear in Colorado.

One of the best preserved examples of Intermountain pottery in Colorado is from the Whitecotton site (5RT1334), just south of Steamboat Springs (Ross 2001). The site contains sherds from one partially complete vessel (the author estimates it is roughly 70 percent complete) found on private land. No other artifacts were associated with the vessel and the site is not dated. The vessel is quite similar to the one from Roberts, although the shoulder and rim is out-curving compared to the straight necked Roberts vessel (Ross 2001:Figure 3). It is slightly shorter than the Roberts vessel at 21.2 cm from the lip to base, and the rim diameter is smaller at 21-22 cm (Ross 2001:Table 1).

Another Colorado site with a flat bottomed Intermountain Ware partial vessel is Graeber Cave (5JF8), a rock shelter near Tiny Town in the foothills of Jefferson County (Nelson and Graeber 1966). The assemblage includes an un-notched, triangular projectile point along with 100 sherds that refit to form a partially complete vessel with a flat bottom and out-curving body (Nelson and Graeber 1966:Figure 4). It is about half as tall as the Roberts vessel (approximately 14 cm) but the rim diameter is larger at roughly 28.5 cm. Charcoal from the site returned a date of 630±75 RCYBP (Nelson and Graeber 1984), although a thermoluminesence date on the sherd returned an age of less than 100 years (Benedict 1989:8). The discrenpency between these two dates has not been resolved.

Flayharty and Morris (1974:165) describe sherds thought to represent a single flat-bottom vessel at the T-W-Diamond site (5LR200). The site, located very close to the Roberts jump, has 47 rock rings along with many projectile points similar to the styles found at the Roberts site. The two radiocarbon dates published by Flayharty and Morris (1974:168) are A. D. 1170±220 and A.D. 400±340. Both have broad deviations and are difficult to interpret with the associated collection, especially the earlier date. Two recent AMS bone dates on the site are more similar to the later date presented by Flaharty and Morris (Hallie Meeker, personal communication 2016), suggesting the site is a few hundred years older than the Roberts jump. Additionally, Flayharty and Morris (1974:165) caution that while they assign a Shoshonean affiliation to the ceramics, it is so incomplete their hypothesis is "tentative…at best".

The other ceramic style represented at the site, Uncompahgre Brown Ware, is most often affiliated with the Utes (Buckles 1971). Benedict (1985a:143) notes that most Uncompahgre Brown Ware pottery is found in the mountains and western plateaus of Colorado, areas that were inhabited by the Utes during historic-era American settlement. Both plain and punctate sherds recovered from the Caribou Lake site (5GA22) are described as being from the same component, and both are most similar to Ute ceramics (Benedict 1985a:140-144). A reassessment of the dates from Caribou Lake, including dated carbon residue from the interior of the punctate jar vessel, led Benedict (1989:7-8) to conclude that the ceramics most likely date to 665±80 RCYBP. In his discussion of Ute ceramics from western Colorado and eastern Utah, Reed (1995) notes that this style dates to at least A. D. 1100, and continues to at least the late 1600s (1995:Table 1).

Ellwood (2002:70-72) describes the Bellair-Zimmerman-Red Feather Lakes whole vessel. The vessel was found in early 1900s near Red Feather Lakes, very close to the Roberts site. It has a conical base and wide shoulders, with a straight rim. The wall thickness is greater than the Roberts vessel, ranging between 9 and 10 mm from the rim to the shoulder. The exterior surface is "crudely marked by rows of fingernail indentations "…[that] meander haphazardly around the vessel" (Ellwood 2002:72). The paste and temper described for the vessel are very similar to sherds from Roberts, including the presence of mica in the clay. Ellwood suggests the clay is from a nearby, local source (2002:71). The location of this find, along with the similarities to the fingernail impressed sherds from the Roberts site, shows that this style is not solely restricted to the Western Slope of Colorado. However, as there is no date for the Red Feather Lakes vessel, it is impossible to draw any further conclusions about the relationship to the Roberts site.

The fact that two distinct pottery styles are represented at the site offers some intriguing speculations. The two styles are thought to be related to two different cultural groups, the Shoshone and the Utes. The co-occurrence of these two styles is not well understood based on the existing literature. Benedict (1985b) notes both Intermountain Ware and Uncompahgre Brown Ware at the Old Man Mountain site in Estes Park. However, this site also contains pottery from the Southwest, along with a variety of other styles. Benedict interprets the site as a vision quest locality, so perhaps not the best comparison, in terms of assemblage composition, to a camp or kill site.

The Carter site in central Wyoming contains sherds similar to Intermountain Ware pottery and Uncompahgre Brown Ware. However, the sherds are distinct enough from these two styles for Martin (2000) to suggest a provisional name for the style, Waltman Brown Ware. Middleton et al. (2007) classify ceramics from the Firehole Basin site in southwestern Wyoming as Uncompahgre Brown Ware, but also note that the ceramics are similar to the assemblage from the Carter site.

Another possibility is that the fingernail impressed sherds are not, in fact, Uncompahgre Brown Ware. Multiple instances of Intermountain Ware pottery with fingernail impressed surfaces have been documented (see discussions in Finley and Boyle 2014:42; Martin 2000:319). These impressions, however, are generally limited to two-four rows along the midsection or shoulder of the pot (Martin 2000:319). The sherds from the Roberts site appear to have more than this, but not enough of the vessel is present to make a firm determination.

Additional analysis needs to be undertaken with the ceramic collection. This includes more in-depth analysis of the construction methods, paste and temper descriptions, and additional comparisons of the styles to other known samples in the region. Some of these are underway, including petrographic analysis, which may help determine the clay source and how they are similar or different to other pottery found on the Roberts Ranch, including T-W Diamond (Jason LaBelle, personal communication 2015).

Non-Vessel Ceramic Assemblage

Three pieces of fired clay appear to be from the same broken pendant (Figure 4.4g). Two of the artifacts refit, forming a half circular-shaped object 59.4 mm in diameter. The third does not refit but shares a similar paste composition as well as thickness. Thickness of the three pieces ranges from 11.3-13.7 mm, which is greater than the majority of the vessel sherds. The paste is different than the vessel sherds, with larger pieces of crushed rock as temper and no mica in the clay. All three have provenience data that place them in somewhat close proximity (all separated by approximately five feet), just outside of one of the main bone concentrations and near a probable hearth feature (see chapter 6 for more details on the spatial association of these artifacts).

The other ceramic artifact is a piece of fired clay that is elongated and oval in shape (Figure 4.4f). Like the three pendant pieces, it has no residual mica in the paste, and has larger crushed rock for temper. It is heavily polished along the margins and both faces, with one face showing both heavy polish and many linear striations oriented on the long axis of the artifact. This suggests it was used as some type of polishing or finishing piece, but the exact function is not known.

Radiocarbon Dates

Charcoal samples with reliable provenience data are not available. Additionally, AMS dates on bone collagen from a secure provenience with known association to the rest of the assemblage allows for a date of the actual event when the animal was killed and are not subject to potential problems like old wood. Therefore, five bone samples were selected for AMS radiocarbon dating (Table 4.15). Four of the samples are first phalanx; two were selected from the east side of the bone bed (catalog numbers 5516 and 5519) and two from the west side of the bonebed (5518 and 5532) (Figure 4.5). These elements were chosen not only for their location and controlled provenience,

Table 4.15. Radiocarbon results of five bison bone samples. Calibrated dates were obtained using OxCal Version 4.2.4 (Bronk Ramsey 2009) using the IntCal13 calibration dataset (Reimer *et al.* 2013). Calibrated dates exclude ranges falling in the modern era.

Lab No.	Unit No.	Catalog No.	Element	$\delta^{13}C$	Age (^{14}C yr B.P.)	2σ Calibrated Date Range (calAD)
Aeon-1583	24.3	5518	1st Phalanx	-12.1	165±25	1664-1697(16.7%); 1725-1814 (52.1%)
Aeon-1584	20.4	5519	1st Phalanx	-17.3	290±20	1520-1592 (62.4%); 1619-1654 (33.0%)
Aeon-1714	21.3	5516	1st Phalanx	-14.6	190±25	1654-1686 (20.3%); 1730-1809 (53.7%)
Aeon-1715	24.1	5532	1st Phalanx	-11.4	210±25	1646-1684 (30.4%); 1736-1805 (48.3%)
Aeon-1716	TT3	7095	Radius (fetal)	-12.1	185±25	1656-1690 (19.6%); 1728-1810 (54.7%)

but also based on good preservation and the known likelihood of suitable bone collagen for dating. Measurements on each element were taken to ensure the best possible chance that the elements were from different individuals. The other sample, 7095, is the left radius of a fetal bison from the base of the cliff at southern end of the site. This sample was chosen in order to link the main bone concentrations with the component at the base of the cliff. All samples were sent to Aeon Laboratories in Tucson, AZ, for bone pretreatment and dating (Appendix D).

The five samples were analyzed using the R_Combine function in OxCal 4.2. A chi-square test showed the five samples were not statistically similar at a 2-sigma confidence interval. The oldest sample, CN5519, was removed and the chi-square results show the remaining four samples are statistically the same, with a weighted mean age of 188±13 ^{14}C years B.P (Figure 4.6). The individual plot for CN5519 is shown in Figure 4.7. Based on the artifact assemblage, including the absence of trade goods such as metal knives or glass beads (c.f. Newton 2008; von Wedell 2011), an argument can be made that the calibrated date range for these four samples is almost certainly in the seventeenth or eighteenth centuries. Dated events in the seventeenth to nineteenth centuries are nearly impossible to interpret accurately due to a plateau in the radiocarbon calibration curve, so a more refined age for the site, based solely on the radiocarbon data, is not possible.

The weighted mean age and the measured age of sample 5519 were compared with a chi-square test and the results show that the two dates are, expectedly, statistically different. Thus, based

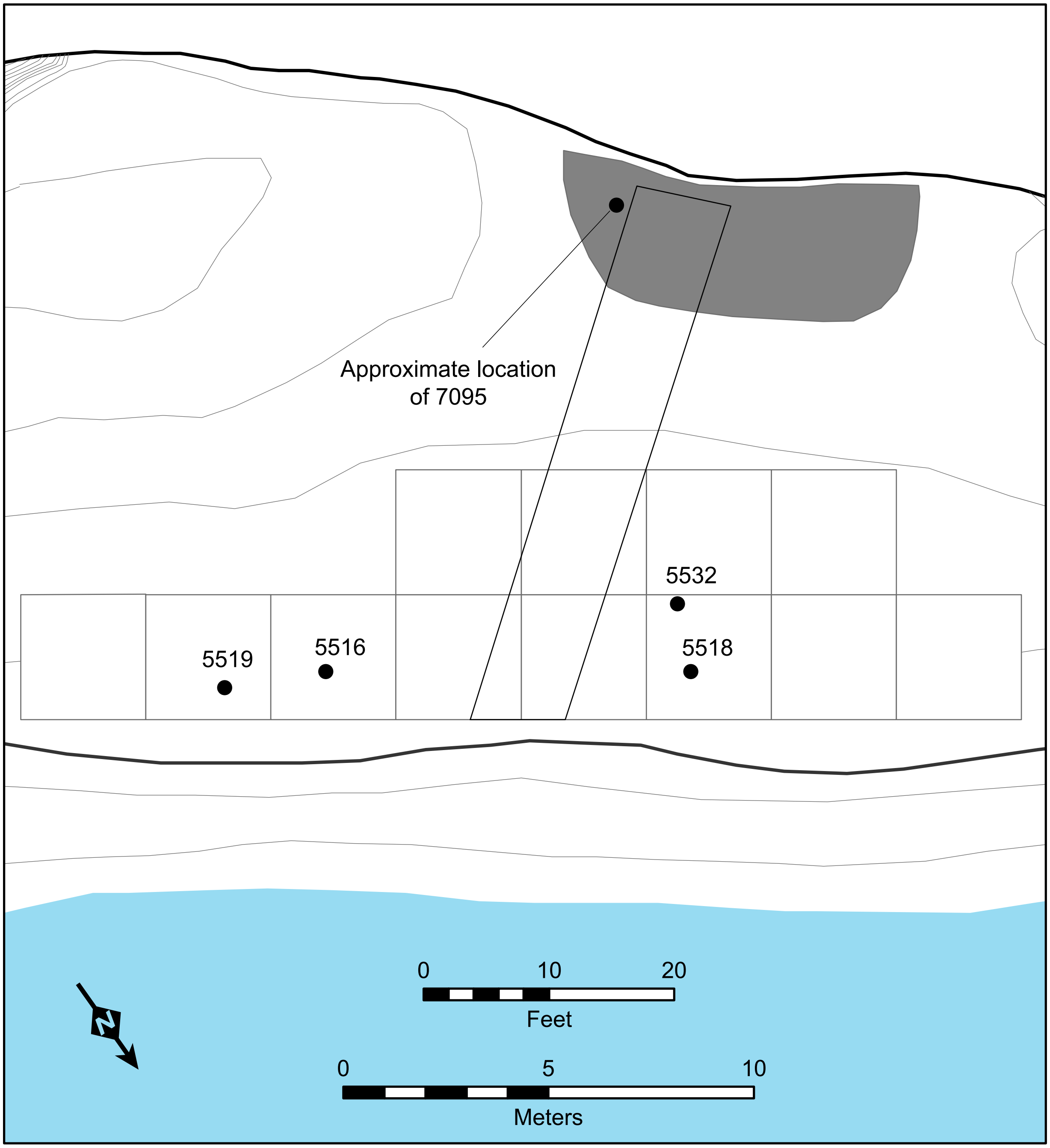

Figure 4.5. Location of the five radiocarbon dated bone samples.

solely on radiocarbon dates, it appears that there could be multiple components represented at the site. Suzanne McKetta (2014), in her analysis of carbon and nitrogen isotopes from the site as part of her larger research on bison presence-absence in northern Colorado, also suggests that multiple

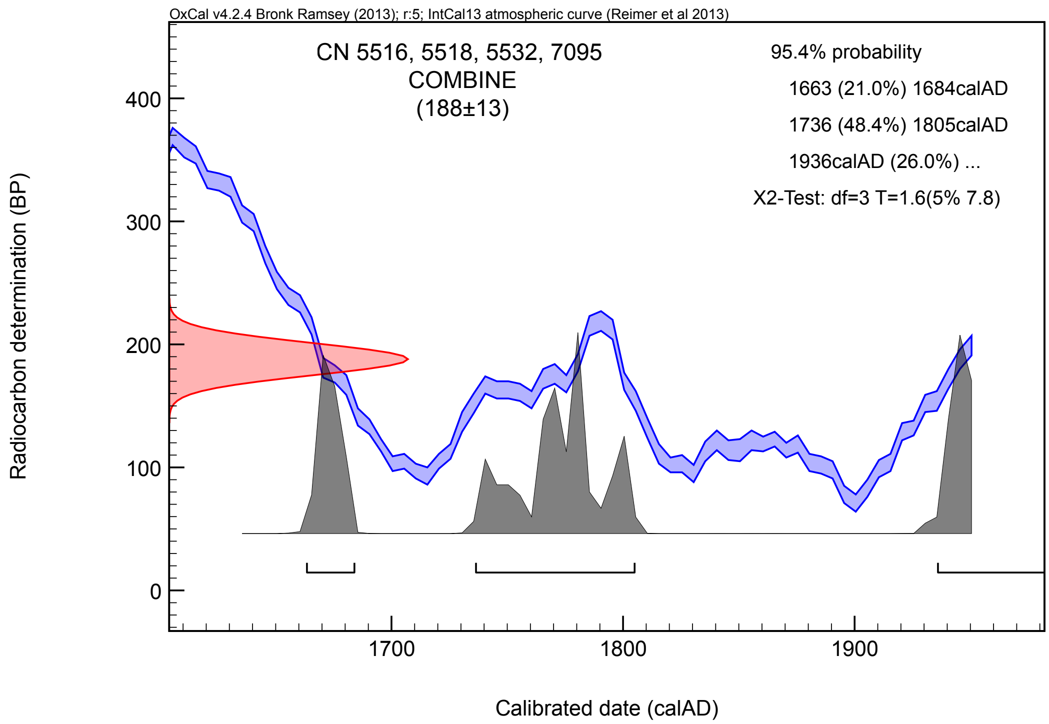

Figure 4.6. Two-sigma calibrated distribtuion of the four combined bone dates. Calibrated ranges are from A.D. 1663-1684 (21 percent) or A.D. 1736-1805 (48 percent). Modern sample can be eliminated from the range.

kill episodes may be represented at the site. However, based on the stratigraphic profile data (see Figure 2.8), the artifact assemblage, as well as the spatial distribution of artifacts shown in chapter 6, there is little reason to suggest multiple components are represented at the site. Rather, it is possible some digenetic factors have impacted the bone sample, creating an errant date.

Regardless, four of the five bone dates are clustered fairly tightly, and all come from the same context, leading to the most parsimonious explanation of the assemblage being just one component, dating to either A. D. 1663-1684 or 1736-1808 (the later range shown in Figure 4.6 can be eliminated as it is surely a factor of the probability sampling of radiocarbon dating methods). Further, based on the lack of European trade goods, as well as the timing of the introduction of the

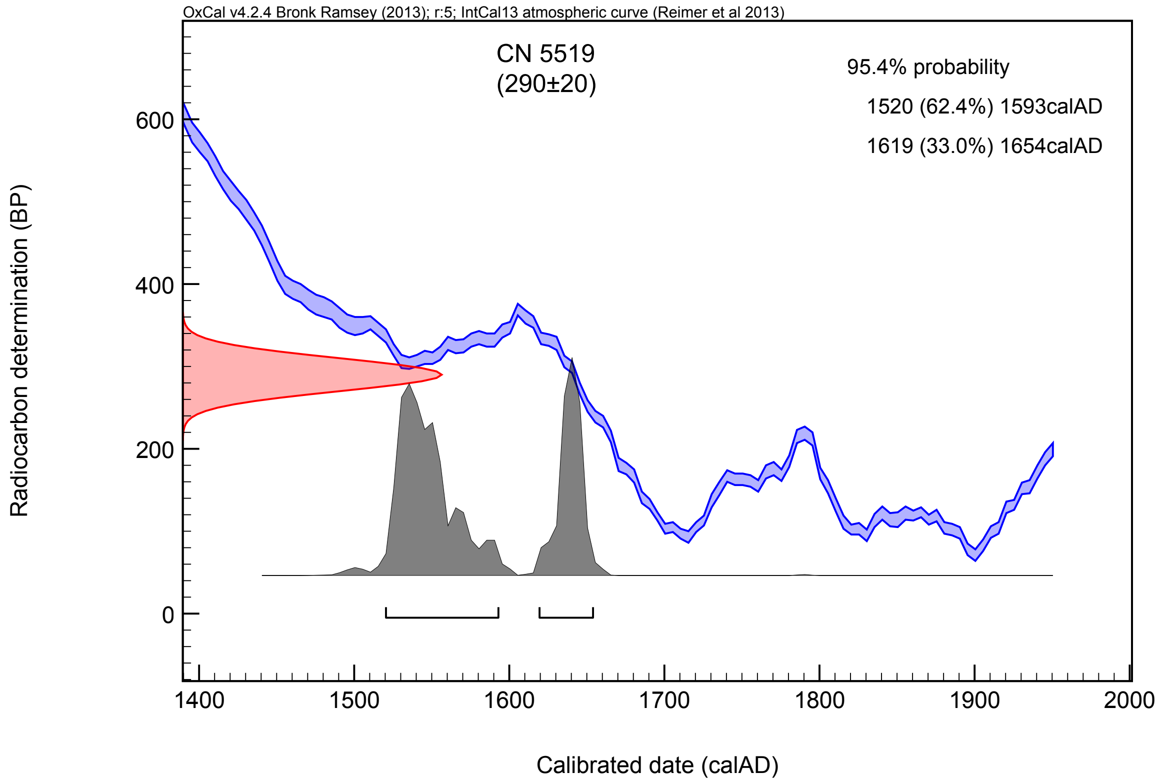

Figure 4.7. Two-sigma calibrated age range of the one statistically different bone date (CN5519). Calibrated ranges are between A.D. 1520-1593 or A.D. 1619-1654.

horse which largely altered Native American hunting methods (Newton 2008:96-97), it is likely the site dates to the earlier range in the late A. D. 1600s.

Summary

The non-bone artifact assemblage from the Roberts jump indicates the butchery and processing of the kill is a primary activity taking place at the site. The chipped stone assemblage is mostly related to butchery and processing, including multiple knives, flake tools, and scrapers. Some of the bone tools, including the metapodial flesher, also clearly are associated with processing related activities. The presence of projectile points, many of which are broken from an impact, indicates the bison likely did not die from the fall and needed to be dispatched.

The bone bead manufacturing assemblage appears, at first, to be an odd activity associated with a kill site. However, as referenced in that section, it is not an uncommon activity seen at kill-processing sites. This, along with the ceramic assemblage, suggests people were partaking in other activities at the site. The ceramics suggest additional time was being spent at the site, perhaps cooking portions of the kill while the rest was being processed. Additionally, evidence presented in the chipped stone analysis shows that at least eight partially finished projectile points were being manufactured on site. This represents efforts to re-supply or gear-up, potentially after the processing had been completed. As will be shown in chapter 6, most of these activities are taking place away from the main bone piles.

Diagnostic artifacts, including the projectile points and ceramics, are contemporaneous with the radiocarbon dates. Furthermore, the majority of diagnostic projectile points are triangular, un-notched points, a style that typically is later than side-notched points. This is consistent with the radiocarbon ages of the site, which indicate an age between the late A. D. 1600s to the early 1800s. Based on the lack of European trade goods, the site most likely dates to the late A. D. 1600s.

The ceramic assemblage includes styles traditionally related to two different cultural groups. This could be the result of multiple factors. One possible factor is trade or interaction between these two linguistically related groups. This could be interpreted as intermarriage, or merely just representing trade or exchange. It may also be that the pottery is just representative of a variation of one ceramic tradition; additional work is necessary to parse this out further.

The non-faunal artifact assemblage is consistent with what is seen at other kill and processing sites during this period. When these data are shown visually in chapter 6 in relation to the bone data presented in the next chapter, some rather remarkable patterns can be seen that show the site is centered around the butchery and processing of a large bison kill.

CHAPTER 5: THE BISON BONE ASSEMBLAGE

The focus of this chapter is twofold. It starts with the question: what is the general composition of the bison bone component of the assemblage? Specifically, this question focuses on the NISP (number of individual specimens), MNI (minimum number of individuals), MNE (minimum number of elements) and MAU (minimum animal units) values for the assemblage. The second portion of the analysis focuses on the question: how has the assemblage been altered by cultural and natural factors that could affect how the bone assemblage is interpreted? The analysis is split in two sections. The first section deals with the entire adult and sub-adult bison bone assemblage. The second section details the fetal bison bone assemblage. Both analyses follow a similar pattern that addresses the questions posed above. These data quantitatively illustrate the general makeup of the bone assemblage and allow for further investigation of multiple issues, such as patterning of certain elements to better define if the assemblage is from a kill or processing area, and examining the overall yield of the assemblage and processing intensity.

Binford (1978a) suggests that these bone assemblage data, specifically MAU, can be used to explore different processing and transport behaviors at kill sites and the overall degree of processing taking place. For example, an over representation of low yield or low utility elements (or those elements that contain less consumable portions), such as lower limb elements or cranial elements, are likely representative of a primary kill spot. This is primarily based on ethnographic data of kill sites, where higher utility elements are carried away from the kill for further processing and consumption.

Conversely, an over representation of higher yield elements, such as upper limb bones, are more likely to represent a secondary processing area. This pattern shows only selected elements being processed and consumed, with a lack or complete absence of bones containing little to no economic or nutritional value. Assemblages that have relatively equal representations of elements are most likely to represent a bulk utility strategy (Binford 1978a; Emerson 1990). Assemblages like this could also be interpreted to represent both kill and processing sites contained within the same assemblage. Examining these data by element is one way to explore such patterns. Entire carcass portions, such as hindlimbs and forelimbs, can also be viewed together to see if patterns are present in the way different sections of the carcass have been processed.

A more specific approach to understanding utility is to examine the overall economic value of different elements. Binford (1978a) developed the MGUI, or modified general utility index, to show that animals represented in archaeofauna assemblages are processed in patterned ways relative to their economic utility in terms of meat, fat and/or marrow yield. Speth (1983) also recognized that sex and season of kill would be cause for differential processing of carcasses. He noted that because the condition of the animals changed based on mating (and the energy expended during the rut), availability of forage, and a variety of other factors, so too would the manner in which meat and other products were utilized. For example, males at fall season kills are likely to be less intensively processed, if at all, because of their poor condition. This has important implications for how kill assemblages should be studied and interpreted and can offer many insights to the nature of the assemblage. Kills that are predominately females, for instance, are much more likely to be late fall to early winter season because females are in good overall condition relative to other seasons.

In his MGUI model Binford (1978a) measured the economic value of sheep. While useful for his purposes, a more specific analog was needed to examine the large number of bison kills on the Great Plains. Emerson (1990) provides such a study. Emerson's data, which are numerous and therefore only a select sample will be tested here, are broken down by element, season of death, and sex for a sample of four modern bison. The measured utility values for different classes (e.g., overall total products, fat, marrow, etc.) are provided for individual elements and are compared to the MAU values to see if patterned butchery practices are represented in this assemblage. The expectation is if the carcasses were being processed in a predictable fashion based on certain utility values, then this pattern should be represented in the element data.

While this does seem straightforward, other factors can alter the assemblage in a way that could mimic patterned behavior. This issue presents the second question discussed for this analysis: how has this assemblage been altered by cultural and natural factors? The presence of cultural modifiers can simply show that the assemblage has indeed been impacted by cultural agents, and patterning of these modifiers on certain elements can show specific behavioral choices, such as patterns of cutmarks or elements consistently being broken for marrow extraction.

More relevant to the issue of patterned carcass processing as represented by element frequency, however, are other processes that can remove certain elements or portions of elements from an assemblage. Lyman (1985) suggests that patterns represented by models such as Binford's MGUI (and later ones like Emerson's utility data), may be the result of differential destruction of the bone by natural agents rather than their removal by human agents. He suggests that many high utility elements are often the least dense bones and thus subject to greater rates of destruction compared to the denser, but lower utility, elements. This has the potential to produce an assemblage that appears to have been predictably altered by humans when in fact it is caused by natural agents. Marean (1991), and Marean and Spencer (1991), among others, have recognized that carnivores will also modify assemblages and potentially remove certain elements (or element portions), again more likely to be the less dense higher yield elements, from assemblages.

To further explore this issue, data gathered from the first question regarding the composition of the assemblage are used to determine if density mediated attrition has contributed to some of the patterns presented in this chapter. Specifically, bison bone mineral density data (Kreutzer 1992) will be compared to MAU values, where a strong positive correlation between bone density and MAU would suggest that perhaps bone density is a factor in the represented element distribution. Additionally, quantification of other modifications such as the presence of cutmarks, green bone fractures, and carnivore modification will be used to show the different processes which have affected the composition of the bone assemblage. Lastly, portions of the bone assemblage may have been discarded in the past by CSU researchers. This certainly could impact which elements are represented and compared in these models. To test this, a completeness index was developed to examine the frequency of complete versus fragmented bone to show that there does appear to be a high frequency of only complete elements.

Adult and Sub-Adult Bison Bone Assemblage

Table 5.1 lists the NISP, MNE and MAU values for the bison assemblage. These numbers include all of the bison bone in the existing collection. The collection contains 3,005 specimens, including 1,007 specimens identifiable to element and 1,998 indeterminate or non-identifiable specimens. Just over 50 percent of the identifiable specimens (n=582) were used to determine the MNE. Table 5.1 also lists the portion of each individual element used to determine the MNE. The majority of elements used to compute these values are complete, or complete elements combined with the most frequent portion represented. Bone condition or weathering was not coded, but nearly all of the bones are in good condition, suggesting they were not exposed to weathering processes for a long period. This also suggests that the deposits were likely intact when they were excavated.

Left mandibles were used to determine a MNI of 19. Complete (or nearly complete) mandibles account for the majority of specimens used to calculate MNI, but also include the

Table 5.1. Skeletal element abundance of the bison bone assemblage (does not include fetal elements).

Element	Code	NISP	L	R	Unsided	MNE	MAU	Percent MAU	Portion Used[a]
Cranium	CRN	64	5	5	0	10	5.0	27.8%	Occipital
Mandible	MR	62	19	17	0	36	18.0	100.0%	CO, Horizontal Ramus
Hyoid	HY	8	-	-	5	5	5.0	27.8%	CO, Body
Atlas	AT	5	-	-	5	5	5.0	27.8%	CO, Centrum
Axis	AX	4	-	-	4	4	4.0	22.2%	CO
Cervical Vertebra (3-7)	CE	32	-	-	26	26	5.2	28.9%	CO, Centrum
Lumbar Vertebra (1-5)	LM	40	-	-	27	27	5.4	30.0%	CO, Centrum
Thoracic Vertebra (1-14)	TH	70	-	-	39	39	2.8	15.5%	CO, Centrum
Rib	RB	314	37	37	0	74	2.6	14.7%	CO, Proximal
Sacrum	SAC	4	-	-	3	3	3.0	16.7%	CO
Sacral Vertebra	SA	7	-	-	6	6	1.2	6.7%	CO, Centrum
Caudal Vertebra	CA	12	-	-	11	11	2.2	12.2%	Anterior Epiphysis
Scapula	SC	25	10	10	0	20	10.0	55.6%	CO, Glenoid
Humerus	HM	21	10	9	0	19	9.5	52.8%	CO, Distal
Radius	RD	13	8	5	0	13	6.5	36.1%	CO, Distal
Ulna	UL	16	7	2	0	9	4.5	25.0%	CO, Proximal
Radial Carpal	CPR	7	4	3	0	7	3.5	19.4%	CO
Intermediate Carpal	CPI	7	5	2	0	7	3.5	19.4%	CO
Ulnar Carpal	CPU	5	4	1	0	5	2.5	13.9%	CO
Second Carpal	CPS	7	3	4	0	7	3.5	19.4%	CO
Accessory Carpal	CPA	3	1	2	0	3	1.5	8.3%	CO
Fourth Carpal	CPF	2	-	-	2	2	1.0	5.6%	CO
Metacarpal	MC	14	5	6	0	11	5.5	30.6%	CO, Distal
Fifth Metacarpal	MCF	1	-	-	1	1	0.5	2.8%	CO
Innominate	IM	21	5	3	0	8	4.0	22.2%	CO, Acetabulum
Femur	FM	27	4	10	0	14	7.0	38.9%	CO, DS (Left), PR (Right)
Tibia	TA	21	10	6	0	16	8.0	44.4%	CO, Distal
Astragalus	AS	19	10	9	0	19	9.5	52.8%	CO
Calcaneous	CL	18	9	9	0	18	9.0	50.0%	CO
First Tarsal	TRF	0	-	-	-	-	-	0.0%	
Fused Central and 4th Tarsal	TRC	18	7	11	0	18	9.0	50.0%	CO
Fused 2nd and 3rd Tarsal	TRS	2	-	-	2	2	1.0	5.6%	CO
Metatarsal	MT	26	11	14	0	25	12.5	69.4%	CO
Proximal Sesamoid	SEP	14	-	-	14	14	0.9	4.9%	CO
First Phalanx	PHF	25	-	-	25	25	3.1	17.4%	CO
Second Phalanx	PHS	36	-	-	36	36	4.5	25.0%	CO
Distal Sesamoid	SED	3	-	-	3	3	0.4	2.1%	CO
Third Phalanx	PHT	34	-	-	34	34	4.3	23.6%	CO
Identifiable Specimen Total		1007							
Indeterminate Flat Bone	FB	4							
Indeterminate Long Bone	LB	415							
Indeterminate Metapodial	MP	11							
Indeterminate Vertebra	VT	3							
Costal Cartilage	CS	1							
Indeterminate Molar	MUN	16							
Indeterminate Premolar	PUN	5							
Unidentified Fragment	UN	1543							
Non-ID/Indeterminate Total		1998							
Total NISP		3005							

[a]CO=complete

horizontal ramus. The next most represented element are metatarsals (69.4 percent MAU) followed by scapulae, humeri, astragali, and calcanei (Figure 5.1). Distal sesamoids are the least represented element at 2.1 percent MAU. Other elements with less than 10 percent MAU are fused second and third tarsals, fifth metacarpals, proximal sesamoids, fourth carpals, accessory carpals, and sacral vertebra. The low MAU value for crania is interesting because mandibles are used to calculate the MNI and are the highest MAU value. This could be the result of multiple factors, including a collection or curation bias against more fragmentary specimens, or the degradation of the more fragile crania (Todd and Rapson 1999:488-490). Some of these issues will be further explored later in this chapter.

Previous work on the assemblage (Simcox 2013) shows that it is comprised mostly of females (Figure 5.2) and an age profile distribution based on tooth eruption indicates a likely late fall to winter season of death (Zawasky 1971). Speth (1983) has shown that fall to winter season kills are more likely to be cow-calf herds than bachelor herds as females are in much better condition during

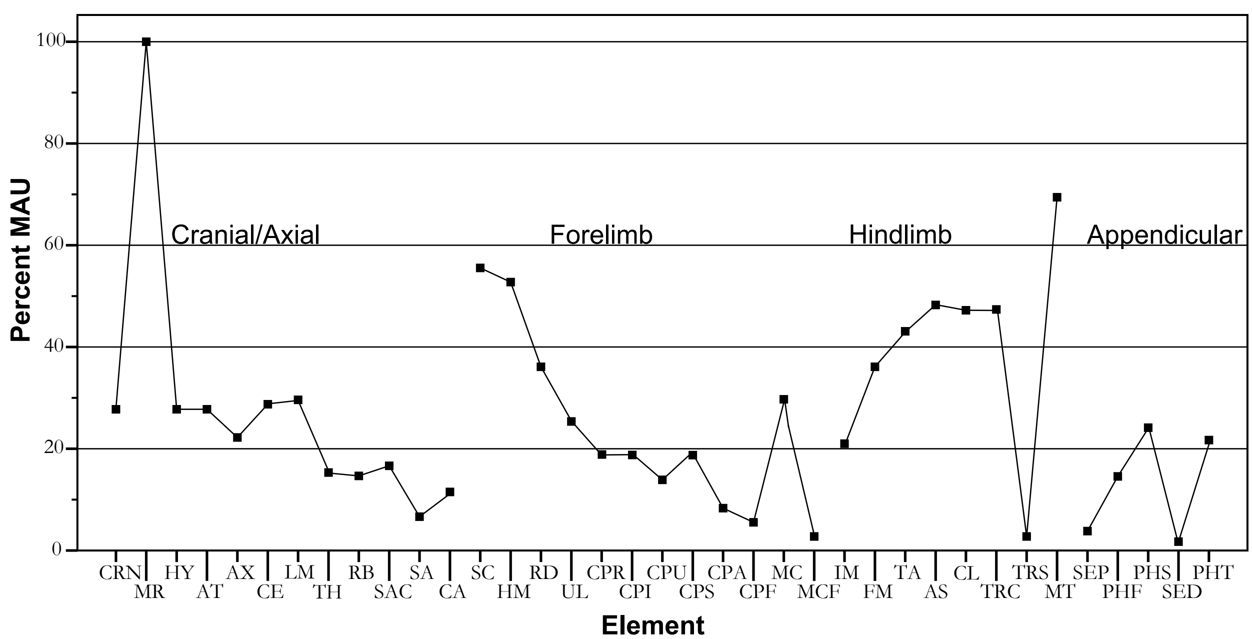

Figure 5.1. Element profile of the adult and sub-adult bison assemblage.

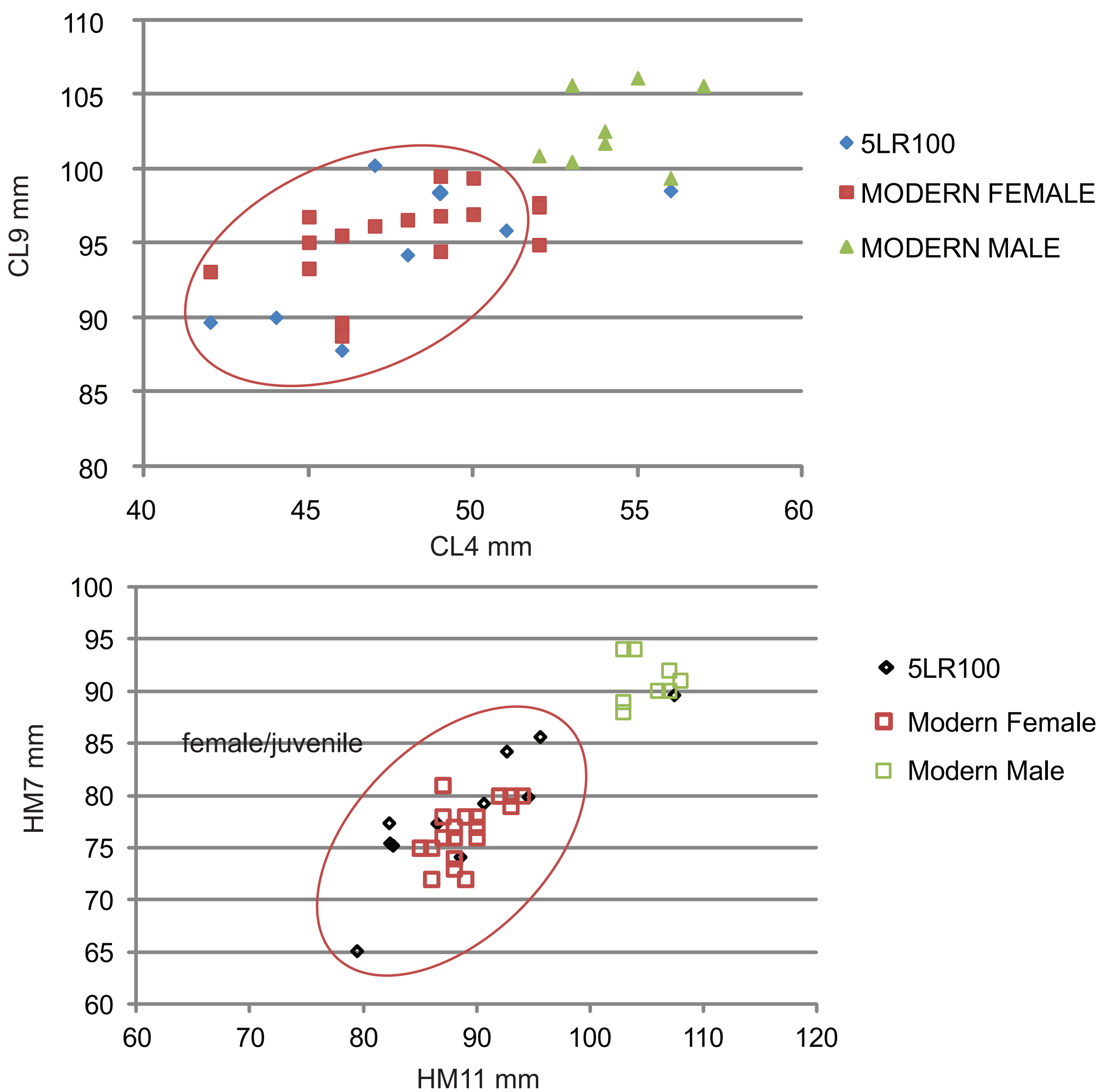

Figure 5.2. Age/sex profile based on calcanei (top) and humeri (bottom). Adapted from Simcox (2013). See Todd (1983) for measurement descriptions.

this time. There is evidence that suggests at least one adult male is in the assemblage (Figure 5.2). As will be discussed later in this chapter, at least eight of the bison were females and of reproductive age.

The percent MAU values show wide variability in element representation (Figure 5.1). Factors controlling or affecting this variability could include differential destruction or degradation of certain elements over others, collection or curation biases, carnivore modification, butchery and processing behavioral decisions, or a combination of multiple factors.

One of the potential causes for this distribution is a collection or curation bias. It is clear that major long bones and other easily identifiable elements are well represented in the assemblage. However, 17 of the 37 identifiable elements coded in this analysis have NISP, MNE, and MAU values based only on complete elements (Table 5.2). While most of these elements are smaller and more durable, and thus less subjected to fragmentation, these data may show a collection or curation bias to only keeping smaller complete elements and discarding harder to identify fragments. This may also reflect a slight coding bias where harder to identify fragments were coded as one of the indeterminate categories rather than to a particular element, which would have inflated the NISP. Exactly what elements, and how many, were discarded in the past will never be known. Even with a potential bias in the collection, a rather robust bone assemblage remains that provides valuable and interpretable data.

Another potential cause for this distribution could be density mediated attrition (Figure 5.3). Morlan (1994:804) notes that this relationship is best expressed using a rank order correlation, or Spearman's rho, to examine the statistical relationship between these two variables. As Figure 5.3 shows, there is no correlation between MAU and volume density (r=.337, p=.10). This indicates that the distribution of bone is likely not impacted by density mediated attrition. Therefore, some of the patterns seen in the bone assemblage more than likely can be attributed to other factors, mainly butchery and processing decisions (but also perhaps other factors, such as carnivore attrition).

Because the element distribution is likely a representation of butchery and processing decisions, closer inspection of the element profiles in Figure 5.1 reveals some interesting patterns. On the forelimb, the upper elements (scapulae and humeri) are fairly equally represented which is to

Table 5.2. Completeness index showing number and percent of complete elements and NISP.

Element	NISP	Number Complete	Percent Complete
Cranium	64	0	0.0
Mandible	62	21	33.9
Hyoid	8	3	37.5
Atlas	5	1	20.0
Axis	4	4	100.0
Cervical Vertebra (3-7)	32	21	65.6
Lumbar Vertebra (1-5)	40	20	50.0
Thoracic Vertebra (1-14)	70	32	45.7
Rib	314	17	5.4
Sacrum	4	2	50.0
Sacral Vertebra	7	4	57.1
Caudal Vertebra	12	3	25.0
Scapula	25	14	56.0
Humerus	21	4	19.0
Radius	13	4	30.8
Ulna	16	3	18.8
Radial Carpal	7	7	100.0
Intermediate Carpal	7	7	100.0
Ulnar Carpal	5	5	100.0
Second Carpal	7	7	100.0
Accessory Carpal	3	3	100.0
Fourth Carpal	2	2	100.0
Metacarpal	14	9	64.3
Fifth Metacarpal	1	1	100.0
Innominate	21	2	9.5
Femur	27	1	3.7
Tibia	21	5	23.8
Calcaneous	18	18	100.0
Astragalus	18	18	100.0
Fused 2nd and 3rd Tarsal	2	2	100.0
Fused Central and 4th Tarsal	18	18	100.0
Metatarsal	26	22	84.6
Proximal Sesamoid	14	14	100.0
First Phalanx	25	25	100.0
Second Phalanx	36	36	100.0
Distal Sesamoid	3	3	100.0
Third Phalanx	34	34	100.0
Total	1007	393	39.0

be expected if they were part of the same butchering package. Lower limb elements, specifically the radius and ulna, drop off steeply compared to the upper limb elements.

Comparative elements on the hindlimb (e.g., femora and tibiae) are also roughly equally represented, although at a slightly lower frequency than the upper forelimbs. However, rather than a sharp decline for the lower hindlimb elements (astragalus, calcaneous, and tarsals) there is a relatively equal representation. The exception is for fused second and third tarsals (TRS)

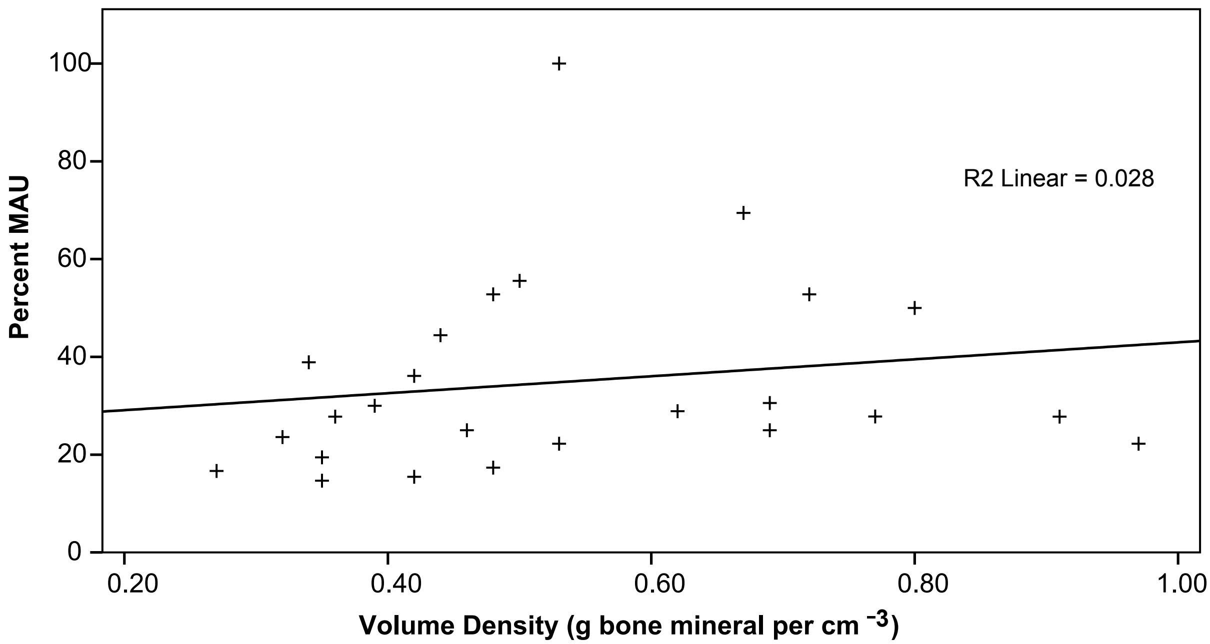

Figure 5.3. Bison bone volume density compared to percent MAU. Regression line shown for reference only.

Table 5.3. Bison bone volume density data. Density values from Kruetzer (1992).

Element	Percent MAU	MAU Rank	Vd Scan Site	VD	VD Rank	Portion Used
Cranium	27.8%	11	-	-	-	
Mandible	100.0%	26	DN4	0.53	15	CO, Horizontal Ramus
Hyoid	27.8%	11	HYOID	0.36	6	CO, Body
Atlas	27.8%	11	AT2	0.91	24	CO, Centrum
Axis	22.2%	6	AX3	0.97	25	CO
Cervical Vertebra (3-7)	28.9%	15	CE2	0.62	17	CO, Centrum
Lumbar Vertebra (1-5)	30.0%	16	LU3	0.39	7	CO, Centrum
Thoracic Vertebra (1-14)	15.5%	2	TH1	0.42	8	CO, Centrum
Rib	14.7%	1	RI2	0.35	4	CO, PR
Sacrum	16.7%	3	SC1	0.27	1	CO
Scapula	55.6%	24	SP1	0.5	14	CO, Glenoid
Humerus	52.8%	22	HU4	0.48	12	CO, DS
Radius	36.1%	18	RA4	0.42	8	CO, DS
Ulna	25.0%	9	UL2	0.69	19	CO, PR
Carpals	19.4%	5	LUNAR	0.35	4	CO
Metacarpal	30.6%	17	MC3	0.69	19	CO, DS
Innominate	22.2%	6	AC1	0.53	15	CO, Acetabulum
Femur	38.9%	19	FE2	0.34	3	CO, DS (left), PR (right)
Tibia	44.4%	20	TI4	0.44	10	CO, DS
Astragalus	52.8%	22	AS1	0.72	21	CO
Calcaneous	50.0%	21	CA2	0.8	23	CO
Tarsals	27.8%	14	NC3	0.77	22	CO
Metatarsal	69.4%	25	MR3	0.67	18	CO
First Phalanx	17.4%	4	P11	0.48	12	CO
Second Phalanx	25.0%	9	P23	0.46	11	CO
Third Phalanx	23.6%	8	P31	0.32	2	CO

which drop dramatically and are only represented by two specimens. This could be a reflection of misidentification of this element, especially considering the fairly equal representation of similar and associated elements. If this is removed, then the lower hind and forelimb elements are almost equally represented.

These element profiles suggest that upper forelimb packages were being utilized but far fewer lower forelimbs were processed in the excavation area. This strategy resembles a secondary processing locale rather than the primary kill locus. Complete hindlimb packages, however, including both upper and lower elements, were being processed more fully at the site. This strategy is more representative of a kill-processing locale. This could mean that the underrepresented forelimb elements are in another area of the site not excavated. Alternatively, viewing the assemblage as a whole, this could represent a bulk utility strategy. These assumptions, however, are far from conclusive based solely on these data.

Utility Models

When the MAU values are compared to Emerson's (1990) utility values, some slightly different patterns emerge (Table 5.4). There is no correlation between MAU and the Total Products model (r=.054, p=.803). However, there are correlations between MAU and the other two models. There is a moderately positive correlation between MAU and the skeletal fat model (r=.441, p=.040) (Figure 5.4). Further, there is a strong positive correlation between percent MAU and the marrow fat utility model (r=.556, p=.025) (Figure 5.5).

The two models that correlate with percent MAU suggest there may be some butchery and processing decisions illustrated by bone assemblage. In fact, the two models more closely align with expectations of a camp or secondary processing site than they do with a kill site. In other words,

Table 5.4. Bison bone utility indices. Utility values from Emerson (1990) and are based on element portion used to calculate percent MAU.

Element	Percent MAU	MAU Rank	(s)MAVGTP	Rank	(s)AVGMAR	Rank	(s)AVGSKF	Rank
Cranium	27.8	11	14.2	13	-	-	-	-
Mandible	100.0	26	14.2	13	-	-	-	-
Atlas	27.8	11	6.4	5	-	-	1.6	2
Axis	22.2	6	7.8	8	-	-	1.1	1
Cervical Vertebra (3-7)	28.9	15	56.6	20	-	-	3.3	3
Lumbar Vertebra (1-5)	30.0	16	82.9	22	-	-	18.3	5
Thoracic Vertebra (1-14)	15.5	2	84.7	23	-	-	16.8	4
Rib	14.7	1	100.0	24	-	-	38.7	11
Scapula	55.6	24	31.6	18	36.9	7	53.7	16
Humerus	52.8	22	25.1	16	69.2	14	77.2	20
Radius	36.1	18	12.1	9	50.3	9	59.1	17
Ulna	25.0	9	20.8	15	68.6	13	72.3	19
Carpals	19.4	5	6.6	6	36.2	6	39.2	12
Metacarpal	30.6	17	3.9	4	18.2	5	24.2	9
Innominate	22.2	6	54.7	19	6.7	1	70.6	18
Femur	38.9	19	69.4	21	97.2	16	100.0	22
Tibia	44.4	20	25.5	17	84.5	15	78.0	21
Astragalus	52.8	22	13.6	10	55.2	10	51.6	13
Calcaneous	50.0	21	13.6	10	55.2	10	51.6	13
Tarsals	27.8	14	13.6	10	55.2	10	51.6	13
Metatarsal	69.4	25	7.5	7	40.6	8	37.5	10
First Phalanx	17.4	4	2.4	1	12.9	2	23.5	6
Second Phalanx	25.0	9	2.4	1	12.9	2	23.5	6
Third Phalanx	23.6	8	2.4	1	12.9	2	23.5	6

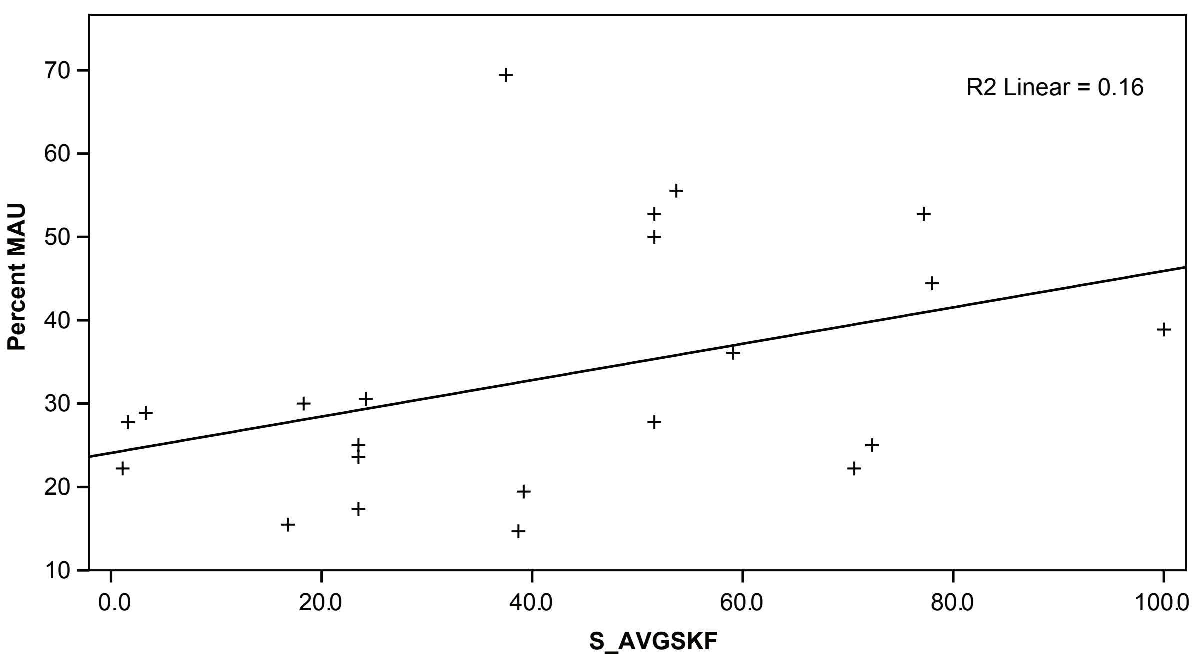

Figure 5.4. Percent MAU against bison skeletal fat utility values. Regression line for reference only.

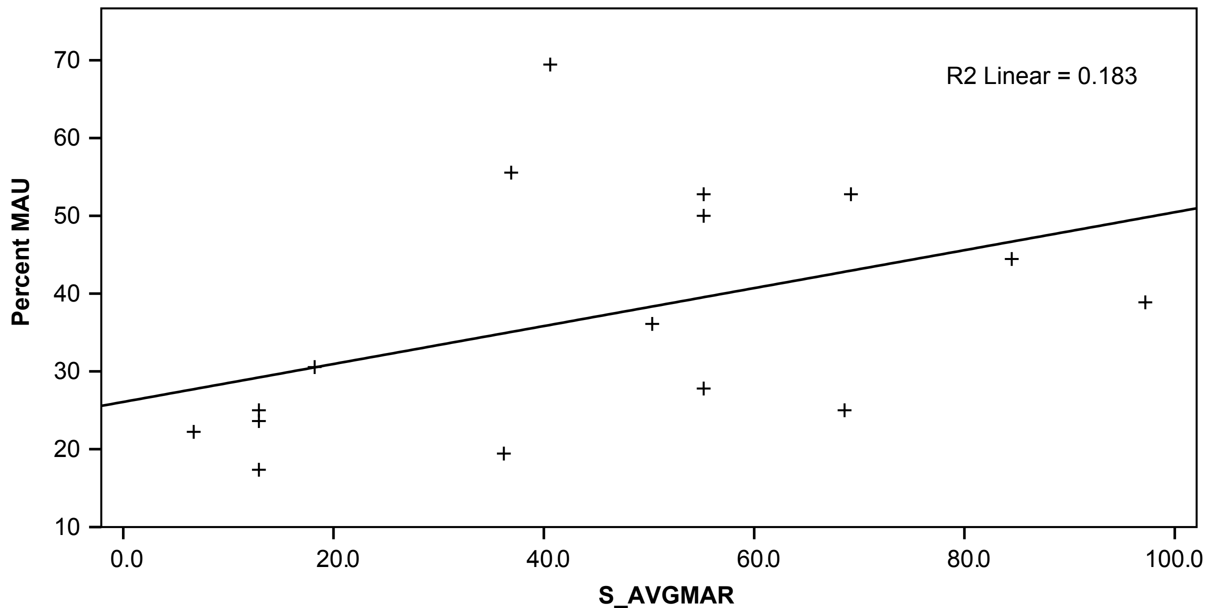

Figure 5.5. Percent MAU against bison marrow fat utility values. Regression line for reference only.

there is greater representation of higher utility elements than lower utility elements. However, there are alternative explanations that could be creating this correlation. For example, the manner in which MNE (and thus percent MAU) are calculated can impact how these values are interpreted. As Table 5.1 shows, some of the highest NISP values also have some of the lowest MAU values. Fragmentation of these bones, either soon after the kill or in the 40 plus years since the excavation, has caused lower MAU values to be calculated. Many of these are also moderate to lower yield elements, which can skew the distribution of these correlations.

Elements that tend to be higher utility in both of these models are also larger and sturdier elements and thus more likely to be easily identified, deemed useful for future analysis, and less subjected to post-depositional fragmentation that could make identifying these elements in the lab more difficult. In fact, as there is no reason to suspect the site is anything but a kill-processing locale (e.g., winter season occupation, a tool assemblage primarily composed of butchery and processing tools, north facing and thus likely quite cold in the winter, as well as a massive bone pile at the base of a cliff) the data from these models in some ways supports the evidence of a collection or curation bias within the assemblage. Additionally, there are unexcavated portions of the site that may contain higher concentrations of low utility elements.

Additionally, if the assemblage is most representative of targeting marrow or skeletal fat, the mere abundance of these higher utility elements is suspect. Marrow extraction is a destructive process. Cracking open the marrow rich long bones would still leave diagnostic articular ends, but there should be more evidence for spirally fractured bone. Skeletal fat extraction is an even more destructive process, where bones need to be small enough to boil and render grease. Doing large amounts of this would likely destroy any evidence that many of these bones even existed at the site. There is evidence for both spiral fractures and bone grease production (discussed later in this chapter), but based on the relative abundance of these higher yield elements, they cannot be a baseline reflection of the assemblage composition. As Brink (2001) notes, only a certain amount of utility data can be gleaned from the bones themselves, and it would useful to remember that other lines of evidence need to be employed beyond just a model that only accounts for certain factors.

Interpretations from MAU and the utility models are most useful when bones are removed from a site or completely obliterated for marrow extraction and grease fat production. Since neither of these are overtly represented in the Roberts assemblage, the overall value of these types of analyses is limited. Therefore, while suggestive of a particular pattern, the more parsimonious explanation is that of a bulk utility approach described by Emerson (1990) and Binford (1978a). This strategy implies a more general focus on moderate to high utility elements. If the element assemblage was only reflective of a marrow-based utility strategy (and thus a secondary processing or camp site), there would likely be far fewer extraneous elements at the site. While useful in some regards, such as attempting to identify if a random assemblage is more like a kill than a processing or camp site, the overall usefulness and results of these types of models should be more thoroughly questioned. Furthermore, these models are most useful on assemblages from completely excavated sites, which Roberts likely is not.

Human and Carnivore Modifications to the Bone Assemblage

As discussed earlier in this section, natural processes such as density mediated attrition have not impacted the element frequency distribution. Two other modifiers were also examined to explore the degree to which the bonebed may have been altered: carnivore modification and cultural modifications. Fifty-eight elements show clear evidence of being altered by carnivores (Table 5.5) (see Burke [2008] for discussions of carnivore modification). Eight different elements show evidence of carnivore modification; six of these have carnivore modification on more than one element. Most notable are the ribs with 25 instances, the majority of which are single puncture marks through the rib shaft. However, these only represent eight percent of the NISP for ribs. Ten humeri (48 percent) are modified by carnivores, including seven that have the entire proximal ends completely gnawed off. Kreutzer (1992:279) shows that the proximal end is more than half as dense as the distal end on humeri (density measurement of 0.24 vs. 0.67, respectively), making the proximal end significantly easier for carnivores to access the marrow cavity. All of the modifications on femora and tibiae are the complete removal of articular ends, also suggesting access to the marrow cavity.

Cultural modifiers include the presence of cut marks (Fisher 1995) and indications of a green bone, or spiral, fracture (e.g., Morlan 1984; Todd and Rapson 1987). While not all spiral fractures are the result of humans (e.g., Haynes 1983), evidence presented later in this chapter shows that bones were being broken down for marrow extraction and grease fat rendering. Therefore,

Table 5.5. Count of carnivore modified bones from the entire assemblage.

Element	Count	Percent of NISP
Thoracic Vertebra	7	10%
Rib	25	8%
Humerus	10	48%
Radius	1	8%
Ulna	1	6%
Femur	6	22%
Tibia	6	29%
Metatarsal	2	8%
Total	58	6%

Table 5.6. Count of spiral fractures and presence of cut marks on bone from the entire assemblage.

	Spiral Fracture		Cut Marks	
Element	Count	Percent of NISP	Count	Percent of NISP
Hyoid	-	-	1	13%
Thoracic Vertebra	-	-	1	1%
Rib	-	-	6	2%
Humerus	6	29%	2	10%
Radius	2	15%	-	-
Ulna	1	6%	1	6%
Metacarpal	2	14%	-	-
Femur	11	40%	-	-
Tibia	7	33%	1	5%
Astragalus	-	-	2	11%
Metatarsal	1	4%	-	-
Indeterminate Long Bone	8	2%	2	<1%
Indeterminate Metapodial	2	18%	-	-
Total	40		16	

spiral fractures were considered human modifications. Cut marks were only identified via naked-eye inspection; no microscopic identification of cut marks was undertaken. Blumenschine et al. (1996) show that naked eye identification of cut marks is far lower than when a hand lens or low-power microscope are used.

Forty bones are spirally fractured (Table 5.6). This does not include small, unidentified fragments, many of which almost certainly are related to cracking open green bone. The three highest percentages of spirally fractured bone (femur, tibia, and humerus) are the three bones that would yield the most marrow.

Only 16 bones show evidence of cut marks (Table 5.6). The low frequency of cut marks is surprising and suggests that perhaps evidence for this was missed during coding or alternative methods should have been used to identify cut marks (e.g., Blumenshine et al. 1996). As Egeland (2003) notes, however, there does not appear to be a direct link between the observed frequency of cutmarks and processing intensity. Furthermore, he suggests (2003:48) that experienced butchers may leave few, if any, cutmarks on bones while processing animals. While the low frequency is curious, it does show that some evidence of butchery is present in this assemblage.

The frequency of spiral fractures is more insightful about potential behavioral choices. Similar to carnivore modification, femora and humeri have a high frequency of spiral fractures. This presumably was for marrow extraction which appears to have been targeted to only a select few elements. The single occurrence of spiral fractures on three elements (metacarpal, metatarsal and ulna) may be the result of marrow extraction, or could possibly be a green bone fracture from the impact of the fall from the cliff.

Up to this point, the collection has been considered as a whole; in other words, bones from all three excavations (and those with unknown provenience data) have been considered together. There are some data available about the area some of the bones come from based on the excavation year. These data are instructive to examining potential activity areas within the site that will help illustrate other patterns identified in chapter 6.

Based on the available data from the collection, only 33 identifiable elements could be shown to come from the 1966 excavation at the base of the cliff. Only 34 identifiable elements come from the CSU testing in 1969 that spanned the later 1970 block up to the cliff. Practically all of these are single or less than three specimens per element. The one exception is 16 rib specimens that come from the 1966 excavation block. It is certainly the case that more identifiable elements come from both of these excavations. For instance, pictures from the 1966 excavation (now on file at the CSU Archaeological Repository) show at least seven metapodials from that excavation, but none are identified as coming from that area in the current assemblage. Therefore, some of the unlabeled bones may be from the 1966 excavation or from the 1969 testing.

What is still curated with the collection are a large number of unidentifiable bone fragments and indeterminate long bone fragments, most of which have approximate provenience data based on the excavation year (Table 5.7). In terms of count, the 1966 excavations contain nearly half (48 percent) of these fragments from the entire collection. However, the 1970 main block excavation contains only about 15 percent, and about 33 percent have an unknown provenience. Only four percent come from the 1969 test excavations. When considered by mass, the 1966 collections contain over 50 percent of the unidentifiable and indeterminate long bone fragments, while the 1970 collection contains about 30 percent. Only nine percent of the mass of unidentifiable and indeterminate long bone fragments come from an unknown provenience. This indicates that more fragmentation of elements, likely for marrow or grease rendering, was taking place at the base of the cliff where the 1966 excavations occured. This area also happens to be the flattest part of the entire site. This pattern will be further explored in chapter 6.

Only seven bones identifiable to element show evidence of burning. Four of these are from the 1969 test excavations and include a fragment of a femur, a tibia fragment, a metapodial

Table 5.7. Count and weight of unidentifiable bone fragments from all excavations. (Mass is rounded to the nearest gram).

	1966 Block		1969 Test		1970 Block		Unknown		Total	
Element	Count	Mass	Count	Mass	Count	Mass	Count	Mass	Count	Mass
Unidentified Fragment	659	1398	76	242	275	891	533	221	1543	2752
Indeterminate Long Bone	281	674	6	120	9	292	119	168	415	1254
Total	940	2072	82	362	284	1183	652	389	1958	4006

fragment, and a proximal sesamoid. Three burned identifiable elements come from the 1966 excavations and include a metapodial fragment, a first phalanx, and another proximal sesamoid. The rest of the burned bone consists of unidentifiable fragments and long bone fragments.

Table 5.8 lists the mass and percent of NISP for burned unidentified and indeterminate long bone fragments from all three excavations and those with an unknown provenience. While only 26 percent of the 1966 excavations are identified as burned, this represents over 50 percent of the burned unidentified and indeterminate long bone fragments from the entire site. Conversely, 68 percent of the fragments from an unknown provenience are burned, but this accounts for only 25 percent of the entire burned assemblage. Only seven percent of the burned fragments come from the 1969 testing. However, nearly all of these are from the higher numbered test grids that are spatially close to the 1966 excavation area. Thus, nearly 60 percent of the burned bone fragments come from the area originally labeled by Witkind (1971) as the "habitation" area. This will be further explored in chapter 6.

Table 5.8. Mass of burned and calcined unidentifiable bone from all three excavations. (Percentages are mass of burned bone divided by total mass identified in Table 5.7.)

Element	1966 Block	1969 Test	1970 Block	Unknown	Total
Unidentified Fragment	537 g (38%)	70 g (30%)	109 g (12%)	171 g (77%)	887 g (32%)
Indeterminate Long Bone	7 g (1%)	8 g (6%)	51 g (17%)	92 g (55%)	158 g (13%)
Total	544 g (26%)	78 g (22%)	160 g (13%)	263 g (68%)	1045 g (26%)

Fetal Bison Bone

The collection includes 181 fetal bison specimens (Figure 5.6). Of these, 138 were identifiable to element and 43 were either unidentifiable or indeterminate element classes (Table 5.9). There is an MNI of eight fetal bison based on the left metatarsal and left radius. The metatarsal also has the highest MAU value. Most of the highest represented elements, based on percent MAU, are long bones such as humeri, radii, femora and tibiae; all are represented by MAU values above 50 percent. The only other element above 50 percent MAU is the innominate. Ribs, thoracic vertebra, and indeterminate metapodial fragments have the highest NISP values.

Most of the axial and lower limb elements are grossly underrepresented in the fetal assemblage. This could be due to a variety of factors, including density mediated attrition, a collection bias due to the smaller size of many of the elements that may have been missed or passed through screens, or behavioral choices made by the butchers.

Figure 5.6. Selected sample of the fetal bison remains.

Table 5.9. Fetal bison skeletal element abundance.

Element	Code	NISP	L	R	Unsided	MNE	MAU	Percent MAU	Portion Used[a]
Cranium	CRN	2	-	1	-	1	0.5	7.1%	Zygomatic
Thoracic Vertebra (1-14)	TH	22	-	-	22	22	1.5	22.4%	CO, Distal
Rib	RB	30	1	1	20	22	0.8	11.2%	CO, Proximal
Sacral Vertebra	SA	2	-	-	2	2	0.4	5.7%	CO
Caudal Vertebra	CA	1	-	-	1	1	0.2	2.9%	CO
Scapula	SC	7	3	3	-	6	3.0	42.9%	CO, Glenoid
Humerus	HM	7	5	2	-	7	3.5	50.0%	CO, Distal
Radius	RD	11	8	3	-	11	5.5	78.6%	CO, Distal
Ulna	UL	3	1	2	-	3	1.5	21.4%	Proximal
Metacarpal	MC	3	-	-	2	2	1.0	14.3%	CO
Innominate	IM	11	5	-	3	8	4.0	57.1%	CO, Illium
Femur	FM	11	6	3	-	9	4.5	64.3%	CO, Proximal
Tibia	TA	10	7	1	-	8	4.0	57.1%	CO, Distal
Calcaneous	CL	3	2	1	-	3	1.5	21.4%	CO
Metatarsal	MT	14	8	6	-	14	7.0	100.0%	CO
First Tarsal	TRF	1	-	-	1	1	0.5	7.1%	CO
Identifiable Specimen Total		138							
Indeterminate Long Bone	LB	2							
Indeterminate Metapodial	MP	22							
Indeterminate Vertebra	VT	5							
Costal Cartilage	CS	1							
Sternal Element	SN	1							
Indeterminate Phalanx	PH	2							
Unidentified Fragment	UN	10							
Non-ID/Indeterminate Total		43							
Total NISP		181							

[a]CO=complete

Fetal bone is certainly more fragile and porous compared to adult bone. Without any data on the bone density of fetal bison elements it is impossible to confirm preservation issues as a factor in the elemental representation of the fetal assemblage. However, if density values listed in Table 5.3 for adult bison are any indication, attrition may not be the main cause for the assemblage composition. For example, femurs are ranked the third least dense element, yet they are the third most represented fetal element. Conversely, more dense elements like the calcaneous (third most dense in Table 5.3), are very underrepresented. Additionally, many sites, including Paleoindian-age kills like the Casper site (Wilson 1974), contain fetal bison bone suggesting that although fetal bone is more porous and softer than adult or sub-adult bone it does not necessarily degrade at a faster rate. Therefore, other potential factors like butchery decisions and a recovery bias need to be considered as agents controlling the fetal assemblage composition.

A recovery bias, like density mediated attrition, is virtually impossible to quantitatively show. There is no indication of the size of screens being used, but the assumption is a quarter-inch screen, which aligns well with the chipped stone data presented in chapter 4. If this is the case, then bones with a diameter smaller than 6.3 mm would most likely fall through the screen. Data presented later in this section notes the mean diaphyseal diameter for the fetal femora average about 9.8 mm, or big enough to not pass through a quarter-inch screen. Femora are fairly well represented in the assemblage, but are also one of the larger bones. Other large bones, such as humeri, radii, and tibiae, are also fairly well represented. Conversely, smaller bones (relative to long bones) such as phalanx, tarsals, and vertebra, are very underrepresented or non-existent in the collection. Wilson (1974:146-147) notes limb bones of *Bos tarus* calves "grow most intensively during the second half of uterine development, with comparatively slight intensity of axial bone growth". In other words, limb bones (the most well represented elements in the Roberts fetal assemblage) are disproportionately larger than axial elements, which are grossly underrepresented in the assemblage. Thus, a recovery bias because of screen size may play a factor in the assemblage composition.

It is clear that the fetal bison were processed and consumed on site. Thirty-three fetal specimens are burned, representing 18 percent of the entire fetal assemblage (Table 5.10). The major long bones are the most represented in terms of burning, including femora, tibiae, and humeri, clearly indicating that selective elements were being cooked and consumed. Additionally, 40 percent of the unidentified fragments are burned.

Table 5.10. Count and percent of NISP of burned fetal bison bone.

Element	Count	Percent of NISP
Thoracic Vertebra (1-14)	1	5%
Rib	3	10%
Scapula	1	14%
Humerus	2	29%
Radius	4	36%
Innominate	2	18%
Femur	4	36%
Tibia	5	50%
Metatarsal	3	21%
Indeterminate Metapodial	4	18%
Unidentified Fragment	4	40%
Total	33	18%

Only five elements show evidence of cut marks. This low frequency is consistent with the butchery marks noted on the adult bison. None of the elements are spirally fractured and only three elements show evidence of carnivore modification. All three are tooth punctures and not furrowing on the ends like is seen in the adult bones for what is presumably marrow extraction. Anecdotally then, it does not seem marrow extraction from fetal specimens is a fruitful endeavor for humans or carnivores. Thus, it is likely that a recovery bias coupled with some butchery decisions are both factors contributing to the assemblage composition.

Interestingly, 145 are either from the test unit grids from 1969 (NISP=94) or from the 1966 block (NISP=51); only four fetal specimens are noted with rough grid coordinates from the 1970 excavation. The remaining 32 fetal specimens have no spatial or recovery data associated with them.

Table 5.11 examines these data more closely in terms of the MNE and MAU values. Specifically, elements are grouped as coming from the 1966 excavation area (again, the area originally defined as the “habitation” area) or from the 1969 and 1970 testing and block excavation by CSU. However, fetal specimens from the 1969 testing that come from the upper two grids closest to (or coming in to) the 1966 excavation area are included with the 1966 group in Table 5.11. Thus, the NISP values in Table 5.11 are slighlyt different than the NISP values for the excavation year

Table 5.11. MNE and percent MAU of fetal bison bone from the 1966 and 1969/1970 excavations.

	1966 Block			1969 Test/ 1970 Block		
Element	MNE	MAU	Percent MAU	MNE	MAU	Percent MAU
Cranium	1	0.50	7%	-	-	0%
Thoracic Vertebra (1-14)	14	1.00	14%	4	0.29	4%
Rib	10	0.36	5%	11	0.39	6%
Sacral Vertebra	1	0.20	3%	1	0.20	3%
Caudal Vertebra	1	0.20	3%	-	-	0%
Scapula	4	2.00	29%	1	0.50	7%
Humerus	7	3.50	50%	-	-	0%
Radius	5	2.50	36%	4	2.00	29%
Ulna	3	1.50	21%	-	-	0%
Metacarpal	-	-	0%	1	0.50	7%
Innominate	4	2.00	29%	1	0.50	7%
Femur	5	2.50	36%	3	1.50	21%
Tibia	4	2.00	29%	1	0.50	7%
Calcaneous	2	1.00	14%	-	-	0%
Metatarsal	4	2.00	29%	8	4.00	57%
First Tarsal	-	-	0%	1	0.50	7%
Total MNE	65	-	-	36	-	-

discussed in the above paragraph. It is also important to note that the percent MAU values are based on the assemblage as a whole as depicted in Table 5.9, and not as percent MAU of the assemblage with known provenience information.

These data demonstrate that fetal bison, or at least portions of them, were moved to the flattest area of the site. This is the same area that had a high incidence of bone fragmentation and burning that was discussed in the previous section. Furthermore, the percent MAU values illustrate that the meatier portions of the fetal bison (upper hind and fore limbs) are better represented in this area compared to the main bonebed, which contains mostly axial and lower yield elements.

Fifteen of the burned fetal specimens come from either the 1966 block or the test unit grids closer to the 1966 excavations. Thirteen burned fetal specimens come from the other 1969 test trenches that crossed the 1970 excavations; five burned specimens have no provenience data associated with them.

Age of Fetal Bison

An important component of the fetal bison assemblage is determining an approximate fetal age of the specimens and determining if the fetal assemblage is temporally related to the rest of the kill. Previous work on the adult bison assemblage suggested it is primarily composed of females or juveniles (Simcox 2013) and the age profiles, based on tooth eruption, suggest a late fall to early winter kill (Zawasky 1971).

In chapter 4, radiocarbon results from one fetal specimen showed that the fetal assemblage is statistically equivalent in age to three other dates on adult bison bone. This demonstrates that the fetal bison bones are very likely contemporaneous with the rest of the bone assemblage and are not likely to be from a later occupation. Further, as the kill appears to have occurred during the fall-winter seasons, and is comprised mostly of females, it stands to reason that the cows would be pregnant during this time and thus would have yielded a moderately large fetal assemblage (at least eight of the cows were pregnant, or 42 percent of the adult and sub-adult MNI were carrying fetuses).

Visual inspection of the fetal bones shows that the same elements are roughly similar in size. For example, all of the complete humeri are nearly identical in size to one another. The same can be said for most of the elements with multiple occurrences. Quantitatively, these data can be expressed by three measurements noted in chapter 3 (also see McKee 1988). These measurements are the maximum diaphyseal length (MDL), the minimum antero-posterior diaphyseal diameter (MAPDD), and the minimum transverse diaphyseal diameter (MTDD).

Table 5.12 lists these measurements for the entire collection of fetal femora. The MDL measurement was only taken on complete specimens. As these data demonstrate, there is little variation in size between the fetal femora. These measurements were plotted against a sample of

Table 5.12. Measurements on fetal femora used to examine fetal age profile.

CN	ELE	POR	SIDE	MDL (mm)	MAPDD (mm)	MTDD (mm)
7098.1	FM	CO	L	55.45	10.01	10.16
7100.4	FM	CO	L	47.45	7.11	6.86
7106.1	FM	CO	R	60.81	10.14	10.24
7107.8	FM	PRS	L	57.93	11.47	12.21
7116.3	FM	CO	L	62.10	11.34	11.08
7126.5	FM	PRS	L	51.20	9.33	9.56
7126.6	FM	CO	R	50.13	8.65	9.15
7126.7	FM	PRS	L	55.35	10.45	10.82
7128.3	FM	SH	L	45.39	10.37	8.91
7134.1	FM	DS	L	35.80	9.60	9.32
			Average	52.16	9.85	9.83
			Std. Deviation	7.95	1.29	1.45

femora from the River Bend site (McKee 1988:Table 4.1) and femora from modern fetal bison and young calves of a known ages (McKee 1988:Table 4.2). The River Bend site is interpreted to represent a season-long accumulation of fetal bison and thus cover a broad fetal age profile. The plot shows a clear concentration of similarly sized elements in the Roberts assemblage (Figure 5.7). The strong correlation shown in the plot is a direct result of the relationship of these measurements and fetal age. Thus, the tight distribution of fetal femora from Roberts indicates the fetal bison were about the same age at death and were likely conceived only a few weeks to a month apart.

McKee (1988:84) suggests that the River Bend femora represent two age classes, based on both these measurements as well as periosteal counts shown to represent stages of growth (Wilson 1974:147-148). The two age classes represented at the River Bend site are believed to be about 4-5 months gestational age (those on the lower end of Figure 5.7) and approximately 8 months gestational age (those on the higher end of Figure 5. 7). Therefore, the fetal bison from the Roberts assemblage appear to fall between these two ranges, or about 5-7 months gestational age.

Walde (2006) provides a detailed critique of past archaeological studies that purport to show fetal bison and tooth eruption as reliable seasonality indicators for time of death. In his review, Walde (2006:481-483) notes that studies of modern bison calving is not nearly as restricted as some

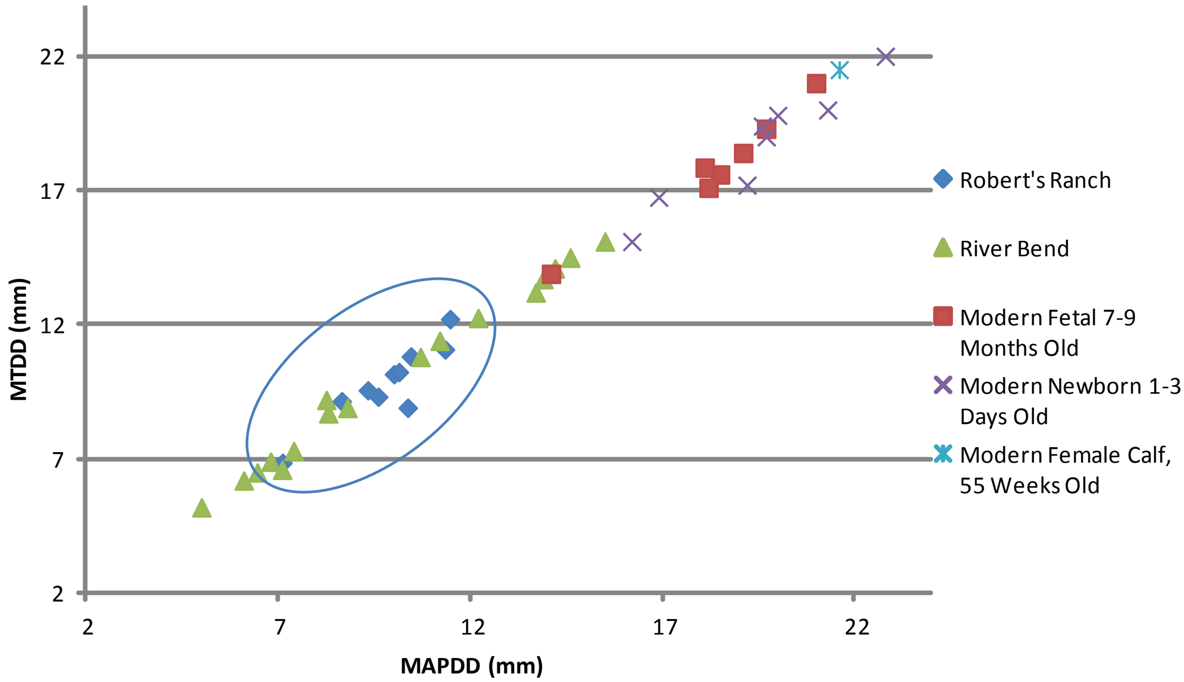

Figure 5.7. Plot of fetal femora from the RBJ assemblage with samples of known age and from River Bend.

have suggested (e.g., Frison and Reher 1970:46; Wilson 1974:151). Instead, he notes that calving should be considered across a longer continuum, possibly as much as 98 days extending from mid-April to late July, or even longer. Walde (2006:489) determines that fetal bone of about the same size could, plausibly, have been conceived some three months apart. In other words, sites like River Bend that are interpreted to represent season-long accumulations of fetal bone may in fact represent one kill episode with fetal bison that were conceived at different times and well within the range demonstrated by modern herds. This has clear implications for seasonality determinations. Walde (2006:489) concludes that the presence of fetal bone can merely indicate a "probable winter death" and nothing more.

In theory, Walde's data could be problematic for catastrophic kill episodes containing fetal bones of different ages interpreted to be multi-component kill sites. However, the fetal bones from the Roberts assemblage do not show gross variations in size. The tight clustering of measurements on the fetal femora indicate conception at about the same time. The little variation shown in the Roberts measurements confirm Walde's point that conception may vary based on estrous or other factors, but that the bison fetuses from Roberts were conceived during a fairly restricted period, perhaps within a month or so. The one outlier in the Roberts data further confirms his point that while the majority of breeding happens in a fairly restricted period, there is some variation from the mean. While Walde's conclusions have implications for season or number of kill events represented at sites like River Bend, they do not refute the fact that multiple age profiles are represented in the River Bend assemblage. The Roberts fetal bone falls between the two River Bend age profiles, and represents fetal calves between five and seven months fetal age killed at the same time.

Walde's (2006:484) data on modern bison herds show that conception occurrs between early July and late October. As has been demonstrated above, the fetal calves are likely between five to seven months gestational age. Using both ranges, the month of the kill could be anywhere between December and May. He does demonstrate that roughly 80 percent of births occur between mid-April and early June. Working back, these numbers place about an 80 percent likelihood of conception between mid-July and mid-September. Therefore, there is a roughly 80 percent likelihood that the Roberts fetal assemblage was killed between about mid-December and mid-April. Additional data could be collected on the fetal assemblage, including counting the periosteal layers to gain a more accurate age of the fetal specimens, but this would only moderately refine the month of death and add little interpretive value than what already is known, which is a likely early- to mid-winter kill.

Summary

The data presented in this chapter set out to accomplish two goals. The first was to examine the overall assemblage diversity by determining the MNI, MNE, and MAU values using a variety of established methods. The second goal was to attempt to better understand certain factors that may contribute to the element abundance such as bone mineral density, carnivore modification, and human caused modifications.

The data show that a herd consisting of at least 19 bison, primarily females and juveniles, along with at least eight fetal bison, were butchered and processed on site. Density mediated attrition has not likely impacted the assemblage composition. However, there may be alternative factors that have affected the bone distribution including human butchery choices. The utility models shows a preference for higher utility elements to be represented at the site. The best way to interpret the assemblage is with a more general utility strategy rather than a strategy targeting specific portions of the bison. Using this method, the hunters focused much of their attention on processing moderate to high utility elements, including some bone grease production but primarily meat stripping and discarding the bones on site. Further, as will be shown more clearly in the next chapter, the restricted space within which the hunters worked likely necessitated lower utility elements being discarded away from the main butchery area, perhaps impacting how the assemblage is viewed archaeologically.

The data also show that carnivores impacted the assemblage to a degree, but this impact is likely minimal and has not greatly altered the element distribution. For instance, many mostly-complete long bones are only missing their softer articular ends, indicating carnivores targeted specific elements for marrow but did not destroy the entire bone.

Mainly, the data show a mass of bone largely the result of human butchery practices. This likely obscured the archaeological signature of the actual kill spot which has been replaced by the remains of the butchery and processing activities There are bones that have been spirally fractured, presumably for marrow extraction, as well as some cut marks showing butchery of certain elements. Lastly, there are indications of bones being heavily fragmented and boiled down to render bone fat and grease. These activities, along with clear intentional butchery of fetal bison carcasses, mostly appear in one area of the site. These data, as well as data from chapter 4, will comprise the spatial analysis discussion in the following chapter, further strengthening the argument that the bone pile is largely the result of human behavior.

CHAPTER 6: SPATIAL ANALYSIS

Recognizing patterns in the material remains can suggest at least some aspect of past human behavior (Binford 1978b, 1983; Enloe 1983:28-29; Enloe et al. 1994:105-106; O'Connell 1987:74; Rigaud and Simek 1991:200-201). As O'Connell notes (1987:74), this approach is commonly referred to as "site structure" (also see Binford 1978b, 1983). The basic premise behind a site structure approach is that humans exhibit patterned behavior when carrying out specific tasks and these patterns can be gleaned from the archaeological record, most often by using comparative data from ethnoarchaeological case studies (e.g., Binford 1978b; O'Connell 1987; O'Connell el al. 1992). These patterns, generally defined by distinct groupings of related artifacts, often will show what have been termed "activity areas" (Rigaud and Simek 1991:200), or areas where functions related to a particular task(s) were undertaken at a site.

A site structure approach has commonly been used at hunter-gatherer residential and camp sites (Bamforth et al. 2005; Binford 1978a, 1978b; Enloe 1983; Enloe et al. 1994; Hill et al. 2011; Rigaud and Simek 1991; Simek and Larick 1983) or sites directly affiliated with hunter-gatherer groups but not entirely focused on residential activities (O'Connell et al. 1992). As Enloe (1983:28-29) discusses in his overview of the theory behind site structure, in order to link artifacts and behavior "we must look at the dynamics of operating systems". In other words, the causal relationship between the two variables can only be determined based on observable actions by modern-hunter-gatherers. As observations have been made on modern hunter-gatherer groups at residential bases or on foraging expeditions (Binford 1978b; O'Connell 1987) there are baseline data from ethnoarchaeology with which to compare against the "static derivatives" (aka artifacts) (Enloe 1983:28) of the archaeological record.

Even without the direct analogy of observed behaviors producing an archaeological signature at a particular site type, the process of those behaviors should manifest themselves in the same or a very similar way, regardless of the functional interpretation of site type (Enloe et al. 1994:111-112). Site structure analyses, regardless of site type, should provide a set of baseline expectations that can be tested at other sites, specifically the bonebeds of mass kill events.

Bartram (1993:131) notes that mass kills differ from single animal kills in that multiple animals killed at one time will result in more readily identifiable signatures of element utility and transport decisions. This could be extended to include other patterned behaviors at mass kills, such as the patterned break down of carcasses, something Frison (1970) identified when he describes the near standardized butchery processes at Glenrock. Additionally, certain elements may have been further processed in different areas of the site. This provides an expectation that can be tested at mass kills.

Enloe (1983), Simek and Larick (1983), and Koetje (1994) describe patterns in lithic debris activity areas, many of which center around hearth features. The hearth, acting as central core around which people congregate and carry out activities, could easily be substituted with faunal bone, specifically patterns identified by the spatial distribution of bone. If bone elements are patterned based on butchery decisions, then lithic debris should show a pattern around those bone clusters. Using these baseline data to create expectations, we can ask general questions about the Roberts artifact assemblage to try and glean potential spatial patterns displayed by those artifacts.

The primary question addressed in this chapter is: what is the spatial association of the bonebed and other artifact classes? This question allows for more detailed questions to be addressed about the spatial association of the cultural materials recovered from the excavation. For instance, are there spatial patterns represented by the bone? Is there evidence to support Witkind's (1971) original hypothesis that initial butchery and secondary processing locations are separate? Are there discrete activity loci within or outside the bonebed represented by non-faunal artifacts? These questions are addressed by using the data presented in the previous two chapters combined with spatial analysis. The detailed methods used herein are presented in chapter 3. Where relevant, several of these methods will be revisited in this chapter.

Mapping the Collection

Not all of the artifacts described in the previous two chapters have associated spatial data. Over the 40 plus years since the excavation, some of these data have been lost to the vestiges of time. The collections from 1966 and 1969 have no direct relationship to the 1970 grid system and thus cannot be displayed in the plan maps that follow. Some artifacts from the 1969 testing were converted to the 1970 grid coordinate system, at least on a general basis, and these data are utilized when appropriate. Artifacts from the 1966 excavation have no firm spatial data, but their place within the site (what Wikind called the habitation area) is discrete enough to talk about in a broad sense.

As noted in chapter 2, the exact location of the 1969 test trench is unclear, other than it goes through multiple grids (Witkind 1971:Figure 1). The test trench did extended beyond the limits of the 1970 excavation, and appears to have connected to the 1966 excavation area, or at least up against it (Figure 6.1). The size and direction of the 1969 test trench is likely exaggerated some, but is based on the photographs from the 1970 excavation as well as some artifacts from the 1969 testing that had been converted to coordinates relating to the 1970 grid system. Further, one document in the site files at the CSU Archaeological Repository shows the test trench was divided in to seven grids, which matches the coding system (Grid 12 is also noted on some artifacts but its

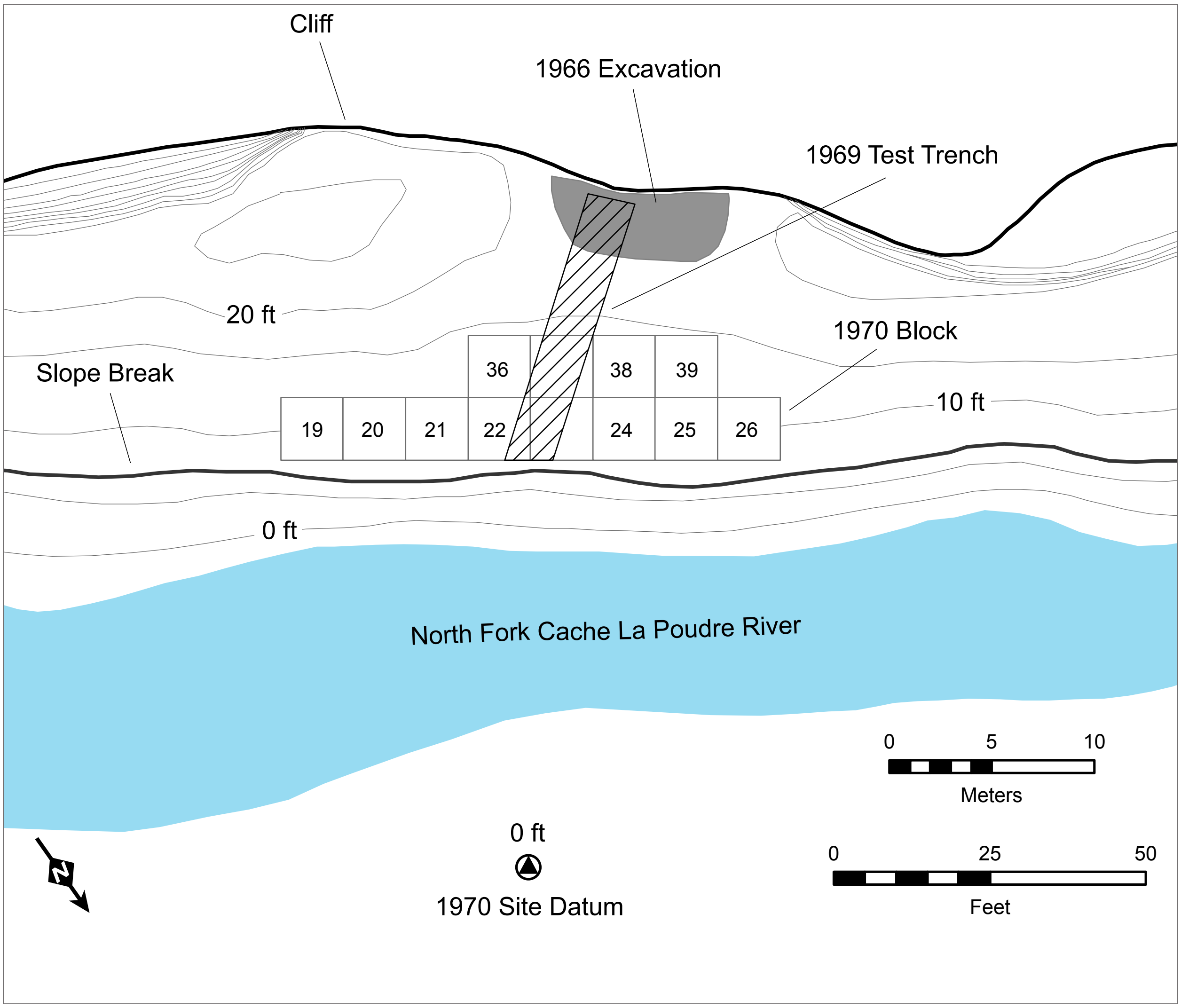

Figure 6.1. Plan map of the Roberts site showing major topographic features and excavation areas.

location within the site is unknown). While the exact size and locations of these grids (in relation to the 1970 grid) are unknown, it is clear that the lower 1969 test grid numbers (grids 1-4) are more or less within in the area of the 1970 excavation. Test grids 6 and 7 are definitely up the slope and closer to the location of the 1966 excavation. Therefore, these data can also be used to provide some general statements about the spatial arrangement of artifacts from the 1969 testing.

The bulk of the spatial data presented in this chapter comes from the 1970 block excavation and is presented as such. An overview of the mapping and provenience methods used in 1970 are described in chapter 2, but a brief summary is provided here. Twelve 10 x 10 ft blocks were established, designated by a numeral 19-26 (ones on the river side in Figure 6.1) and 36-39 (on the cliff side). These were then divided into four, 5 x 5 ft squares, designated with a point value (e.g., 20.1, 20.2, 20.3, and 20.4). Within these squares, artifacts were coded with a letter A through Y, representing a 1 x 1 ft square. Finally, within that square, another number was added, 1 through 9, which represented a 4 x 4 in block. So, at maximum, artifacts were mapped to within a 4 x 4 in block and, at worst (excluding non-mapped artifacts), to the center point of a 10 x 10 ft square.

A completely mapped artifact from the 1970 excavation would have a provenience of something like "20.2A9". While extremely accurate for the time, this hierarchical system is not conducive to working in a geographic information system that relies on X, Y, and Z values. Therefore, with the assistance of Noah Benedict (a CSU undergraduate student at the time), a script was created to translate all of these data to an X, Y coordinate system. Many of the long bone elements were mapped with multiple points, all of which were translated to X, Y coordinates and then mapped as one line. All of these data were imported to ArcGIS 10.2 and analyzed further to address the questions posed for this chapter.

Spatial Organization of the Roberts Buffalo Jump

This section discusses the spatial distribution of the artifacts recovered from the three excavations at the site. It mainly focuses on artifacts that could be plotted to the 1970 grid, but when relevant, data from the 1966 and 1969 excavations are discussed even though most are not able to be plotted on the maps.

Non-Fetal Bison Bone Distribution

A total of 682 non-fetal bison bone elements had enough spatial data to be mapped (Figure 6.2). Of these, 652 are identifiable elements, accounting for about 65 percent of the total identifiable elements. The other 30 are flat bones, long bones, metapodials, and unidentifiable elements. The bone elements that could not be mapped included some with no associated spatial data at all, as well as others that have unclear or questionable spatial data and thus were excluded as to not inflate the results. While it certainly would be ideal to have high precision spatial data on every artifact, for a collection that is over 40 years old these data are rather remarkable.

Figure 6.2 shows three main clusters of bone. The black lines represent bones with multiple plotted points, while the gray dots represent bones with only one point. In general, multi-point bones are long bones, ribs, and mandibles, while the single points generally represent smaller elements such as phalanges, lower limb bones, and vertebra.

A major blank spot is present in Grid 22, adjacent to one of the big concentrations (noted in Figure 6.2). While nothing is displayed in this area immediately next to the concentration, field maps from the 1970 excavation show very few bones from this unit (because no bones in the collection retained these provenience data they are not displayed in this map). Additionally, there are no field maps for Grids 23 and 37, suggesting that while these grids were identified, the only excavation occurring in them was the 1969 testing, thus the lack of data within these units. Even with a likely exaggerated size of the 1969 test trench, there is a clear segregation of bone piles. While this could partly be a reflection of excavation intensity, the plotted elements are restricted to certain areas away from the edges of some grids. While some spatial data may be lacking, the map of the bone distribution is likely a good reflection of the extent of the excavated bonebed in this immediate area.

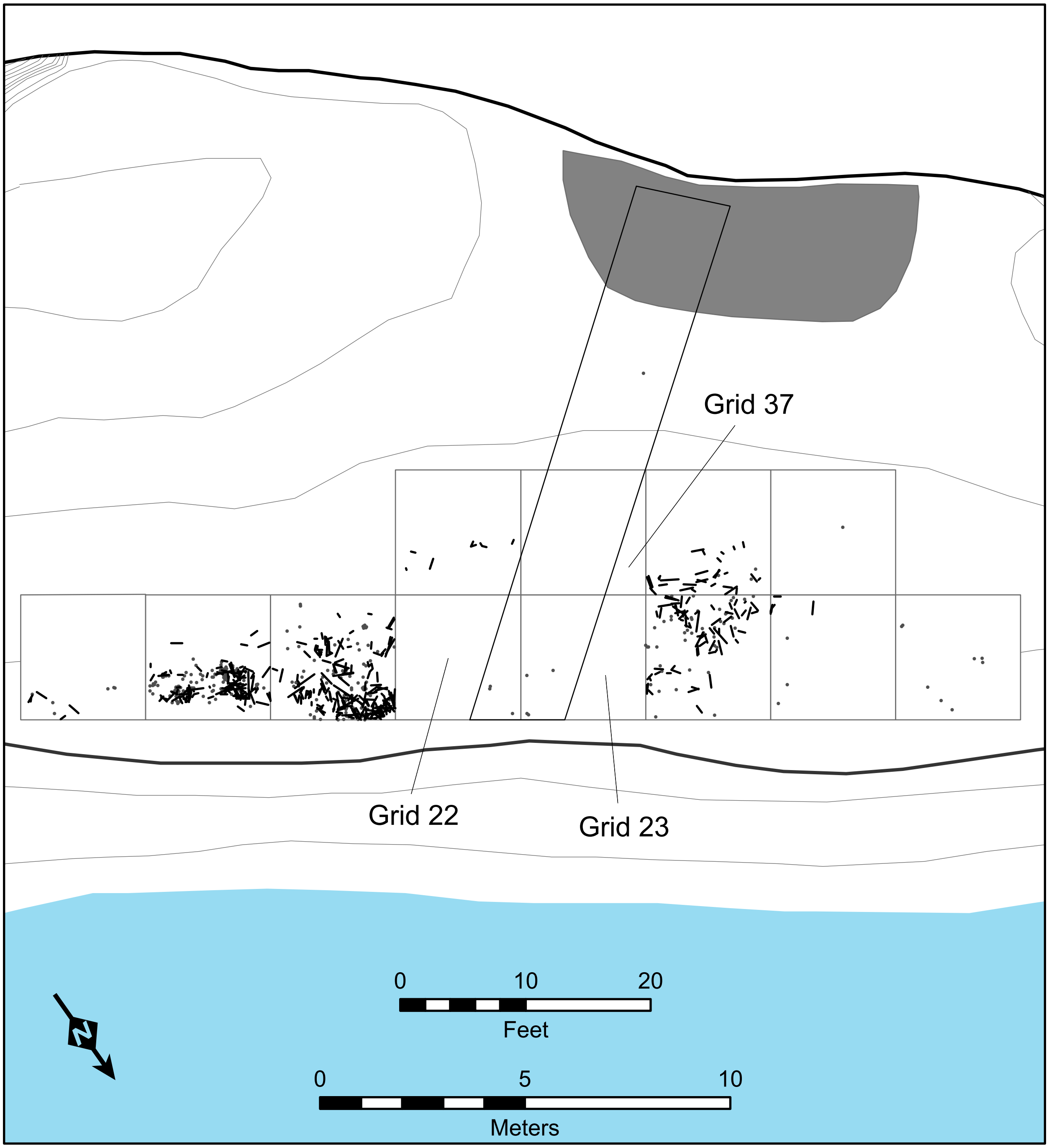

Figure 6.2. Plan map showing all of the plotted bone elements.

To simplify the display of these data, I performed a kernel density algorithm in ArcGIS to identify clusters of bone (Figure 6.3). This created a contour density map and confirmed the three main concentrations of bone within the 1970 excavation block. This map shows that the two clusters on the left side of the excavation block have denser concentrations of bone, while the one on the right side is a little more dispersed, a pattern that can be visually seen in Figure 6.2. Even with the incomplete spatial data from 1969 testing, it is clear that there are some spatially discrete concentrations of bone. To further simplify the discussion of these bone concentrations, the two clusters on the left side of the block will be referred to as Cluster 1, and the one on the right side of the block will be referred to as Cluster 2.

Modified Stone

There is some level of spatial data related to the 1970 grid system for 613 of the 1,904 flakes in the assemblage. Sixty two percent of these (n=378) are able to be mapped to the 4 x 4 in grid, while another 38 percent (n=235) could be mapped to either the 5 x 5 ft or 10 x 10 ft block. Flakes from the 1969 testing account for another 232 of the total assemblage, while 344 come from contexts associated with the 1966 excavations away from the main bone concentration. Thus, 1,189 flakes come from excavated contexts. The remaining include 715 flakes identified as coming from a surface context but the excavation year is unknown, as well as flakes that do not have any spatial or provenance data associated with them.

The 613 plotted flakes are shown in Figure 6.4 in relationship to bone Clusters 1 and 2. There are a few dense clusters of flaking debris that are within the 1969 test trench. For instance, one in the center of unit 23 (representing flakes that could only be plotted to the 10 x 10 ft block) and one on the lower right corner of unit 37 (representing a cluster that could only be plotted to the

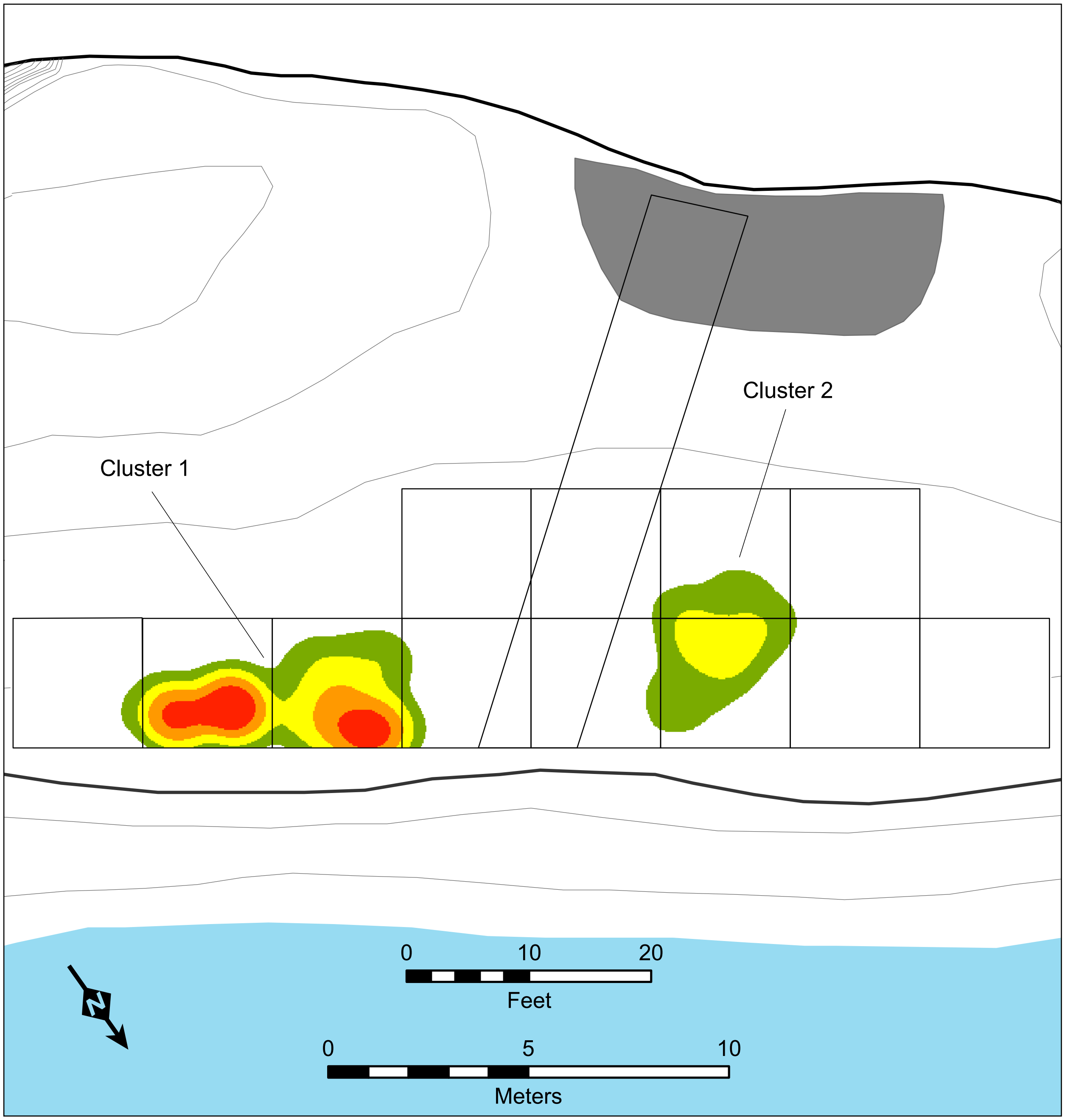

Figure 6.3. Plan map showing a density contour distribution of the bone.

5 x 5 ft block), along with three clusters outside of the 1970 block. These represent flakes recovered from the 1969 testing that were converted to the 1970 grid system at some point in the past.

Figure 6.4 clearly shows that the large majority of flaking debris is outside of the main bone concentrations. In fact, there is a dense concentration of flaking debris ringing the outside of Cluster 2, but very little flaking debris associated with Cluster 1. When compared to Figure 6.2, which shows the individual bone plots, it is clear there are very few bones in the units with greater concentrations of flaking debris. Only eight flakes were recorded from within and around Cluster 1. This indicates the majority of flaking, and thus tool production and maintenance, was taking place outside of the main bone concentrations.

As noted in chapter 4, 38 percent of the flaking debris assemblage is burned. Of the flakes that could be plotted, 61 percent (n=373) are burned. When these burned flakes a plotted in relation to the 1970 grid and bone clusters (Figure 6.5), their visual distribution is roughly similar to the display in Figure 6.4. However, 76 percent (n=232) of the burned flakes are within a 1 x 1 m square in the upper right corner of unit 38. This suggests that a hearth feature may have been present in this area that was missed during the 1970 excavations.

About a third of the stone tools have spatial data associated with them (n=24 out of 65). These include eight projectile points and point fragments, four bifaces, five scrapers, three utilized flakes, three core fragments, and the grooved abrader. Even with a less than ideal sample size, the spatial patterning of tools in relation to the three main bone concentrations follows a similar trend as the flaking debris (Figure 6.6). However, there are also some discrete and interesting patterns to note of certain tool types in relation to the bone.

The two tools that appear to be associated with Cluster 1 on the left side of the grid (a utilized flake tool and biface fragment) are both functionally related to butchering activities. In fact,

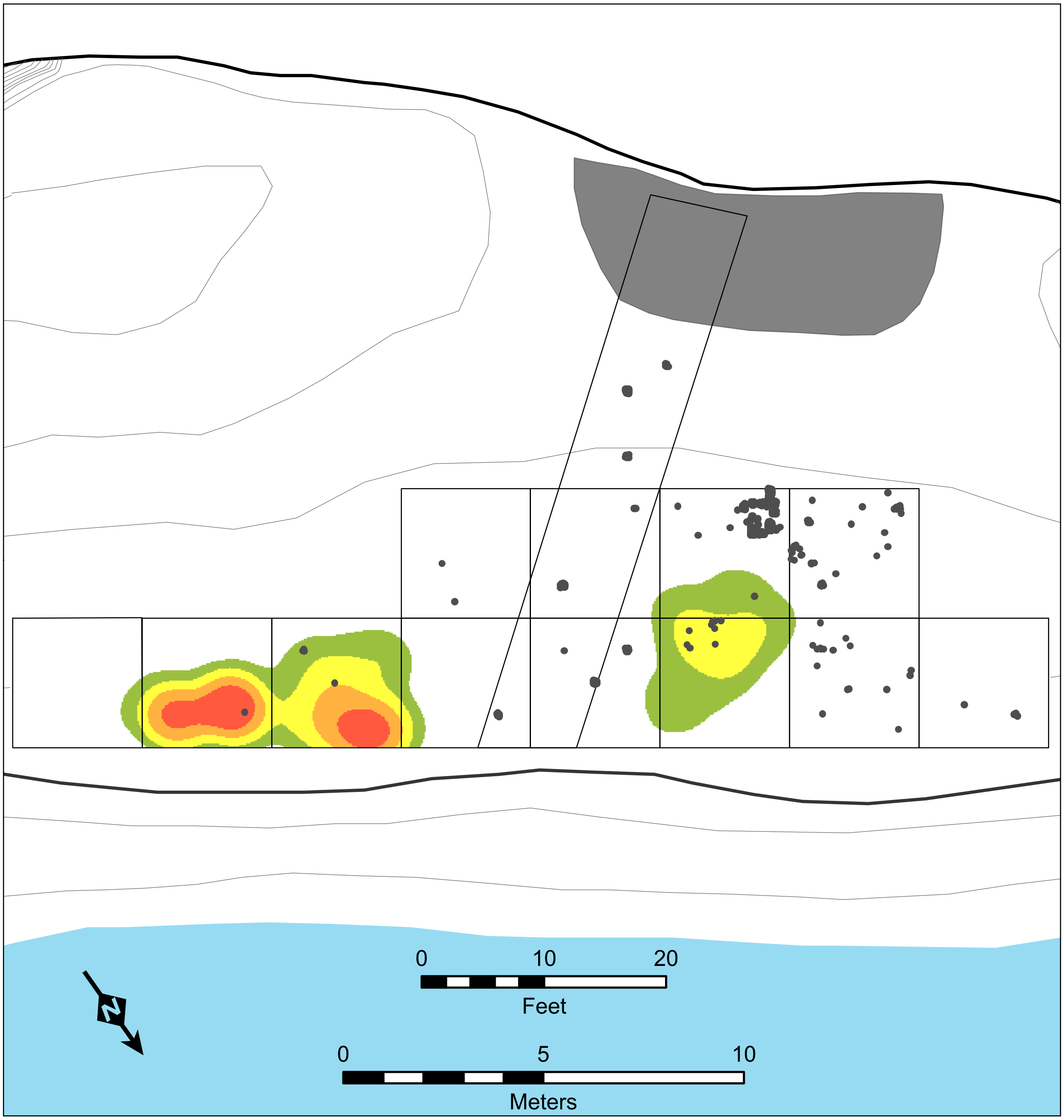

Figure 6.4. Plan map showing a plot of flaking debris relative to bone concentrations.

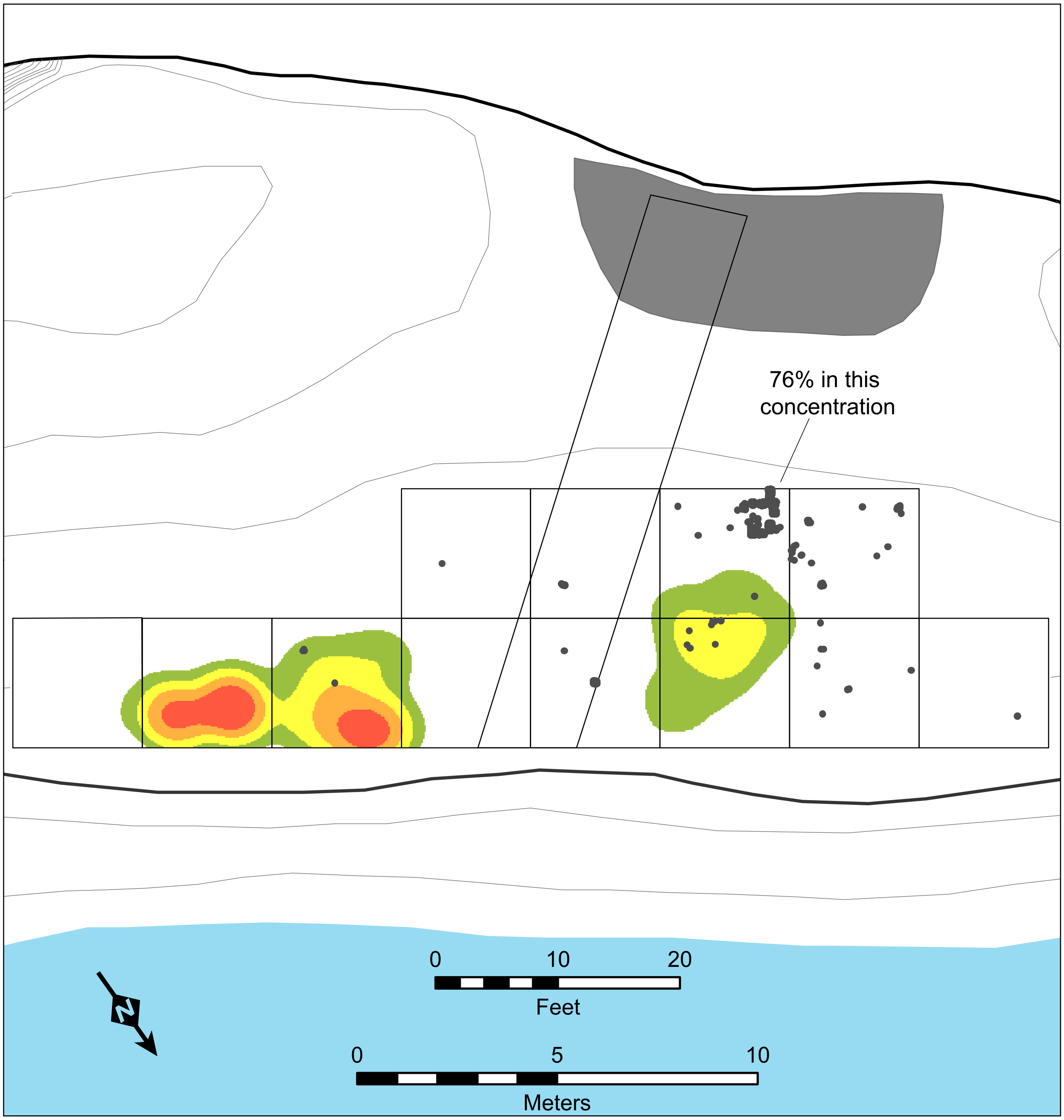

Figure 6.5. Plan map showing a plot of burned flaking debris relative to bone concentrations.

the flake tool is the same quartzite chopper or cutting tool shown in Figure 4.1e. Similar chopper tools are noted at many butchery locales, including the Piney Creek site (Frison 1967:13) and Glenrock (Frison 1970:Figure 23). At the Vore site Reher and Frison (1980:24, Figure 23) describe large quartzite choppers as being used to "break animals down in to portable units". Even if the tool is not a chopper and instead a large cutting tool, it's size and durable material would make it an ideal tool for cutting up larger portions of meat, such as what likely happened in Cluster 1.

Four projectile points are within and very near Cluster 2. Three of these have use-phase classifications of finished but unusable due to breakage (the point closest to the river is only a tip), while the other is classified as complete and useable. Two of these are un-notched triangular points (Figure 4.2e) and one is a tri-notched point (Figure 4.2c). The other three tools within Cluster 2 are the grooved abrader (Figure 4.1g), a biface (appears to be a knife-like tool) and a utilized flake. The latter two are both tools considered to be associated with butchery activities.

Two of the three projectile points away from the main bone concentrations are broken via impact fractures and both are missing the tips; one is a tri-notched point (Figure 4.2b) and the other is un-notched (Figure 4.2d). This indicates both point fragments were removed from their shaft and discarded away from the butchery and processing areas. A third point fragment, located in the upper right of grid 39 and furthest away from any of the main bone piles, is a tip fragment.

As discussed in chapter 4, eight projectile points are use stages 2 or 3, meaning they are in the production phase and not finished or useable points. Unfortunately, none of these points have data to plot on the 1970 grid. However, all eight do have some level of spatial data and either come from the 1966 excavation or 1969 test trench. All come from areas of the site spatially separated from the main bone clusters, indicating point manufacture was taking place away from the butchery and processing locations. Other tools from the 1966 area that could not be plotted include five

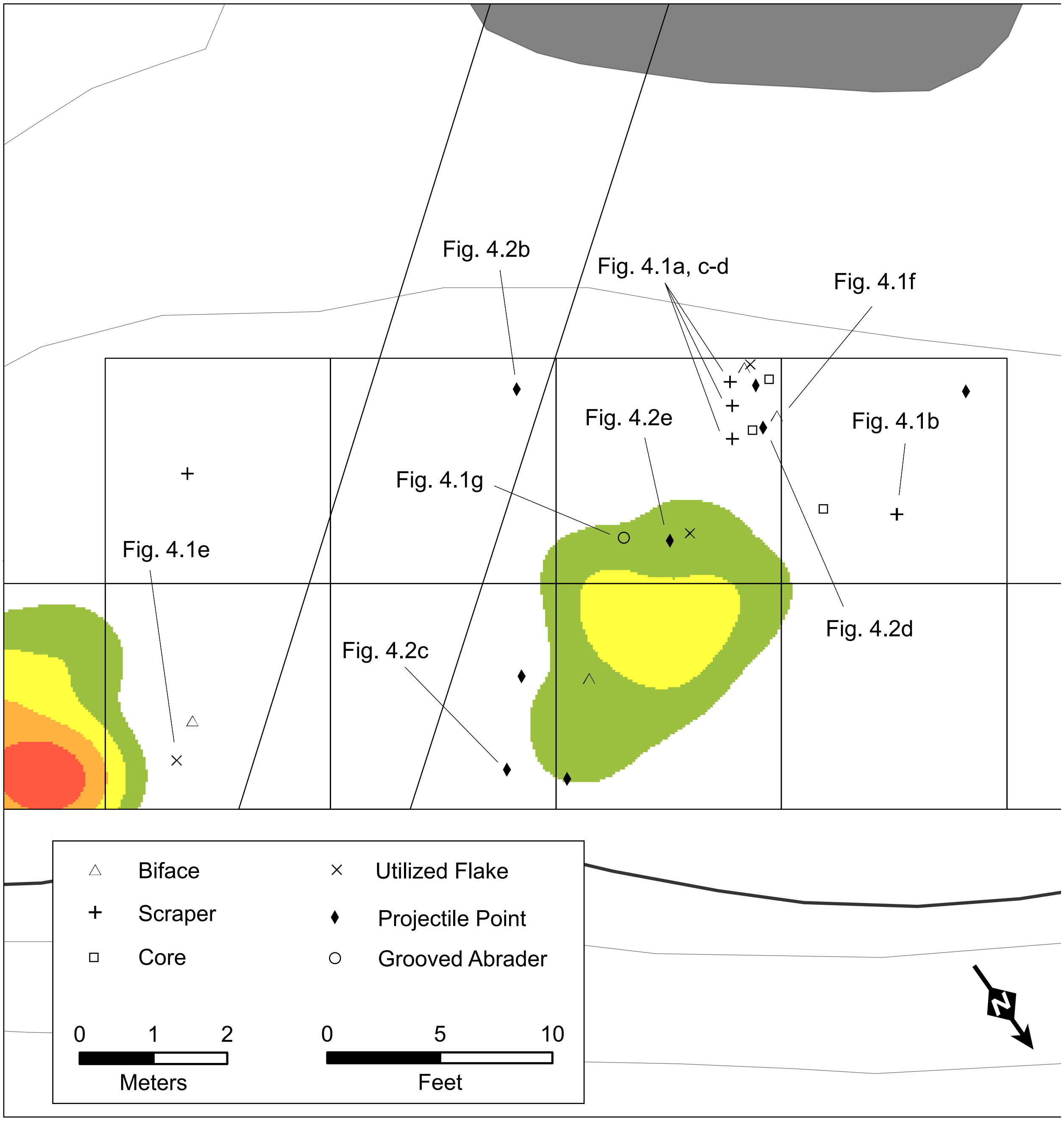

Figure 6.6. Plan map showing a plot of stone tools relative to bone concentrations. Select tools are keyed to Figures 4.1 and 4.2.

utilized flakes and three biface fragments, one of which is a lateral margin of a cutting tool. The alternate beveled knife (catalog number 3052) and the Shoshone knife fragment (CN3051) (also see Figure 4.2h-i) come from the 1969 testing, but in grids away from the 1970 block and closer to the 1966 area.

The rest of the plotted tools are outside the main bone concentrations and are functionally diverse, but most are related to butchery and processing activities. Two are bifaces, both of which are burned and are near the concentration of burned flaking debris. One of these bifaces is the serrated hafted knife fragment shown in Figure 4.1f. One tool is a utilized flake that has been fragmented due to burning; it too is located within the same concentration of burned flaking debris. The three cores are just outside Cluster 2 and amongst the heavy flaking debris concentrations. Their location suggests they were used to create expedient flake tools for processing the bison carcasses then discarded when their utility was maximized. The remaining tools are five scrapers and scraper fragments. These include the three scrapers in the upper right corner of grid 38, which are shown in Figure 4.1a, c-d. All of these are away from the bone concentrations, and hint at specialized task areas focused on hide preparation.

Modified Bone and Ceramics

Only two pieces of modified bone, both bead manufacturing fragments, have spatial data (Figure 6.7). One was recovered during the 1969 testing and has translated grid coordinates; the other was recovered from the 1970 excavation. Both are plotted well away from the bone concentrations. Sixteen of the other 21 pieces of bead manufacturing debris come from test unit grids that are in this same general area but their exact location is unknown. Two bone tools, both

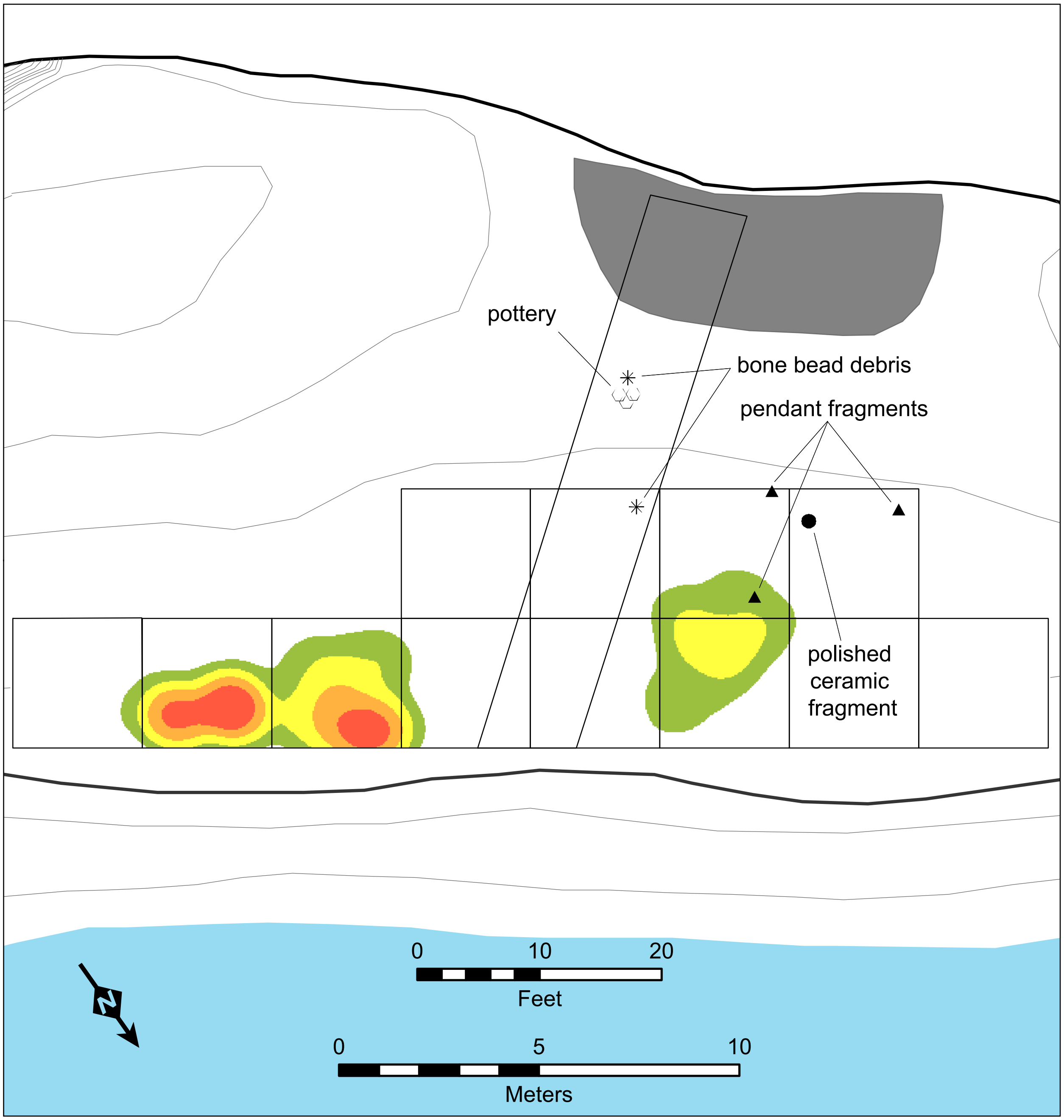

Figure 6.7. Plan map showing locations of ceramics and modified bone relative to bone concentrations.

appearing to be flaking tools, also come from the test trench grid away from Clusters 1 and 2. These data also suggest discrete activity areas away from the bonebed.

Data on the ceramic assemblage is just as sparse. The three pendant pieces and the heavily polished, elongated ceramic artifact (see Figure 4.e-f) are all away from the bone concentrations, near the flaking debris and stone tools. The only vessel sherds that could be plotted come from the 1969 testing that were translated to approximate 1970 grid coordinates. Two are classified in chapter 4 as Intermountain sherds, and the other is too small and is classified as unknown. These also are well away from the main bone concentrations. Ten additional sherds have data linking them to the 1969 test trench. Six of these come from grids closer to the cliff and definitely away from the bonebed; four are actually closer to the bone concentrations. The other 11 sherds have no spatial or provenance data associated with them. It should be noted that the partially reconstructed vessel was recovered during the 1966 excavation. It is unknown if this was reconstructed only from sherds from the 1966 excavation or if sherds recovered from elsewhere were used; however it is likely that the majority are from the 1966 area as seemingly none of them are curated with the 1969 and 1970 collections.

Fetal Bison Bone

In chapter 5 I presented data on the spatial organization of the fetal bison specimens. A total of 101 fetal specimens have spatial data, with 100 recovered from the 1966 and 1969 excavations. Only one fetal element has 1970 grid coordinates (two others have coordinates that could only link to a 10 x 20 ft area). It is a metapodial recovered from the upper right corner of grid 38, very near the concentration of flaking debris and stone tools. The remainder of the fetal specimens have no spatial or provenience data associated with them.

As I discussed in chapter 5 (also see Table 5.11), nearly 65 percent of the fetal specimens come from either the 1966 excavations or the 1969 test grids that are closer to the cliff and away from the main bonebed. Furthermore, the higher utility elements are much more greatly represented in the 1966 assemblage than the 1969 or 1970 assemblages. As the elevation data show in Figure 6.2, the 1966 excavation area also happens to be the flattest area of the entire site. This suggests that fetal bison were transported away from the main bone clusters and were likely processed and consumed on site.

Spatial Organization Summary

Using data from the previous two chapters combined with their spatial distribution shows that there do appear to be discrete activity areas at the Roberts jump. Most of the flaking debris and discarded stone tools are concentrated in one area away from the bone clusters. Other artifacts, such as the pottery and bone bead manufacturing debris, are even further away, identifying at least one other activity area (what Witkind [1971] refers to as the habitation area). This clear division of task areas confirms that a site structure approach can be utilized at non-residential sites to reveal patterned behavior in a kill-butchery assemblage. The next section further investigates the bone data specifically to see if there are clear distributions of certain elements or butchery units that can identify primary and secondary processing locales.

Organization of the Bonebed

The previous section identified the spatial distribution of artifacts across the site. This distribution shows that there does appear to be specific task areas situated around the bone clusters, in addition to other task areas not directly related to the bone clusters. To provide more context to this, the bone clusters are examined more closely to see the role natural and cultural processes may have played in creating some of these patterns. Specifically, modifications recorded on the bone during analysis (e.g., carnivore modification) are analyzed spatially to attempt to discern patterns. This is followed by an examination of cultural process (e.g., spiral fractures) to see if these pattern in a specific way. A method to discern potential butchery patterns is also discussed to see if the two main clusters differ in their element composition that could reveal initial and secondary processing areas within the site.

Natural Processes Impacting the Spatial Distribution of Bone

One major factor controlling the distribution of bone across the site is the restricted space within which to work. The site is bounded by the cliff on one side and the river on another (although the river course has changed over the years it still likely was an impediment to transporting larger butchery packages off site). The other two sides are bounded by fairly steep slopes, essentially restricting the working area of the site to about 500-600 m^2. This alone will control (or restrict) the distribution of bone even when other factors are considered.

A total of 37 carnivore modified bones are able to be mapped to the 1970 grid. Of these, 16 are within and near Cluster 1 on the left side of the grid, while 19 are associated with Cluster 2 on the right side (Figure 6.8). This more or less even distribution suggests that carnivores did not drag certain elements away from one mass of bone and create or inflate another concentration. However, as percentages of the total NISP from Clusters 1 and 2 (503 and 138, respectively), there are far more carnivore modified bones in Cluster 2 (13.8 percent) than in Cluster 1 (3.2 percent). Data discussed later in this section will indicate that this is likely a by-product of the human agents creating the bonebed and not a direct reflection of carnivores overly modifying the assemblage.

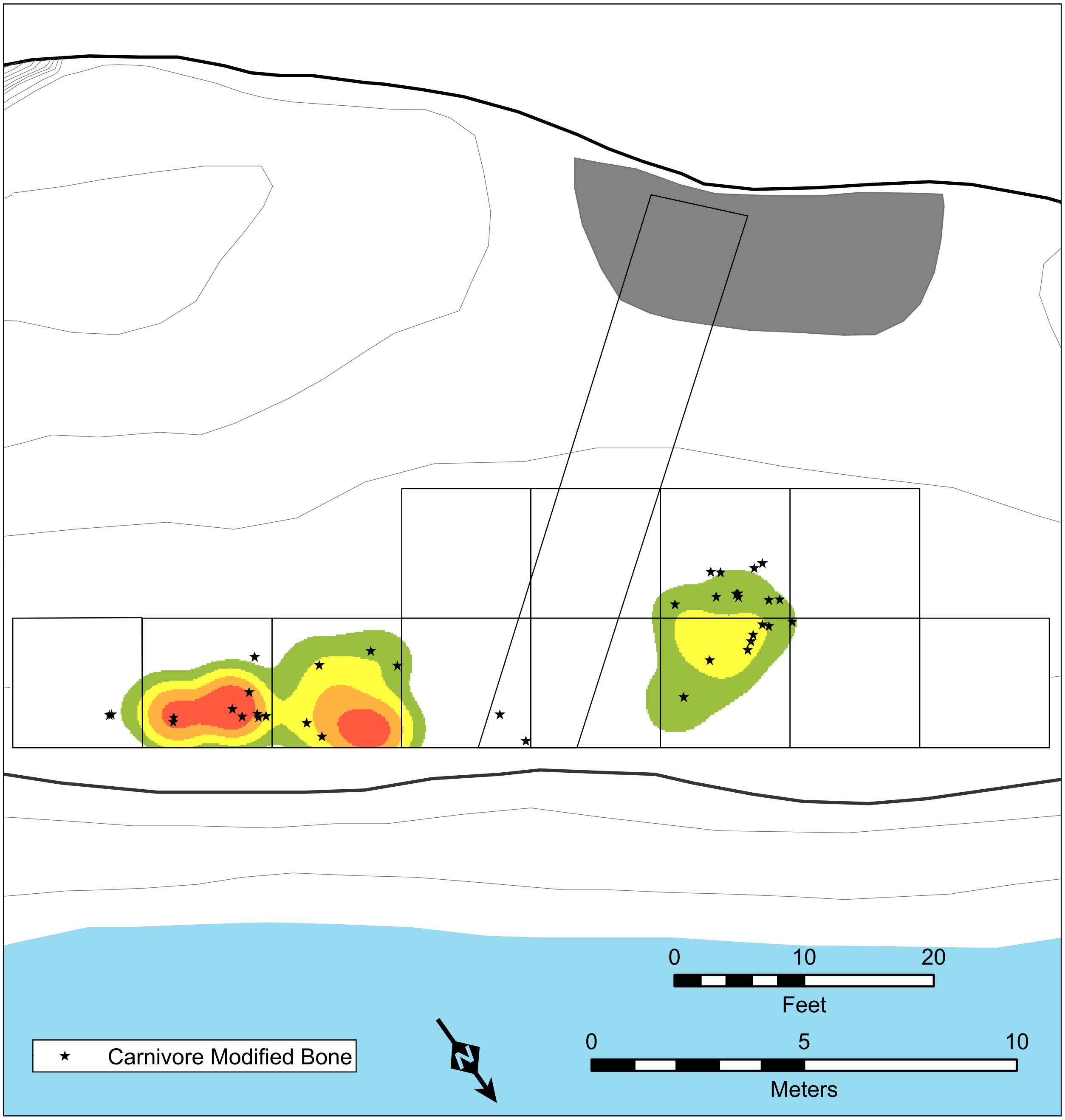

Figure 6.8. Plan map showing locations of carnivore modified bone relative to bone concentrations.

Cultural Processes Impacting the Spatial Distribution of Bone

Since non-cultural agents do not appear to have impacted the clusters, the next step is to examine the role human agents had in creating the patterns seen in the bone assemblage. Data from chapter 5 shows that a total of 40 bone elements are spirally fractured (21 of which could be mapped) and 16 have cut-marks (10 of which could be mapped) (Figure 6.9). By count, there are more spirally fractured elements in Cluster 1 than in Cluster 2 (n=13 and 7, respectively). The NISP in Cluster 1 is 503 and in Cluster 2 it is 138. Therefore, about 2.5 percent of the NISP in Cluster 1 are spirally fractured, but nearly two times that amount in Cluster 2 are spirally fractured. Six bones have cut-marks in Cluster 1 (about 1.2 percent) and four bones in Cluster 2 have cut-marks (almost 3 percent). While all of these numbers are small, it does show that bones in Cluster 2 appear, at least in some ways, to have been more heavily processed by humans, potentially showing that Cluster 2 is more representative of a secondary processing area.

Because only 682 of the 3004 non-fetal bison specimens could be mapped to at least a 10 x 10 ft grid, portions of elements were coded by "Package", based on the relationship to fairly general butchery units. Due to the small sample size, plotting by element would not likely yield any meaningful patterns and thus a butchery package was deemed the most useful. For instance, all forelimb elements were coded as Package 3, while all hindlimb elements were coded as Package 4. Other divisions included cranial, axial, unspecified limb (e.g., unidentified long bone or metapodial) and unknown (non-identifiable bone). This coarse coding of elements allows for more general statements about potential butchery and processing activity areas to be identified while also allowing for high enough values to gather statistically meaningful data. If the two clusters do represent initial butchery and secondary processing locales, respectively, then coding by package should reveal if one cluster contains more of certain packages than others.

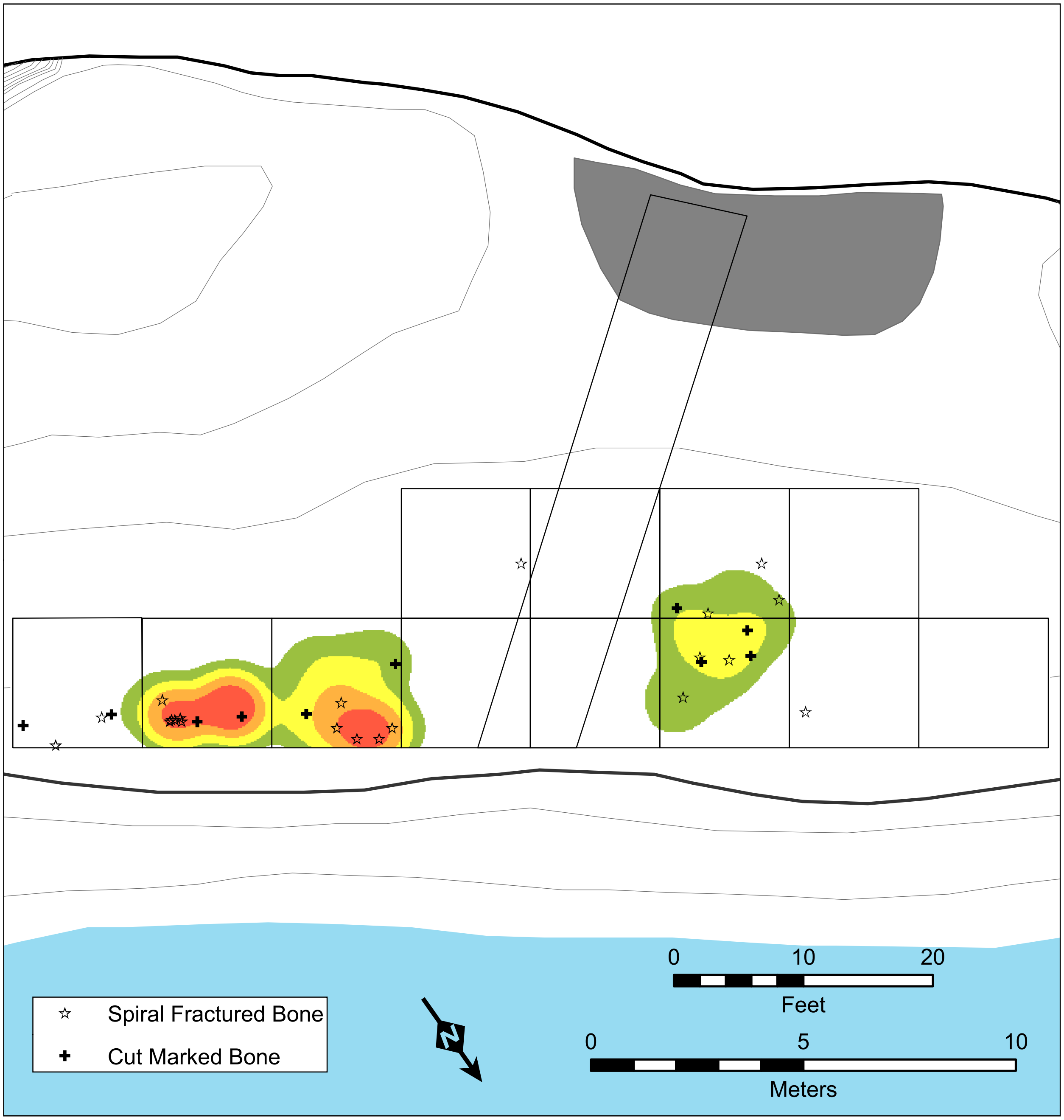

Figure 6.9. Plan map showing locations of spiral fractured and cut makred bone relative to bone concentrations.

Unidentified elements (n=15) were removed from the dataset, and the remaining 667 bone elements were compared in a chi-square test (Table 6.1). The table is significant X^2 (*df*=4, *N*=627)=40.4, *p*=<.05, suggesting there is some difference between package code and bone clusters (40 bones that were plotted and are Package Codes 1-5 are not within the two clusters and were excluded from the results in Table 6.1). Fewer than expected axial elements are represented in Cluster 2, which also has more than expected cranial elements. Unspecified limb elements are about as expected in Cluster 1, but very underrepresented in Cluster 2. This suggests that perhaps more marrow extraction (and thus more long bone breakage) was occurring in Cluster 1. This is more or less supported by the spirally fractured frequency data by cluster presented earlier in this section.

The most significant result shown in Table 6.1 is that far fewer than expected hindlimb elements are observed in Cluster 1 while Cluster 2 has significantly more hindlimb elements than expected. Meanwhile, forelimb elements are roughly equally distributed. These data suggest that hindlimb packages were being selected for further (or more) intensive processing in Cluster 2 than in Cluster 1. As discussed in chapter 5 (also see Table 5.4), major hindlimb elements (femora and tibiae) have overall more utility value than major forelimb elements (humeri and radii), although they are closely ranked on all utility indices.

These are also the elements most likely to be selected for by carnivores. Because more of them are located in Cluster 2 it is not surprising that the relative frequency of carnivore modification is higher than in Cluster 1, supporting the notion presented earlier that carnivores did not create or inflate the bone distribution. Since there are other elements not generally targeted by carnivores (e.g. cranial elements) as well as a clear task area associated with Cluster 2, it is unlikely that this cluster is the product of carnivore selection and modification.

Table 6.1. Chi-square results of element package by bone cluster (package codes in parentheses).

Package		Cluster 1	Cluster 2	Total
		Cluster		
Cranial (1)	Count	47	24	71
	Expected Count	55.4	15.6	71.0
	Std. Residual	-1.1	2.1	
Axial (2)	Count	256	48	304
	Expected Count	237.1	66.9	304.0
	Std. Residual	1.2	-2.3	
Forelimb (3)	Count	51	14	65
	Expected Count	50.7	14.3	65.0
	Std. Residual	.0	-.1	
Hindlimb (4)	Count	62	43	105
	Expected Count	81.9	23.1	105.0
	Std. Residual	-2.2	4.1	
Unspecified Limb (5)	Count	73	9	82
	Expected Count	64.0	18.0	82.0
	Std. Residual	1.1	-2.1	
Total	Count	489	138	627
	Expected Count	489.0	138.0	627.0

While somewhat coarse-grained, these data suggest that Cluster 2 more closely resembles a secondary processing locale and Cluster 1 more closely resembles a primary butchery area, confirming the original interpretation of the bonebed (Witkind 1971). The higher than expected cranial package values in Cluster 2 could indicate areas where crania were broken open for brain removal. Unfortunately, the cranial elements are highly fragmented and offer no direct evidence that this was ocurring on site so such an idea is merely speculation. Even so, with the forelimb and hindlimb data as well as the unspecified long bone data discussed above, there is evidence to support the notion that there is spatial segregation within the bonebed.

Summary

This chapter used data to answer one central question: what is the spatial relationship between the bonebed and the rest of the artifact assemblage? While broad in concept, this question allowed for more specific discussions dealing the spatial distribution of artifacts at the site. The results show that there are meaningful distributions of certain artifact classes in spatially discrete areas of the site.

One of the most meaningful results of this analysis is that there does not appear to have been any major post-depositional or taphonomic impacts to the site that affected the distribution of artifacts. The discrete clusters of bone, along with a fairly spatially restricted distribution of flaking debris and stone tools suggests that, for the most part, the deposits were intact.

By employing a "site structure" (Binford 1978b; 1983) approach to these spatial data, meaningful patterns were realized. This approach has typically been employed at hunter-gatherer residential or camp sites and has rarely been used at mass kill sites. However, the tenets behind such an approach, discerning patterned behavior represented archaeologically by discrete clusters of artifacts, or activity areas, is useful to examine the spatial patterns of mass kill sites.

The distribution of bone appears to be clustered in two, and possibly three discrete areas. Missing spatial data from portions of the collection does not appear to have greatly impacted the patterns that can be seen by the available data. For example, the bone clusters have fairly defined edges that end before the suspected location of the test trench is reached. Additionally, the flaking debris is tightly concentrated in one area, far away from the location of the test trench. Therefore, the artifacts that can only loosely be mapped from the 1969 testing, at most, could only mean an additional cluster or two are missing. Rather than changing how the available data are interpreted, this would likely only strengthen the argument for defined spatial segregation of activities.

The clearest example of a localized task area is the tight concentration of flaking debris and stone tools ringing the outside of Cluster 2. The "package" data suggest that Cluster 2 is a secondary processing area, where more intensive butchery and carcass processing was taking place. The large concentration of flaking debris along with discarded and broken stone tools supports this interpretation. More intensive processing requires more intensive tool use, thus making this area the likely main processing activity area. The evidence also suggests that a hearth feature is close by, making this task area an example of a hearth-centered activity area (Binford 1983:149-159).

While some kill-processing sites are more spatially segregated, such as the Wardell bison trap (Frison 1973), this does not appear to be the case at the Roberts kill. However, there are two simple reasons that this is likely the case. First, access to the site is fairly restricted an all sides. Obviously it is bounded by the cliff face, which runs to either side, and it is also bounded by the river. Even though the course has been altered, it likely was still an impediment to removing even partial carcasses away from the main kill area. Second, the site area itself is fairly steep, with only about 500 to 600 m^2 of available work area before the land mass dissipates.

Within this area, however, there is still only limited space to work (Figure 6.10). The 1966 excavation area is the flattest spot on the entire site. The total area of this flat spot, including beyond the excavated area in 1966 to the contours on all sides covers just about 80 m^2. The area is mostly flat but slopes up to 20 percent on the perimeter. The western edge of Cluster 1 (the right edge on the planview maps) to just outside the western edge of Cluster 2 and extending across the north-south extent of the excavation blocks covers approximately 60 m^2. The slope in this area is about 29 percent. This makes it the only other even remotely flat spot in which to work. The rest of the landform around the site has slopes between 40 and 56 percent. It may be no coincidence that certain elements were moved a short distance away (about 7 m are between Clusters 1 and 2) to help facilitate further processing.

Therefore, the geography of the landform necessitated that kill, butchery and processing all took place in about the same area. This also likely explains the lack of any overtly obvious spatial distribution of certain elements and the lack of articulated elements. Additionally, if the kill,

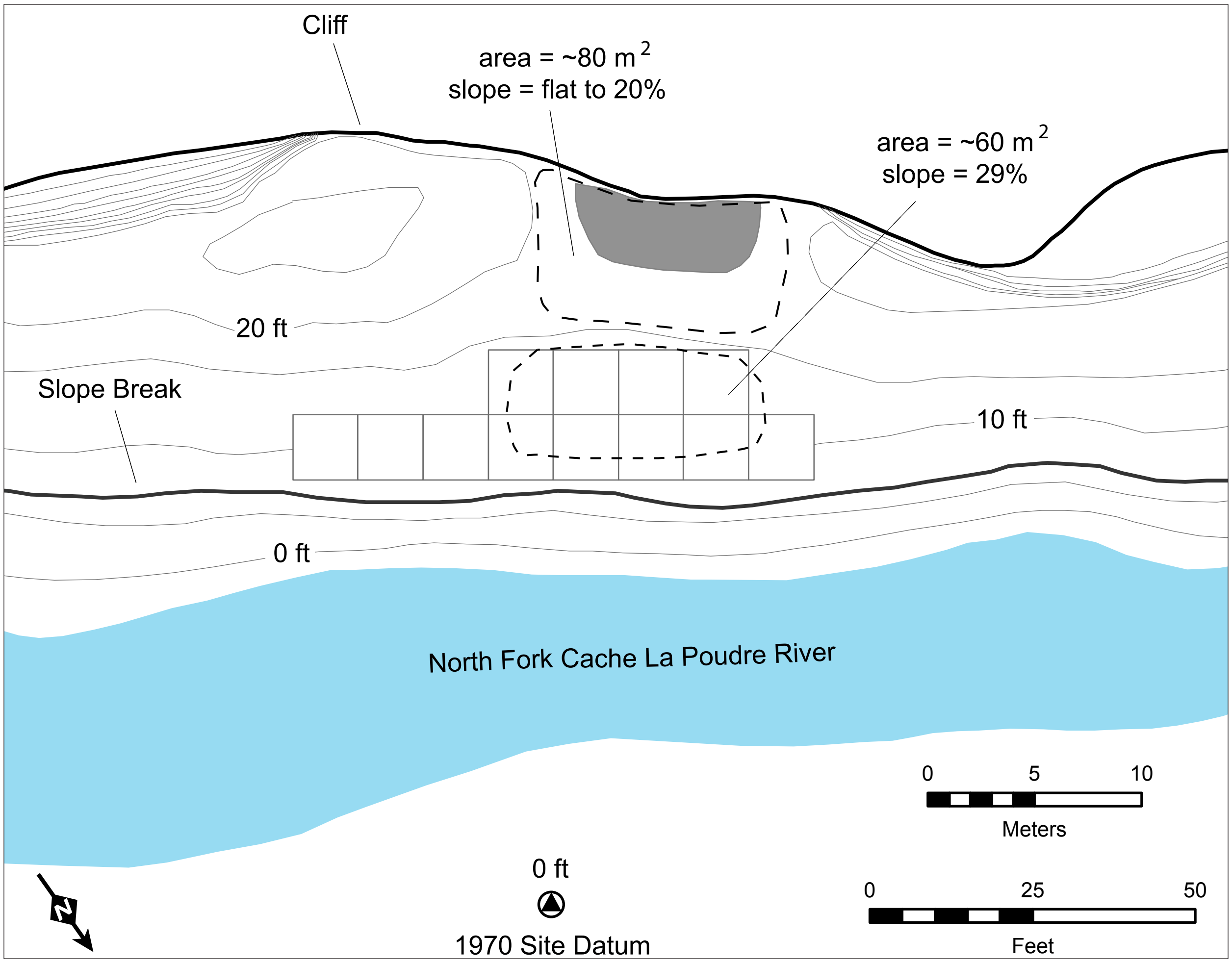

Figure 6.10. Annotated plan map showing area and slope of task locales. Areas not outlined range from about 40 to 56 percent slope.

butchery, and processing are all taking place in relatively the same place, there is little chance that obvious transport decisions can be observed. Considering the number of projectile points, including both broken bases and tips, overall the site looks most like a kill site, followed by extensive butchery and processing of the bison carcasses. This butchery and processing was has likely eliminated any evidence of where the actual kill took place.

Based on the radiocarbon dates, the similar artifact assemblage, as well as a discussion in Witkind's (1971:49-52) original documentation of the site, there is no reason to suspect that there are different or multiple occupations represented at the site. Instead, the 1966 excavation area likely represents an extension of the task area identified within the 1970 excavation block and 1969 testing. Data presented in chapter 5 shows that large majority of unidentifiable and long bone fragments come from the 1966 excavation area, much of which are also burned. This area is only about 4 m upslope of the flaked stone cluster and is about the only flat spot on the entire site. Therefore, this area was likely used to further reduce bone for marrow extraction and bone grease production, further evidenced by the extensive ceramic vessel assemblage from the 1966 area.

This is further supported by the high concentration of fetal bison bone in this same area. There are multiple ethnographic accounts of fetal bison being considered the choicest cut of meat. For instance, Boller (1959:236) recorded between 1858 and 1866 in the Great Plains that "a young calf before it is born is the greatest delicacy of all". Samuel Hearne (1911) noted in 1772, near present day Manitoba, that "the young calves, cut out of [cow's] bellies, are reckoned a great delicacy indeed". These two examples indicate that, if available, fetal bison were likely immediately consumed. The high concentration of meatier elements of fetal bone in this flat area, some of which are clearly burned, indicates that the fetal bison were likely quickly removed, processed, and consumed on site.

Employing site structure method and theory, combined with all available spatial data from a collection over 40 years old and the artifact coding presented in chapters 4 and 5, allowed for these patterns to be realized and activities at the site to be decoded. Even though the site is obviously a kill, butchery, and processing locale, these data can parse out where butchery and processing activities associated with kill took place, as well as identifying where activities that were not directly associated with the kill occurred.

Using all of this information, a picture of how the site operated has emerged. Once the bison were driven over the cliff to their demise (some of which likely needed to be dispatched after the fall owing to the number of projectile points at the site), the initial butchery process began. This is likely represented by Cluster 1, which has the highest concentration of identifiable bone elements on the entire site. The only two stone tools near Cluster 1 are also larger butchery tools that would be needed to perform rough butchery and division of major meat packages. Some of these meat packages were removed, represented by Cluster 2 which is about 7 m away from Cluster 1, and further processed. There is also evidence to indicate that some level of processing undoubtedly occurred at Cluster 1. The more intensive processing around Cluster 2 is represented by the majority of flaking debris and discarded stone tools. Many of these artifacts are burned, indicating a hearth feature was nearby. This could have been used for cooking, warming, for light, or most likely, a combination of all three. These intensive butchery and processing locales likely destroyed much of the evidence of where the actual kill took place.

Other activities were being carried out upslope of the butchery-processing area. This is represented by the presence of large amounts of fetal bone, likely being prepared for immediate consumption, bone grease production (represented by the large amounts of fragmented and burned bone), along with pottery, and even other tasks not directly associated with the kill, such as bone bead and projectile point manufacture. The results of this analysis show the efficacy of using a site structure approach at mass kill sites.

CHAPTER 7: CONCLUSION

When Witkind (1971) first reported on the Roberts Buffalo Jump, there were only a few publications on bison jumps and mass bison kills in the Great Plains. Almost immediately following Witkind's research, a slew of archaeological literature was published on these types of sites. This research developed new methodologies, interpretations, and ways of contextualizing mass bison kills and the lives of prehistoric hunter-gatherers occupying the Plains. This thesis set out to utilize these new data sets and methodologies to re-examine the Roberts assemblage.

I focused this research by asking three general questions: 1) What is the non-faunal artifact assemblage at the site? 2) What is the composition of the bison bone assemblage? And 3) How are these two sets of data spatially organized at the site? These questions opened the door to many additional and more focused questions that directed the results presented in the previous three chapters. For instance, how old is the site? What factors may have contributed to the bone element distribution? Do certain classes of data (e.g., flaking debris or butchery packages) cluster in any meaningful patterns? While some of these questions were designed to refute or confirm previous interpretations made by Witkind (1971), this was not the express intent. Instead, one the primary goals of this thesis was to show that old collections, when analyzed using newly developed methods and techniques, can yield interesting and valuable results. These results can ultimately impact how the archaeological record is interpreted in a particular region. Assemblages like the Roberts site are increasignly rare in modern archaeology. Most research-based archaeology does not, and cannot, excavate on the scale and magnitude of projects from years past. Such large and important collections from sites are now the rareity, and archaeologists have ethical obligations to extract as much data as possible from these types of assemblages.

The chipped stone assemblage is mostly related to butchery and processing, including multiple knives, flake tools, and scrapers. The projectile points, many of which are broken from an impact, also indicate that some of the bison needed to be killed after the fall. Some of the bone tools, including the metapodial flesher, are also associated with processing related activities.

The bone bead manufacturing assemblage appears, at first, to be an odd activity associated with a kill site. However, as referenced in that section, it is not an uncommon activity seen at kill-processing sites. This, along with the ceramic assemblage, suggests people undertook other activities at the site. Additionally, evidence presented in the chipped stone analysis shows that projectile points were being manufactured on site. This represents efforts to re-supply or gear-up, potentially after the processing was completed.

All of the diagnostic artifacts, including the projectile points and ceramics, are contemporaneous with the radiocarbon dates. The majority of diagnostic projectile points are triangular, un-notched points, a style that is typically later than side-notched points. This is consistent with the radiocarbon ages of the site, which indicate an A. D. seventeenth to eighteenth century age.

The bone data show that a herd consisting of 19 bison, primarily females and juveniles, along with at least eight fetal bison were killed, butchered and processed on site. It was shown that density mediated attrition has not impacted the assemblage composition. However, there may be alternative factors that have affected the bone distribution, including collection bias and human butchery choices. While the utility models shows a preference for higher utility elements to be represented at the site, a better way to examine the bone assemblage is by thinking about a more general utility strategy. If most of the butchery and processing was done for marrow extraction and meat stripping, and not removing entire meat packages from the site, then utility models and interpretations using MAU may not be very revealing. Using the bulk or general utility method, the hunters appear to have focused much of their attention on processing moderate to high utility elements, but left the bones on site. The restricted space with which the hunters had to work likely necessitated lower utility elements being discarded away from the main butchery area, perhaps also impacting how the assemblage is seen archaeologically. Evidence of the exact kill spot has likely been transformed or obscured by the intensive butchery and processing occurring in about the same spot as the kill.

The data also show that carnivores have impacted the assemblage to a degree, but this impact is likely minimal and has not greatly altered the element distribution. For instance, many mostly complete long bones are only missing their softer articular ends, indicating carnivores targeting specific elements for marrow but not destroying the entire bone.

Mainly, the data show a mass of bone largely the result of human butchery practices. There are bones that have been spirally fractured, presumably for marrow extraction, as well as some cut marks showing butchery of certain elements. Lastly, there are indications of bones being heavily fragmented and boiled down to render bone fat and grease. These activities, along with clear intentional butchery of fetal bison carcasses, mostly appear in one area of the site, a result that was strengthened when the data were analyzed spatially.

One of the most meaningful results of the spatial analysis is that there does not appear to have been any major post-depositional or taphonomic impacts to the site that may affect the distribution of artifacts. The discrete clusters of bone, most of which is unweathered and in good condition, along with a fairly spatially restricted distribution of flaking debris and stone tools suggests that the deposits were intact when excavated.

By employing a site structure approach to these spatial data, meaningful patterns were realized. This approach has typically been employed at hunter-gatherer residential or camp sites and very rarely been used at mass kill sites. However, the tenets behind such an approach, discerning patterned behavior represented archaeologically by discrete clusters of artifacts, or activity areas, is useful to examine the spatial patterns of mass kill sites.

The distribution of bone appears to be clustered in two, and possibly three discrete areas within the site. Missing spatial data do not appear to have greatly impacted the patterns that can be seen by the available data. For example, the bone clusters have fairly defined edges that end before the suspected location of the test trench is reached. Additionally, the flaking debris is tightly concentrated in one area, far away from the location of the test trench. Therefore, the artifacts that can only loosely be mapped from the 1969 testing, at most, could only mean an additional cluster or two are missing. Rather than changing how the available data are interpreted, this would likely only strengthen the argument for spatially segregated activities on the site.

The clearest example of a localized task area is the tight concentration of flaking debris and stone tools ringing the outside of bone Cluster 2. The "package" data suggest that Cluster 2 may be more akin to a secondary processing area, where more intensive butchery and carcass processing took place. The large concentration of flaking debris along with discarded and broken stone tools supports this interpretation.

The landform on which the kill took place necessitated that the kill, butchery and processing occured in about the same area. This could explain the lack of any overtly obvious spatial distribution of certain elements. Also, if the kill, butchery, and processing are all taking place in about the same space, there is little chance that obvious transport decisions can be observed.

Based on the radiocarbon dates, the similar artifact assemblage, as well as a discussion in Witkind's (1971:49-52) original documentation of the site, there is no reason to suspect that there are different or multiple occupations represented at the site. Instead, the 1966 excavation area likely represents an extension of the task area identified on the cliff-side of the 1970 excavation block. The 1966 area is only about 4 m upslope of the flaked stone cluster and is the only flat spot on the entire site. Therefore, this area was likely used to further reduce bone for marrow extraction and bone grease production, as well as undertaking other activities such as bone bead production and projectile point manufacture.

This is further supported by the high concentration of fetal bison bone in this same area. There are multiple ethnographic accounts of fetal bone being considered the choicest cut of meat that suggest, if available, fetal bison were likely be immediately consumed. The high concentration of meatier elements of fetal bone in this flat area, some of which are clearly burned, indicates that the fetal bison were likely quickly removed, processed, and consumed on site.

Future Research

The summary presented above and the results of this thesis show that applying new methods and techniques to older collections does yield valuable results. However, as with any major research project, there is still much that can be done with the Roberts Buffalo Jump collection. The remainder of this chapter offers some directions for future research on the collection.

Modified Stone

The chipped stone analysis was designed to collect only baseline data about the assemblage. Much remains to be done with this collection. I only coded basic raw materials and unsystematically noted obvious raw material sources. Much more intensive work could be done with the raw material analysis. For instance, certain tools (e.g. the Shoshone knife and the end scraper made of Tiger chert) hint at possible affinities to northwest Colorado and southwest Wyoming cultural groups.

This could be further tested by a more detailed raw material analysis examining where certain materials are primarily located.

I also did not code any more detailed technological attributes on the flaking debris. A technological analysis of the flaking debris, such as coding for platform type and flake type, could further enhance the interpretation of the presumed function of the chipped stone assemblage. These data, that can now be quickly visualized spatially, could also help to further clarify or define the task areas identified in this research.

Ceramics

In the ceramics discussion in chapter 4 I noted some current research being conducted on the ceramics from the site as well as from other sites on the Roberts Ranch. In addition to these data, much more needs to be done with the ceramic assemblage. I did not attempt an in-depth analysis of the ceramic typology and how it relates to different ceramic traditions. I only used basic descriptive data on surface treatment and decoration to assign two different ceramic typologies. More work could be completed to better support these designations. This could include collecting data on ceramic assemblages from across northern Colorado and southern Wyoming to better define the ceramic types and their distributions. Such a research project would require a sample far larger than the Roberts assemblage, but the results of this project could greatly enhance the interpretations made in this thesis.

Bison Bone and Faunal Analysis

While the bison bone analysis was rather thorough, there is still additional work to be done. For instance, additional data could be analyzed to better refine the age profile at the site. The data on tooth eruption was collected by Peter Zawasky (1971) when this research method was just being developed. These methods have been refined and could readily be applied to the Roberts assemblage. Because so much other data on the Roberts assemblage is now available, this research would make a nice compliment to bolster the interpretations presented here.

Additionally, more work needs to be done to parse out the utility and methods applied to analyzing fetal bison bone. While some argue that these data cannot be used to identify a refined season of kill, data presented in chapter 5 shows that if enough data are available, meaningful interpretations can be made using fetal bone. Gathering data on fetal bison of known ages could greatly enhance the value of using fetal bone for seasonality studies.

The faunal remains from the site consist almost entirely of bison bone. However, as noted in chapter 4, the remains of two Canid sp. (domesticated dogs according to Witkind [1971:46]) are also in the collection. Analysis of these remains was completed by Danny Walker but was outside the scope of the research presented in this thesis. Further analysis of these remains, including their spatial distribution (many of them appear to come from in and around Cluster 2) could be completed. Missing elements from these remains could also be compared to the bone bead manufacturing debris to see if these were in fact being made from the remains of these two animals.

Spatial Analysis

Perhaps the most fruitful direction of future research lies in the use of the spatial data presented here. I only presented a few baseline examples of what could be done, but the possibilities are numerous. For example, much more could be done with examining bone element distribution at the site. I utilized coarse "package" data that could be further refined or adjusted and then quickly analyzed spatially. Nutritional utility values could be added to the database to better utilize those data in a spatial context. These data could also now utilize different spatial statistics to examine for other meaningful patterns not recognized here.

As noted above, additional data could be collected on aspects of the assemblage, such as the flaking debris. Now that many of these artifacts have spatial coordinates that can be quickly mapped, these data can be easily analyzed for patterned distributions.

Further work with the spatial data could also be completed to explore alternative taphonomic factors. For instance, the orientation of the long bones could be examined to see if the spatial distribution of the bones has been impacted by fluvial events. While this seems unlikely, considering the bones are in relatively good condition and were likely rapidly buried, it is worth exploring further to confirm the interpretations made herein. Other work, such as the effects of down slope movement of the bones, could also be explored to help elaborate on the spatial distribution of the bone and other artifact assemblage.

Other Research

One intriguing result that was realized near the completetion of this thesis is the contemproneity of the Roberts jump and the Killdeer Canyon (5LR289) stone ring site. Killdeer is just a few miles west of the jump, and is also on the Roberts Ranch. Collections from the site are currently being analyzed by Hallie Meeker as part of her Master's thesis work on residential sites in northern Colorado. The site has two dates that are very similar to the Roberts jump that calibrate to about the same age (Hallie Meeker, presonal communication 2016). We made brief attempts to refit lithic artifacts between the two sites with no results but much more work could be done with this. Many kill sites have associated (or presumed to be) camp sites. Whether or not Killdeer is directly related to the Roberts jump is unknown but it is an idea worth exploring with additional research.

Fieldwork

The three excavations appear to have removed the large majority of the assemblage from the site. However, there is additional fieldwork that could be done as a result of this thesis. For instance, there was no excavation completed upslope (on the cliff side) of grids 17-21, where the bone Cluster 1 was identified. Further excavation in this area might reveal if Cluster 1 actually represents a toss zone from another bone pile. Additionally, the stratigraphy at the site could be better defined by limited testing, which could also explore the potential for deeper deposits at the site. Also, areas near where the 1966 excavation could be further explored to test the idea that this area was indeed where non-butchery activities primarily took place. While the 2013 fieldwork identified some logistical issues with further fieldwork at the site, proper planning could mitigate some of these issues.

Lastly, while much can still be done with the Roberts jump, there are countless other similar sites, including many Late Prehistoric bison kills, which are in need of updated analyses. The methods presented in this thesis are just one way of getting new data from old sites. The scale of excavations at older sites like Roberts is rarely done in modern archaeology; the results of this thesis have shown that investigating old data with new methods can offer new and valuable interpretations, perhaps even altering how we view the archaeological record.

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APPENDIX A: ARTIFACT CODES

BONE CODES

ELEMENT (ELE)

Cranium/Teeth

CRN	cranium
DPUN	indeterminate deciduous premolar
HS	horn sheath
HY	stylohyoid
MR	mandible
MUN	indeterminate molar
PUN	indeterminate premolar
TFR	indeterminate tooth fragment

Axial

AT	atlas vertebra
AX	axis vertebra
CA	caudal vertebra
CE	cervical vertebra
CS	costal cartilage
LM	lumbar vertebra
MN	manubrium
RB	rib
SA	sacral vertebra
SAC	sacrum
SN	sternal element
TH	thoracic
VT	indeterminate vertebra

Appendicular (Forelimb)

CP	indeterminate carpal
CPA	accessory carpal (dew claw)
CPF	4th carpal
CPI	indetermediate carpal
CPR	radial carpal
CPS	fused 2nd and 3rd carpal
CPU	ulnar carpal
HM	humerus
MC	metacarpal
MCF	5th metacarpal
RD	radius
RDU	radius-ulna
SC	scapula
UL	ulna

Appendicular (Hindlimb)

AS	astragalus
CL	calcaneus
FM	femur
LTM	lateral malleous
IM	innominate
MT	metatarsal
MTS	2nd metatarsal
PT	patella
PV	complete pelvis
TA	tibia
HS	horn sheath
INV	incisive
JUG	jugal process
TR	indeterminate tarsal
TRC	fused central and 4th tarsal
TRF	1st tarsal
TRS	fused 2nd and 3rd tarsal

Other Appendicular

DEW	accessory phalanx
MP	indeterminate metapodial
PH	indeterminate phalanx
PHF	1st phalanx
PHS	2nd phalanx
PHT	3rd phalanx
SE	indeterminate sesamoid
SED	distal sesamoid
SEP	proximal sesamoid

Fragments

CB	indeterminate cancellous bone
FB	indeterminate flat bone
LB	indeterminate long bone
UN	unidentified fragment

PORTION (POR)

Long Bone

BL	blade of scapula or rib
CDL	condyle
CO	complete
DDS	distal diaphysis
DF	diaphysis
DFD	DS+DSE
DFP	DF+PRE
DPR	proximal diaphysis
DS	distal end
DSE	distal epiphysis
DSH	distal, articular end > 1/2 shaft
DSS	distal, articular end < 1/2 shaft
EP	epiphysis
FK	flake, <1/2 circumference of shaft
HE	head
IFC	impact cone
IFK	impact flake
PR	proximal end
PRE	proximal epiphysis
PRS	proximal, articular end plus >1/2 shaft
PSH	proximal, articular end plus <1/2 shaft
SH	long bone shaft
US	unspecified

Cranium

BRC	braincase
BSL	basilar
DP2-4	deciduous maxillary premolar
EN	tooth enamel
FN	frontal
HC	horn core
PEP	posterior epiphysis
TSP	transverse spinous process

LC	lacrimal
M1-3	maxillary molar #
MUN	indeterminate maxillary molar
MX	maxilla
NSL	nasal
OCC	occipital
PAL	palatine
PAR	parietal
PET	petrosal
P2-4	maxillar premolar #
PUN	indeterminate maxillary premolar
SKO	other combination
SR	skull roof (FN+HC)
TMP	temporal
TW	tooth row
ZYG	zygomatic
	Mandible
ANG	angle
BDR	distal border
CP	condylar process
CRD	coronoid process
DAM	DRM+RAM
DIC	deciduous incisor
DP2-4	deciduous mandibular premolar
DRM	dentary ramus
EN	tooth enamel
HRM	horizontal ramus
IC	incisor
P2-4	mandibular premolar #
M1-3	mandibular molar
MUN	indeterminate mandibular molar
PUN	indeterminate mandibular premolar
RAM	ascending ramus
SYM	symphysis
TW	tooth row
	Stylohyoid
ANG	angle
BOD	body
	Vertebra
AEP	anterior epiphysis
AP	articular process
CN	centrum
CAN	CN+AP
CNN	CN+neural arch
CNS	CN+dorsal spine
CNW	atlas, CN+wings
CNT	CN+TSP
DSP	dorsal spinous process
NAS	neural arch+spine
	Scapula
CRB	cranial border
CBD	caudal border
GN	glenoid
GS	GN+spine
GNB	GN+blade fragment
	Ulna
ANC	trochlear notch portion
OLC	olecranon portion
SH	shaft
	Innominate
AC	acetabulum
ACL	AC+IL
ACP	AC+PB
ACS	AC+IS
IL	illium
ILC	illium (cranial)
ILD	ilium (caudal)
IS	ischium
ISC	ischium (cranial)
ISD	ischium (caudal)
PB	pubis
PBS	pubis symphysis
VPT	ventral pubic tubercle
SEGMENT (SEG)	
AL	anterolateral
AM	anteromedial
CD	caudal (posterior)
CDL	condyle
CO	complete
CR	cranial
DR	dorsal
DS	distal
EN	tooth enamel
EX	exterior
FO	fore
FR	fragment
HB	split rib blade
HD	hind
HE	head
IN	interior
LT	lateral
ME	medial
PL	posterolateral
PM	posteromedial
PR	proximal
SP	spine
TW	tooth row
VN	ventral
US	unspecified
#	vertebra/rib/tooth

SIDE (SD)

L	left
N	not sided
R	right

FUSION-Proximal and Distal (PF; DF)

0	unfused
1	partially fused
2	fused, line visible
3	complete fusion
4	broken, indeterminate
5	not applicable

BURN

0	not burned
1	charred
2	calcined

SPIRAL FRACTURE (FRACT)

0	absent
1	present

CARNIVORE MODIFICATION (CARV)

0	absent
1	present

CUT

0	absent
1	present

Modified Stone

Technological Class (TECH)

1	Patterned small thin biface
2	Patterned large thin biface
3	Unpatterned small to medium biface
4	Patterned steeply beveled flake tool
5	Unpatterned flake tool, retouched or use modified
6	Large thick bifacial core-tool
7	Non bipolar core and core –tool
8	Bipolar core and core-tool
9	Unpatterned pecked and ground tool
10	Patterned peck or ground tool
11	Radial break tool
12	Retouched tabular piece or plate

Functional Class (FUNC)

BF	biface
BL	blade
BU	burin
CHP	chopper
CR	core
DN	denticulate
DR	drill
ES	end scraper
GR	graver
GRD	ground stone fragment
HS	hammerstone
MAN	handstone/mano
MET	grinding surface/metate
MP	manuport
OT	other formal tool
PP	projectile point
PRE	preform
RET –	retouched flake
SA	shaft abrader
SC	unidentified scraper
SH	shatter
SP	heat spall
SS	side scraper
TC	tested cobble
UF	edge modified flake

Material (RAWMAT)

1	chert
2	chalcedony
3	quartzite
4	tuff
5	basalt
6	petrified wood
7	obsidian
8	sandstone
9	quartz
99	unknown

Heat (HEAT)

0	unheated
2	heat treated
9	not applicable

Burning (BURN)

0	not burned
2	burned
9	not applicable

Cortex (CORT)

0	no cortex
1	cortex present

Size Grade (SIZE)

1	G1
2	G2
3	G3
4	G4

APPENDIX B: MODIFIED STONE DATA

Chipped Stone Flaking Debris (CSFD):

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1001	38.2	H3	19	2	9	2	0	25.3	2	1.4	1	57.68	18.75
1002	38.2	R4	22	1	9	2	0	20.9	2	0.8	1	57.31	16.40
1003	38.2	I1	18.5	2	9	2	0	21	2	1.2	1	58.13	18.69
1004	38.2	R4	22	2	9	2	0	24	2	1.1	1	57.18	16.63
1005	38.2	N8	14.5	1	9	2	0	21.2	2	1.3	1	58.64	17.10
1006	38.2	R6	19	2	9	2	0	35.1	3	2.6	1	57.84	16.38
1007	38.2	R4	22	2	9	2	0	31	3	2.7	1	57.29	16.49
1008	38.2	R6	19	2	9	2	0	36.2	2	5.7	1	57.71	16.56
1009	21.1		0-19	1	9	2	0	14.5	2	0.5	1	22.43	7.45
1010	38.2	I3	17	1	9	2	0	26.4	3	2	1	58.76	18.75
1011	25.1		20-32	2	9	2	0	15.4	2	0.4	1	62.47	7.57
1012	38.2	H1	19	3	9	9	0	29.5	3	2.7	1	57.16	18.83
1013	38.2	M5	12	2	9	2	0	24.6	2	1	1	57.61	17.64
1014	38.2	H1	19	1	9	2	0	20.6	2	1.7	1	57.10	18.80
1015	38.2	I3	17	1	9	2	0	39.3	3	2.4	1	58.77	18.81
1016	38.2	N8	14.5	2	9	2	0	21.3	2	0.7	1	58.64	17.25
1017	38.2	D8	19	1	9	2	0	30.7	3	2.7	1	58.49	19.25
1018	38.2	I3	14.5	2	9	2	0	27.8	3	1.2	1	58.69	18.82
1019	38.2	R4	22	1	9	2	0	27	3	2.7	1	57.02	16.53
1020	38.2	I1	18.5	2	9	2	0	15.2	2	0.5	1	58.09	18.93
1021	38.2	D8	19	1	9	2	0	18.8	2	1.8	1	58.65	19.14
1022	38.2	R4	22	2	9	2	0	23.5	2	1.1	1	57.01	16.40
1023	38.2	D8	19	1	9	2	0	32.7	3	2.6	1	58.39	19.30
1024	38.2	M1	14	2	9	2	0	35.5	2	3.5	1	57.17	17.87
1025	39.1	U5	16	1	9	2	0	25	2	0.9	1	60.52	15.58
1026	38.2	N5	18	3	9	9	0	21.4	2	1	1	58.42	17.38
1027	38.2	R4	22	2	9	2	0	28.9	3	1.9	1	57.30	16.47
1028	38.2	H1	19	1	9	2	0	26.5	3	0.6	1	57.26	18.96
1029	38.2	R1	16	1	9	2	0	20.5	2	0.7	1	57.03	16.83
1030	38.2	I3	17.5	3	9	9	0	35.4	3	2.4	1	58.95	18.83
1031	38.2	R4	22	1	9	2	0	27.4	3	2.1	1	57.13	16.49
1032	38.2	R1	16	2	9	2	0	23	2	1	1	57.31	16.80

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1033	38.2	R6	19	1	9	2	0	25.5	3	1.5	1	57.88	16.53
1034	39.2	I5	17	1	9	2	0	41.9	2	3.7	1	68.38	18.55
1035	38.2	I3	17	1	9	2	0	47	2	4.3	1	58.97	18.94
1036	38.2	N8	14.5	2	9	2	0	22.7	2	0.7	1	58.38	17.17
1037	38.2	H1	19	1	9	2	0	20.7	2	0.8	1	57.09	18.77
1038	38.2	S2	17.5	1	9	2	0	27.9	3	1.4	1	58.38	16.70
1039	21.1		0-19	1	9	2	0	9.7	3	0.1	1	22.56	7.43
1040	38.2	N8	14.5	2	9	2	0	23.4	2	1.6	1	58.50	17.05
1041	38.2	N8	14.5	1	9	2	0	22	2	1.3	1	58.38	17.12
1042	21.1		0-19	2	9	2	0	15.2	2	0.3	1	22.51	7.57
1043	38.2	N8	14.5	2	9	2	0	23.7	2	1.9	1	58.41	17.28
1044	21.1		0-19	1	0	0	0	15.7	2	0.6	1	22.59	7.41
1045	38.2	R4	22	1	9	2	0	32	3	1.6	1	57.21	16.58
1046	38.1	G5	18	1	9	2	0	20.7	2	1	1	51.41	18.63
1047	38.2	G5	18	1	9	2	0	24.7	2	1	1	56.52	18.55
1048	38.2	N8	14.5	2	9	2	0	20.7	2	0.5	1	58.38	17.26
1049	25.1		12-18	2	9	2	0	11.8	3	0.03	1	62.66	7.57
1050	38.2	D5	18	2	9	2	0	22.6	2	0.7	1	58.49	19.43
1051	38.2	N8	14.5	1	9	2	0	16.3	2	1	1	58.36	17.02
1052	39.2	I8	17	1	9	2	0	28	3	2.1	1	68.64	18.09
1053	38.2	D8	19	1	9	2	0	23.1	2	0.7	1	58.49	19.18
1054	38.2	H3	19	1	9	2	0	51.4	2	5	1	57.98	18.94
1055	38.2	D8	19	1	9	2	0	32.3	3	1.9	1	58.49	19.21
1056	38.2	D5	18	1	9	2	0	25.8	3	1	1	58.62	19.62
1057	21.1		0-19	1	9	2	1	13.8	2	0.1	1	22.54	7.54
1058	38.2	G5	18	2	9	2	0	29.7	3	1.9	1	56.52	18.40
1059	38.2	I3	17.5	1	9	2	0	26.7	3	1.5	1	58.70	18.70
1060	38.2	H1	19	2	9	2	0	32.8	2	4.4	1	57.01	18.80
1061	38.2	R4	22	2	9	2	0	20.2	2	0.7	1	57.20	16.36
1062	38.2	N5	11	3	9	9	0	37.2	3	1.6	1	58.57	17.38
1063	38.2	H3	19	1	0	0	0	23.3	2	1.1	1	57.98	18.94
1064	39.3	A4	16	2	9	2	0	25.8	3	1.6	1	60.15	14.51
1065	38.2	R4	22	1	9	2	0	30.7	3	1.7	1	57.32	16.34
1066	38.2	N8	14.5	3	9	2	0	29.5	3	1.4	1	58.48	17.33
1067	38.2	D8	19	1	9	2	0	47.9	1	9.1	1	58.39	19.21
1068	38.2	N8	14.5	1	9	2	0	29.4	3	2.5	1	58.66	17.33
1069	38.2	I3	17	2	9	2	0	16.1	2	0.3	1	58.73	18.94
1070	38.2	N8	14.5	3	9	9	0	25.5	3	1.2	1	58.53	17.05
1071	38.2	R4	22	1	0	0	0	22.7	2	1	1	57.22	16.58

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1072	38.2	N8	14.5	3	9	2	0	29.1	3	1.4	1	58.61	17.18
1073	25.1		12-18	1	0	0	1	19.8	2	1.9	1	62.41	7.64
1074	38.2	H1	14	1	9	2	0	29.2	3	2.4	1	57.23	18.69
1075	38.2	G5	18	2	9	2	0	21.9	2	1.3	1	56.38	18.41
1076	38.2	D8	19	3	9	9	0	35.2	3	2.6	1	58.43	19.30
1077	39.4	B3	17	2	9	2	0	35.8	3	2.8	1	66.75	14.77
1078	38.2	S3	17.5	3	9	9	0	20.8	2	0.8	1	58.77	16.94
1079	38.2	R4	22	1	9	2	0	42	2	4.3	1	57.27	16.50
1080	38.2	I1	18.5	2	9	2	0	37.8	2	4.7	1	58.26	18.79
1081	38.2	I2	16	1	9	2	0	47.7	2	4.7	1	58.57	18.85
1082	38.2	D5	18	1	9	2	0	37.7	2	5.4	1	58.49	19.63
1083	39.2	I5	17	1	9	2	0	23.9	2	1.3	1	68.34	18.39
1084	21.1	2	0-19	1	9	2	0	26.3	3	2.4	1		
1085	38.2	D8	17	1	9	2	0	32.7	3	1.4	1	58.46	19.16
1086	38.2	D5	18	3	9	9	0	24.5	2	4.6	1		
1087	38.2	R6	19	1	9	2	0	39.6	3	1.8	1	57.81	16.54
1088	38.2	R4	22	3	9	9	0	22.9	2	0.9	1	57.15	16.39
1089	38.2	M8	12	1	9	2	0	21.7	2	1.3	1	57.64	17.19
1090	38.2	N8	14.5	2	9	2	0	23.3	2	1.2	1	58.54	17.08
1091	38.2	H3	19	1	9	2	0	26.3	3	2.6	1	57.72	18.89
1092	38.2	G5	18	3	9	9	0	30	3	1.8	1	56.48	18.45
1093	38.2	S2	17.5	2	9	2	0	35	2	5.1	1	58.59	16.70
1094	38.2	I3	18	1	9	2	0	41.2	2	4.3	1	58.69	18.92
1095	38.2	G5	18	1	9	2	0	32.5	3	1.8	1	56.41	18.64
1096	38.2	H1	19	3	9	9	0	33.2	2	3.4	1	57.32	18.78
1097	38.2	S2	17.5	1	9	2	0	26.9	3	1.8	1	58.37	16.78
1098	38.2	I2	16	1	9	2	0	39.3	2	4.4	1	58.57	18.70
1099	38.2	N8	14.5	2	9	2	0	26.3	3	2.3	1	58.35	17.08
1100	38.2	N8	14.5	2	9	2	0	30	3	1.5	1	58.54	17.26
1101	38.2	G5	18	1	9	2	0	30.6	3	2.2	1	56.59	18.58
1102	38.2	R5	19	1	9	2	0	22.1	2	0.6	1	57.56	16.53
1103	38.2	M5	12	2	9	2	0	22.9	2	1.4	1	57.61	17.65
1104	38.2	S2	17.5	2	9	2	0	20.8	2	1	1	58.43	16.74
1105	38.2	R6	19	1	9	2	0	31.4	3	2.1	1	57.92	16.38
1106	38.2	R4	22	2	9	2	0	18.9	2	0.6	1	57.32	16.51
1107	39.2	I5	17	1	9	2	0	28.4	3	2.5	1	68.41	18.43
1108	38.2	I1	18.5	2	9	2	0	19.7	2	0.8	1	58.11	18.75
1109	38.2	I3	17	2	9	2	0	26.4	3	1.6	1	58.93	18.69
1110	38.2	G5	18	2	9	2	0	42.4	2	4.1	1	56.59	18.36

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1111	38.2	R1	16	2	9	2	0	23.3	2	1	1	57.21	16.89
1112	38.2	D5	18	2	9	2	0	24.2	2	0.9	1	58.56	19.48
1113	38.2	N8	14.5	1	9	2	0	22.6	2	1.4	1	58.46	17.06
1114	39.1	U5	15	1	9	2	0	18.9	2	0.8	1	60.36	15.51
1115	38.2	N8	14.5	1	9	2	0	23.8	2	1	1	58.53	17.06
1116	21.1		0-19	1	0	0	0	28.1	2	3	1	22.47	7.46
1117	38.2	I3	17.5	1	9	2	0	52.5	1	9.3	1	58.94	18.91
1118	38.2	S3	17.5	1	9	2	0	33.8	2	4.2	1	58.94	16.78
1119	38.2	N8	14.5	2	9	2	0	31.7	3	2	1	58.52	17.04
1120	38.2	I2	16	2	9	2	0	39.4	2	3.5	1	58.41	18.87
1121	38.2	R1	16	1	9	2	0	27	3	1.5	1	57.18	16.89
1122	38.2	N8	14.5	1	9	2	0	26.2	3	1.7	1	58.35	17.08
1123	38.1	R6	19	2	9	2	0	21.5	2	0.7	1	52.95	16.35
1124	38.2	I3	17	1	9	2	0	32.6	3	1.3	1	58.98	18.89
1125	38.2	I3	17.5	2	9	2	0	25.5	3	1.8	1	58.79	18.91
1126	38.2	R4	22	2	9	2	0	25.9	3	2.2	1	57.28	16.44
1127	38.2	G7	15	1	9	2	0		3	1.7	1	56.01	18.32
1128	38.2	R4	22	2	9	2	0	31.4	3	1.9	1	57.01	16.34
1129	38.2	T3	17.5	3	9	9	0	28.4	3	2.4	1		
1130	38.2	H3	19	1	9	2	0	30.2	3	1.8	1	57.72	18.77
1131	38.2	S3	17.5	1	9	2	0	20.1	2	0.8	1	58.88	16.87
1132	38.2	D8	19	2	9	2	0	23.3	2	0.8	1	58.34	19.16
1133	38.2	I3	17	2	9	2	0	21.1	2	0.9	1	58.94	18.99
1134	38.2	R6	19	2	9	2	0	28	3	1.3	1	57.78	16.54
1135	38.2	N5	11	3	9	9	0	47.3	1	14.4	1	58.52	17.43
1136	38.2	I3	17	2	9	2	0	45.4	1	6.1	1	58.96	18.94
1137	38.2	R2	14	1	9	2	0	45.3	1	9	1	57.51	16.84
1138	38.2	D5	18	1	9	2	0	57.1	1	9.6	1	58.41	19.46
1139	38.2	M5	12	1	9	2	0	37.4	1	6.1	1	57.56	17.52
1140	38.2	I3	17.5	2	9	2	0	21.7	2	1.2	1	58.74	18.96
1141	38.2	I3	17.5	3	9	9	0	27.7	3	1.1	1	58.78	18.70
1142	38.2	G5	18	3	9	9	0	42.2	2	5	1	56.54	18.36
1143	38.2	N8	14.5	2	9	2	0	24.5	2	1	1	58.48	17.16
1144	38.2	I3	17.5	3	9	9	0	39	2	5.4	1	58.72	18.70
1145	38.2	I3	17	2	9	2	0	30.8	3	2	1	58.95	18.68
1146	38.2	M1	19	3	9	9	0	57.8	1	8.2	1	57.11	17.84
1147	38.2	D2	18	2	9	2	0	34.7	2	3	1	58.61	19.71
1148	38.2	D2	18	2	9	2	0	29.7	3	2.3	1	58.39	19.72
1149	38.2	D2	18	1	9	2	0	34.5	3	1.9	1	58.51	19.83

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1150	38.2	D2	18	2	9	2	0	39.2	3	2.7	1	58.46	19.79
1151	38.2	D2	18	2	9	2	0	30.6	3	2.7	1	58.62	19.80
1152	39.2	I4	7.25	2	2	0	0	16.2	2	0.5	1	68.27	18.52
1153	38.2	D2	18	1	9	2	0	37.3	1	6.9	1	58.63	19.80
1154	25.1	L3	22	2	0	0	0	38.8	2	5.5	1	61.83	7.87
1155	38.2	D2	18	1	9	2	0	46.8	3	2	1	58.45	19.91
1156	39.1	O9	9	2	0	0	0	29.8	3	1.8	1	64.79	17.23
1157	25.1	M4	26	2	0	0	0	22.2	2	1.1	1	62.18	7.55
1158	36.3	T7	18	1	0	0	0	44.8	1	8.7	1	34.15	11.23
1159	38.2	D2	18	2	9	2	0	32.1	3	2	1	58.41	19.89
1160	25.1	R7	16	2	9	2	0	25.9	3	2.2	1	62.16	6.26
1161	38.2	T1	19	1	9	2	0	30	2	3.4	1	59.08	16.87
1162	38.2	D2	18	2	9	2	0	46.6	1	10.1	1	58.39	19.79
1163	39.2	I4	7.25	2	0	0	0	32.4	3	1.8	1	68.10	18.40
1164	38.2	D2	18	1	9	2	0	42.8	2	3.9	1	58.42	19.69
1165	38.2	I9	19	2	9	2	0	28	2	3.2	1	58.70	18.25
1166	38.2	D2	18	1	9	2	0	43.6	2	4.4	1	58.65	19.74
1167	25.1	J	25	2	0	0	0	42.1	1	8.6	1	64.40	8.38
1168	38.2	D2	18	3	9	9	0	31.7	3	1.9	1	58.42	19.98
1169	38.2	I9	19	2	9	2	0	24.1	2	1.1	1	58.86	18.05
1170	25.2	Y2	30	1	9	2	0	31.5	2	3.6	1	69.40	5.91
1171	38.2	I9	19	1	9	2	0	20.9	2	0.7	1	58.98	18.02
1172	38.2	D2	18	3	9	9	0	35.7	2	3.5	1	58.40	19.95
1173	38.2	D2	18	1	9	2	0	35.7	1	6.1	1	58.66	19.70
1174	38.2	D2	18	1	9	2	0	36.4	2	5.2	1	58.64	19.92
1175	38.2	D8	19	2	9	2	0	24.7	2	1.4	1	58.49	19.12
1176	39.2	R	16	2	0	0	0	22	2	0.6	1	67.37	16.57
1177	21.1	2	0-19	2	9	2	0	14.8	2	0.4	1		
1178	38.2	I5	17	1	9	2	0	71.4	1	18.3	1	58.64	18.49
1179	39.2	I5	17	1	9	2	0	54	1	31.5	1	68.51	18.47
1180	38.2	H1	19	1	9	2	0	68.2	1	57.5	1	57.14	18.71
1181	39.2	I5	17	8	9	2	0		1	52.2	1	68.36	18.47
1182	38.2	N8	14.5	2	9	2	0	32.7	3	2.8	1	58.54	17.14
1183	38.2	54	19	3	9	9	0	39.5	1	6.4	1		
1184	38.2	M5	12	1	9	2	0	22.2	2	1	1	57.50	17.50
1185	38.2	R1	16	2	9	2	0	29.7	3	2.2	1	57.24	16.98
1186	38.2	D8	19	2	9	2	0	27	3	1	1	58.47	19.30
1187	38.2	H1	19	1	9	2	0	33.7	3	2.5	1	57.06	18.95
1188	38.2	I1	18.5	1	9	2	0	30.7	3	1.9	1	58.20	18.79

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1189	38.2	D5	18	1	9	2	0	57.9	1	20.4	1	58.63	19.54
1190	38.2	S3	17.5	2	9	2	0	31	3	2.5	1	58.85	16.88
1191	21		19-29	1	9	2	0	29.9	2	4.2	1	24.91	4.95
1192	38.2	I3	17	3	9	9	0	30.7	3	2.1	1	58.71	18.74
1193	38.2	N8	14.5	2	0	0	0	21.5	2	1.1	1	58.39	17.27
1194	38.2	D8	19	2	9	2	0	22.9	2	0.9	1	58.43	19.06
1195	38.2	H3	19	3	9	9	0	38.9	3	2.7	1	57.92	18.81
1196	38.2	H1	19	2	9	2	0	38	2	4	1	57.08	18.76
1197	38.2	I3	17	2	9	2	0	42.7	1	6.1	1	58.84	18.71
1198	38.2	R6	19	1	9	2	0	24.4	2	1.6	1	57.76	16.47
1199	38.2	N8	14.5	1	9	2	0	51.6	1	30.5	1	58.34	17.05
1200	38.2	H3	19	2	9	2	0	21.4	2	1.2	1	57.97	18.95
1201	38.2	S3	17.5	1	9	2	0	25.8	3	1.5	1	58.89	16.79
1202	38.2	N8	14.5	1	9	2	0	29	3	1.6	1	58.50	17.26
1203	39.1	U9	18	2	0	0	0	26.4	3	2	1	60.79	15.33
1204	38.2	D2	18	1	9	2	0	31.3	2	3.6	1	58.57	19.84
1205	25.3	E5	20	2	9	2	0	29	2	3.2	1	64.51	4.48
1206	39.1	L	15.5	2	9	2	0	30	3	1.7	1	61.62	17.34
1207	25.2	Y	25	1	0	0	0	46.9	1	6.2	1	69.34	5.55
1208	26.3	I8	24	2	0	0	0	41.6	1	8.3	1	73.52	3.28
1209	25.4	C5	24	2	0	0	0	39.7	2	5.5	1	67.52	4.46
1210	38.2	I9	19	1	9	2	0	30.8	3	2.5	1	58.89	18.28
1211	25.1	O3	24	1	0	0	0	48.1	1	9.9	1	64.73	7.82
1212	38.2	D2	18	2	9	2	0	36.3	2	4.7	1	58.57	19.93
1213	38.2	D2	18	2	9	2	0	41.8	2	5.6	1	58.52	19.72
1214	39.3	I	9	2	0	0	0	27.3	3	2.5	1	63.57	13.39
1215	38.2	I9	19	2	9	2	0	25.4	3	1	1	58.79	18.24
1216	39.1	B9	12	2	2	0	0	33.4	2	4.5	1	61.80	19.08
1217	38.2	I4	19	3	9	9	0	24.5	2	1.1	1	58.26	18.57
1218	38.2	I9	19	1	9	2	0	27.3	3	1.3	1	58.81	18.33
1219	38.2	I9	19	2	9	2	0	20.9	2	0.7	1	58.78	18.13
1220	38.2	D2	18	1	9	2	0	29.6	2	3.7	1	58.53	19.83
1221	38.2	I4	19	1	0	0	0	23.2	2	1	1	58.93	18.28
1222	38.2	I9	19	2	9	2	0	24.2	2	1	1	58.98	18.24
1223	38.2	G2	18	2	9	2	0	44	1	6.5	1	56.57	18.84
1224	38.2	T1	19	2	9	2	0	29.2	2	3.2	1	59.29	16.96
1225	25.3	E5	18	1	9	2	0	37	1	9.7	1	64.62	4.49
1226	25.1	C	24	1	9	2	0	33.8	2	4.5	1	62.40	9.62
1227	39.1	L	15.5	2	9	2	0	25.2	2	1.4	1	61.51	17.54

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1228	39.1	L	15.5	2	9	2	0	36.8	2	4.5	1	61.43	17.51
1229	38.2	D2	18	1	9	2	0	29.6	3	2.6	1	58.37	19.91
1230	38.2	D2	18	2	9	2	0	28.2	3	1.5	1	58.52	19.74
1231	39.2	F	12	2	9	2	0	23.1	2	1.8	1	65.64	18.58
1232	38.2	I1	19	3	9	9	0	36.3	1	6.1	1	58.08	18.77
1233	38.2	L6	16	3	9	9	0	29	2	3.1	1	56.99	17.50
1234	38.2	N8	14.5	1	9	2	0	37	3	2.8	1	58.39	17.32
1235	38.2	N8	14.5	2	9	2	0	38.5	2	4.4	1	58.58	17.24
1236	38.2	N8	14.5	1	9	2	0	36.2	3	1.7	1	58.56	17.26
1237	38.2	I3	17.5	2	9	2	0	32.1	2	3.3	1	58.68	18.89
1238	38.2	I3	17	2	9	2	0	33.2	3	2.3	1	58.69	18.71
1239	38.2	N8	14.5	1	9	2	0	25.5	3	0.7	1	58.53	17.05
1240	38.2	D8	19	2	9	2	0	26.8	3	1.9	1	58.57	19.19
1241	38.2	D5	18	1	9	2	0	27.7	3	1.9	1	58.41	19.47
1242	39.2	W5	10	2	9	2	0	41	1	6.2	1	67.59	15.46
1243	38.2	R6	19	1	9	2	0	61.9	1	27.3	1	57.83	16.43
1244	38.2	I1	18.5	1	0	0	0	25.9	3	2.2	1	58.09	18.76
1245	38.2	I3	17	3	9	9	0	39.1	2	3.1	1	58.83	18.74
1246	39.2	I5	17	8	9	2	0		1	82.1	1	68.55	18.50
1247	25.1	N5		1	0	0	0	42.8	2	3.9	1	63.36	7.46
1248	38.2	I9		1	9	2	0	29.7	3	2.6	1	58.72	18.18
1249	38.2	I9		1	9	2	0	15.7	2	0.4	1	58.94	18.04
1250	66.3		22-33	2	0	0	1	16.7	2	0.5	1	52.50	42.34
1251	66.3		22-33	2	0	0	1	16.7	2	0.2	1	52.51	42.45
1252	66.3		22-33	2	0	0	0	14	2	0.2	1	52.47	42.64
1253	66.3		22-33	2	0	0	1	11.1	3	0.1	1	52.48	42.38
1254	66.3		22-33	2	0	0	0	13.9	2	0.2	1	52.59	42.58
1255	66.3		22-33	2	0	0	1	14.2	2	0.1	1	52.44	42.39
1256	66.3		22-33	2	0	0	0	16.1	2	0.4	1	52.43	42.44
1257	66.3		22-33	2	0	0	0	14.1	2	0.4	1	52.65	42.40
1258	66.3		22-33	2	0	0	0	11	3	0.2	1	52.65	42.49
1259	66.3		22-33	2	0	0	0	15.1	2	0.2	1	52.37	42.61
1260	66.3		22-33	2	0	0	0	19.9	2	0.5	1	52.45	42.53
1261	66.3		22-33	2	0	0	0	7.6	3	0.03	1	52.42	42.51
1262	66.3		14-16	2	0	0	0	9.8	3	0.1	1	52.55	42.55
1263	66.3		14-16	1	0	0	0	11.1	3	0.1	1	52.60	42.49
1264	66.3		14-16	1	0	0	0	11.6	3	0.03	1	52.59	42.47
1265	66.3		14-16	2	0	0	0	11	3	0.1	1	52.44	42.56
1266	66.3		7	2	0	0	0	31.3	2	3.8	1	52.47	42.61

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1267	37.3		17-27	1	9	2	0	12.3	3	0.6	1	42.65	12.52
1268	37.3		17-27	2	0	0	0	12.1	3	0.3	1	42.52	12.49
1269	37.3		17-27	2	0	0	0	10.6	3	0.2	1	42.63	12.45
1270	37.3		17-27	1	0	0	0	11.1	3	0.1	1	42.55	12.65
1271	37.3		17-27	2	0	0	0	14.5	2	0.4	1	42.52	12.45
1272	37.3		17-27	2	0	0	0	10.7	3	0.3	1	42.65	12.36
1273	37.3		17-27	3	9	9	0	13.1	2	0.1	1	42.65	12.59
1274	37.3		17-27	3	9	9	0	12.9	2	0.1	1	42.47	12.40
1275	37.3		17-27	1	9	2	0	9	3	0.03	1	42.66	12.54
1276	37.3		17-27	1	0	0	0	13.9	2	0.1	1	42.61	12.38
1277	37.3		17-27	2	0	0	0	9.3	3	0.03	1	42.34	12.56
1278	37.3		17-27	1	0	0	0	10.1	3	0.1	1	42.46	12.48
1279	37.3		17-27	2	0	0	0	10.5	3	0.1	1	42.57	12.43
1280	37.3		17-27	1	0	0	0	9.6	3	0.1	1	42.50	12.49
1281	37.3		17-27	2	0	0	0	7.9	3	0.03	1	42.55	12.59
1282	37.3		17-27	3	9	9	0	9.2	3	0.1	1	42.64	12.64
1283	37.3		17-27	2	0	0	0	9.6	3	0.03	1	42.34	12.34
1284	66.3			2	0	0	0	17.1	2	0.7	1	52.48	42.63
1285	66.3			1	0	0	0	22.3	2	2.5	1	52.42	42.54
1286	66.3			2	0	0	0	20.8	2	0.9	1	52.52	42.63
1287	66.3			2	0	0	0	18.8	2	0.5	1	52.61	42.43
1288	66.3			2	0	0	0	15.9	2	0.6	1	52.60	42.56
1289	66.3			2	0	0	0	16.4	2	0.5	1	52.43	42.59
1290	66.3			2	0	0	0	10.8	3	0.1	1	52.42	42.50
1291	23.2			2	0	0	0	36.6	2	5.1	1	47.48	7.44
1292	23.2			2	0	0	0	17.5	2	0.4	1	47.38	7.53
1293	23.2			2	0	0	0	31.1	3	2.6	1	47.60	7.66
1294	23.2			9	9	9	0	18.3	2	0.9	1	47.39	7.49
1295	23.2			2	0	0	0	17.4	2	0.9	1	47.62	7.56
1296	23.2			2	0	0	0	8.4	3	0.03	1	47.55	7.65
1297	23.2			2	0	0	0	14.7	2	0.2	1	47.55	7.38
1298	23.2			2	0	0	1	12.8	2	0.3	1	47.45	7.59
1299	23.2			2	0	0	0	11.7	3	0.2	1	47.34	7.66
1300	23.2			2	0	0	0	11.2	3	0.5	1	47.65	7.48
1301	23.2			2	0	0	0	13.5	2	0.03	1	47.54	7.35
1302	23.2			2	0	0	0	17.6	2	0.4	1	47.40	7.55
1303	23.2			9	9	9	0	14.5	2	0.3	1	47.53	7.52
1304	23.2			1	0	0	0	11.8	3	0.1	1	47.57	7.34
1305	23.2			4	0	0	0	10.3	3	0.1	1	47.43	7.35

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1306	51.4		0-12	2	0	0	0	12.6	3	0.1	1	47.54	22.42
1307	51.4		0-12	9	9	9	0	12.1	3	2.8	1	47.63	22.60
1308	51.4		0-12	1	0	0	0	26.3	3	0.03	1	47.66	22.35
1309	51.4		0-12	1	0	0	0	8.3	3	0.03	1	47.53	22.42
1310	51.4		0-12	1	0	0	0	34.4	3	2.3	1	47.37	22.39
1311	51.4		0-12	2	9	2	0	23.2	2	0.9	1	47.61	22.47
1312	51.4		0-12	2	0	0	0	16.2	2	0.5	1	47.46	22.35
1313	51.4		0-12	1	2	0	0	18.1	2	0.5	1	47.40	22.56
1314	51.4		0-12	1	9	2	0	16.4	2	0.9	1	47.44	22.44
1315	51.4		0-12	1	0	0	0	14.7	2	0.4	1	47.44	22.51
1316	37.3			2	9	2	0	18.3	2	0.7	1	42.56	12.54
1317	37.3			1	9	2	0	18.8	2	0.7	1	42.41	12.62
1318	37.3			1	9	2	0	30.2	3	1.5	1	42.50	12.55
1319	66.3			1	0	0	0	27.6	3	1.1	1	52.42	42.41
1321	66.3			1	0	0	0	16	2	0.1	1	52.35	42.41
1322	66.3			2	0	0	0	19.4	2	0.4	1	52.48	42.39
1323	66.3			2	0	0	0	18.6	2	0.2	1	52.62	42.46
1324	66.3			2	0	0	0	11	3	0.1	1	52.48	42.63
1325	66.3			1	0	0	0	8.9	3	0.03	1	52.36	42.66
1326	66.3			2	0	0	0	8.5	3	0.3	1	52.47	42.45
1327	66.3			2	0	0	0	13.2	2	0.1	1	52.46	42.63
1328	66.3			1	0	0	0	12.4	3	0.1	1	52.55	42.58
1329	66.3			3	9	9	0	15.9	2	0.6	1	52.49	42.38
1330	66.3			1	0	0	0	12	3	0.1	1	52.42	42.54
1331	66.3			1	0	0	0	11.9	3	0.03	1	52.58	42.39
1332	66.3			2	0	0	0	12.5	3	0.2	1	52.47	42.43
1333	66.3			1	0	0	0	16.7	2	0.3	1	52.53	42.37
1334	66.3			2	0	0	0	11.2	3	0.1	1	52.57	42.38
1335	66.3			2	0	0	0	10	3	0.03	1	52.58	42.47
1336	66.3			2	0	0	0	11	3	0.2	1	52.38	42.48
1337	66.3			1	0	0	0	10.1	3	0.1	1	52.65	42.49
1338	66.3			1	0	0	0	10.9	3	0.03	1	52.64	42.59
1339	66.3			1	0	0	0	9	3	0.03	1	52.39	42.61
1340	66.3			3	9	9	0	7.8	3	0.03	1	52.62	42.46
1341	66.3			2	0	0	0	8.2	3	0.03	1	52.53	42.47
1342	66.3			1	0	0	0	9.5	3	0.03	1	52.43	42.61
1343	66.3			2	0	0	0	9.2	3	0.1	1	52.57	42.61
1344	66.3			1	9	2	0	8.2	3	0.1	1	52.57	42.45
1345	66.3			1	9	2	0	13.4	2	0.4	1	52.64	42.61

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1346	66.3			2	0	0	0	16.5	2	0.3	1	52.65	42.48
1347	66.3			1	0	0	0	27.5	3	0.6	1	52.53	42.43
1348	66.3			2	0	0	0	19.7	2	1.1	1	52.42	42.53
1349	66.3			1	0	0	0	21.8	2	1.1	1	52.47	42.52
1350	66.3			1	9	2	0	22.5	2	1	1	52.42	42.53
1351	66.3			2	0	0	0	33.4	2	3	1	52.48	42.40
1352	66.3			3	9	9	0	17.3	2	0.9	1	52.47	42.62
1353	66.3			1	0	0	0	23.5	2	1.5	1	52.52	42.53
1354	66.3			9	9	9	0	33.3	1	6.5	1	52.56	42.34
1355	52.1	A.5	12	1	0	0	1	58	1	28.2	1	50.43	29.43
1356	52.1	A.5	12	2	0	0	0	25.7	3	2.5	1	50.51	29.58
1357	52.1	A.5	12	2	0	0	0	21.1	2	0.6	1	50.46	29.62
1358	52.1	A.5	12	1	0	0	0	11.2	3	0.2	1	50.65	29.36
1359	52.1	A.5	12	1	0	0	0	6	4	0.03	1	50.53	29.35
1360	23.1		7	1	9	2	0	17.1	2	0.5	1	42.63	7.45
1361	51.2		10	2	0	0	1	26.3	3	2.1	1	47.61	27.34
1362	51.2		10	1	9	2	0	23.4	2	2	1	47.49	27.63
1363	51.2		10	2	0	0	0	15.2	2	0.4	1	47.63	27.43
1364	51.2		10	1	0	0	0	19.6	2	0.8	1	47.41	27.47
1365	51.2		10	3	9	9	0	23.4	2	1.2	1	47.58	27.41
1366	51.2		10	1	0	0	0	18.8	2	0.8	1	47.44	27.41
1367	51.2		10	2	0	0	0	20.4	2	0.8	1	47.59	27.65
1368	51.2		10	2	0	0	0	11.9	3	0.2	1	47.47	27.43
1369	51.2		10	1	0	0	0	25.3	2	1.3	1	47.44	27.43
1370	51.2		10	2	0	0	0	12.5	3	0.2	1	47.62	27.53
1371	51.2		10	1	0	0	0	18.3	2	0.2	1	47.36	27.65
1372	51.2		10	2	0	0	0	17.2	2	0.4	1	47.38	27.43
1373	51.2		10	3	9	9	0	29.8	2	3.7	1	47.57	27.39
1374	51.2		10	2	0	0	0	11.3	3	0.03	1	47.44	27.44
1375	51.2		10	1	0	0	0	21	2	0.5	1	47.60	27.53
1376	51.2		10	2	0	0	0	20.2	2	0.5	1	47.42	27.37
1377	51.2		10	2	9	2	0	14.9	2	0.2	1	47.45	27.56
1378	23		13-16	3	9	9	0	27.1	3	2.1	1	45.02	4.99
1379	23		13-16	2	9	2	0	25.3	2	1.4	1	45.16	4.94
1380	23		13-16	2	0	0	1	26.4	2	5.3	1	44.86	5.16
1381	23		13-16	2	9	2	0	27.3	3	2.4	1	45.11	4.91
1382	23		13-16	2	9	2	0	29.8	3	2.8	1	45.00	4.92
1383	23		13-16	2	9	2	0	11.2	3	0.1	1	44.90	5.02
1384	23		13-16	1	9	2	0	23.8	2	1	1	45.05	5.15

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1385	23		13-16	2	9	2	0	21.4	2	1.3	1	44.99	4.99
1386	23		13-16	2	9	2	0	19.2	2	0.5	1	45.06	4.95
1387	23		13-16	3	9	9	0	15.8	2	0.7	1	44.95	4.87
1388	23		13-16	1	9	2	0	17	2	1.2	1	44.98	5.10
1389	23		13-16	1	9	2	0	21.8	2	2.4	1	44.92	5.13
1390	23		13-16	2	9	2	0	23	2	1.4	1	44.93	4.98
1391	23		13-16	1	9	2	0	14.4	2	0.3	1	45.03	5.00
1392	23		13-16	2	9	2	0	17.5	2	1	1	44.92	5.10
1393	23		13-16	2	9	2	0	14.4	2	0.5	1	45.02	5.14
1394	23		13-16	2	9	2	0	12.7	2	0.3	1	44.87	4.95
1395	23		13-16	2	9	2	0	9.1	3	0.2	1	45.03	4.91
1396	23		13-16	2	9	2	0	20.9	2	1.3	1	44.87	4.91
1397	23		13-16	2	9	2	0	22.8	2	1.3	1	45.04	4.88
1398	23		13-16	2	9	2	0	10.2	3	0.2	1	44.95	5.04
1399	23		13-16	3	9	9	0	19.9	2	0.7	1	45.09	5.05
1400	23		13-16	1	9	2	0	11.4	3	0.2	1	45.07	5.06
1401	23		13-16	2	9	2	0	14.5	2	0.2	1	45.11	5.04
1402	23		13-16	1	9	2	0	20.1	2	0.8	1	44.88	5.12
1403	23		13-16	1	9	2	0	18.7	2	0.7	1	44.90	5.14
1404	23		13-16	1	9	2	0	12	3	0.4	1	45.16	5.11
1405	23		13-16	1	9	2	0	10.5	3	0.1	1	45.06	4.91
1406	23		13-16	1	9	2	0	26.7	3	0.6	1	45.14	4.99
1407	66.3		4-12	3	9	9	0	24.4	2	1.3	1	52.62	42.61
1408	66.3		4-12	1	9	2	0	15.8	2	0.3	1	52.64	42.48
1409	66.3		4-12	1	9	2	0	8.4	3	0.1	1	52.58	42.62
1410	66.3		4-12	2	0	0	0	8.2	3	0.1	1	52.50	42.34
1411	66.3		4-12	1	9	2	0	18.1	2	0.6	1	52.63	42.55
1412	66.3		4-12	1	0	0	0	17.5	2	0.4	1	52.39	42.63
1413	66.3		4-12	2	0	0	0	13.6	2	0.2	1	52.56	42.48
1414	51.2		10	2	0	0	0	13.3	2	0.1	1	47.61	27.54
1415	51.2		10	2	0	0	0	17.6	2	0.4	1	47.47	27.62
1416	51.2		10	1	0	0	0	10.7	3	0.2	1	47.60	27.39
1417	51.2		10	2	0	0	0	12.6	3	0.2	1	47.35	27.60
1418	51.2		10	1	0	0	0	20.1	2	0.5	1	47.66	27.51
1419	51.2		10	2	9	2	0	18.2	2	0.4	1	47.60	27.42
1420	51.2		10	2	0	0	0	10.3	3	0.1	1	47.46	27.54
1421	51.2		10	1	0	0	0	10.2	3	0.03	1	47.44	27.36
1422	51.2		10	1	0	0	0	14.1	2	0.5	1	47.63	27.62
1423	51.2		10	1	0	0	0	12.4	3	0.2	1	47.63	27.64

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1424	51.2		10	1	0	0	0	11.8	3	0.3	1	47.51	27.43
1425	51.2		10	2	0	0	0	10.9	3	0.03	1	47.41	27.64
1426	51.2		10	1	0	0	0	15.5	2	0.2	1	47.65	27.34
1427	51.2		10	2	0	0	0	10.2	3	0.03	1	47.46	27.59
1428	51.2		10	2	0	0	0	20.9	2	1.1	1	47.41	27.60
1429	51.2		10	2	0	0	0	14.6	2	0.7	1	47.66	27.46
1430	51.2		10	1	9	2	0	19.1	2	0.8	1	47.47	27.66
1431	51.2		10	2	0	0	0	15.3	2	0.4	1	47.46	27.44
1432	51.2		10	2	0	0	0	15.8	2	0.1	1	47.35	27.52
1433	51.2		10	1	0	0	0	11.5	3	0.2	1	47.59	27.53
1434	51.2		10	2	0	0	0	9.1	3	0.03	1	47.51	27.54
1435	51.2		10	1	0	0	0	12.7	2	0.2	1	47.55	27.48
1436	51.2		10	2	0	0	0	16.4	2	0.5	1	47.54	27.40
1437	51.2		10	1	9	2	0	8.7	3	0.03	1	47.64	27.60
1438	51.2		10	2	0	0	0	12.1	3	0.2	1	47.43	27.65
1439	51.2		10	1	0	0	0	28.2	3	1.8	1	47.57	27.51
1440	22.4			1	0	0	0	9	3	0.1	1	37.63	2.38
1441	22.4			3	9	9	0	13.6	2	0.1	1	37.48	2.47
1442	22.4			2	0	0	0	7.6	3	0.03	1	37.58	2.37
1443	22.4			1	0	0	0	8.3	3	0.03	1	37.50	2.66
1444	22.4			2	0	0	0	9.9	3	0.1	1	37.52	2.45
1445	22.4			3	9	9	0	24.4	2	1.4	1	37.64	2.52
1446	22.4			4	9	9	0	18.3	2	0.5	1	37.43	2.60
1447	22.4			1	0	0	0	31.7	2	3	1	37.50	2.51
1448	66.3		14-18	1	9	2	0	27.4	3	1.5	1	52.41	42.65
1449	66.3		14-18	2	0	0	0	9.3	3	0.03	1	52.64	42.42
1450	66.3		14-18	1	0	0	0	22	2	0.6	1	52.46	42.39
1451	66.3		14-18	2	0	0	0	21.3	2	0.7	1	52.45	42.59
1452	66.3		14-18	2	9	2	0	17.5	2	0.2	1	52.35	42.35
1453	66.3		14-18	1	0	0	0	13.2	2	0.4	1	52.48	42.49
1454	66.3		14-18	1	0	0	0	12.3	3	0.1	1	52.65	42.38
1455	66.3		14-18	2	0	0	0	8.4	3	0.03	1	52.57	42.43
1456	66.3		14-18	1	0	0	0	13.5	2	0.1	1	52.55	42.60
1457	66.3		14-18	1	0	0	0	9.9	3	0.1	1	52.44	42.58
1458	66.3		14-18	2	0	0	0	9.5	3	0.03	1	52.55	42.62
1459	66.3		14-18	2	0	0	0	19.7	2	0.5	1	52.38	42.37
1460	66.3		14-18	2	0	0	0	11.6	3	0.2	1	52.59	42.53
1461	66.3		14-18	1	9	2	0	14.4	2	0.7	1	52.57	42.60
1462	66.3		14-18	1	0	0	0	12.8	2	0.03	1	52.58	42.38

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1463	66.3		14-18	3	9	9	0	21.2	2	0.5	1	52.58	42.47
1464	66.3		14-18	1	0	0	0	15.7	2	0.3	1	52.42	42.65
1465	66.3		14-18	3	9	9	0	9.7	3	0.2	1	52.36	42.35
1466	66.3		14-18	1	2	0	0	27.2	3	0.8	1	52.54	42.54
1467	25.3		5-26	1	9	2	0	13.7	2	0.4	1	62.57	2.59
1469	39.3	A5	14	1	9	2	0	19.6	2	0.8	1	60.40	14.42
1470	37.2	I4	7.25	1	0	0	0	10.2	3	1.2	1	48.03	18.46
1471	37.2	I4	7.25	1	2	0	0	13.3	2	0.1	1	48.14	18.44
1472	38.2	I3	17.5	3	9	2	0	12.9	2	0.8	1	58.67	18.80
1473	38.2	I3	17.5	1	9	2	0	19.3	2	0.9	1	58.72	18.95
1474	38.2	I3	17.5	1	9	2	0	16.8	2	0.8	1	58.97	18.96
1475	38.2	I3	17.5	1	9	2	0	18.8	2	0.4	1	58.85	18.76
1476	38.2	I3	17.5	1	9	2	0	13.3	2	0.2	1	58.67	18.86
1477	38.2	I1	18.5	1	9	2	0	10.2	3	0.2	1	58.24	18.87
1478	38.2	I1	18.5	1	9	2	0	10.9	3	0.1	1	58.23	18.88
1479	38.2	I1	18.5	1	9	2	0	8.5	3	0.03	1	58.06	18.88
1480	38.2	I1	18.5	1	9	2	0	19.1	2	0.2	1	58.20	18.83
1481	38.2	I1	18.5	1	9	2	0	11.7	3	0.3	1	58.14	18.75
1482	39.3	B9	15	1	9	0	0	16.1	2	0.8	1	61.71	14.13
1483	39.3	B9	15	1	9	2	0	17.3	2	0.5	1	61.71	14.21
1484	39.3	B9	15	2	0	0	0	5.6	4	0.03	1	61.95	14.24
1485	39.3	A3	14	1	9	2	0	35.4	3	1.7	1	60.89	14.78
1486	39.3	A3	14	2	9	2	0	12.1	3	1.1	1	60.94	14.84
1487	39.1	U7	17	2	9	2	0	19.5	2	0.5	1	60.15	15.19
1488	39.1	U7	17	2	9	2	0	8.2	3	0.2	1	60.25	15.01
1489	39.1	U7	17	2	9	2	0	9.3	3	0.1	1	60.28	15.27
1490	39.1	U7	17	2	9	2	0	14.4	2	0.8	1	60.22	15.17
1491	38.2	S4	19	2	9	2	0	16.1	2	0.5	1	58.13	16.38
1492	TT1			2	0	0	0	30.3	3	2.3	1		
1493	TT1			2	0	0	0	20.1	2	0.7	1		
1494	TT1			2	0	2	0	33.5	3	2.7	1		
1495	TT1			2	0	2	0	38	1	7.2	1		
1496	TT1			2	0	2	0	22.7	2	0.5	1		
1497	TT1			3	9	9	0	9.8	3	0.1	1		
1498	TT1			2	0	2	0	34.2	2	3	1		
1499	TT1			2	0	2	0	20.3	2	0.9	1		
1500	TT1			2	0	2	0	23.9	2	1.2	1		
1501	TT1			2	0	2	0	18.7	2	0.3	1		
1502	TT1			2	0	0	0	50.7	1	12.7	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1503	TT1			2	0	0	0	18.9	2	0.8	1		
1504	TT1			2	0	2	0	14.3	2	0.3	1		
1505	TT1			2	0	2	0	18.9	2	0.9	1		
1506	TT1			2	0	2	0	35.8	2	4.5	1		
1507	TT1			2	0	2	0	19.8	2	0.9	1		
1508	TT1			2	0	2	0	26.5	3	1.7	1		
1509	TT1			2	0	2	0	16.9	2	0.3	1		
1510	TT1			2	0	2	0	12.9	2	0.2	1		
1511	TT1			2	0	2	0	12.8	2	0.2	1		
1512	TT1			2	0	0	0	16.4	2	0.3	1		
1513	TT1			2	0	0	0	16.2	2	0.4	1		
1514	TT1			2	0	0	0	21	2	1.1	1		
1515	TT1			2	0	0	0	28.8	3	1.2	1		
1516	TT1			2	0	0	0	15	2	0.2	1		
1517	TT1			2	0	0	0	13.8	2	0.5	1		
1518	TT1			2	0	0	0	19.9	2	0.7	1		
1519	TT1			2	0	0	0	17.4	2	0.3	1		
1520	TT1			2	0	0	0	14.7	2	0.1	1		
1521	TT1			2	0	0	0	16	2	0.2	1		
1522	TT1			2	0	0	0	11.3	3	0.1	1		
1523	TT1			2	0	0	0	16	2	0.2	1		
1523	TT1			2	0	0	0	15.5	2	0.3	1		
1524	TT1			2	0	0	0	18.4	2	0.3	1		
1526	TT1			3	9	9	0	28.4	3	1.9	1		
1527	TT1			2	0	0	0	14.7	2	0.1	1		
1528	TT1			2	0	2	0	21.3	2	1.1	1		
1529	TT1			1	0	0	0	28	3	1.8	1		
1530	TT1			1	0	2	0	33.1	2	3.4	1		
1531	TT1			1	0	0	0	38.8	3	2.2	1		
1532	TT1			1	0	0	0	30.6	3	1.3	1		
1533	TT1			1	0	0	0	32	3	2.1	1		
1534	TT1			1	0	2	0	18.8	2	1	1		
1535	TT1			1	0	2	0	28.4	3	1.3	1		
1536	TT1			1	0	2	0	16.7	2	0.4	1		
1537	TT1			1	0	2	0	21.8	2	1.4	1		
1538	TT1			1	0	2	0	18.7	2	0.8	1		
1539	TT1			1	0	2	0	20.5	2	0.9	1		
1540	TT1			1	0	2	0	19.5	2	0.6	1		
1541	TT1			1	0	0	0	8.2	3	0.03	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1542	TT1			1	0	0	0	7.9	3	0.03	1		
1543	TT1			1	0	2	0	28.9	2	3.6	1		
1544	TT1			1	0	2	0	17.4	2	0.3	1		
1545	TT1			1	0	2	0	19.2	2	0.4	1		
1546	TT1			1	0	2	0	40.1	2	3	1		
1547	TT1			2	0	0	1	14.5	2	0.4	1		
1548	TT1			3	9	9	0	19.2	2	0.7	1		
1549	TT1			2	0	0	0	20.6	2	0.3	1		
1560	TT1			2	0	0	0	18.7	2	0.4	1		
1561	TT1			2	0	0	0	23.3	2	0.4	1		
1562	TT1			2	0	0	0	20.1	2	0.2	1		
1563	TT1			2	0	2	0	18.5	2	0.5	1		
1565	TT1			1	0	0	0	25.2	2	1.2	1		
1566	TT1			1	0	0	0	16.9	2	0.3	1		
1567	TT1			1	0	0	0	19	2	1.4	1		
1567	TT1			1	0	0	0	19	2	0.6	1		
1568	TT1			1	0	0	0	26	3	0.7	1		
1569	TT1			1	0	0	0	20.7	2	0.3	1		
1570	GRID9		27-35	1	0	2	0	38.7	1	6.8	1		
1571	GRID9		27-35	2	0	2	0	17.8	2	1.1	1		
1572	GRID9		27-35	1	0	0	0	35.4	2	4.7	1		
1573	GRID9		27-35	1	0	0	1	47.9	1	9.1	1		
1574	GRID2		1-12	9	9	9	0	24.7	2	2.5	1		
1575	GRID2		1-12	2	0	2	0	19.6	2	2	1		
1576	GRID2		1-12	1	0	2	0	48.7	1	22.6	1		
1577	GRID2		1-12	1	0	2	0	32	1	6.1	1		
1578	GRID2		1-12	2	0	2	0	38.5	1	10.8	1		
1579	GRID2		1-12	1	0	0	0	37.7	3	2.4	1		
1580	GRID2		1-12	2	0	2	0	19.9	2	0.6	1		
1581	GRID2		1-12	2	0	2	0	23.8	2	1.2	1		
1582	GRID2		1-12	2	0	0	0	17.6	2	0.4	1		
1583	GRID2		1-12	1	0	0	0	17.4	2	0.3	1		
1584	GRID2		12-18	9	9	9	0	29.5	2	3	1		
1585	GRID2		12-18	1	0	2	0	40.5	1	10.6	1		
1586	GRID2		12-18	2	0	2	0	44.2	2	4.2	1		
1587	GRID2		12-18	1	0	2	0	33.2	1	7.3	1		
1588	GRID2		12-18	2	0	2	0	28.4	3	2.4	1		
1589	GRID2		12-18	2	0	0	0	21.9	2	0.9	1		
1590	GRID2		12-18	2	0	2	0	21.5	2	1.4	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1591	TT3		6-12	1	0	0	0	34.4	3	2.8	1		
1592	TT3		6-12	1	0	0	1	10.2	3	0.3	1		
1593	TT3		6-12	1	0	0	1	39.2	2	3.1	1		
1594	TT3		6-12	1	0	0	0	14.6	2	0.4	1		
1595	TT3		6-12	1	0	0	1	19.6	2	1.6	1		
1596	TT3		6-12	1	0	0	0	18.5	2	1.6	1		
1597	TT3		6-12	1	0	0	0	26.9	2	5.1	1		
1598	TT3		6-12	1	0	0	1	73.1	1	14.6	1		
1599	TT3		6-12	1	0	0	0	13.7	2	0.3	1		
1600	TT3		6-12	1	0	0	1	36.7	1	22.4	1		
1601	TT3		6-12	1	0	0	1	31.6	2	3.3	1		
1602	TT3		6-12	1	0	0	0	17.2	2	0.6	1		
1603	TT3		6-12	1	0	0	1	16.6	2	0.5	1		
1604	TT3		6-12	1	0	0	1	25	2	1.6	1		
1605	TT3		6-12	1	0	0	1	44.2	1	10.9	1		
1606	TT3		6-12	1	0	0	0	43.7	1	16.7	1		
1607	TT3		6-12	1	0	0	1	28.4	3	1.9	1		
1608	TT3		6-12	1	0	0	1	31.8	1	22.2	1		
1609	TT3		6-12	1	0	0	1	28.6	2	3	1		
1610	TT3		6-12	1	0	0	1	74.6	1	99.9	1		
1611	TT3		6-12	2	0	0	1	24	2	1.8	1		
1612	TT3		6-12	3	0	0	1	11.6	3	0.2	1		
1613	GRID4		12-18	9	0	0	0	15.5	2	0.3	1		
1614	GRID4		12-18	1	0	0	0	23.9	2	2.4	1		
1615	GRID4		12-18	1	0	0	1	25	2	4.7	1		
1616	GRID4		12-18	2	0	0	1	19.3	2	0.8	1		
1617	GRID4		12-18	2	0	0	1	11.5	3	0.2	1		
1618	GRID4		12-18	2	0	0	1	22.1	2	1.9	1		
1619	GRID4		12-18	2	0	0	1	23.4	2	1	1		
1620	GRID1		12-18	2	0	2	0	26.8	3	2.6	1		
1621	GRID1		12-18	2	0	0	0	24.6	2	1.4	1		
1622	GRID1		12-18	1	0	0	0	31.1	2	3.4	1		
1623	GRID1		12-18	2	0	2	0	19.9	2	1	1		
1624	GRID1		12-18	9	9	9	0	19.6	2	0.8	1		
1625	GRID1		12-18	1	0	2	0	18.6	2	0.9	1		
1626	GRID1		12-18	2	0	2	0	16.5	2	0.7	1		
1627	GRID1		12-18	9	9	9	0	14.5	2	0.4	1		
1628	GRID1		12-18	1	0	0	0	15.2	2	0.1	1		
1629	GRID1		12-18	9	9	9	0	12.6	3	0.4	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1630	GRID1		12-18	1	0	0	0	14.5	2	0.2	1		
1631	GRID1		12-18	2	0	0	1	16.8	2	0.5	1		
1632	GRID1		12-18	2	0	0	0	14.3	2	0.5	1		
1633	GRID1		12-18	2	0	2	0	13.5	2	0.1	1		
1634	GRID1		12-18	2	0	2	0	15.4	2	0.4	1		
1635	GRID1		12-18	2	0	2	0	14.7	2	0.3	1		
1636	GRID1		12-18	2	0	0	0	16.5	2	0.5	1		
1637	GRID1		12-18	1	0	0	0	17.6	2	0.7	1		
1638	GRID1		12-18	1	0	0	0	23.2	2	1	1		
1639	GRID1		12-18	2	0	2	0	18	2	0.4	1		
1640	GRID1		12-18	9	0	2	0	20.4	2	1	1		
1641	26.4		0-41	2	0	2	0	19.1	2	0.3	1	77.62	2.41
1642	39.1	L	15.5	1	0	2	0	16.3	2	0.7	1	61.45	17.34
1643	26.4		0-41	2	0	0	0	46.4	1	8.6	1	77.50	2.62
1644	20.4	M3	18	3	0	0	0	21.7	2	1.7	1	17.95	2.70
1645	38.2	I9	19	1	0	2	0	62.1	1	27.2	1	58.69	18.17
1646	38.2	P2	18	2	0	2	0	54.1	1	7.1	1	55.41	16.92
1647	38.2	D2	18	1	0	0	0	57.4	1	9.2	1	58.42	19.80
1648	39.2	I	7.25	2	0	0	0	9.4	3	0.1	1	68.63	18.39
1649	26.4		0-41	3	9	9	0	10.3	3	0.1	1	77.38	2.52
1650	39.2	C	7.25	3	9	9	0	21.4	2	1.4	1	67.62	19.66
1651	GRID 2		24-30	3	9	9	0	23.4	2	0.8	1		
1652	GRID 2		24-30	3	9	9	0	20.1	2	0.6	1		
1653	GRID 2		24-30	3	9	9	0	11.7	3	0.2	1		
1654	GRID 2		24-30	2	0	2	0	15.2	2	0.3	1		
1655	GRID 2		24-30	2	0	0	0	8	3	0.3	1		
1656	GRID 2		24-30	2	0	0	0	13.1	2	0.3	1		
1657	GRID 2		24-30	2	0	0	0	5.2	4	0.3	1		
1658	GRID 2		24-30	1	0	0	0	9.4	3	0.3	1		
1659	GRID 4		12-18	2	0	0	0	25.3	2	1.9	1		
1660	GRID 4		12-18	2	0	0	0	19.2	2	0.4	1		
1661	GRID 4		12-18	2	0	0	0	21.6	2	0.6	1		
1662	GRID 4		12-18	2	0	0	0	13.3	2	0.3	1		
1663	GRID 4		12-18	2	0	0	0	19.8	2	1.7	1		
1664	GRID 4		12-18	2	0	0	0	12.4	3	0.4	1		
1665	GRID 4		12-18	2	0	0	0	18.5	2	0.5	1		
1666	GRID 4		12-18	2	0	0	0	22.7	2	0.6	1		
1667	GRID 4		12-18	2	0	0	0	12.6	3	0.3	1		
1668	GRID 4		12-18	2	0	0	0	17.7	2	0.5	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1669	GRID 4		12-18	2	0	0	1	17.3	2	0.3	1		
1670	GRID 4		12-18	2	0	0	1	21.6	2	1.5	1		
1671	GRID 4		12-18	2	0	0	1	23	2	3.3	1		
1672	GRID 4		12-18	2	0	0	1	24.5	2	3.5	1		
1673	GRID 4		12-18	2	0	0	1	21.5	2	1.2	1		
1674	GRID 4		12-18	2	0	0	1	14.5	2	0.4	1		
1675	25.4	S5	21	1	0	0	0	49.7	1	6.6	1	68.46	1.37
1676	38.2	D2	18	1	0	2	0	24.4	2	2.9	1	58.43	19.77
1677	36.3	D7	9	2	0	2	0	30.4	2	4.4	1	33.20	14.19
1678	38.2	I9	19	2	0	2	0	29.8	3	2.3	1	58.71	18.05
1679	24.1		28	1	0	2	0	29.5	3	1.5	1	52.35	7.64
1680	24.1	H1	29	2	0	2	0	10.4	3	0.2	1	52.31	8.98
1681	24.1	E4	28.5	2	0	2	0	25.6	3	1	1	54.02	9.46
1682	24.1	O1	11	2	0	2	0	9	3	0.1	1	54.29	7.94
1683	24.1	E1	29	2	0	2	0	17.7	2	0.3	1	54.24	9.78
1684	24.1	E7	28.5	3	9	9	0	17.8	2	0.3	1	54.27	9.17
1685	24.1	E1	27.5	2	0	2	0	18.5	2	0.7	1	54.10	9.70
1686	24.1	E3	28.5	1	0	2	0	30.8	3	2	1	54.73	9.78
1687	24.1	M1	13	1	0	2	0	17.4	2	0.3	1	52.14	7.90
1688	24.1	E1	30	1	0	2	0	12.4	3	0.3	1	54.25	9.73
1689	39.2	I5	17	2	0	2	0	13.5	2	0.5	1	68.49	18.62
1690	39.2	I5	17	2	0	2	0	10.5	3	0.1	1	68.45	18.43
1691	39.2	I5	17	1	0	2	0	16.7	2	0.7	1	68.57	18.64
1692	39.3		12	1	0	2	0	10.6	3	0.5	1	62.49	12.45
1693	39.3		12	1	0	2	0	19.9	2	0.5	1	62.60	12.66
1694	39.3		12	1	0	2	0	14	2	0.2	1	62.44	12.60
1695	39.3		12	1	0	2	0	17.4	2	0.5	1	62.57	12.66
1696	39.3		12	1	0	2	0	15.2	2	0.2	1	62.45	12.51
1697	39.3		12	2	0	2	0	20.5	2	1.2	1	62.47	12.63
1698	39.3		12	2	0	2	0	20.9	2	1.4	1	62.42	12.52
1699	39.3		12	2	0	2	0	21.2	2	1.5	1	62.66	12.52
1700	39.3		12	2	0	2	0	19.6	2	0.9	1	62.57	12.51
1701	38.2	N8	14.5	2	0	2	0	8	3	0.03	1	58.40	17.06
1702	38.2	N8	14.5	2	0	2	0	22.2	2	0.8	1	58.55	17.07
1703	38.2	N8	14.5	2	0	2	0	13.9	2	0.3	1	58.55	17.30
1704	38.2	N8	14.5	2	0	2	0	14.2	2	0.4	1	58.63	17.28
1705	38.2	N8	14.5	2	0	2	0	18.4	2	0.4	1	58.51	17.23
1706	38.2	N8	14.5	2	0	2	0	12.7	2	0.3	1	58.37	17.15
1707	38.2	N8	14.5	2	0	2	0	15.8	2	0.2	1	58.41	17.20

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1708	38.2	N8	14.5	1	0	2	0	17.1	2	0.7	1	58.37	17.21
1709	38.2	N8	14.5	1	0	2	0	16.8	2	0.7	1	58.36	17.27
1710	38.2	N8	14.5	2	0	2	0	13.5	2	0.2	1	58.53	17.27
1711	38.2	N8	14.5	2	0	2	0	14.8	2	0.7	1	58.57	17.10
1712	38.2	N8	14.5	2	0	2	0	13.4	2	0.2	1	58.53	17.04
1713	38.2	N8	14.5	1	0	2	0	11.2	3	0.3	1	58.54	17.23
1714	38.2	N8	14.5	1	0	2	0	10.4	3	0.2	1	58.34	17.02
1715	38.2	N8	14.5	1	0	2	0	8.8	3	0.03	1	58.63	17.01
1716	38.2	N8	14.5	1	0	2	0	10.7	3	0.2	1	58.36	17.21
1717	38.2	D8	19	1	0	2	0	16.1	2	0.4	1	58.64	19.18
1718	38.2	D8	19	1	0	2	0	9	3	0.1	1	58.59	19.13
1719	38.2	D8	19	2	0	2	0	15.1	2	0.3	1	58.38	19.31
1720	38.2	S3	17.5	1	0	2	0	16.2	2	0.4	1	58.67	16.86
1721	38.2	S3	17.5	2	0	2	0	17.8	2	0.3	1	58.75	16.97
1722	38.2	S3	17.5	1	0	2	0	11	3	0.5	1	58.68	16.96
1723	38.2	S3	17.5	1	0	2	0	7.6	3	0.03	1	58.99	16.71
1724	38.2	S3	17.5	1	0	2	0	9.3	3	0.1	1	58.97	16.90
1725	38.2	R1	16	2	0	2	0	11.6	3	0.2	1	57.21	16.74
1726	38.2	R1	16	2	0	2	0	9.3	3	0.03	1	57.13	16.73
1727	38.2	R1	16	1	0	2	0	8.7	3	0.2	1	57.04	16.96
1728	38.2	R1	16	2	0	2	0	8.3	3	0.1	1	57.21	16.80
1729	38.2	R1	16	1	0	2	0	8.8	3	0.03	1	57.13	16.67
1730	38.2	R1	16	1	0	2	0	7.3	3	0.1	1	57.26	16.68
1731	38.2	R1	16	2	0	2	0	4.5	4	0.03	1	57.29	16.86
1732	38.2	R1	16	1	0	2	0	7.5	3	0.1	1	57.02	16.98
1733	38.2	D5	18	1	0	2	0	13.7	2	0.8	1	58.66	19.65
1734	38.2	D5	18	2	0	2	0	22.8	2	0.6	1	58.56	19.58
1735	38.2	I3	17	2	0	2	0	14	2	0.2	1	58.98	18.94
1736	38.2	I3	17	2	0	2	0	9.8	3	0.1	1	58.69	18.84
1737	38.2	L6	19	3	9	9	0	13.6	2	0.2	1	56.72	17.40
1738	38.2	L6	19	3	9	9	0	15.6	2	0.5	1	56.99	17.58
1739	38.2	L6	19	1	0	2	0	16.5	2	0.4	1	56.82	17.38
1740	38.2	L6	19	2	0	2	0	16	2	0.7	1	56.96	17.46
1741	38.2	H1	19	2	0	2	0	20.8	2	0.6	1	57.10	18.77
1742	38.2	H1	19	1	0	2	0	17	2	1.9	1	57.23	18.93
1743	38.2	H3	19	1	0	2	0	16.4	2	0.8	1	57.80	18.71
1744	38.2	H3	19	1	0	2	0	15.4	2	0.3	1	57.88	18.67
1745	38.2	H3	19	2	0	2	0	10.8	3	0.2	1	57.78	18.83
1746	38.2	H3	19	2	0	2	0	22.9	2	0.8	1	57.75	18.72

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1747	38.2	H3	19	2	0	2	0	13.1	2	0.2	1	57.84	18.80
1748	38.2	S2	17.5	2	0	2	0	10.3	3	0.1	1	58.37	16.69
1749	38.2	S2	17.5	2	0	2	0	12.8	2	0.4	1	58.60	16.91
1750	38.2	S2	17.5	2	0	2	0	12.4	3	0.4	1	58.39	16.70
1751	38.2	S2	17.5	2	0	2	0	11.8	3	0.3	1	58.55	16.95
1752	38.2	S2	17.5	2	0	2	0	8.9	3	0.1	1	58.63	16.78
1753	38.2	S2	17.5	2	0	2	0	13	2	0.4	1	58.53	16.97
1754	38.2	S2	17.5	1	0	2	0	14.6	2	0.2	1	58.42	16.68
1755	38.2	S2	17.5	1	0	2	0	9.9	3	0.1	1	58.44	16.91
1756	38.2	S2	17.5	2	0	2	0	8.4	3	0.1	1	58.38	16.80
1757	38.2	S2	17.5	2	0	2	0	6.5	3	0.03	1	58.50	16.77
1758	38.2	S2	17.5	2	0	2	0	6.1	4	0.03	1	58.54	16.73
1759	38.2	S2	17.5	2	0	2	0	6.4	3	0.03	1	58.64	16.89
1760	38.2	R6	19	3	9	9	0	11.3	3	0.1	1	57.89	16.54
1761	38.2	R6	19	2	0	2	0	11.7	3	0.2	1	57.86	16.54
1762	38.2	R6	19	2	0	2	0	13.8	2	0.3	1	57.98	16.53
1763	38.2	R6	19	1	0	2	0	10.1	3	0.1	1	57.92	16.65
1764	38.2	R6	19	1	0	2	0	6.8	3	0.03	1	57.70	16.34
1765	38.2	R6	19	2	0	2	0	11.8	3	0.2	1	57.85	16.40
1766	38.2	R6	19	1	0	2	0	13	2	0.03	1	57.68	16.51
1767	38.2	R6	19	2	0	2	0	8.2	3	0.03	1	57.94	16.45
1768	38.2	R6	19	1	0	2	0	11.2	3	0.1	1	57.79	16.42
1769	38.2	R6	19	1	0	2	0	10.8	3	0.2	1	57.89	16.50
1770	38.2	R6	19	2	0	2	0	11.5	3	0.3	1	57.77	16.59
1771	38.2	R4	22	2	0	2	0	21.2	2	0.6	1	57.07	16.38
1772	38.2	R4	22	2	0	2	0	13.7	2	0.1	1	57.33	16.57
1773	38.2	R4	22	2	0	2	0	16.4	2	0.5	1	57.27	16.43
1774	38.2	R4	22	1	0	2	0	17.3	2	1.1	1	57.26	16.46
1775	38.2	R4	22	2	0	2	0	15.2	2	0.4	1	57.22	16.35
1776	38.2	R4	22	2	0	2	0	22.7	2	1.7	1	57.31	16.55
1777	38.2	R4	22	2	0	2	0	8.3	3	0.1	1	57.07	16.41
1778	38.2	R4	22	2	0	2	0	10.3	3	0.1	1	57.30	16.64
1779	38.2	R4	22	2	0	2	0	14.8	2	0.2	1	57.01	16.55
1780	38.2	R4	22	2	0	2	0	20.1	2	1.2	1	57.20	16.51
1781	38.2	R4	22	2	0	2	0	13.8	2	0.4	1	57.05	16.51
1782	38.2	R4	22	1	0	2	0	13.2	2	0.4	1	57.28	16.49
1783	38.2	R4	22	2	0	2	0	16.1	2	0.8	1	57.02	16.41
1784	38.4	R4	22	2	0	2	0	6.7	3	0.1	1	57.30	11.65
1785	38.2	R4	22	2	0	2	0	7.3	3	0.1	1	57.09	16.44

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1786	38.2	R4	22	1	0	2	0	7	3	0.03	1	57.03	16.63
1787	38.2	R4	22	2	0	2	0	9.3	3	0.1	1	57.14	16.62
1788	38.2	R4	22	1	0	2	0	10.6	3	0.2	1	57.14	16.65
1789	38.2	R4	22	1	0	2	0	7	3	0.03	1	57.28	16.43
1790	38.2	R4	22	2	0	2	0	10.5	3	0.03	1	57.10	16.39
1791	38.2	R4	22	2	0	2	0	8.3	3	0.1	1	57.24	16.53
1792	38.2	R4	22	1	0	2	0	3.1	4	0.03	1	57.11	16.63
1793	38.2	R4	22	2	0	2	0	14.7	2	0.1	1	57.18	16.39
1794	TT1		L2	1	0	0	1		1	15.1	1		
1795	TT1		L2	2	9	2	0		2	22.6	9		
1796	TT1		L2	2	0	0	0		2	18	8		
1797	TT1		L2	1	0	0	0		2	11.1	3		
1798	TT1		L2	1	9	2	1		2	20.7	2		
1799	TT1		L2	1	9	2	0		2	58.6	11		
1800	TT1		L2	2	0	0	1		2	2.6	1		
1801	TT1		L2	3	9	9	0		3	1.5	1		
1802	TT1		L2	2	0	0	0		3	12.8	23		
1803	TT1		L2	2	0	0	1		3	2.4	3		
1804	TT1		L2	2	9	2	0		3	5.1	7		
1805	TT1		L2	2	9	2	1		3	1.2	1		
1806	TT1		L2	1	0	0	1		3	2.8	1		
1807	TT1		L2	1	9	2	0		3	3.8	6		
1808	TT1		L2	1	0	0	0		3	6.6	10		
1809	TT1		L2	1	0	0	0		4	0.1	1		
1810	TT1		L2	2	0	0	0		4	0.5	2		
1811	TT1		L1	1	0	0	1		1	27.7	1		
1812	TT1		L1	1	9	2	0		2	12.6	4		
1813	TT1		L1	2	9	2	0		2	8.8	3		
1814	TT1		L1	2	0	0	0		2	13.9	7		
1815	TT1		L1	2	0	0	1		2	7.1	2		
1816	TT1		L1	3	9	9	0		2	6.1	3		
1817	TT1		L1	1	9	2	0		2	15.4	4		
1819	TT1		L1	3	9	9	1		2	1.7	1		
1820	TT1		L1	2	0	0	0		3	13.8	22		
1821	TT1		L1	3	9	9	0		3	3.9	3		
1822	TT1		L1	1	0	0	0		3	9.9	12		
1823	TT1		L1	2	9	2	0		3	3	4		
1824	TT1		L1	1	9	2	0		3	0.8	2		
1825	TT1		L1	7	0	0	0		3	0.7	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1826	TT1		L1	1	0	0	0		4	0.03	1		
1827	TT1		L1	2	0	0	0		4	0.1	1		
1828	TT1		L1	2	0	0	0		4	0.03	1		
1829	GRID4		18-24	1	0	0	1		1	26.9	1		
1830	GRID4		18-24	1	0	0	0		1	22.3	1		
1831	GRID4		18-24	9	0	0	0		2	3.9	1		
1832	GRID4		18-24	2	0	0	0		2	7.7	4		
1833	GRID4		18-24	1	0	0	0		2	27.8	4		
1834	GRID4		18-24	1	0	0	0		3	1.1	3		
1835	GRID4		18-24	2	0	0	0		3	0.6	3		
1836	GRID4		18-24	9	0	0	0		3	3.6	2		
1837	GRID4		18-24	2	9	2	0		3	0.2	1		
1838	GRID4		18-24	1	0	0	0		4	0.1	2		
1839	GRID6		6-12	1	0	0	1		1	19	1		
1840	GRID6		6-12	1	0	0	0		2	4.5	1		
1841	GRID6		6-12	3	9	9	0		2	3	1		
1842	GRID6		6-12	2	0	0	0		2	3.6	2		
1843	GRID6		6-12	2	0	0	1		2	1.8	1		
1844	GRID6		6-12	9	0	0	0		2	15.6	1		
1845	GRID6		6-12	3	9	9	0		3	2.1	3		
1846	GRID6		6-12	1	9	2	0		3	0.4	1		
1847	GRID6		6-12	2	0	0	0		3	2.4	4		
1848	GRID6		6-12	1	0	0	1		3	0.9	1		
1849	GRID6		6-12	1	0	0	0		3	3.5	2		
1850	GRID3		0-6	1	0	0	0		1	47.9	1		
1851	GRID3		0-6	1	0	0	0		3	4.4	6		
1852	GRID3		0-6	2	0	0	0		3	2.3	2		
1853	GRID3		0-6	2	0	0	0		3	2.7	6		
1854	GRID1		0-12	1	9	2	0		1	34.7	1		
1855	GRID1		0-12	2	9	2	0		2	1.5	1		
1856	GRID1		0-12	1	0	0	1		2	3.2	2		
1857	GRID1		0-12	1	9	2	1		2	7.3	1		
1858	GRID1		0-12	9	0	0	0		2	2.1	1		
1859	GRID1		0-12	2	0	0	0		2	5.4	2		
1860	GRID1		0-12	1	0	0	0		2	7.8	3		
1861	GRID1		0-12	2	0	0	1		3	4.1	5		
1862	GRID1		0-12	2	0	0	0		3	4.1	6		
1863	GRID1		0-12	9	0	0	0		3	1.5	1		
1864	GRID1		0-12	3	9	9	0		3	0.9	2		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1865	GRID1		0-12	1	9	2	0		3	0.5	1		
1866	GRID1		0-12	1	0	0	0		3	1.9	7		
1867	GRID1		0-12	1	0	0	1		3	3.2	2		
1868	GRID1		0-12	1	0	0	0		4	0.03	1		
1869	GRID7		0-6	2	0	0	0		2	4.8	2		
1870	GRID7		0-6	1	0	0	0		2	3.6	1		
1871	GRID7		0-6	1	0	0	0		3	0.6	1		
1872	GRID7		0-6	2	0	0	0		3	2.6	3		
1873	GRID7		0-6	9	0	0	0		3	1.3	1		
1874	GRID4		1-12	1	9	2	0		2	8.1	1		
1875	GRID4		1-12	1	0	0	0		3	0.3	1		
1876	GRID4		1-12	2	0	0	0		3	1.2	2		
1877	GRID7		12-18	2	0	0	0		2	1.7	1		
1878	GRID7		12-18	2	0	0	1		3	1.8	1		
1879	GRID7		12-18	2	0	0	0		4	0.03	1		
1880	GRID1		18-24	1	9	2	0		1	24.1	1		
1881	GRID1		18-24	2	0	0	1		2	3.3	1		
1882	GRID1		18-24	3	9	9	0		3	1.3	1		
1883	GRID1		18-24	1	9	2	0		4	0.2	2		
1884	GRID6		12-18	1	0	0	0		1	23.8	1		
1885	GRID6		12-18	2	0	0	0		3	1.2	2		
1886	GRID6		12-18	1	0	0	1		3	1.2	1		
1887	GRID4		24,30,30-36	1	0	0	1		2	9.5	2		
1888	GRID4		24,30,30-36	2	0	0	0		3	1.6	2		
1889	GRID4		24,30,30-36	9	0	0	0		3	0.5	1		
1890	GRID3		6-12	2	0	0	0		2	1.3	1		
1891	GRID3		6-12	2	0	0	0		3	1.8	2		
1892	GRID7		6-12	2	0	0	0		2	5.9	2		
1893	GRID7		6-12	1	0	0	0		3	0.6	1		
1894	GRID7		6-12	2	0	0	0		3	1.5	1		
1895	GRID7		6-12	3	9	9	0		3	0.9	1		
1896	GRID7		6-12	9	0	0	0		3	1.3	1		
1897	GRID12			3	9	9	0		2	9.7	1		
1898	GRID3		18-24	1	0	0	0		2	6.7	1		
1899	GRID3		18-24	2	0	0	0		2	2.6	1		
1900	GRID3		18-24	2	0	0	0		3	1.1	2		
1901	TT1		L2	1	0	0	0		2	11.1	2		
1902	GRID9		17-24	7	0	0	0		2	0.7	1		
1903	TT1		L1	2	0	0	0		3	1	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1904	TT1		L1	2	9	2	0		3	0.2	2		
1905	TT3		0-6	1	0	0	1		2	3.3	2		
1906	TT3		0-6	3	9	9	0		2	3.9	1		
1907	TT3		0-6	1	9	2	0		3	0.8	1		
1908	TT3		0-6	1	0	0	0		3	1.7	2		
1909	GRID5		0-12	1	0	0	1		1	20.5	1		
1910	GRID5		0-12	2	0	0	0		3	0.5	1		
1912	GRID7		18-24	9	0	0	0		3	1.6	1		
1913	GRID7		18-24	3	9	9	0		3	1	1		
1914	GRID7		18-24	7	0	0	0		3	0.2	1		
1915	TT3		6-12	7	0	0	0		3	0.3	1		
1916	TT3		6-12	3	9	9	0		3	0.9	1		
1917	GRID6		18-24	2	0	0	0		3	0.7	2		
1918	GRID6		12-18	9	0	0	0		3	1.3	1		
1919	GRID8		12-18	1	0	0	0		2	3.9	1		
1920	GRID8		12-18	3	9	9	0		3	0.6	2		
1921	GRID3			1	0	0	0		2	2.6	1		
1922	GRID3			2	0	0	0		3	1.3	1		
1923	GRID7		24-30	1	0	0	0		3	0.6	1		
1924	GRID7		24-30	2	0	0	0		3	0.9	1		
1925	TT3		6-12	1	0	0	0		4	0.1	1		
1926	TT1			2	0	0	0		4	0.2	1		
1927	TT2			3	9	9	0		3	1.6	3		
1928	TT2			1	0	0	0		3	0.4	1		
1929	GRID5		12-18	1	0	0	0		1	19.5	1		
1930	GRID5		12-18	2	0	0	0		2	2.7	1		
1931	GRID5		12-18	1	0	0	0		2	1	1		
1932	GRID5		12-18	2	0	0	1		3	0.4	1		
1933	GRID5		12-18	2	0	0	0		3	0.5	1		
1934	GRID5		12-18	1	0	0	0		3	0.6	1		
1935	GRID5		12-18	3	9	9	0		3	0.1	1		
1936	TT3		9	1	0	0	1		3	9.2	1		
1937	TT2			3	9	9	0		2	1.6	1		
1938	TT2			2	0	0	0		2	0.8	1		
1939	FIRE PIT			1	0	0	1		1	34.1	1		
1940	FIRE PIT			3	9	9	0		3	1.8	1		
1941	FIRE PIT			2	9	2	0		2	5.3	1		
1942	FIRE PIT			1	9	2	0		3	0.7	1		
1943	FIRE PIT			1	9	2	0		3	0.4	1		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1944	FIRE PIT			1	0	0	1		2	4.1	1		
1945	HABITATION			1	0	0	0		3	1.2	1		
1946	HABITATION			3	9	9	0		2	16.9	1		
1947	HABITATION			7	0	0	0		3	3.4	1		
1948	HABITATION-FIRE PIT		0-36	2	0	0	0		2	16	1		
1949	HABITATION-FIRE PIT		0-36	2	9	2	0		2	2.1	1		
1950	HABITATION-FIRE PIT		0-36	1	9	2	1		2	10.5	2		
1951	HABITATION-FIRE PIT		0-36	1	0	0	0		2	6.4	1		
1952	HABITATION-FIRE PIT		0-36	9	0	0	0		3	2.5	2		
1953	HABITATION-FIRE PIT		0-36	1	0	0	1		3	3	2		
1954	HABITATION-FIRE PIT		0-36	1	0	0	0		3	2.2	6		
1955	HABITATION-FIRE PIT		0-36	1	9	2	0		3	0.1	1		
1956	HABITATION-FIRE PIT		0-36	2	0	0	1		3	0.8	1		
1957	HABITATION-FIRE PIT		0-36	2	0	0	0		3	4.6	6		
1958	HABITATION-FIRE PIT		0-36	2	9	2	0		3	6	11		
1959	HABITATION			9	9	0	1		2	8.6	1		
1960	HABITATION			1	0	0	1		2	17.2	1		
1961	HABITATION			1	0	0	0		2	15.7	1		
1962	HABITATION			2	0	0	0		2	3.9	2		
1963	HABITATION			9	0	0	0		3	0.4	1		
1964	HABITATION			3	9	9	0		2	3.1	2		
1965	HABITATION			2	9	2	0		3	0.8	2		
1966	HABITATION			2	0	0	0		3	1	2		
1967	HABITATION			1	0	0	0		3	0.4	1		
1968	HABITATION			1	9	2	0		3	2.7	2		
1969	UNKNOWN			1	9	2	0		3	1.1	1		
1970	UNKNOWN			3	9	9	0		3	0.2	1		
1971	UNKNOWN			2	0	0	0		3	0.6	2		
1972	UNKNOWN			3	9	9	0		4	0.03	1		
1973	UNKNOWN			2	0	0	0		4	0.1	1		
1974	UNKNOWN			1	9	2	0		4	0.03	1		
1975	UNKNOWN			1	0	0	0		2	0.9	1		
1976	UNKNOWN			1	0	0	0		3	0.8	1		
1977	UNKNOWN			1	9	2	0		3	1.6	1		
1978	UNKNOWN			2	0	0	0		3	3.3	4		
1979	SURFACE		0	1	0	0	1		2	48.7	14		
1980	SURFACE		0	1	0	0	0		2	27.7	10		
1981	SURFACE		0	1	9	2	1		3	3.3	3		
1982	SURFACE		0	1	9	2	0		3	7.4	9		

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	LENGTH (mm)	SIZE	MASS(g)	QTY	X CORD	Y CORD
1983	SURFACE		0	1	0	0	0		3	52.1	73		
1984	SURFACE		0	1	0	0	1		3	28.7	35		
1985	SURFACE		0	1	0	0	0		4	2.9	32		
1986	SURFACE		0	1	0	0	1		4	0.4	3		
1987	SURFACE		0	1	0	0	0		4	0.03	5		
1988	SURFACE		0	9	0	0	0		2	13.3	3		
1989	SURFACE		0	9	0	0	0		3	16.9	25		
1990	SURFACE		0	9	0	0	0		4	0.7	6		
1991	SURFACE		0	9	0	0	0		4	0.03	2		
1992	SURFACE		0	3	9	9	0		1	14.8	1		
1993	SURFACE		0	3	9	9	1		2	17.5	5		
1994	SURFACE		0	3	9	9	0		2	101	30		
1995	SURFACE		0	3	9	9	0		3	168.1	264		
1996	SURFACE		0	3	9	9	1		3	7.1	9		
1997	SURFACE		0	3	9	9	0		4	5.1	44		
1998	SURFACE		0	2	9	2	0		2	10.9	3		
1999	SURFACE		0	2	9	2	1		2	1.5	1		
2000	SURFACE		0	2	0	0	1		2	10.3	5		
2001	SURFACE		0	2	0	0	0		2	22.6	6		
2002	SURFACE		0	2	9	2	0		3	3.5	6		
2003	SURFACE		0	2	0	0	0		3	25.7	60		
2004	SURFACE		0	2	0	0	1		3	19.8	29		
2005	SURFACE		0	2	9	2	0		4	0.03	1		
2006	SURFACE		0	2	0	0	1		4	0.1	1		
2007	SURFACE		0	2	0	0	0		4	2.1	19		
2008	TT1		0	7	9	9	0	25.4	3	0.8	1		
2009	GRID1		0-12	7	9	9	0	17.3	2	0.6	1		
2010	GRID1		0-12	7	9	9	0	13.6	2	0.7	1		
2011	TT1		L2	7	9	9	0	15	2	0.2	1		
2012	TT1		L2	7	9	9	0	20.5	2	1.1	1		
2013	TT1		L2	7	9	9	0	17.2	2	0.3	1		

Stone Tools:

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	TECH	FUNC	LENGTH (mm)	WIDTH (mm)	THICK (mm)	MASS (g)
3000	38.2	H3	19	1	0	2	0	4	ES	52.7	34.0	7.4	12.3
3001	32.2	R6	26	1	0	0	0	4	ES	59.8	40.4	11.8	27.2
3002	39.4	F7	8	1	0	0	1	4	ES	54.6	31.5	8.6	14.5
3003	19.3		38	3	9	9	0	4	SC	66.6	51.2	12.9	43.3
3004	22.3	N7	25	3	9	9	0	5	UF	117.4	43.9	20.1	92.3
3005	38.2	M3	19	1	0	0	0	4	SS	73.9	33.1	8.8	25.5
3006	23.4	R3	28	2	0	0	0	1	PPT	13.1	14.2	2.7	0.4
3007	39.1		9	3	9	9	0	1	PPS	7.0	13.7	3.3	0.3
3008	38.4	P1	24	1	0	0	0	1	PPU	30.6	16.3	4.4	2.2
3009	38.2	I3	11.5	1	9	2	0	1	PPU	23.1	16.9	3.7	1.4
3010				1	9	2	0	1	PPU	27.5	16.6	2.42	1.2
3011	GRID2		24-30	2	0	0	0	1	PPT	17.9	11.2	3.1	0.5
3012	23.2			2	0	0	0	1	PPS	18.0	13.4	3.5	1
3013	38.4	K9	21	3	9	9	0	5	UF	58.6	34.2	7.4	14
3014	38.2	I3	17.5	1	9	2	0	4	GR	40.4	15.6	7.8	3.2
3015	38.2	D2	18	1	9	2	0	5	UF	62	16.4	6.9	5.1
3016	66.3		14-18	1	2	9	0	1	PP	18.8	16.1	4.6	1.3
3017	36.3	D3	9	2	9	2	0	5	SC	29.6	12.7	6.1	1.9
3018	39.1		9	3	9	9	0	5	UF	42.7	28.3	4.7	6.6
3019	22.3	I3	2.1	1	9	2	0	3	BF	35.3	35.9	7.8	6.9
3020	52.1		1.8	1	0	0	0	1	PP	19.1	20.4	4.2	1.6
3021	38.2	D5	18	1	9	2	0	3	BF	35.3	21.5	4.9	2.2
3022	66.3		12-14	2	0	0	0	1	PP	9.2	11.6	3.1	0.3
3023	66.3			2	0	0	0	1	PP	14.6	10.3	2.7	0.3
3024	GRID1		24-36	1	9	2	0	4	ES	30.5	27.9	6.1	6.9
3025	GRID1		0-12	2	0	0	0	7	CR	48.2	38.2	27.4	56.3
3026	GRID3		6-12	3	9	9	0	6	BF	34.1	56.1	11.1	18.5
3027	GRID6		6-12	1	0	0	0	5	UF	84.1	38.2	11.4	30
3028	GRID9		26-27	3	9	9	0	2	BF	54.7	45.4	10.1	26.3
3029	GRID4		24-36	1	0	0	0	2	BF	19.4	38.3	8.1	5.5
3030	GRID12			1	0	0	0	1	PP	25.5	21.0	4.4	2.4
3031	TT1		L2	1	9	2	0	5	UF	40.1	37.5	8.7	12.4
3032	GRID1		13	1	0	0	0	1	PPT	12.5	11.4	2.8	0.4
3033	37.2	I4	7.25	3	9	9	0	1	PPT	12.4	12.7	2.8	0.4
3034	23.2	X2	27	1	0	0	0	1	PPU	14.1	13.6	2.2	0.4
3035	39.2	I4	7	2	0	0	0	1	PP	14.9	12.1	2.2	0.3

CN	GRID	LETTER	DEPTH	RAWMAT	HEAT	BURN	CORT	TECH	FUNC	LENGTH (mm)	WIDTH (mm)	THICK (mm)	MASS (g)
3036	24.3	P	28	3	9	9	0	1	PP	26.8	14.1	4.6	1.7
3037	38.2	O6	18	2	9	2	0	2	BF	51.7	22.3	6.7	7.5
3038	52.1		18	2	0	0	0	1	PPU	29.7	14.6	3.1	1.5
3039	38		21	1	9	2	0	4	ES	28.0	32.8	5.0	5.7
3040	TT1		L2	3	9	9	0	3	BF	22.2	18.6	3.4	1.8
3041	TT1		L1	2	0	0	0	5	UF	46.4	22.7	6.7	5.2
3042	66.3		33	1	0	0	0	1	PPU	17.2	11.8	3.1	0.5
3043	TT1		L1	2	0	0	0	5	UF	28.7	30.3	6.7	4
3044	TT1		L1	3	9	9	0	1	PP	22.8	13.4	4.7	1.2
3045	TT1		L1	3	9	9	0	2	BF	32.4	28.7	8.1	7.5
3046	TT1		L2	2	0	0	0	5	UF	29.8	41.4	5.4	5.6
3047	24.1	V2	6	2	0	0	0	1	BF	18.6	24.7	6.4	2.4
3048	GRID9		17-24	2	0	0	0	1	PPU	16.6	16.0	4.2	0.8
3049	GRID1		24-36	2	0	0	0	1	PPU	13.2	12.4	2.4	0.3
3050	TT1		L2	1	9	2	0	5	UF	23.4	17.8	4.3	1.8
3051	GRID9		17-24	3	9	9	0	2	OT	52.4	16.7	5.0	3.9
3052	GRID6		18-24	3	9	9	0	3	BF	50.5	31.6	7.7	11.3
3053	HABITATION			3	9	9	0	1	PP	22.3	17.7	3.1	1
3054	GRID7		18-24	9	9	9	0	1	PPU	22.7	22.4	5.3	2.2
3055	FIRE PIT			1	0	0	0	5	UF	51.3	39.4	8.1	15.1
3056	TT1		L2	7	9	9	0	3	BF	38.2	31.5	11.1	9.4
3057	51.4		9	1	0	0	0	1	PPU	23.1	16.2	2.4	0.9
3058	66.3		22-33	1	0	0	0	1	PPU	21.3	14.5	2.7	1
3059	38.2	R4	22	1	9	2	0	1	PP	30.3	23.7	4.9	3.6
3060	38.2	R4	22	1	9	2	1	7	CR	60.9	35.2	33.8	91.6
3061	39.3	B9	15	1	9	2	1	7	CR	61.5	35.8	37.6	92
3062	39.1		9	1	9	2	1	7	CR	37.6	22.1	31.8	26.4
3063	38.2	N8	14.5	1	9	2	0	7	CR	26.5	22.3	14.7	9.9
3064	39.1		9	9	9	9	1	7	CR	21.9	23.3	14.4	9.5
3065	38.3	T5	24	8	9	2	0	10	GRD	51.1	40.5	28.2	94.2

APPENDIX C: BISON BONE DATA

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5001	21.4	N5-N6-O4	23	HM	CO	CO	R	3	3	0	0	0	0	707	1	28.64	2.55
5002	20			HM	CO	CO	R	3	3	0	0	0	1	1253	1		
5003	21			HM	DFD	CO	R	2	3	0	0	1	0	444	1		
5004	38.4	W4-W7	27	HM	CO	CO	R	0	0	0	0	0	0	166	1	57.12	10.44
5005	24		32	HM	DSH	CO	R	4	0	0	0	1	0	115	1		
5006	25.1	A1-A3	25	HM	DFD	CO	R	4	3	0	0	1	0	414	1	60.18	9.73
5007				HM	DFD	CO	R	4	3	0	0	1	0	495	1		
5008	38.3	X6-X9	27	HM	DSS	CO	R	4	3	0	1	0	0	150	1	53.69	10.42
5009	20.4	M6-R5	36	HM	DFD	CO	L	4	3	0	0	1	1	610	1	17.72	2.41
5010	38.3	Q7-R8	27	HM	DSH	ME	L	4	3	0	0	1	0	242	1	51.14	11.09
5011	38.4	S5-S9	27	HM	DFD	CO	L	4	3	0	0	1	0	350	1	58.34	11.41
5012	22.4	M	28	HM	DFD	CO	L	4	3	0	0	1	0	461	1	37.58	2.59
5013	21.4	V2-V6	23	HM	DSS	CO	L	4	3	0	1	0	0	461	1	26.59	0.71
5014	24.1	N7	32	HM	DSS	CO	R	4	3	0	1	0	0	343	1	53.10	7.02
5015				HM	DFD	CO	L	1	2	0	0	0	0	362	1		
5016	21.4	P4-U4	23	HM	DSS	CO	L	4	2	0	1	0	0	240	1	25.05	1.52
5017				HM	CO	CO	L	0	0	0	0	1	0	128	1		
5018	24		32	HM	DS	CO	L	0	3	0	1	0	0	186	1		
5019	21.3	T7-Y1	23	RDU	CO	CO	R	3	3	0	0	0	0	417	1	24.30	1.11
5020				RDU	CO	CO	L	3	3	0	0	0	0	406	1		
5021				RDU	CO	CO	L	3	3	0	0	0	0	607	1		
5022	21.4	W2-7	23	RD	CO	CO	L	3	3	0	0	0	0	365	1	27.45	0.72
5023				RD	CO	CO	L	3	3	0	0	0	0	416	1		
5024	21.4	R5-R8	23	TRC	CO	CO	L	5	5	0	0	0	0	49	1	27.58	1.48
5025	20.4	B8	36	TRC	CO	CO	L	5	5	0	0	0	0	47	1	16.64	4.06
5026	21.4	H5	23	TRC	CO	CO	R	5	5	0	0	0	0	35	1	27.42	3.50
5027	20.3	I8	48	TRC	CO	CO	R	5	5	0	0	0	0	83	1	13.57	3.03
5028	20.4	G4	36	RD	DSE	CO	R	5	0	0	0	0	0	28	1	16.26	3.65
5029	20.3	T2	48	RD	DSE	CO	L	5	0	0	0	0	0	42	1	14.60	1.96
5030	20.4	G2	36	RD	DSE	CO	L	5	0	0	0	0	0	44	1	16.48	3.98
5031	20.3	S1-S4	36	TA	DSE	CO	R	5	0	0	0	0	0	47	1	13.32	1.72
5032	20.3	N7	36	TA	DSS	CO	L	4	3	0	1	0	0	164	1	13.06	2.06
5033				TA	DSH	CO	R	4	0	0	0	1	0	167	1		
5034				RD	DSH	CO	R	4	0	0	0	1	0	219	1		
5035	21.4	W8-X7	23	UL	DSH	CO	L	0	4	0	0	0	0	70	1	27.36	0.33
5036	21.4	R8-W5	27	UL	DSH	CO	L	0	4	0	0	0	0	48	1	27.61	1.15

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5037	20.3-4			UL	DSS	CO	R	0	4	0	1	0	1	176	1		
5038	20.4	G5-L2	36	RD	CO	CO	L	5	0	0	0	0	0	211	1	16.40	3.35
5039	20.3	G2-G4	23	RD	DSH	CO	R	5	0	0	1	0	0	119	1	11.58	3.70
5040				TA	CO	CO	R	0	3	0	0	0	0	535	1		
5041	21.4	W4-5	23	TA	PRE	CO	R	0	5	0	0	0	0	24	1	27.17	0.45
5042	38.3	J5-J9	27	TA	DF	CO	R	5	5	0	0	1	0	105	1	54.63	13.55
5043	24.2	B9-G3	32	TA	CO	CO	L	0	0	0	0	0	1	228	1	56.76	9.08
5044	24.1	I7-N4	32	TA	CO	CO	L	0	0	0	0	0	0	257	1	53.08	8.14
5045	24		32	TA	DSH	CO	L	5	0	0	0	1	0	234	1		
5046	20.4	S6-T9	36	TA	CO	CO	L	3	3	0	0	0	0	551	1	18.72	1.46
5047	24.2	G9-L1	32	TA	DSH	CO	L	5	3	0	0	1	0	258	1	56.99	8.22
5048	20.4	L3-M2	36	TA	DSH	CO	L	5	2	0	0	1	0	421	1	16.96	2.98
5049				TA	DSH	CO	L	5	3	0	0	1	0	281	1		
5050	21.4	T4-Y2	23	TA	PRS	CO	L	2	5	0	1	0	0	301	1	29.30	1.53
5051	20.4	I1-S1	36	TA	CO	CO	L	3	3	0	0	0	0	784	1	18.32	3.79
5052	38.4	T4-7	27	FM	SH	CO	R	5	5	0	1	1	0	131	1	59.21	11.44
5053				FM	PSH	CO	R	5	5	0	0	1	0	140	1		
5054	24.3	G3-H1	32	FM	DSS	CO	R	5	3	0	1	1	0	203	1	51.77	3.90
5055	25.3	L1	20	FM	PRS	CO	R	0	5	0	1	0	0	151	1	61.24	2.78
5056	24.2	G5	32	FM	DSE	CO	R	5	0	0	0	0	0	51	1	56.36	8.56
5057				FM	DSE	CO	R	5	0	0	0	0	0	174	1		
5058	20.3	M7-Q6	36	FM	PRS	CO	R	0	5	0	1	0	0	229	1	12.26	2.16
5059				FM	PRE	HE	R	0	5	0	0	0	0	55	1		
5060				FM	PRS	CO	R	2	5	0	1	0	0	142	1		
5061				FM	PRS	CO	R	2	5	0	1	0	0	227	1		
5062				FM	CO	CO	R	2	0	0	0	1	0	600	1		
5063				FM	DSE	CO	L	5	0	0	0	0	0	125	1		
5064	24.2	B6	32	FM	DSE	CO	L	5	0	0	0	0	0	74	1	56.84	9.57
5065	24.1	C1	32	FM	CDL	ME	L	5	0	0	0	0	0	39	1	52.16	9.83
5066				FM	DSH	CD	L	5	3	0	1	0	0	222	1		
5067				FM	PSH	CD	L	3	5	0	1	0	0	169	1		
5068	21.1	S5-S6	23	FM	PRS	CO	L	0	0	0	0	1	0	199	1	23.65	6.38
5069	38.4	C9-H3	27	FM	SH	CO	L	5	5	0	1	1	0	167	1	57.87	14.25
5070	20.3-4			RB	PRS	CO	R	5	5	0	0	0	0	65.7	1		
5071	21.4	T4-T7	23	RB	PRS	CO	L	5	5	0	0	0	0	81.6	1	29.22	1.57
5072				RB	CO	CO	R	5	5	0	0	0	0	60.4	1		
5073				RB	PRS	CO	L	5	5	0	0	0	0	65	1		
5074	21.4	U6-V6	23	RB	PSH	CO	L	5	5	0	0	0	0	31	1	25.88	0.54
5075				RB	CO	CO	L	5	5	0	0	0	0	80	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5076	21.4	U5-U4	23	RB	BL	CO	L	5	5	0	0	0	0	98	1	25.43	0.59
5077	21.4	T8-Y5	23	RB	PRS	CO	L	5	5	0	0	0	0	46	1	29.37	1.24
5078	21.4	V2-V9	21	RB	PSH	CO	L	5	5	0	0	0	0	27	1	26.55	0.67
5079	21.3	M1-M4	23	RB	PSH	CO	L	5	5	0	0	0	0	31	1	22.22	2.72
5080	20.4	H2-H8	36	RB	PSH	CO	L	5	5	0	0	0	0	20	1	17.58	3.80
5081	21.4	T7-X2	23	RB	PRS	CO	L	5	5	0	0	0	0	16	1	29.32	1.25
5082	21.2	H6-I4	23	RB	PSH	CO	L	5	5	0	0	0	0	30	1	27.96	8.63
5083	21.4	Q2-Q4	21	RB	PRS	CO	L	5	5	0	0	0	0	37	1	26.40	1.69
5084	20.4	H6-L5	36	RB	BL	CO	L	5	5	0	0	0	0	46	1	17.91	3.53
5085	21.3	E1-E6	21	RB	PRS	CO	L	5	5	0	0	0	0	53	1	24.33	4.87
5086				RB	PRS	CO	L	5	5	0	0	0	0	88	1		
5087				RB	BL	CO	L	5	5	0	0	1	0	91	1		
5088	38.4	K3-L4	27	RB	BL	CO	L	5	5	0	0	0	0	63	1	55.67	12.74
5089				RB	PRS	CO	L	5	5	0	0	1	0	92	1		
5090	20.2	N9-S2	36	RB	PRS	CO	L	5	5	0	0	1	0	20	1	18.67	7.02
5091	20.4	N6-N7	36	RB	PRS	CO	L	5	5	0	0	1	0	51	1	18.89	2.63
5092				RB	BL	CO	L	5	5	0	0	0	0	75	1		
5093				RB	CO	CO	L	5	5	0	0	0	0	93	1		
5094	19.3	P3-P5	38	RB	BL	CO	L	5	5	0	0	0	1	48	1	0.80	1.69
5095	24.1	Y1-T9	32	RB	BL	CO	L	5	5	0	0	0	0	75	1	54.26	5.90
5096				RB	CO	CO	L	5	5	0	0	0	0	233	1		
5097				RB	PRS	CO	L	5	5	0	0	0	0	148	1		
5098				RB	BL	CO	L	5	5	0	0	0	0	74	1		
5099				RB	PRS	CO	L	5	5	0	0	0	0	90	1		
5100	24.2	A7-F2	32	RB	PRS	CO	L	5	5	0	0	0	0	29	1	55.18	9.05
5101	24.3	K4-K8	32	RB	PRS	CO	L	5	5	0	0	0	0	33	1	50.04	2.34
5102	38.3	T4-T3	27	RB	PRS	CO	L	5	5	0	0	1	0	19	1	54.30	11.65
5103	38.3	I6-J5	27	RB	BL	CO	L	5	5	0	0	1	0	59	1	53.89	13.58
5104	20.3	G4-G6	23	RB	PRS	CO	L	5	5	0	0	0	0	10	1	11.17	3.57
5105	24.2	G5	32	RB	PSH	CO	L	5	5	0	0	0	0	18	1	56.55	8.62
5106	21.4	O8-T9	23	RB	BL	CO	L	5	5	0	0	0	0	38	1	29.34	2.05
5107	22.4	Y	36	RB	BL	CO	L	5	5	0	0	1	0	108	1	39.62	0.53
5108	21.4	W5-X4	21	RB	CO	CO	L	5	5	0	0	0	0	20	1	27.58	0.41
5109				RB	BL	CO	L	5	5	0	0	0	0	51	1		
5110	21.3	D2	21	RB	PRS	CO	L	5	5	0	0	0	0	39	1	23.41	4.79
5111	21.3	X3-Y1	23	RB	BL	CO	R	5	5	0	0	1	0	57	1	23.87	0.86
5112				RB	BL	CO	L	5	5	0	0	0	0	51	1		
5113	20.3-4			RB	BL	FR	L	5	5	0	0	0	0	5	1		
5114	21.4	U5-U7	21	RB	PSH	CO	L	5	5	0	0	0	0	14	1	25.44	0.38

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5115	21.3	S9-Y1	23	RB	BL	CO	L	5	5	0	0	0	0	44	1	23.77	1.28
5116	21.4	K1-R8	23	RB	BL	CO	L	5	5	0	0	0	0	64	1	25.30	2.91
5117				RB	BL	CO	L	5	5	0	0	0	0	93	1		
5118	21.2	T5-T8	23	RB	BL	CO	L	5	5	0	0	0	1	31	1	29.58	6.49
5119	25.1	A7-F1-F4	28	RB	BL	CO	L	5	5	0	0	0	0	45	1	60.17	9.06
5120	19.4		38	RB	BL	CO	L	5	5	0	0	1	0	79	1	7.46	2.52
5121	21.3	Y1-4	23	RB	BL	CO	L	5	5	0	0	0	0	45	1	24.14	0.67
5122	21.1	W6-X7	23	RB	BL	CO	L	5	5	0	0	0	0	38	1	22.93	5.48
5123	21.4	T3-T4	23	RB	BL	CO	L	5	5	0	0	0	0	67	1	29.90	1.75
5124				RB	BL	CO	R	5	5	0	0	0	0	46	1		
5125	20.4	L3-L6	36	RB	BL	CO	R	5	5	0	0	0	0	9	1	16.69	2.68
5126	21.4	F5-G2	23	RB	BL	CO	R	5	5	0	0	0	0	44	1	25.58	3.65
5127	21.4	X6-Y2	21	RB	PSH	CO	R	5	5	0	0	0	0	33	1	28.67	0.61
5128	21.3	R1-R4	23	RB	BL	CO	N	5	5	0	0	0	0	63	1	22.23	1.81
5129	21.4	A4-A9	23	RB	BL	CO	N	5	5	0	0	0	0	47	1	25.29	4.51
5130	21.4	R5-S4	23	RB	BL	CO	N	5	5	0	0	0	0	24	1	27.36	1.35
5131	20.3	O1	23	FM	PRE	HE	R	5	5	0	0	0	0	41	1	14.29	2.99
5132	21.4	V1	21	FM	PRE	HE	L	5	5	0	0	0	0	15	1	26.13	0.89
5133	20.3	N6-N9	48	RB	BL	CO	N	5	5	0	0	0	0	18	1	13.67	2.43
5134	24.3	F5-F7	32	RB	BL	CO	N	5	5	0	0	0	0	54	1	50.61	3.48
5135	19.3	P3-P6	38	RB	BL	CO	N	5	5	0	0	0	0	56	1	0.83	1.68
5136	19.3-4		38	RB	BL	CO	N	5	5	0	0	0	0	59	1		
5137	21.4	S4-X7	23	RB	BL	CO	L	5	5	0	0	0	0	69	1	28.04	1.34
5138	20.4	K8-L5	36	RB	BL	CO	N	5	5	0	0	0	0	16	1	15.41	2.31
5139	24.4	F1	32	RB	BL	CO	N	5	5	0	0	0	0	48	1	55.11	3.94
5140				RB	BL	CO	N	5	5	0	0	0	0	41	1		
5141	38.3	V1-V3	27	RB	BL	CO	L	5	5	0	0	0	1	31	1	51.31	10.78
5142	21.1	X6-Y4	23	RB	BL	CO	N	5	5	0	0	0	0	16	1	23.90	5.50
5143	21.3	J1-O3	23	RB	BL	CO	R	5	5	0	0	0	0	51	1	24.05	3.72
5144	20.4	F	48	AS	CO	CO	R	5	5	0	0	0	0	71	1	15.42	3.43
5145	20.4	F	48	AS	CO	CO	R	5	5	0	0	0	0	102	1	15.56	3.41
5146	20.4	G4	36	TRC	CO	CO	R	5	5	0	0	0	0	77	1	16.13	3.58
5147	20.4	L7	36	TRC	CO	CO	R	5	5	0	0	0	0	46	1	16.28	2.22
5148	24.2	L1	32	AS	CO	CO	L	5	5	0	0	0	0	62	1	56.14	7.94
5149	24.2	L1	32	TRC	CO	CO	L	5	5	0	0	0	0	35	1	56.08	7.89
5150	19		38	RB	BL	CO	N	5	5	0	0	1	0	51.8	1		
5151	20.3		68	RB	BL	CO	N	5	5	0	0	0	0	86.2	1	12.44	2.46
5152	21.3	H3	23	RB	BL	CO	N	5	5	0	0	0	0	39.3	1	22.79	3.79
5153	21.1	T8-Y6	23	RB	CO	CO	L	5	5	0	0	0	0	43	1	24.57	6.10

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5154	21.4	T1-T8	23	RB	BL	CO	N	5	5	0	0	0	0	65.5	1	29.27	1.67
5155	20.4	C9-H5	36	RB	BL	CO	N	5	5	0	0	0	0	70.3	1	17.86	4.31
5156	38.4	P3-P5	27	RB	BL	CO	N	5	5	0	0	1	0	26.5	1	55.84	11.89
5157	21.4	Q3-Q5	21	RB	BL	CO	L	5	5	0	0	0	0	13.1	1	26.73	1.86
5158	21.4	S8-X6		RB	BL	CO	N	5	5	0	0	0	0	27.7	1	28.44	1.11
5159	38.4	Q1-Q2	27	RB	BL	CO	N	5	5	0	0	1	0	26	1	56.01	11.67
5160	21.4	W8	23	RB	BL	CO	N	5	5	0	0	0	0	35.5	1	27.53	0.14
5161	20.4	G5	36	RB	DSS	CO	N	5	5	0	0	0	0	11.7	1	16.65	3.61
5162	21.1	T1-T4	23	RB	BL	CO	R	5	5	0	0	0	0	17.9	1	24.26	6.91
5163	21.4	I2-I8	21	RB	BL	CO	N	5	5	0	0	0	0	18.1	1	28.46	3.95
5164	21.4	B4-F3	21	RB	BL	CO	N	5	5	0	0	0	0	22.4	1	26.28	4.51
5165	21.1	X5-X9	23	RB	DSH	CO	N	5	5	0	0	0	0	43.3	1	23.50	5.46
5166	21.4	K8-P6	23	RB	BL	CO	N	5	5	0	0	0	0	23.9	1	25.49	2.25
5167	20.3-4		46	RB	BL	CO	N	5	5	0	0	1	0	13.7	1		
5168	21.4	T4-T8	23	RB	BL	CO	N	5	5	0	0	0	0	47	1	29.28	1.66
5169	21.4	X2-Y3	23	RB	BL	CO	L	5	5	0	0	0	0	39.1	1	28.62	0.89
5170	21.4	P3-Q2	23	RB	BL	HB	N	5	5	0	0	0	0	13.3	1	25.73	1.92
5171	20.3	K2	23	RB	BL	HB	N	5	5	0	0	0	0	9.4	1	10.53	2.88
5172	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	7.5	1		
5173	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	10.4	1		
5174	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	6	1		
5175	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	11.6	1		
5176	20.3	N7-N5	23	RB	BL	HB	N	5	5	0	0	0	0	12.8	1	13.09	2.31
5177	20.4	L3-L6	36	RB	BL	HB	N	5	5	0	0	0	0	2	1	16.75	2.92
5178	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	3.2	1		
5179	20.4	L3-L6	36	RB	BL	HB	N	5	5	0	0	0	0	7.1	1	16.74	2.89
5180	20.4	L3-L6	36	RB	BL	CO	N	5	5	0	0	0	0	4.2	1	16.77	2.94
5181	20.4	L3-L6	36	RB	BL	HB	N	5	5	0	0	0	0	9.5	1	16.73	2.67
5182	20.4	L5-L8	36	RB	BL	CO	N	5	5	0	0	0	0	6.4	1	16.45	2.34
5183	20.3	G6	23	RB	BL	CO	N	5	5	0	0	0	0	7.5	1	11.99	3.57
5184	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	13.5	1		
5185	21.4	U2-U3	21	RB	BL	HB	N	5	5	0	0	0	0	3.9	1	25.47	0.69
5186	21.3	O9-T6	23	RB	BL	HB	N	5	5	0	0	0	0	20.4	1	24.77	2.21
5187	20.4	B6-H4	36	RB	BL	CO	N	5	5	0	0	0	0	10.5	1	16.70	4.39
5188	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	4.7	1		
5189	21.4	O8-T9	23	RB	BL	HB	N	5	5	0	0	0	0	5.3	1	29.45	2.32
5190	21.4	X7-X8	23	RB	BL	HB	N	5	5	0	0	0	0	7	1	28.23	0.14
5191	21.4	A4-F1	23	RB	BL	HB	N	5	5	0	0	0	0	9.3	1	25.17	4.46
5192	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	2.9	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5193	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	6.3	1		
5194	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	4.1	1		
5195	20.3	N6	46	RB	BL	CO	N	5	5	0	0	0	0	1.4	1	13.76	2.58
5196	20.3	G5	23	RB	BL	CO	N	5	5	0	0	0	0	7.3	1	11.43	3.37
5197	20.3	R2	36	RB	BL	HB	N	5	5	0	0	1	0	7.7	1	12.40	1.98
5198	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	4.1	1		
5199	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	6.5	1		
5200	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	6.8	1		
5201	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	5	1		
5202	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	5.5	1		
5203	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	3.9	1		
5204	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	5.4	1		
5205	21.2		23	RB	BL	HB	N	5	5	0	0	0	0	7.8	1	27.47	7.50
5206	20.3-4			RB	BL	CO	N	5	5	0	0	1	0	4.8	1		
5207	20.4	H6-L5	36	RB	BL	HB	N	5	5	0	0	0	0	8.6	1	17.94	3.59
5208	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	4.5	1		
5209	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	3.6	1		
5210				RB	BL	HB	N	5	5	0	0	0	0	2.8	1		
5211	20.4	G3-H2	36	RB	BL	HB	N	5	5	0	0	0	0	6.3	1	16.77	3.86
5212	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	7.1	1		
5213	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	2.5	1		
5214	20.3	M5-M6	48	RB	BL	CO	N	5	5	0	0	0	0	9.2	1	12.44	2.56
5215	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	4.4	1		
5216	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	2.2	1		
5217	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	3.8	1		
5218	21.2		23	RB	BL	HB	N	5	5	0	0	1	0	7.7	1	27.64	7.49
5219	20.4	K2	23	RB	BL	HB	N	5	5	0	0	0	0	8.5	1	15.37	2.69
5220	20.4	M2-M3	36	RB	BL	CO	N	5	5	0	0	0	0	7	1	17.61	2.84
5221	20.4	H6-L5	36	RB	BL	HB	N	5	5	0	0	0	0	3.2	1	17.82	3.54
5222	20.4	L3-6	36	RB	BL	HB	N	5	5	0	0	0	0	2	1	16.94	2.90
5223	20.4	K5	36	RB	BL	CO	N	5	5	0	0	0	0	4.3	1	15.37	2.39
5224	21.3	H5	23	RB	BL	CO	N	5	5	0	0	0	0	9.3	1	22.66	3.37
5225	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	2.6	1		
5226	20.4	R1-M9	36	RB	BL	CO	N	5	5	0	0	0	0	12.4	1	17.19	1.93
5227	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	2.2	1		
5228	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	5.5	1		
5229	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	9	1		
5230	20.3		66	RB	PSH	CO	R	5	5	0	0	0	0	16.7	1	12.58	2.49
5231	21.4	S9-Y1	23	RB	PRS	CO	L	5	5	0	0	0	0	16.2	1	28.70	1.19

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5232	20.3	A5-A8	23	RB	BL	HB	N	5	5	0	0	0	0	8.4	1	10.42	4.57
5233	20.3-4			RB	PSH	CO	L	5	5	0	0	0	0	7	1		
5234	20.3-4			RB	BL	HB	N	5	5	0	0	0	0	1.5	1		
5235	20.4	M5-N1	36	RB	BL	HB	N	5	5	0	0	0	0	2.7	1	17.66	2.55
5236	21.4	W6-W8	23	RB	BL	HB	N	5	5	0	0	0	0	2	1	27.92	0.41
5237	20.4	G5	36	RB	BL	HB	N	5	5	0	0	0	0	11.3	1	16.65	3.49
5238	20.4	G2-H1	36	RB	BL	HB	N	5	5	0	0	0	0	14.5	1	16.61	3.92
5239	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	11.5	1		
5240	20.4		36	RB	BL	HB	N	5	5	0	0	0	0	2.1	1	17.37	2.43
5241	20.4		36	RB	BL	HB	N	5	5	0	0	0	0	8.9	1	17.63	2.47
5242	20.4	G2-G8	36	RB	BL	CO	N	5	5	0	0	0	0	16.3	1	16.42	3.98
5243	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	1.2	1		
5244	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	11.6	1		
5245	21.4	A4-F1	23	RB	BL	CO	N	5	5	0	0	0	0	20.7	1	25.17	4.48
5246	24.1	C7-C9	32	RB	BL	CO	N	5	5	0	0	0	0	35.7	1	52.20	9.21
5247	21.4	W6-W8	23	RB	BL	CO	N	5	5	0	0	0	0	66.2	1	27.75	0.40
5248	24.2	D5-I3	32	RB	DSS	CO	N	5	5	0	0	1	0	19.1	1	58.36	9.42
5249	20.4	K9-L8	36	RB	DSH	CO	N	5	5	0	0	0	0	54.6	1	15.71	2.23
5250	21.1	T5-T8	23	RB	BL	CO	N	5	5	0	0	0	0	31.2	1	24.35	6.46
5251	20.4	L5-L8	36	RB	BL	HB	N	5	5	0	0	0	0	16.3	1	16.54	2.40
5252	21.3	I5-L6	21	RB	BL	CO	N	5	5	0	0	0	0	35.5	1	23.47	3.60
5253	21.3	O9-T6	23	RB	BL	HB	N	5	5	0	0	0	0	17.6	1	24.89	2.07
5254	20.4	L3-L6	36	RB	BL	HB	N	5	5	0	0	0	0	16.9	1	16.87	2.77
5255	21.2	X5	23	RB	BL	HB	N	5	5	0	0	0	0	8	1	28.39	5.43
5256	20.3	N5	68	RB	BL	HB	N	5	5	0	0	0	0	23.3	1	13.34	2.38
5257	21.2	T6-Y7	23	RB	BL	CO	N	5	5	0	0	0	0	29	1	29.70	6.49
5258				RB	BL	CO	N	5	5	0	0	1	0	25.6	1		
5259	21.3	M8-R2	23	RB	BL	CO	N	5	5	0	0	0	0	43.5	1	22.57	2.23
5260	21.3	J7-O5	23	RB	DSS	CO	N	5	5	0	0	0	0	10.9	1	24.24	3.12
5261	20.4	M6-L5	36	RB	BL	HB	N	5	5	0	0	0	0	16.3	1	17.99	2.59
5262	21.3	Q2-M5	23	RB	BL	CO	N	5	5	0	0	0	0	16.4	1	21.34	1.98
5263	24.2	M8-R3	32	RB	BL	CO	N	5	5	0	0	0	0	21.8	1	57.57	7.16
5264	25.1	A7-F1-F4	28	RB	BL	CO	N	5	5	0	0	0	0	16.4	1	60.28	9.28
5265	20.3	M5-M8	48	RB	BL	CO	N	5	5	0	0	0	0	17.9	1	12.65	2.64
5266	21.4	V7-V9	23	RB	BL	CO	N	5	5	0	0	0	0	32.1	1	26.10	0.27
5267	20.3	N5-N8	23	RB	BL	HB	N	5	5	0	0	0	0	26.4	1	13.44	2.39
5268	21.4	F4-G2	23	RB	DSH	CO	N	5	5	0	0	0	0	59.6	1	25.04	3.64
5269	21.4	M9-N5	23	RB	BL	CO	N	5	5	0	0	0	0	41.3	1	27.99	2.12
5270	20.3-4			RB	DSS	CO	N	5	5	0	0	0	0	28	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5271	21.4	X2-X6	23	RB	BL	CO	N	5	5	0	0	0	0	29.2	1	28.38	0.85
5272	21.2	J9-O8	23	RB	BL	CO	N	5	5	0	0	0	0	15	1	29.88	8.22
5273	21.1	T5-T8	23	RB	BL	HB	N	5	5	0	0	0	0	9.1	1	24.53	6.36
5274	24.1	H5-H6	32	RB	BL	CO	N	5	5	0	0	0	0	47.9	1	52.60	8.50
5275	38.4	V1-V6	27	RB	BL	CO	N	5	5	0	0	0	0	35.8	1	56.16	10.86
5276	21.4	A4-B7	23	RB	PRS	CO	R	5	5	0	0	0	0	54.3	1	25.20	4.66
5277	21.1	X6-Y4	23	RB	DSH	CO	N	5	5	0	0	0	0	37.4	1	23.89	5.58
5278	20.4	I5-N5		RB	BL	CO	N	5	5	0	0	0	0	83.1	1	18.66	3.49
5279	20.3-4			RB	DSS	CO	N	5	5	0	0	0	0	49.6	1		
5280	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	32.1	1		
5281	21.4	M8-R5	23	RB	DSH	CO	N	5	5	0	0	0	0	18.7	1	27.40	2.28
5282	21.2	T6-Y7	23	RB	DSH	CO	N	5	5	0	0	1	0	51.8	1	29.69	6.36
5283	21.2	P6-U7	23	RB	BL	CO	N	5	5	0	0	0	0	26.9	1	25.76	6.65
5284	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	19.2	1		
5285	21.3	M1	23	RB	BL	CO	N	5	5	0	0	0	0	19.6	1	22.03	2.90
5286	20.3-4			RB	BL	CO	N	5	5	0	0	0	0	21.7	1		
5287	20.3	N5-S5	23	RB	BL	HB	N	5	5	0	0	0	0	22.2	1	13.40	2.38
5288	20.3-4			RB	PSH	CO	L	5	5	0	0	0	0	5.6	1		
5289	24.1	S3	32	TH	DSP	CO	N	5	5	0	0	1	0	22.2	1	53.81	6.78
5290				RB	BL	CO	N	5	5	0	0	0	0	72.1	1		
5291	20.4	M5-R3	36	RB	BL	CO	N	5	5	0	0	0	0	56.1	1	17.49	2.38
5292	21.3	R2-R8	23	RB	BL	CO	N	5	5	0	0	0	0	344	1	22.61	1.89
5293				RB	CO	CO	R	5	5	0	0	0	0	141.5	1		
5294	21.4	N6-N7	23	RB	BL	CO	N	5	5	0	0	0	0	29	1	28.73	2.52
5295				RB	BL	CO	N	5	5	0	0	0	0	87.9	1		
5296	24.2	I2-I7	32	RB	CO	CO	L	5	5	0	0	0	0	66.7	1	58.52	8.91
5297	38.4	P3-P5	27	RB	BL	CO	N	5	5	0	0	1	0	53.8	1	55.96	11.92
5298				RB	DSH	CO	N	5	5	0	0	0	0	62	1		
5299	24.1	Y1-T2	32	RB	CO	CO	R	5	5	0	0	0	0	420	1	54.11	5.75
5300				RB	BL	CO	N	5	5	0	0	0	0	74.5	1		
5301	21.4	O6-T9	23	RB	CO	CO	R	5	5	0	0	0	0	36	1	29.96	2.65
5302	24.3	N8-O4	32	RB	PRS	CO	R	5	5	0	0	0	0	70.3	1	53.38	2.09
5303				RB	DSH	CO	R	5	5	0	0	0	0	89.4	1		
5304				RB	CO	CO	R	5	5	0	0	0	0	71	1		
5305	20.4	H7-M5	36	RB	PRS	CO	R	5	5	0	0	0	0	79.1	1	17.24	3.16
5306				RB	CO	CO	R	5	5	0	0	0	0	74.1	1		
5307	25.1	Q	28	RB	BL	CO	R	5	5	0	0	0	0	89.4	1	61.55	6.49
5308	20.4	M4-R2	36	RB	BL	CO	R	5	5	0	0	0	0	52.8	1	17.11	2.55
5309	20.3	O7-N9-S3	48	RB	BL	CO	R	5	5	0	0	0	1	45.2	1	14.28	2.02

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5310	21.3	Q3-R1	23	RB	PRS	CO	R	5	5	0	0	0	0	49.9	1	21.84	1.75
5311	19.4		38	RB	BL	CO	R	5	5	0	0	1	1	126.6	1	7.63	2.59
5312	21.3	X3-Y4	23	RB	BL	CO	R	5	5	0	0	0	0	89.8	1	23.78	0.70
5313	21.4	W2-X6	23	RB	BL	CO	R	5	5	0	0	0	0	97.3	1	27.53	0.73
5314	24.3	N6-O4	32	RB	BL	CO	R	5	5	0	0	0	0	101.5	1	53.84	2.38
5315				RB	PRS	CO	R	5	5	0	0	0	0	52.2	1		
5316	24.2	F9-K4	32	RB	CO	CO	R	5	5	0	0	0	0	138.2	1	55.77	8.09
5317	20.3	N2-N8-S2	48	RB	BL	CO	R	5	5	0	0	0	0	56.1	1	13.46	2.70
5318				RB	CO	CO	R	5	5	0	0	0	0	30.8	1		
5319				RB	BL	CO	R	5	5	0	0	0	0	48.2	1		
5320	20.3	Q2-Q4	36	RB	BL	HB	R	5	5	0	0	0	0	30.1	1	11.37	1.90
5321				RB	CO	CO	R	5	5	0	0	0	0	143.7	1		
5322				RB	PRS	CO	R	5	5	0	0	0	0	111.2	1		
5323	24.1	C7-I4	32	RB	BL	CO	R	5	5	0	0	0	0	68	1	52.01	9.03
5324	21.1	T5-T8	23	RB	PRS	CO	R	5	5	0	0	0	0	16	1	24.59	6.66
5325	21.1	M	30	RB	BL	CO	R	5	5	0	0	0	0	54.4	1	22.43	7.63
5326	21.4	L7-K9	21	RB	PRS	CO	R	5	5	0	0	0	0	13.4	1	26.26	2.31
5327	20.3	M9-N7-N8		RB	PSH	CO	R	5	5	0	0	0	0	39.1	1	12.67	2.21
5328	20.3-4			RB	BL	CO	R	5	5	0	0	0	0	13.6	1		
5329				RB	CO	CO	R	5	5	0	0	0	0	61.9	1		
5330	20.4	D7-I2	36	RB	PSH	CO	R	5	5	0	0	1	0	14.7	1	18.26	4.31
5331	24.2	L6-R1	32	RB	PSH	CO	R	5	5	0	0	1	0	38.3	1	56.71	7.58
5332	21.4	X5-X9	23	RB	PRS	CO	R	5	5	0	0	0	0	19.9	1	28.48	0.34
5333	20.3-4			RB	PSH	CO	R	5	5	0	0	0	0	12.3	1		
5334	20.4	N4-S9	36	RB	PSH	CO	R	5	5	0	0	0	0	65.4	1	18.19	2.46
5335				RB	PSH	CO	R	5	5	0	0	1	0	49.5	1		
5336	21.4	Y1-Y4	23	RB	BL	CO	N	5	5	0	0	0	0	15	1	29.33	0.84
5337	20.4	B6-H4	36	RB	PRS	CO	R	5	5	0	0	0	0	16.1	1	16.85	4.51
5338	21.3	A9-F9	23	RB	PRS	CO	R	5	5	0	0	0	0	67.8	1	20.79	4.25
5339	21.3	A7-F2	23	RB	PSH	CO	R	5	5	0	0	0	0	45	1	20.28	4.21
5340	20.4	H4	36	RB	PSH	CO	R	5	5	0	0	0	0	10.4	1	17.19	3.47
5341	21.4	F6-G2	23	RB	PSH	CO	R	5	5	0	0	0	0	45.7	1	25.97	3.34
5342	20.3	F5-F8	48	RB	PSH	CO	R	5	5	0	0	0	0	37	1	10.57	3.45
5343	21.2	P8-U3	23	RB	PSH	CO	R	5	5	0	0	0	0	19.5	1	25.57	6.13
5344	19		38	RB	DSS	CO	N	5	5	0	0	0	0	24.2	1		
5345	21.4	X2	23	RB	PSH	CO	R	5	5	0	0	0	0	9.9	1	28.54	0.83
5346	20.4	H1	36	RB	PSH	CO	L	5	5	0	0	0	0	19	1	17.27	3.80
5347	21.4	A9-G1	21	RB	PSH	CO	R	5	5	0	0	0	0	6.4	1	25.99	4.21
5348	20.3-4			TH	DSP	DS	N	5	5	0	0	0	0	19.6	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5349	20.4	G5	36	TH	DSP	FR	N	5	5	0	0	0	0	27.9	1	16.62	3.60
5350				TH	DSP	FR	N	5	5	0	0	1	0	25	1		
5351	20.3		78	TH	DSP	DS	N	5	5	0	0	1	0	43.9	1	12.44	2.34
5352	21.4	N1-N3	23	TH	DSP	DS	N	5	5	0	0	0	0	25.1	1	28.31	2.91
5353	38.4	H1-H4	27	TH	DSP	FR	N	5	5	0	0	1	0	44.6	1	57.23	13.90
5354	24.2	H1-H8	32	TH	DSP	CO	N	5	5	0	0	1	0	80.6	1	57.15	8.73
5355	19.3	R1-L7	38	TH	DSP	FR	N	5	5	0	0	0	0	38	1	2.17	1.74
5356				SC	CO	CO	L	5	5	0	0	0	0	371	1		
5357	24.1	B7-C7	32	SC	GS	CO	L	5	5	0	0	0	0	550	1	51.33	9.04
5358	20.3	N-O	69	SC	GNB	CO	L	5	5	0	0	0	0	225	1	13.53	2.38
5359	19.3	S9-Y1-Y5	36	SC	GS	CO	L	5	5	0	0	0	0	497	1	3.81	1.31
5360				SC	CO	CO	L	5	5	0	0	0	0	344	1		
5361	21.4	Q2-8	23	SC	CBD	FR	L	5	5	0	0	0	0	94	1	26.60	1.89
5362	24.3	C7-H1-H3	32	SC	CO	CO	L	5	5	0	0	0	0	225	1	52.26	4.33
5363	20.4	H5-H6	36	SC	CO	CO	L	5	5	0	0	0	0	90	1	17.66	3.55
5364	21.1	X6-X9	23	SC	CO	CO	L	5	5	0	0	0	0	230	1	23.89	5.46
5365	21.4	R1-R9	23	SC	GNB	CO	L	5	5	0	0	0	0	135	1	27.16	1.82
5366	24		32	SC	CRB	FR	L	5	5	0	0	0	0	62	1		
5367	21.4	C6-C9-D4-D7-H3-H6	23	SC	CO	CO	R	5	5	0	0	0	0	342	1	27.70	4.59
5368				SC	CO	CO	R	5	5	0	0	0	0	422	1		
5369	20.3	Q1-Q6	36	SC	CBD	CO	R	5	5	0	0	0	0	136	1	11.25	1.74
5370				SC	CO	CO	R	5	5	0	0	0	0	344	1		
5371	38.4	V8-W4	27	SC	CO	CO	R	5	5	0	0	0	0	104	1	56.54	10.02
5372				SC	CO	CO	L	5	5	0	0	0	0	319	1		
5373	21.4	X5-X6	23	SC	CO	CO	R	5	5	0	0	0	0	191	1	28.53	0.53
5374				SC	CO	CO	R	5	5	0	0	0	0	482	1		
5375	24		32	SC	GNB	CO	R	5	5	0	0	0	0	125	1		
5376	21.4	X7-9	21	SC	CO	CO	R	5	5	0	0	0	0	206	1	28.11	0.12
5377				SC	CO	CO	R	5	5	0	0	0	0	243	1		
5378				SC	GNB	CO	R	5	5	0	0	0	0	205	1		
5379	20.3-4			SC	CRB	CO	R	5	5	0	0	0	0	40	1		
5380	20.3-4			SC	CRB	FR	N	5	5	0	0	0	0	11	1		
5381	21.4	B5-G2	21	RB	BL	CO	N	5	5	0	0	0	0	24	1	26.62	4.35
5382				IM	ACL	CO	L	5	5	0	0	0	0	408	1		
5383				IM	ACL	CO	L	5	5	0	0	0	0	215	1		
5384	20.4	E9-J5	36	IM	ACL	CO	L	5	5	0	0	0	0	71	1	19.74	4.23
5385				IM	CO	CO	L	5	5	0	0	0	0	425	1		
5386	22.4		32	IM	ACL	CO	L	5	5	0	0	0	0	228	1	37.63	2.36
5387				IM	IL	CO	L	5	5	0	0	0	0	165	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5388	24.2	P5	32	IM	PBS	CO	N	5	5	0	0	0	0	135	1	55.63	6.44
5389	24.1	J4-O7	32	IM	CO	CO	R	5	5	0	0	0	0	365	1	54.02	8.45
5390	24.1	G1-G7	32	IM	ACL	CO	R	5	5	0	0	0	0	153	1	51.08	8.99
5391	21.4	M2-M5	23	IM	IL	FR	R	5	5	0	0	0	0	87	1	27.62	2.74
5392	20.2	R8-X1	36	IM	IS	FR	R	5	5	0	0	0	0	129	1	17.37	6.14
5393				CRN	OCC	CO	R	5	5	0	0	0	0	859	1		
5394				CRN	OCC	CDL	R	5	5	0	0	0	0	97	1		
5395				CRN	OCC	CO	R	5	5	0	0	0	0	585	1		
5396				CRN	OCC	FR	L	5	5	0	0	0	0	112	1		
5397	38.3	Q4-Q7	27	LM	CO	CO	N	5	5	0	0	0	0	77	1	51.29	11.53
5398	38.3	Q4-Q7	27	LM	CO	CO	N	5	5	0	0	0	0		1	51.30	11.38
5399	21.2	F5-F8	32	CRN	OCC	FR	L	5	5	0	0	0	0	51	1	25.48	8.48
5400	36.3	K9-P3	18	AT	CNW	CO	N	5	5	0	0	0	0	142	1	30.82	12.05
5401	25.3	P8	20	AT	CNW	CO	N	5	5	0	0	0	0	145	1	60.61	1.01
5402	38.3	T7-T9	27	AT	CNW	CO	N	5	5	0	0	0	0	59	1	54.31	11.10
5403	24.1	T2	32	AX	CO	CO	N	5	5	0	0	0	0	134	1	54.60	6.89
5404	21.3	T2-T5	23	AX	CO	CO	N	5	5	0	0	0	0	129	1	24.52	1.75
5405	24.1	C3-C9	32	AX	CO	CO	N	5	5	0	0	0	0	138	1	52.91	9.74
5406	24.4	U	23	CE	CO	CO	N	5	5	0	0	0	0	94	1	55.66	0.38
5407				CE	CO	CO	N	5	5	0	0	0	0	206	1		
5408	24.1	I7	32	CE	CO	CO	N	5	5	0	0	0	0	79	1	53.16	8.10
5409	20.3	J8	36	CE	CO	CO	N	5	5	0	0	0	0	54	1	14.63	3.09
5410	20.4	O9-T6	36	CE	CO	CO	N	5	5	0	0	0	0	104	1	19.81	2.11
5411	21.4	L5	23	CE	CO	CO	N	5	5	0	0	0	0	97	1	26.40	2.38
5412	24.3	K1-K7	32	CE	CO	CO	N	5	5	0	0	0	0	71	1	50.19	2.92
5413	24.1	I6-J4	32	CE	CO	CO	N	5	5	0	0	0	0	90	1	53.67	8.39
5414				CE	CO	CO	N	5	5	0	0	0	0	108	1		
5415				CE	CO	CO	N	5	5	0	0	0	0	109	1		
5416				CE	CO	CO	N	5	5	0	0	0	0	151	1		
5417				LM	CO	CO	N	5	5	0	0	0	0	89	1		
5418	24.1	U3	32	AT	CNW	PR	N	5	5	0	0	0	0	137	1	50.82	5.70
5419	51.2	O3	20	AT	CO	CO	N	5	5	0	0	0	0	179	1	49.84	27.73
5420	21.1	V2	18	LM	CO	CO	N	5	5	0	0	0	0	116	1	21.61	5.72
5421				LM	CO	CO	N	5	5	0	0	0	0	69	1		
5422	20.4	I2-I8	36	LM	CO	CO	N	5	5	0	0	0	0	130	1	18.53	3.75
5423				LM	CNN	CO	N	5	5	0	0	0	0	43	1		
5424				LM	CO	CO	N	5	5	0	0	0	0	72	1		
5425				LM	CO	CO	N	5	5	0	0	0	0	52	1		
5426	36.3	G4-G5	18	LM	CNN	CO	N	5	5	0	0	0	0	122	1	31.11	13.58

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5427	38.3	T7-9	27	AX	CO	CO	N	5	5	0	0	0	0	49	1	54.05	11.31
5428	24.1	U1	32	LM	CO	CO	N	5	5	0	0	0	0		1	50.06	5.93
5429	24.1	U1	32	LM	CO	CO	N	5	5	0	0	0	0		1	50.23	5.73
5430	24.1	U1	32	LM	CO	CO	N	5	5	0	0	0	0	403	1	50.03	5.68
5431			23	CA	CO	CO	N	5	5	0	0	0	0	14	1		
5432	21.4	P3	23	CA	CO	CO	N	5	5	0	0	0	0	29	1	25.75	1.86
5433	24.2	P2-K4	32	RD	DSH	CO	R	3	5	0	1	0	0	201	1	55.34	6.82
5434	36.4	E7-5	12	TA	DSH	CO	R	3	5	0	1	0	0	197	1	39.29	14.28
5435	36.3	M3-M9	12	FM	PRS	CO	R	2	5	0	0	0	0		1	32.74	12.85
5436	24.2	C1	32	RD	CO	CO	L	0	0	0	0	0	0	109	1	57.14	9.87
5437	19.3	X7-X8	38	HM	DSH	CO	L	5	3	0	1	0	0	361	1	3.31	0.20
5438	19.4	L6	38	FM	DSS	CO	L	5	3	0	1	0	0	243	1	6.86	2.36
5439	24		32	UL	PSH	CO	L	5	5	0	0	0	0	93	1		
5440				UL	PSH	CO	L	2	5	0	0	0	0	117	1		
5441				UL	PSH	CO	L	0	5	0	0	0	0	157	1		
5442				UL	PRS	CO	L	2	5	0	0	0	0	103	1		
5443	24.3	F4-F8	32	UL	PSH	CO	R	0	5	0	0	0	0	63	1	50.30	3.54
5444				UL	PSH	CO	L	0	5	0	0	1	0	88	1		
5445				MT	CO	CO	R	5	3	0	0	0	0	253	1		
5446	19.3-4		38	MT	CO	CO	R	5	3	0	0	0	0	264	1		
5447	21.4	M9-N7-N8	23	MT	CO	CO	R	5	3	0	0	0	0	281	1	27.87	2.21
5448	24.3	T7-Y5	32	MT	CO	CO	R	5	3	0	0	0	0	244	1	54.29	1.19
5449	24.2	K5	32	MT	CO	CO	R	5	3	0	0	0	0	299	1	55.36	7.39
5450	24.1	C8-H5	32	MT	CO	CO	R	5	3	0	0	0	0	250	1	52.58	9.15
5451	24.2	P8-U4	32	MT	CO	CO	R	5	3	0	0	0	0	228	1	55.46	6.09
5452	23.3	F	27	MT	CO	CO	R	5	3	0	0	0	0	264	1	40.43	3.50
5453	24.2	C6-D4	32	MT	PRS	CO	R	5	3	0	0	1	0	199	1	57.85	9.53
5454	20.4	B6	68	MT	CO	CO	R	5	3	0	0	0	0	201	1	16.85	4.50
5455				MT	CO	CO	R	5	3	0	0	0	0	292	1		
5456	21.3	S4-S7	23	MC	CO	CO	R	5	0	0	0	0	0	162	1	23.07	1.58
5457	23.3	U	26	MC	CO	CO	R	5	3	0	0	0	0	232	1	40.43	0.38
5458	21.4	X3-Y7	23	MC	CO	CO	R	5	3	0	0	0	0	236	1	28.93	0.94
5459				MT	CO	CO	L	5	3	0	0	0	0	250	1		
5460	24.3	F6-G1	32	MT	CO	CO	L	5	3	0	0	0	0	237	1	50.78	3.56
5461				MT	CO	CO	L	5	3	0	0	0	0	293	1		
5462				MT	CO	CO	L	5	0	0	0	0	0	226	1		
5463	24.1	T3-T9	32	MT	CO	CO	L	5	3	0	0	0	0	234	1	54.86	6.82
5464	20.4	H2-I1	36	MT	CO	CO	L	5	3	0	0	0	0	358	1	17.62	3.98
5465	24.2	F3	32	MC	CO	CO	L	5	3	0	0	0	0	210	1	55.91	8.76

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5466	20.4	M1-M2	36	MC	CO	CO	L	5	0	0	0	0	0	179	1	17.10	2.94
5467				MC	CO	CO	L	5	3	0	0	0	0	191	1		
5468				MC	CO	CO	L	5	0	0	0	0	0	106	1		
5469	20.4	O9-T6	36	CE	CO	CO	N	5	5	0	0	0	0	68	1	19.97	2.14
5470	20.4	H5	36	AS	CO	CO	L	5	5	0	0	0	0	82	1	17.39	3.66
5471	20.4	F3-G4	36	AS	CO	CO	L	5	5	0	0	0	0	73	1	15.73	3.84
5472	20.3-4		46	AS	CO	CO	L	5	5	0	0	0	0	134	1		
5473	20.3	H5-6	48	AS	CO	CO	L	5	5	0	0	0	0	99	1	12.45	3.60
5474	24.1	O8	32	AS	CO	CO	L	5	5	0	0	0	0	89	1	54.45	7.14
5475	24.3	U9	32	TRC	CO	CO	R	5	5	0	0	0	0	51	1	50.95	0.26
5476	24.1	K6	32	AS	CO	CO	L	5	5	0	0	0	0	84	1	50.92	7.64
5477	24.1	S4	32	AS	CO	CO	R	5	5	0	0	0	1	91	1	53.22	6.66
5478	24.2	M7	32	AS	CO	CO	R	5	5	0	0	0	1	66	1	57.04	7.11
5479	21.4	C5	23	TRC	CO	CO	R	5	5	0	0	0	0	52	1	27.52	4.34
5480	20.4	H2-H5	36	AS	CO	CO	R	5	5	0	0	0	0	66	1	17.36	3.99
5481	21.1	C8	20	TRC	CO	CO	R	5	5	0	0	0	0	46	1	22.39	9.25
5482	21.4	X2-X5	23	AS	CO	CO	R	5	5	0	0	0	0	95	1	28.47	0.81
5483	24.1	H9-M3	32	AS	CO	CO	R	5	5	0	0	0	0	78	1	52.74	8.29
5484	20.4	S8	36	AS	CO	CO	R	5	5	0	0	0	0	86	1	18.55	1.07
5485	20.4	A9-B7	36	AS	CO	CO	R	5	5	0	0	0	0	82	1	15.69	4.07
5486	21.3	X2	23	AS	CO	CO	L	5	5	0	0	0	0	57	1	23.44	0.90
5487	24.2	C6	32	TRC	CO	CO	R	5	5	0	0	0	0	55	1	57.70	9.61
5488	24.3	K1-K7	32	TRC	CO	CO	R	5	5	0	0	0	0	53	1	50.31	2.77
5489	21.4		23	TRC	CO	CO	R	5	5	0	0	0	0	44	1	27.46	2.48
5490	24		32	TRC	CO	CO	R	5	5	0	0	0	0	52	1		
5491	38.4	N9	27	TRC	CO	CO	L	5	5	0	0	0	0	52	1	58.92	12.11
5492	21.4		23	TRC	CO	CO	L	5	5	0	0	0	0	51	1	27.40	2.54
5493	24.3	B7	32	TRC	CO	CO	L	5	5	0	0	0	0	58	1	51.21	4.32
5494	24.3	G1	32	TRS	CO	CO	L	5	5	0	0	0	0		1	51.28	3.71
5495	24.1	I7-I8	32	CL	CO	CO	R	5	5	0	0	0	0	91	1	53.32	8.07
5496	20.4	F	48	CL	CO	CO	R	5	5	0	0	0	0	101	1	15.53	3.43
5497	20.4	G1-2	36	CL	CO	CO	R	5	5	0	0	0	0	88	1	16.05	3.77
5498	21.3	N6-N9-O4	23	CL	CO	CO	R	5	5	0	0	0	0	80	1	23.67	2.43
5499	24.3		32	CL	CO	CO	R	5	5	0	0	0	0	107	1	52.57	2.42
5500	21.1	C8	20	CL	CO	CO	R	5	5	0	0	0	0	133	1	22.39	9.15
5501				CL	CO	CO	R	5	5	0	0	0	0	114	1		
5502	24.2	H3-H6		CL	CO	CO	R	5	5	0	0	0	0	119	1	57.70	8.81
5503	20.4	H3-I1	36	CL	CO	CO	L	5	5	0	0	0	0	104	1	17.77	3.99
5504	20.4	F5	36	SEP	CO	CO	N	5	5	0	0	0	0	16	1	15.34	3.34

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5505	21.2	O4-O8	23	CL	CO	CO	L	5	5	0	0	0	0	90	1	29.06	7.38
5506	24.1	I9	32	CL	CO	CO	L	5	5	0	0	0	0	175	1	53.73	8.13
5507	24.3	K2	32	CL	CO	CO	L	5	5	0	0	0	0	141	1	50.47	2.70
5508	24		32	CL	CO	CO	L	5	5	0	0	0	0	103	1		
5509	24.2	G5-G6	32	CL	CO	CO	L	5	5	0	0	0	0	55	1	56.36	8.65
5510	20.4	G7	36	CL	CO	CO	L	5	5	0	0	0	0	80	1	16.01	3.12
5511				CL	CO	CO	L	5	5	0	0	0	0	105	1		
5512	21.4	T7-T8	23	CL	CO	CO	L	5	5	0	0	0	0	58	1	29.25	1.02
5513	20.4	C7	36	SEP	CO	CO	N	5	5	0	0	0	0	8	1	17.01	4.25
5514	20.3-4			PHF	CO	CO	N	5	5	0	0	0	0	31	1		
5515	20.3	R4	36	PHF	CO	CO	N	5	5	0	0	0	0	18	1	12.18	1.46
5516	21.3	J2	23	PHF	CO	CO	N	5	5	0	0	0	0	38	1	24.40	3.88
5517	21.4	V4	23	PHF	CO	CO	N	5	5	0	0	0	0	16	1	26.20	0.38
5518	24.3	I2	32	PHF	CO	CO	N	5	5	0	0	0	0	37	1	53.56	3.84
5519	20.4	L4	36	PHF	CO	CO	N	5	5	0	0	0	0	37	1	16.32	2.57
5520	21.3		24	PHF	CO	CO	N	5	5	0	0	0	0	33	1	22.38	2.43
5521	21.4	V6-W7	23	PHF	CO	CO	N	5	5	0	0	0	0	16	1	26.74	0.43
5522	21.4	Q2	21	PHF	CO	CO	N	5	5	0	0	0	0	29	1	26.44	1.93
5523	23.3	U	26	PHF	CO	CO	N	5	5	0	0	0	0	29	1	40.43	0.54
5524				PHF	CO	CO	N	5	5	0	0	0	0	29	1		
5525	21.4	Q1	23	PHF	CO	CO	N	5	5	0	0	0	0	38	1	26.01	1.99
5526	21.4	P9-Q7	21	PHF	CO	CO	N	5	5	0	0	0	0	31	1	25.94	1.23
5527	21.4	T3	23	PHF	CO	CO	N	5	5	0	0	0	0	35	1	29.91	1.97
5528	20.3-4			PHF	CO	CO	N	5	5	0	0	0	0	35	1		
5529	20.3		36	PHF	CO	CO	N	5	5	0	0	0	0	20	1	12.62	2.36
5530	21.3	O2	23	PHF	CO	CO	N	5	5	0	0	0	0	19	1	24.56	2.81
5531	20.3-4			PHF	CO	CO	N	5	5	0	0	0	0	38	1		
5532	24.1	C8-H2	32	PHF	CO	CO	N	5	5	0	0	0	0	33	1	52.49	9.27
5533	20.4	G8	36	PHF	CO	CD	N	5	5	0	0	0	0	16	1	16.54	3.04
5534	21.4	W7	23	PHF	CO	CO	N	5	5	0	0	0	0	37	1	27.06	0.16
5535	20.3-4			PHS	CO	CO	N	5	5	0	0	0	0	28	1		
5536	24.1	I8	32	PHS	CO	CO	N	0	0	0	0	0	0	8	1	53.46	8.31
5537	21.4	T8	23	PHS	CO	CO	N	5	5	0	0	0	0	23	1	29.44	1.04
5538	24.3	L7	32	PHS	CO	CO	N	5	5	0	0	0	0	21	1	51.25	2.18
5539	20.4	MI	36	PHS	CO	CO	N	5	5	0	0	0	0	17	1	17.43	2.36
5540	21.4	U1	23	PHS	CO	CO	N	5	5	0	0	0	0	25	1	25.11	0.71
5541	20.3	R5	36	PHS	CO	CO	N	5	5	0	0	0	0	17	1	12.59	1.37
5542	20.4	H9	36	PHS	CO	CO	N	5	5	0	0	0	0	24	1	17.79	3.14
5543	20.3-4			PHS	CO	CO	N	5	5	0	0	0	0	12	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5544	20.3-4			PHS	CO	CO	N	5	5	0	0	0	0	23	1		
5545	38.4	U1-U2	27	PHT	CO	CO	N	5	5	0	0	0	0	32	1	55.13	10.97
5546	20.3	J5	23	PHT	CO	CO	N	5	5	0	0	0	0	12	1	14.62	3.36
5547	24.2	U2	32	PHT	CO	CO	N	5	5	0	0	0	0	24	1	55.43	5.76
5548	20.3-4			PHT	CO	CO	N	5	5	0	0	0	0	12	1		
5549	38	K4	27	PHT	CO	CO	N	5	5	0	0	0	0	9	1		
5550	20.3		66	PHT	CO	CO	N	5	5	0	0	0	0	27	1	12.40	2.40
5551	20.3-4			PHT	CO	CO	N	5	5	0	0	0	0	26	1		
5552	20.3-4			PHT	CO	CO	N	5	5	0	0	0	0	21	1		
5553	20.3	J5	36	PHT	CO	CO	N	5	5	0	0	0	0	15	1	14.40	3.65
5554	21.4	U8	21	PHT	CO	CO	N	5	5	0	0	0	0	15	1	25.40	0.19
5555	20.3	I	68	PHT	CO	CO	N	5	5	0	0	0	0	15	1	13.51	3.66
5556	20.4	B9	36	PHT	CO	CO	N	5	5	0	0	0	0	11	1	16.96	4.17
5557	24.1	F6-F9	32	PHT	CO	CO	N	5	5	0	0	0	0	23	1	50.75	8.65
5558	20.3	I1	23	PHT	CO	CO	N	5	5	0	0	0	0	19	1	13.27	3.88
5559	20.3-4			PHT	CO	CO	N	5	5	0	0	0	0	22	1		
5560	21.4	G1	23	PHT	CO	CO	N	5	5	0	0	0	0	21	1	26.28	3.78
5561	21.4	K8	23	PHT	CO	CO	N	5	5	0	0	0	0	23	1	25.50	2.11
5562	21.4	V8	21	PHT	CO	CO	N	5	5	0	0	0	0	22	1	26.55	0.31
5563	21.2		23	PHT	CO	CO	N	5	5	0	0	0	0	13	1	27.45	7.56
5564	24.2	UI-U4	32	PHT	CO	CO	N	5	5	0	0	0	0	19	1	55.55	5.63
5565	21.4	R1-U2	23	PHT	CO	CO	N	5	5	0	0	0	0	18	1	27.11	1.70
5566	21.3	X8	23	PHT	CO	CO	N	5	5	0	0	0	0	19	1	23.46	0.26
5567	20.4	B6	36	PHT	CO	CO	N	5	5	0	0	0	0	15	1	16.93	4.56
5568	20.3	N7	48	PHT	CO	CO	N	5	5	0	0	0	0	10	1	13.33	2.18
5569	20.4	G2	36	PHT	CO	CO	N	5	5	0	0	0	0	16	1	16.42	3.99
5570	20.4	L4	36	PHT	CO	CO	N	5	5	0	0	0	0	9	1	16.29	2.57
5571	20.3	D3	48	PHT	CO	CO	N	5	5	0	0	0	0	16	1	13.70	4.82
5572	21.4	N3	21	PHT	CO	CO	N	5	5	0	0	0	0	9	1	28.93	2.72
5573	20.3-4			PHT	CO	CO	N	5	5	0	0	0	0	9	1		
5574	20.3-4			MC	DSS	CO	L	3	5	0	1	0	0	153	1		
5575	20.3	J3-J6	48	MT	CO	CO	R	3	3	0	0	0	0	276	1	14.91	3.93
5576	20.4	N7-R9	36	MT	CO	CO	R	3	0	0	0	0	0	246	1	18.04	2.08
5577	20.3-4			MT	CO	CO	R	3	0	0	0	0	0	251	1		
5578	20.3-4			MT	CO	CO	L	3	3	0	0	0	0	407	1		
5579	21.4	X8-Y7	21	MT	CO	CO	L	3	0	0	0	0	0	166	1	28.64	0.26
5580	21.4	T8-Y6	23	MT	CO	CO	L	3	3	0	0	0	0	242	1	29.60	1.01
5581	21.4	U4-U6	21	MC	CO	CO	R	3	3	0	0	0	0	244	1	25.32	0.55
5582	20.3-4			SEP	CO	CO	N	5	5	0	0	0	0	42	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5583	20.3	G3-H1	48	SEP	CO	CO	N	5	5	0	0	0	0	17	1	11.96	3.83
5584	20.3	H9	48	SEP	CO	CO	N	5	5	0	0	0	0	46	1	12.93	3.06
5585	20.3-4			SEP	CO	CO	N	5	5	0	0	0	0	45	1		
5586	20.3-4			SEP	CO	CO	N	5	5	0	0	0	0	30	1		
5587	20.3	I4	48	SEP	CO	CO	N	5	5	0	0	0	0	28	1	13.02	3.41
5588	20.3-4			SEP	CO	CO	N	5	5	0	0	0	0	35	1		
5589	20.3	E7-J2	48	SEP	CO	CO	N	5	5	0	0	0	0	52	1	14.03	4.27
5590	21.4	R8	23	CPA	CO	CO	R	5	5	0	0	0	0	12	1	27.55	1.14
5591	20.3-4			CPA	CO	CO	R	5	5	0	0	0	0	21	1		
5592	21.4	X3	21	CPS	CO	CO	R	5	5	0	0	0	0	22	1	28.89	0.93
5593	20.3-4			CPS	CO	CO	R	5	5	0	0	0	0	30	1		
5594	21.4	L5	23	CPS	CO	CO	R	5	5	0	0	0	0	18	1	26.39	2.52
5595	21.4	V7		CPS	CO	CO	L	5	5	0	0	0	0	21	1	26.13	0.05
5596	20.3	K3	23	CPS	CO	CO	L	5	5	0	0	0	0	12	1	10.78	2.92
5597	21.4	M9	23	CPU	CO	CO	R	5	5	0	0	0	0	16	1	27.99	2.26
5598	21.2	W3	23	CPU	CO	CO	L	5	5	0	0	0	0	25	1	27.84	5.68
5599	21.4	X4	23	CPU	CO	CO	L	5	5	0	0	0	0	17	1	28.24	0.46
5600	21.2	L8-Q2		CPU	CO	CO	L	5	5	0	0	0	0	27	1	26.44	7.21
5601	20.4	G4	36	CPR	CO	CO	R	5	5	0	0	0	0	13	1	16.19	3.55
5602	20.4	B7	36	CPR	CO	CO	L	5	5	0	0	0	0	15	1	16.09	4.01
5603	20.4	K7	36	CPR	CO	CO	L	5	5	0	0	0	0	13	1	15.08	2.29
5604	20.3-4			CPI	CO	CO	L	5	5	0	0	0	0	10	1		
5605	21.3	X8	23	CPI	CO	CO	R	5	5	0	0	0	0	19	1	23.41	0.33
5606	38.4	P6	27	CPI	CO	CO	L	5	5	0	0	0	0	17	1	55.88	11.37
5607	20.3		66	CPI	CO	CO	L	5	5	0	0	0	0	13	1	12.42	2.50
5608	21.3	J4	36	CPI	CO	CO	L	5	5	0	0	0	0	27	1	24.32	3.43
5609	21.3	X4	23	CPR	CO	CO	R	5	5	0	0	0	0	19	1	23.11	0.52
5610	21.4	F3	23	CPU	CO	CO	L	5	5	0	0	0	0	48	1	25.80	3.89
5611	21.4	F5	23	CPI	CO	CO	L	5	5	0	0	0	0		1	25.64	3.54
5612	21.4	F3	23	CPR	CO	CO	L	5	5	0	0	0	0		1	25.87	3.67
5613	21.4	H9	23	PHS	CO	CO	N	5	5	0	0	0	0	20	1	27.86	3.02
5614				PHS	CO	CO	N	5	5	0	0	0	0	22	1		
5615	21.4	V7	21	PHS	CO	CO	N	5	5	0	0	0	0	19	1	26.27	0.05
5616	21.4	F1	23	PHS	CO	CO	N	5	5	0	0	0	0	22	1	25.14	3.78
5617	20.4	G1	36	PHS	CO	CO	N	5	5	0	0	0	0	16	1	16.14	3.90
5618	21.4	U9	21	PHS	CO	CO	N	5	5	0	0	0	0	24	1	25.95	0.21
5619	20.4	N3		PHS	CO	CO	N	5	5	0	0	0	0	23	1	18.98	2.86
5620	20.3		66	PHS	CO	CO	N	5	5	0	0	0	0	19	1	12.37	2.51
5621	20.3	K8	23	PHS	CO	CO	N	5	5	0	0	0	0	23	1	10.37	2.20

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5622	21.4	G4	21	PHS	CO	CO	N	5	5	0	0	0	0	22	1	26.27	3.35
5623	20.4	B8	36	PHS	CO	CO	N	5	5	0	0	0	0	16	1	16.53	4.24
5624	21.4	O8	23	PHS	CO	CO	N	5	5	0	0	0	0	23	1	29.57	2.26
5625	21.3	X9	23	PHS	CO	CO	N	5	5	0	0	0	0	21	1	23.97	0.19
5626	20.4	N3		PHS	CO	CO	N	5	5	0	0	0	0	28	1	18.76	2.98
5627	21.4	F3	23	PHS	CO	CO	N	5	5	0	0	0	0	20	1	25.98	3.81
5628	20.4	G7	36	PHS	CO	CO	N	5	5	0	0	0	0	19	1	16.24	3.08
5629	20.4	G8	36	PHS	CO	CO	N	5	5	0	0	0	0	16	1	16.55	3.09
5630	20.4	L7	36	PHS	CO	CO	N	5	5	0	0	0	0	19	1	16.04	2.05
5631	20.3	M7	36	MP	DSE	CO	L	5	0	0	0	0	0	54	1	12.05	2.04
5632	21.4	R6-9	23	MP	DSE	CO	L	5	0	0	0	0	0	29	1	27.99	1.50
5633	20.3		66	MP	DSE	CO	L	5	0	0	0	0	0	39	1	12.56	2.57
5634	21.4	W3	23	LM	PEP	CO	N	0	5	0	0	0	0	7	1	27.97	0.86
5635	21.2		23	TH	PEP	CO	N	0	5	0	0	0	0	5	1	27.43	7.45
5636	21.4	P6	23	LM	PEP	CO	N	0	5	0	0	0	0	3	1	25.74	1.48
5637	20.3	G5	23	VT	PEP	CO	N	0	5	0	0	0	0	1	1	11.64	3.55
5638	21.2	P7	23	LM	PEP	CO	N	0	5	0	0	0	0	8	1	25.19	6.21
5639	21.4	V8	21	LM	PEP	CO	N	0	5	0	0	0	0	4	1	26.47	0.06
5640	20.4	G5	36	LM	PEP	CO	N	0	5	0	0	0	0	6	1	16.66	3.63
5641	20.3	G5	23	CA	PEP	CO	N	0	5	0	0	0	0	2	1	11.35	3.39
5642	20.4	P4	36	VT	PEP	CO	N	0	5	0	0	0	0	4	1	15.01	1.34
5643	20.3-4		46	LM	PEP	CO	N	0	5	0	0	0	0	7	1		
5644	20.3-4			MCF	CO	CO	N	5	5	0	0	0	0	4	1		
5645	20.3	K3	23	TH	PEP	CO	N	0	5	0	0	0	0	13	1	10.75	2.73
5646	20.4	F1	36	TH	PEP	CO	N	0	5	0	0	0	0	14	1	15.33	3.96
5647	21.4	T5	23	TH	AEP	CO	N	5	0	0	0	0	0	1.7	1	29.59	1.56
5648	21.4	R9	21	TH	AEP	CO	N	5	0	0	0	0	0	3.2	1	27.67	1.15
5649	21.4	F4	23	LM	AEP	CO	N	5	0	0	0	0	0	2.5	1	25.01	3.63
5650	21.2		23	LM	AEP	CO	N	5	0	0	0	0	0	5	1	27.63	7.54
5651	20.4	G8	36	LM	AEP	CO	N	5	0	0	0	0	0	5.3	1	16.55	3.07
5652	20.3-4			LM	AEP	CO	N	5	0	0	0	0	0	4.8	1		
5653				LM	PEP	CO	N	0	5	0	0	0	0	5.9	1		
5654	20.3-4			LM	PEP	CO	N	0	5	0	0	0	0	3.4	1		
5655	21.4	W3	23	CE	AEP	CO	N	5	0	0	0	0	0	5.8	1	27.75	0.71
5656	21.4	L3	21	CE	AEP	CO	N	5	0	0	0	0	0	5.5	1	26.98	2.88
5657	20.4	H4	36	CE	AEP	CO	N	5	0	0	0	0	0	6	1	17.25	3.51
5658	21.4	V2	21	CA	AEP	CO	N	5	0	0	0	0	0	3.6	1	26.59	0.68
5659	21.4	Q7	21	CA	AEP	CO	N	5	0	0	0	0	0	4.2	1	26.21	1.01
5660				CA	AEP	CO	N	5	0	0	0	0	0	2.3	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5661	21.4	U3	21	TH	AEP	CO	N	5	0	0	0	0	0	2.2	1	25.90	0.92
5662				MR	CO	CO	L	4	4	0	0	0	0	412	1		
5663				MR	CO	CO	L	4	4	0	0	0	0	441	1		
5664				MR	CO	CO	L	4	4	0	0	0	0	205	1		
5665	24.2	K8-Q8	32	MR	HRM	CO	L	4	4	0	0	0	0	266	1	55.64	7.08
5666				MR	CO	CO	L	4	4	0	0	0	0	393	1		
5667	23.2/3			MR	CO	CO	L	4	4	0	0	0	0	236	1		
5668	36.4	B9-G3-H1	12	MR	RAM	CO	L	4	4	0	0	0	0	99	1	36.82	14.25
5669				MR	CO	CO	L	4	4	0	0	0	0	430	1		
5670				MR	HRM	CO	L	4	4	0	0	0	0	250	1		
5671				MR	CO	CO	L	4	4	0	0	0	0	302	1		
5672				MR	CO	CO	L	4	4	0	0	0	0	456	1		
5673	24.1	T4-T3	32	MR	CO	CO	L	4	4	0	0	0	0	377	1	54.15	6.47
5674	21.4	P6-P9-U2	23	MR	CO	CO	L	4	4	0	0	0	0	166	1	25.81	1.41
5675	24.1	B2-C5	32	MR	RAM	CO	L	4	4	0	0	0	0	133	1	51.65	9.90
5676	24.2	P3-K9	32	MR	HRM	CO	L	4	4	0	0	0	0	93	1	55.72	6.89
5677	20.4	B1-5	36	MR	HRM	DS	L	4	4	0	0	0	0	106	1	16.06	4.89
5678	24		32	MR	HRM	CO	L	4	4	0	0	0	0	148	1		
5679		B9-G3-H1		MR	HRM	CO	L	4	4	0	0	0	0	134	1		
5680				MR	HRM	CO	R	4	4	0	0	0	0	158	1		
5681	21.4	K7-P8	23	MR	CO	CO	R	4	4	0	0	0	0	333	1	25.05	2.06
5682	21.3	O1-O7	23	MR	HRM	CO	R	4	4	0	0	0	0	262	1	24.26	2.84
5683	21.3	L9-R4	23	MR	CO	CO	R	4	4	0	0	0	0	355	1	21.68	2.19
5684	38.3	P4-U5	27	MR	CO	CO	R	4	4	0	0	0	0	338	1	50.22	11.61
5685	38.3	X1-Y1	27	MR	CO	CO	R	4	4	0	0	0	0	132	1	53.05	10.74
5686	21.4	A4-B7	23	MR	CO	CO	R	4	4	0	0	0	0	357	1	25.08	4.49
5687	24.1	B2-C5	32	MR	HRM	CO	R	4	4	0	0	0	0	69	1	51.47	9.71
5688	25.1	D-I	20	MR	CO	CO	R	4	4	0	0	0	0	653	1	63.55	9.35
5689	20.1	R7-R9		MR	CO	CO	R	4	4	0	0	0	0	441	1	12.24	6.21
5690				MR	CO	CO	R	4	4	0	0	0	0	383	1		
5691	24.1	H9-I1	32	MR	RAM	CO	R	4	4	0	0	0	0	140	1	52.99	8.29
5692	38.3	U5-U9	27	MR	CO	CO	R	4	4	0	0	0	0	422	1	50.65	10.63
5693	21.1	Y4-Y7	23	MR	HRM	CO	R	4	4	0	0	0	0	133	1	24.20	5.41
5694	24.2	P9-V7	32	MR	CO	CO	R	4	4	0	0	0	0	324	1	55.99	6.31
5695				MR	CO	CO	R	4	4	0	0	0	0	543	1		
5696	20.4	B4	68	MR	HRM	CO	L	4	4	0	0	0	0	114	1	16.11	4.36
5697				MR	HRM	TW	R	4	4	0	0	0	0	117	1		
5698				MR	HRM	TW	R	4	4	0	0	0	0	147	1		
5699	38.3	W6-X6	27	MR	HRM	TW	L	4	4	0	0	0	0	100	1	52.79	10.57

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5700	24.1	Y1-Y7	32	MR	HRM	TW	L	4	4	0	0	0	0	72	1	54.20	5.75
5701				MR	TW	LT	L	4	4	0	0	0	0	52	1		
5702	21.3	M6-M8	23	TH	CO	CO	N	0	0	0	0	0	1	70	1	22.69	2.63
5703	21.3	S6	23	TH	CO	CO	N	3	3	0	0	0	0	98	1	23.95	1.45
5704	20.4	C8-C9	36	TH	CO	CO	N	0	0	0	0	0	0	37	1	17.41	4.16
5705	21.1	X3-X6	23	TH	NAS	CO	N	4	4	0	0	0	0	52	1	23.95	5.91
5706	20.4	G3-F5	36	TH	CO	CO	N	3	3	0	0	0	0	331	1	16.90	3.97
5707	21.3	M9-N7-R3-S1	23	TH	CO	CO	N	2	2	0	0	0	0	90	1	22.96	1.90
5708	21.1	T5-T6	23	TH	CO	CO	N	0	0	0	0	0	0	111	1	24.44	6.48
5709	21.4	P1-P5	23	TH	CO	CO	N	0	0	0	0	0	0	38	1	25.10	1.80
5710				TH	CO	CO	N	0	0	0	0	0	0	46	1		
5711				TH	CO	CO	N	2	2	0	0	0	0	157	1		
5712				TH	CO	CO	N	0	0	0	0	0	0	82	1		
5713	21.1	L8	23	TH	CO	CO	N	0	0	0	0	0	0	32	1	21.63	7.03
5714				TH	CO	CO	N	2	2	0	0	0	0	128	1		
5715				TH	CO	CO	N	0	0	0	0	0	0	34	1		
5716				TH	CO	CO	N	2	2	0	0	0	0	172	1		
5717				TH	CO	CO	N	0	0	0	0	0	0	176	1		
5718				TH	CO	CO	N	2	2	0	0	0	0	108	1		
5719				TH	CO	CO	N	2	2	0	0	0	0	176	1		
5720				TH	CO	CO	N	0	0	0	0	0	0	142	1		
5721				HM	SH	CO	R	5	5	0	0	1	0	267	1		
5722				LM	CO	CO	N	3	3	0	0	0	0		1		
5723				LM	CO	CO	N	3	3	0	0	0	0		1		
5724				LM	CO	CO	N	3	3	0	0	0	0		1		
5725				LM	CO	CO	N	3	3	0	0	0	0		1		
5726				LM	CO	CO	N	3	3	0	0	0	0		1		
5727				TH	CO	CO	N	3	3	0	0	0	0		1		
5728				TH	CO	CO	N	3	3	0	0	0	0		1		
5729				TH	CO	CO	N	3	3	0	0	0	0		1		
5730				TH	CO	CO	N	3	3	0	0	0	0		1		
5731				TH	CN	CO	N	0	0	0	0	0	0	35	1		
5732				TH	CO	CO	N	2	2	0	0	0	0	68	1		
5733	24.1	N2-N4-N5	32	SAC	CO	CO	N	3	3	0	0	0	0	272	1	53.61	7.76
5734				SAC	CO	CO	N	2	2	0	0	0	0	171	1		
5735	21.4	W4-W8	21	CRN	OCC	CO	L	3	3	0	0	0	0	107	1	27.23	0.52
5736	21.4	Y2	21	CRN	OCC	CO	L	3	3	0	0	0	0	86	1	29.47	0.94
5737				CRN	OCC	CO	R	3	3	0	0	0	0	67	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5738	24.3	A9-B8	32	IM	ACL	CO	R	4	4	0	0	0	0	207	1	50.94	4.30
5739	24.2	C4-C7	32	IM	AC	CO	N	4	4	0	0	0	0	53	1	57.13	9.62
5740	20.4		68	IM	AC	US	N	4	4	0	0	0	0	46	1	17.40	2.54
5741	24.1	D2-D7	32	IM	IL	CO	N	2	2	0	0	0	0	128	1	53.59	9.68
5742	24.2	R4-R8	32	IM	IL	US	N	2	2	0	0	0	0	158	1	57.04	6.63
5743	24		32	IM	IL	US	N	4	4	0	0	0	0	34	1		
5744	20.2	T9-X3	30	IM	IL	CO	N	3	3	0	0	0	0	206	1	19.86	6.20
5745	20.4	L4-L5	36	IM	IL	US	N	2	2	0	0	0	0	77	1	16.03	2.40
5746	21.2	S7-X1	32	IM	IL	US	N	4	4	0	0	0	0	72	1	28.01	6.09
5747	26.4	B6	16	UN	US	US	N	4	4	0	0	0	0	7	1	76.80	4.61
5748	21.4	P9-Q8	23	HY	CO	CO	N	5	5	0	0	0	0	8	1	25.78	1.08
5749	20.3	N6	48	HY	ANG	CO	N	5	5	0	0	0	0	3	1	13.87	2.34
5750	20.3		48	HY	BOD	FR	N	5	5	0	0	0	0	4	1	12.48	2.61
5751	26.3		42	HY	ANG	CO	N	5	5	0	0	0	0	6	1	72.54	2.57
5752	24.2	U3	32	HY	CO	CO	N	5	5	0	0	0	0	9	1	55.82	5.86
5753	21.3	L3	23	HY	BOD	CO	N	5	5	0	0	0	0	6	1	21.98	2.99
5754	21.4	N5-O4	23	HY	CO	CO	N	5	5	0	0	0	0	8	1	28.40	2.45
5755	21.4	V1	21	TH	DSP	FR	N	5	5	0	0	0	0	31	1	26.24	0.90
5756	21.4	F5-L1	23	MT	PRS	CO	L	3	4	0	1	0	0	85	1	25.39	3.49
5757	20.4	N6-05	36	TH	CO	CO	N	2	2	0	0	1	0	86	1	18.98	2.37
5758	21.3	R3-M9-N7-S1	23	TH	CO	CO	N	2	2	0	0	1	0	79	1	22.71	1.92
5759				LM	CO	CO	N	3	3	0	0	0	0		1		
5760				LM	CO	CO	N	3	3	0	0	0	0		1		
5761				LM	CO	CO	N	3	3	0	0	0	0		1		
5762				LM	CO	CO	N	3	3	0	0	0	0		1		
5763				LM	CN	CO	N	3	3	0	0	0	0		1		
5764	21.4	X4-7	23	TH	CO	CO	N	2	2	0	0	0	0	170	1	28.15	0.56
5765	21.2	X4-X9	23	TH	CNS	CO	N	0	0	0	0	0	0		1	28.20	5.50
5766	21.2	Y4-X9	23	TH	CN	CO	N	0	0	0	0	0	0		1	29.33	5.36
5767	21.4	R4-R7	23	TH	DSP	FR	N	4	4	0	0	0	0	17	1	27.09	1.37
5768	21.4	N9-T1	23	TH	DSP	FR	N	4	4	0	0	0	0	21	1	28.75	2.14
5769	21.4	A3-A4	21	TH	DSP	FR	N	4	4	0	0	0	0	43	1	25.99	4.91
5770	21.4	S2-S7	21	TH	DSP	FR	N	4	4	0	0	0	0	54	1	28.51	1.88
5771	20.3-4			TH	DSP	FR	N	4	4	0	0	0	0	90	1		
5772	20.3-4			TH	DSP	FR	N	4	4	0	0	0	0	43	1		
5773	20.3	R3-S1-N7	48	TH	DSP	FR	N	4	4	0	0	0	0	45	1	12.79	1.70
5774	21.2		23	TH	DSP	FR	N	4	4	0	0	0	0	22	1	27.65	7.46
5775	20.4	L5-L9	36	TH	DSP	FR	N	4	4	0	0	0	0	16	1	16.49	2.58
5776	21.4	U5-U7	21	TH	DSP	FR	N	4	4	0	0	0	0	31	1	25.52	0.48

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5777	20.3			TH	DSP	FR	N	4	4	0	0	0	0	16	1		
5778	21.3	H4-H7		TH	CNS	CO	N	4	4	0	0	0	0	75	1	22.10	3.55
5779	20.4	R1-S1	23	TH	CN	CO	N	0	0	0	0	0	0	165	1	17.20	1.88
5780	20.4	M1-S1	23	TH	DSP	FR	N	4	4	0	0	0	0	34	1	17.03	2.78
5781	21.3	N5-N8	23	TH	CNS	CO	N	0	0	0	0	0	0	72	1	23.52	2.66
5782	21.2	Y4-X9	23	TH	CNS	CO	N	1	1	0	0	0	0	72	1	29.27	5.60
5783	20.4	K1-K4	36	TH	DSP	FR	N	0	0	0	0	0	0	15	1	15.21	2.74
5784	20.3	S5	48	SAC	DSP	SP	N	2	2	0	0	0	0	69	1	13.40	1.51
5785	20.3	R3	36	LM	CN	CO	N	0	0	0	0	0	0	59	1	12.98	1.84
5786	20.3	G5	23	LM	CAN	CO	N	0	0	0	0	0	0	78	1	11.38	3.45
5787	21.4	W7	23	LM	CAN	CO	N	0	0	0	0	0	0	74	1	27.08	0.27
5788	21.4	V3-W4	23	LM	CAN	CO	N	0	0	0	0	0	0	35	1	26.83	0.93
5789	21.3	O5-O8	23	CE	CO	CO	N	0	0	0	0	0	0	128	1	24.41	2.54
5790	20.3	G5	23	CE	CO	CO	N	0	0	0	0	0	0	31	1	11.63	3.48
5791	20.3		66	CE	CN	CO	N	0	2	0	0	0	0	32	1	12.36	2.43
5792	20.3	N6	36	CE	CN	CO	N	0	0	0	0	0	0	42	1	13.69	2.45
5793	20.3	G5	23	CE	CO	CO	N	0	0	0	0	0	0	35	1	11.55	3.59
5794	20.4	H1	36	CE	CO	CO	N	0	0	0	0	0	0	31	1	17.06	3.68
5795	20.3-4		46	CE	CN	CO	N	1	0	0	0	0	0	35	1		
5796				MR	COR	CO	R	4	4	0	0	0	0	27.9	1		
5797	24.1	T4-T3	32	MR	COR	CO	L	4	4	0	0	0	0	47.1	1	54.33	6.42
5798	21.1	X2-X5	23	MR	COR	CO	L	4	4	0	0	0	0	101.3	1	23.55	5.82
5799	20.3	K2	23	MR	US	US	N	4	4	0	0	0	0	21.4	1	10.36	2.89
5800	20.4	R1-S1	23	MR	US	US	N	4	4	0	0	0	0	12.2	1	17.29	1.73
5801	20.3	K2	23	MR	US	US	N	4	4	0	0	0	0	8.6	1	10.38	2.69
5802	20.4	P1-P2	36	MR	US	US	N	4	4	0	0	0	0	63.1	1	15.09	1.75
5803	20.3	R6	36	MR	US	US	N	4	4	0	0	0	0	12.7	1	12.78	1.66
5804	21.4	X1-X5	21	FM	FK	LT	R	4	4	0	1	0	0	43.4	1	28.30	0.71
5805	20.3-4			LM	US	US	N	4	4	0	0	0	0	5.3	1		
5806	20.3	G5	23	UL	SH	CO	N	0	0	0	0	0	0	22.1	1	11.34	3.40
5807	21.4	V3-V6	21	CS	US	US	N	4	4	0	0	0	0	11.3	1	26.80	0.93
5808	20.3-4			UL	SH	FR	N	4	4	0	0	0	0	35.8	1		
5809	20.3-4			RB	BL	FR	N	4	4	0	0	0	0	4.1	1		
5810	20.3-4			UN	US	US	N	4	4	0	0	0	0	0.8	1		
5811	20.4	R1-S1	23	RB	BL	FR	N	4	4	0	0	0	0	10.2	1	17.25	1.85
5812	20.3-4			RB	PR	CO	L	4	4	0	0	0	0	2.9	1		
5813	20.4	H4-H8	36	RB	DS	CO	N	4	4	0	0	0	0	4.3	1	17.09	3.58
5814	20.3-4			MC	PR	FR	R	4	4	0	0	0	0	31.6	1		
5815	20.3-4			MC	PR	FR	L	4	4	0	0	0	0	16	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5816	20.3-4			MC	SH	FR	N	4	4	0	0	0	0	33.9	1		
5817	20.3-4			HM	DT	LT	N	4	4	0	0	0	0	3.8	1		
5818	20.3-4			MP	US	US	N	4	4	0	0	0	0	2.2	1		
5819	20.3	M7-M8	36	TA	FK	CR	R	4	4	0	1	0	0	50.4	1	12.13	2.03
5820	20.3	M8	36	TA	FK	CD	R	4	4	0	1	0	0	18.5	1	12.52	2.17
5821	20.3	M9	36	TA	FK	CD	R	4	4	0	1	0	0	38.6	1	12.92	2.28
5822	21.4	V6	23	FB	US	US	N	4	4	0	0	0	0	18	1	26.80	0.58
5823	20.3-4		46	FB	US	US	N	4	4	0	0	0	0	58.2	1		
5824	20.3	Q1-Q6	36	FB	US	US	N	4	4	0	0	0	0	5.3	1	11.26	1.80
5825	20.4	H5	36	CE	CAN	CO	N	0	0	0	0	0	0	79.1	1	17.60	3.54
5826	20.3	N5	36	SA	CO	CO	N	0	0	0	0	0	0	20	1	13.49	2.40
5827	20.3	K8	23	VT	CN	CO	N	0	0	0	0	0	0	58.8	1	10.58	2.24
5828	20.3		66	SA	CO	CO	N	0	0	0	0	0	0	9.5	1	12.61	2.53
5829	20.3	M6	36	SA	CO	CO	N	0	0	0	0	0	0	8.5	1	12.88	2.46
5830	20.3		66	SA	CO	CO	N	0	0	0	0	0	0	5.5	1	12.48	2.44
5831	20.4	B9	36	SA	FR	FR	N	0	0	0	0	0	0	10.3	1	16.92	4.23
5832	20.3	M8	36	SAC	FR	CR	N	1	1	0	0	0	0	61.1	1	12.48	2.15
5833	20.4	P5	36	SA	CN	CO	N	0	0	0	0	0	0	13	1	15.58	1.55
5834	20.3	F9	23	SA	CN	CO	N	0	0	0	0	0	0	11.8	1	10.98	3.10
5835	20.3	R8	23	UN	US	US	N	4	4	0	0	0	0	22.1	1	12.39	1.25
5836	20.3		23	UN	US	US	N	4	4	0	0	0	0	6.3	1	12.62	2.37
5837	21.4	X4-X5	23	UL	OLC	CO	N	4	4	0	0	0	0	28.7	1	28.33	0.40
5838	20.3	E4	48	UN	US	US	N	4	4	0	0	0	0	30.6	1	14.23	4.57
5839	20.3-4			FM	DPR	FR	R	4	4	0	0	0	0	52.9	1		
5840	20.3	Q3	36	FM	DS	ME	R	0	4	0	0	0	0	49.5	1	11.81	1.97
5841	20.3	S1-S4	36	MP	SH	FR	N	4	4	0	0	0	0	50	1	13.01	1.99
5842	20.3	R2-R4	36	LB	SH	FR	N	4	4	0	0	0	0	55.8	1	12.57	1.94
5843	20.3	R3-R6	36	LB	SH	FR	N	4	4	0	0	0	0	50.6	1	12.71	1.87
5844	20.3	S1-S4	36	MP	SH	FR	N	4	4	0	0	0	0	40.1	1	13.01	1.72
5845	20.4	R8-W3	36	LB	SH	FR	N	4	4	1	0	0	0	51.3	1	17.57	1.06
5846	20.3	S1-S4	36	LB	SH	FR	N	4	4	0	0	0	0	16.8	1	13.22	1.69
5847	20.3-4			LB	SH	FR	N	4	4	0	0	0	0	29	1		
5848	21.2	Q4	23	LB	SH	FR	N	4	4	0	0	0	0	37.6	1	26.30	6.38
5849	20.3-4			UN	US	US	N	4	4	0	0	0	0	18.3	1		
5850	21.2	J9-O8	23	CRN	NSL	FR	N	4	4	0	0	0	0	8.5	1	29.78	8.31
5851	20.3-4			CRN	HC	FR	N	4	4	0	0	0	0	29	1		
5852	24.2	I5-I6	32	CRN	US	US	N	4	4	0	0	0	0	52.5	1	58.42	8.41
5853	20.4	H1	36	CRN	US	US	N	4	4	0	0	0	0	45.8	1	17.01	3.88
5854	20.3		66	CRN	US	US	N	4	4	0	0	0	0	113.3	1	12.43	2.40

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5855	20.3-4			CRN	US	US	N	4	4	0	0	0	0	62.1	1		
5856				CRN	US	US	N	4	4	0	0	0	0	26.7	1		
5857	20.3		66	CRN	US	US	N	4	4	0	0	0	0	8.3	1	12.47	2.53
5858	20.3		66	CRN	US	US	N	4	4	0	0	0	0	10.6	1	12.34	2.63
5859	20.4	B4	36	CRN	US	US	N	4	4	0	0	0	0	10.6	1	16.04	4.66
5860	21.3	G9	23	CRN	US	US	N	4	4	0	0	0	0	25.8	1	21.71	3.08
5861	20.4	B8	36	CRN	US	US	N	4	4	0	0	0	0	11	1	16.35	4.25
5862	24.1	J1	32	CRN	US	US	N	4	4	0	0	0	0	26.3	1	54.28	8.70
5863	21.4	T9	23	CRN	US	US	N	4	4	0	0	0	0	11.8	1	29.67	1.25
5864	21.2	Y3	23	CRN	US	US	N	4	4	0	0	0	0	11.1	1	29.96	5.72
5865	20.4	N3		CRN	US	US	N	4	4	0	0	0	0	14.5	1	18.95	2.91
5866	21.4	T4-T3	23	CRN	US	US	N	4	4	0	0	0	0	9.3	1	29.33	1.61
5867	21.2	V1-V2	23	CRN	US	US	N	4	4	0	0	0	0	11.1	1	26.10	5.79
5868	21.4	T6-T9	23	CRN	US	US	N	4	4	0	0	0	0	88.6	1	29.72	1.48
5869	21.2	W4	23	CRN	US	US	N	4	4	0	0	0	0	41.1	1	27.17	5.35
5870	21.1	Y2-Y8-Y9-Y6	23	CRN	MX	FR	N	4	4	0	0	0	0	223	1	24.51	5.67
5871	20.3		36	UN	US	US	N	4	4	0	0	0	0	7.1	1	12.54	2.45
5872	21.4	W5	23	UN	US	US	N	4	4	0	0	0	0	12.6	1	27.35	0.48
5873	20.4	R1-S1	23	UN	US	US	N	4	4	0	0	0	0	2.8	1	17.18	1.76
5874	20.3-4			UN	US	US	N	4	4	0	0	0	0	303			
5875	26.4	B3	16	CRN	MX	FR	N	4	4	0	0	0	0	93	1	76.67	4.99
5876				CRN	MX	FR	N	4	4	0	0	0	0	122	1		
5877	24.4	F4-K4	32	CRN	US	FR	N	4	4	0	0	0	0	18	1	55.25	3.34
5878	20.4	B8	36	CRN	US	FR	N	4	4	0	0	0	0	43	1	16.43	4.03
5879	24.1	Y1-Y7	32	CRN	US	FR	N	4	4	0	0	0	0	51	1	54.29	5.82
5880	38.3	P4-U5	27	CRN	NSL	FR	N	4	4	0	0	0	0	39	1	50.13	11.49
5881				CRN	MX	FR	N	4	4	0	0	0	0	303	1		
5882	26.1	K	25	CRN	MUN	CO	N	4	4	0	0	0	0	45	1	70.43	7.36
5883	26.4	B1	16	CRN	MUN	CO	N	4	4	0	0	0	0	44	1	76.26	4.74
5884	26.3	S5	20	CRN	MUN	CO	N	4	4	0	0	0	0	49	1	73.57	1.62
5885	39.2	U6	16	CRN	MUN	CO	N	4	4	0	0	0	0	31	1	65.67	15.37
5886	20.4	L9	36	CRN	MUN	CO	N	4	4	0	0	0	0	59	1	16.78	2.26
5887	21.1	R7-R9	18	CRN	US	FR	N	4	4	0	0	0	0	14	1	22.18	6.12
5888	24.1	H9-I1	32	CRN	US	FR	N	4	4	0	0	0	0	24	1	52.86	8.08
5889	21.3		24	CRN	PUN	CO	N	4	4	0	0	0	0	8	1	22.65	2.48
5890	24.1	H9-I1	32	CRN	PUN	CO	N	4	4	0	0	0	0	16	1	52.76	8.15
5891	26.3	Y2	20	CRN	MUN	FR	N	4	4	0	0	0	0	38	1	74.40	0.79
5892	38.4	S8	27	CRN	MUN	CO	N	4	4	0	0	0	0	54	1	58.64	11.29
5893	26.1	K	25	CRN	PUN	CO	N	4	4	0	0	0	0	19	1	70.44	7.42

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5894	21.4		24	CRN	PUN	CO	N	4	4	0	0	0	0	7	1	27.55	2.45
5895	21.4	C3	23	MR	COR	CO	L	4	4	0	0	0	0	44	1	27.75	4.86
5896	20.3-4			MR	ANG	CO	L	4	4	0	0	0	0	32	1		
5897				MR	RAM	CO	R	4	4	0	0	0	0	25	1		
5898				MR	RAM	CO	L	4	4	0	0	0	0	84	1		
5899	20.3		66	MR	TW	FR	R	4	4	0	0	0	0	59	1	12.50	2.39
5900	21.4	W8	23	MR	CP	FR	L	4	4	0	0	0	0	37	1	27.53	0.22
5901	21.4	C8	20	MR	COR	CO	L	4	4	0	0	0	0	28	1	27.45	4.06
5902	24.2	D2	32	MR	CP	CO	L	4	4	0	0	0	0	11	1	58.41	9.94
5903	20.4			MR	PUN	CO	N	4	4	0	0	0	0	21	1		
5904	20.3			MR	MUN	CO	N	4	4	0	0	0	0	118	1		
5905	20.4			MR	FR	FR	N	4	4	0	0	0	0	391	1	17.52	2.64
5906	23.3	H2	39	CRN	US	FR	N	4	4	0	0	0	0	134	1	42.50	3.86
5907				PHS	CO	CO	N	4	4	0	0	0	0	12	1		
5908				CRN	US	FR	N	4	4	0	0	0	0	1111	1		
5909				CRN	MUN	FR	N	4	4	0	0	0	0	563	1		
5910	23			MR	US	FR	N	4	4	0	0	0		286	1		
5911	36.4	B7-G1-G2	18	CRN	MX	FR	R	4	4	0	0	0	0	199	1	36.23	14.20
5912	GRID 3			UN	US	FR	N	4	4	1	0	0	0	74	1		
5913	GRID 3			MR	MUN	FR	N	4	4	0	0	0	0	25	1		
5914	GRID 3			UN	US	FR	N	4	4	1	0	0	0	22.1	1		
5915	GRID 3			PHS	CO	CO	N	4	4	0	0	0	0	22.2	1		
5916	23.2/4			MR	MUN	FR	N	4	4	0	0	0	0	51.1	1		
5917	20.4	N6-N9	36	MP	SH	FR	N	4	4	0	0	0	0	34.4	1	18.93	2.45
5918				CRN	HC	FR	N	4	4	0	0	0	0	5918	1		
5919	24		32	RB	BL	FR	N	4	4	0	0	0	0	51.2	1		
5920	19.3-4		38	RB	BL	FR	N	4	4	0	0	0	0	10.2	1		
5921	19.3	K9	38	RB	BL	FR	N	4	4	0	0	0	0	22.8	1	0.68	2.07
5922	19.3-4		38	RB	BL	FR	N	4	4	0	0	0	0	13.7	1		
5923	24		32	RB	BL	FR	N	4	4	0	0	0	0	16.5	1		
5924	20		78	RB	BL	FR	N	4	4	0	0	0	0	12.9	1		
5925	20.4	O5	36	RB	BL	FR	N	4	4	0	0	1	0	8.4	1	19.55	2.46
5926	20.4	M1-M2	36	RB	BL	FR	N	4	4	0	0	0	0	17.2	1	17.31	2.90
5927	19		38	RB	BL	FR	N	4	4	0	0	0	0	10.3	1		
5928	19.3	R	38	RB	BL	FR	N	4	4	0	0	0	0	28.5	1	2.50	1.41
5929	24.2	U5-U6	32	RB	BL	FR	N	4	4	0	0	0	0	12	1	55.64	5.55
5930	19		38	RB	BL	FR	N	4	4	0	0	0	0	6.6	1		
5931	19.3	W6	38	RB	PR	CO	L	4	4	0	0	0	0	9.4	1	2.68	0.52
5932				PHS	CO	CO	N	4	4	0	0	0	0	19.3	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5933				MP	SH	FR	N	4	4	0	1	0	0	86.8	1		
5934	24.1	D3	32	CE	TSP	CO	N	4	4	0	0	0	0	5.9	1	53.89	9.90
5935	19.3-4		38	LB	US	FR	N	4	4	0	0	0	0	14.5	1		
5936	19.3-4		38	LB	US	FR	N	4	4	0	0	0	1	15.3	1		
5937				CA	CO	CO	N	4	4	0	0	0	0	14.4	1		
5938				UN	US	FR	N	4	4	0	0	0	0	10.7	1		
5939				CRN	OCC	CO	R	2	4	0	0	0	0	100	1		
5940				RB	BL	FR	N	4	4	0	0	0	0	8.3	1		
5941				CRN	TMP	FR	N	2	2	0	0	0	0	81.6	1		
5942				CE	CO	CO	N	0	4	0	0	0	0	18.8	1		
5943				UN	US	FR	N	4	4	0	0	0	0	18.2	1		
5944				UN	US	FR	N	4	4	0	0	0	0	44.5			
5945				UN	US	FR	N	4	4	0	0	0	0	107	1		
5946				UN	US	FR	N	4	4	2	0	0	0	13.4	1		
5947				UN	US	FR	N	4	4	0	0	0	0	49.7	1		
5948	24.2	G9		CRN	US	FR	N	4	4	0	0	0	0	11.2	1	56.74	8.22
5949				CRN	US	FR	N	4	4	0	0	0	0	82.5	1		
5950	20.3-4			MT	PR	CO	L	4	4	0	0	0	0	49	1		
5951				UN	US	FR	N	4	4	0	0	0	0	56.2			
5952	21.4	W1		CPS	CO	CO	L	4	4	0	0	0	0	12.2	1	27.31	0.96
5953	20.3-4			SEP	CO	CO	N	4	4	0	0	0	0	5.6	1		
5954	21.2	Q9		SED	CO	CO	N	4	4	0	0	0	0	4.1	1	26.79	6.05
5955	21.4	R3		CPF	CO	CO	N	0	0	0	0	0	0	6.2	1	27.77	1.86
5956	21.4	V6-W7		CPF	CO	CO	N	0	0	0	0	0	0	6.8	1	26.77	0.39
5957	21.3	H7-M1		TRC	CO	CO	N	3	0	0	0	0	0	18.9	1	22.28	3.30
5958	20.4	M8		TH	AEP	CO	N	5	0	0	0	0	0	7.9	1	17.66	2.12
5959	20.4	H1		CA	AEP	CO	N	5	0	0	0	0	0	9.3	1	17.28	3.70
5960	20.3	M7		CA	AEP	CO	N	5	0	0	0	0	0	2.9	1	12.03	2.17
5961	20.3			CA	AEP	CO	N	5	0	0	0	0	0	2.3	1	12.47	2.54
5962	21.4	T3		CA	AEP	CO	N	5	0	0	0	0	0	2.2	1	29.72	1.89
5963	20.3	G5		CA	AEP	CO	N	5	0	0	0	0	0	1.5	1	11.51	3.51
5964	20.4	R2		CE	AEP	CO	N	5	0	0	0	0	0	1.9	1	17.64	1.81
5965	20.4	M9		CE	AEP	CO	N	5	0	0	0	0	0	4.4	1	17.84	2.15
5966	38.4	G4-G7		LB	US	FR	N	4	4	0	0	0	0	21	1	56.20	13.46
5967	24.1	L2		TH	CO	CO	N	2	2	0	0	0	0	10.7	1	51.43	7.76
5968	24			TH	CO	CO	N	0	2	0	0	0	0	5.5	1		
5969	21.4			TH	CO	CO	N	2	2	0	0	0	0	6.5	1	27.47	2.62
5970	21.1	W1		TH	CO	CO	N	2	2	0	0	0	0	11.8	1	22.19	5.91
5971	24.1	M1		TH	CO	CO	N	2	2	0	0	0	0	11.7	1	52.13	7.99

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
5972	24.1	H7		TH	CO	CO	N	2	2	0	0	0	0	27.7	1	52.13	8.28
5973				CE	CO	CO	N	2	4	0	0	0	0	14.7	1		
5974				CE	CO	CO	N	2	2	0	0	0	0	11.1	1		
5975				CE	CO	CO	N	2	2	0	0	0	0	11	1		
5976	20.4			UN	US	FR	N	4	4	0	0	0	0	8.8		17.50	2.66
5977	20.4			UN	US	FR	N	4	4	0	0	0	0	3.2		17.35	2.46
5978	21.4			UN	US	FR	N	4	4	0	0	0	0	0.6	1	27.50	2.43
5979				UN	US	FR	N	4	4	0	0	0	0	1.2	1		
5980	20.3			UN	US	FR	N	4	4	0	0	0	0	0.7	1	12.58	2.37
5981	20.4	F3		CPA	CO	CO	L	0	0	0	0	0	0	7.1	1	15.70	3.87
5982	21.4			UN	US	FR	N	4	4	0	0	0	0	29.7		27.35	2.53
5983	20			UN	US	FR	N	4	4	0	0	0	0	31.1			
5984	20.3			CRN	TFR	FR	N	4	4	0	0	0	0	8.7	1	12.46	2.57
5985	20.4			RB	BL	FR	N	4	4	0	0	0	0	19	1	17.63	2.38
5986	20.4	M4-R2		RB	BL	FR	N	4	4	0	0	0	0	4	1	17.19	2.44
5987	20.4			UN	US	FR	N	4	4	0	0	0	0	8.9		17.61	2.58
5988	20			RB	BL	FR	N	4	4	0	0	0	0	16.8	1		
5989	20			RB	BL	FR	N	4	4	0	0	0	0	12.6	1		
5990	24.1	S1		CPI	CO	CO	R	3	3	0	0	0	0	20.1	1	53.01	6.91
7001	TT2			AS	CO	CO	L	5	5	0	0	0	0	82	1		
7002				PHT	CO	CO	N	5	5	0	0	0	0	24	1		
7003				MUN	CO	CO	N	5	5	0	0	0	0	107	5		
7004	TT1			RB	BL	FR	N	5	5	0	0	0	0	134	12		
7005	TT1			LB	SH	FR	N	4	4	0	1	0	0	194	16		
7006	TT1			UN	US	FR	N	4	4	1	0	0	0	97	28		
7007	TT1			UN	US	FR	N	4	4	0	0	0	0	13	11		
7008	TT1			PHS	CO	CO	N	4	4	0	0	0	0	15	1		
7009	GRID 1		12-18	RB	BL	FR	N	5	5	0	0	0	0	9	1		
7010	GRID 1		12-18	UN	US	FR	N	4	4	0	0	0	0	30	6		
7011	TT3		9	UN	US	FR	N	4	4	0	0	0	0	70	64		
7012	TT3		9	UL	OLC	CO	N	4	4	0	0	0	0	63	1		
7013	TT3		9	CPR	CO	CO	R	0	0	0	0	0	0	9	1		
7014	TT3		9	LB	SH	FR	N	4	4	0	1	0	0	21	2		
7015	TT3		9	RB	BL	FR	N	4	4	0	0	0	0	11	1		
7016	TT3		6-12	LB	SH	FR	N	4	4	0	1	0	0	64	6		
7017	TT3		6-12	UN	US	FR	N	4	4	1	0	0	0	4	6		
7018	TT3		6-12	UN	US	FR	N	4	4	2	0	0	0	12	10		
7019	TT3		6-12	UN	US	FR	N	4	4	0	0	0	0	95	80		
7020	GRID 2		12-18	CE	CO	CO	N	0	0	0	0	0	0	71	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
7021	GRID 2		12-18	RB	BL	FR	N	4	4	0	0	0	0	7	1		
7022	GRID 2		12-18	TRS	CO	CO	N	2	2	0	0	0	0	44	1		
7023	GRID 2		12-18	LB	SH	FR	N	4	4	0	1	0	0	84	4		
7024	GRID 2		12-18	UN	US	FR	N	4	4	0	0	0	0	55	21		
7025	GRID 2		12-18	UN	US	FR	N	4	4	1	0	0	0	2	1		
7026	GRID 2		12-18	UN	US	FR	N	4	4	2	0	0	0	7	4		
7027	GRID 5		12-18	PHF	CO	CO	N	4	4	0	0	0	0	40	1		
7028	GRID 5		12-18	PHS	CO	CO	N	4	4	0	0	0	0	26	1		
7029	GRID 5		12-18	PHT	CO	CO	N	4	4	0	0	0	0	24	1		
7030	GRID 5		12-18	PHF	CO	CO	N	4	4	0	0	0	0	40	1		
7031	GRID 5		12-18	PHS	CO	CO	N	4	4	0	0	0	0	25	1		
7032	GRID 5		12-18	PHT	CO	CO	N	4	4	0	0	0	0	26	1		
7033	GRID 5		12-18	MP	DSH	CO	N	4	2	0	1	0	0	131	1		
7034	GRID 5		12-18	TRF	US	FR	N	4	0	0	0	0	0	1	1		
7035	GRID 5		12-18	LB	SH	FR	N	4	4	0	1	0	0	28	1		
7036	GRID 5		12-18	UN	US	FR	N	4	4	0	0	0	0	5	2		
7037	GRID 1		24-36	UN	US	FR	N	4	4	0	0	0	0	20	3		
7038	HABITATION			LB	SH	FR	N	4	4	0	1	0	0	16	1		
7039	GRID 6		18-24	MUN	US	FR	N	4	4	0	0	0	0	3	1		
7040	GRID 6		0-6	UN	US	FR	N	4	4	0	0	0	0	9	4		
7041				MC	CO	CO	R	2	0	0	0	0	0	191	1		
7042	TT1		LEVEL 1	UN	US	FR	N	4	4	0	0	0	0	212	50		
7043	TT1		LEVEL 1	UN	US	FR	N	4	4	1	0	0	0	115	28		
7044	TT1		LEVEL 1	UN	US	FR	N	4	4	2	0	0	0	72	32		
7045	TT1		LEVEL 1	FM	PR	ME	L	5	2	0	0	0	0	72	1		
7046	TT1		LEVEL 1	PHS	CO	CO	N	5	5	0	0	0	0	26	1		
7047	TT1		LEVEL 1	PHS	CO	CO	N	5	5	0	0	0	0	28	1		
7048	TT1		LEVEL 1	PHF	CO	CO	N	5	5	0	0	0	0	47	1		
7049	TT1		LEVEL 1	RB	BL	FR	N	4	4	0	0	0	0	41	2		
7050	TT1		LEVEL 1	LB	SH	FR	N	4	4	0	1	0	0	79	2		
7051				UN	US	FR	N	4	4	2	0	0	0	3	1		
7052	GRID 1		24-36	UN	US	FR	N	4	4	1	0	0	0	2	1		
7053	GRID 8		0-6	UN	US	FR	N	4	4	0	0	0	0	30	8		
7054	GRID 8		0-6	IM	ILD	FR	N	4	4	0	0	0	0	74	1		
7055	GRID 8		0-6	TA	DSS	CO	R	4	4	2	0	0	0	17	1		
7056	GRID 1		18-24	RB	BL	FR	N	4	4	0	0	0	1	9	1		
7057	GRID 1		18-24	CRN	HC	FR	N	4	4	0	0	0	0	117	1		
7058	GRID 7		6-12	LB	SH	FR	N	4	4	1	0	0	0	8	1		
7059	TT3		0-6	UN	US	FR	N	4	4	0	0	0	0	71	17		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
7060	TT3		0-6	CPS	CO	CO	R	5	0	0	0	0	0	6	1		
7061	GRID 3		6-12	UN	US	FR	N	4	4	2	0	0	0	1	1		
7062	TT2			CPR	CO	CO	L	3	3	0	0	0	0	18	1		
7063	TT2			PHT	CO	CO	N	5	5	0	0	0	0	22	1		
7064	TT2			MUN	CO	CO	N	5	5	0	0	0	0	52	1		
7065	TT2			SED	CO	CO	N	0	0	0	0	0	0	3	1		
7066	TT2			HY	ANG	FR	N	5	5	0	0	0	1	8	1		
7067	TT2			LB	SH	FR	N	4	4	0	0	0	0	38	2		
7068	TT2			UN	US	FR	N	4	4	0	0	0	0	235	72		
7069	TT2			UN	US	FR	N	4	4	1	0	0	0	66	17		
7070	TT2			PHF	CO	CO	N	4	4	1	0	0	0	24	1		
7071	TT2			MP	DS	FR	L	4	4	1	0	0	0	18	1		
7072	TT2			SEP	DS	CO	N	0	2	1	0	0	0	15	1		
7073	TT2			UN	US	FR	N	4	4	2	0	0	0	18	10		
7074	GRID 4		18-24	UN	US	FR	N	4	4	0	0	0	0	14	4		
7075	GRID 4		24-36	SEP	DS	CO	N	0	2	2	0	0	0	8	1		
7076	GRID 4		24-36	UN	US	FR	N	0	0	0	0	0	0	3	1		
7077	TT3		9	TA	DSS	CO	L	4	3	0	1	0	0	160	1		
7078	TT3		9	LB	SH	FR	N	4	4	0	0	0	0	16	1		
7079	TT3		9	UN	US	FR	N	4	4	1	0	0	0	3	2		
7080	GRID 7		0-6	UN	US	FR	N	4	4	0	0	0	0	2	1		
7081	GRID 7		0-6	UN	US	FR	N	4	4	2	0	0	0	2	1		
7082	GRID 7		0-6	FM	HE	CO	R	5	0	2	0	0	0	12	1		
7083	GRID 6		6-12	UN	US	FR	N	4	4	0	0	0	0	4	5		
7084	TT1		LEVEL 2	RB	CO	CO	L	5	5	0	0	0	0	6	1		
7085	TT1		LEVEL 2	UN	US	FR	N	4	4	2	0	0	0	57	15		
7086	GRID 3		18-24	UN	US	FR	N	4	4	1	0	0	0	14	2		
7087	GRID 8		6-12	CE	CN	CO	N	4	4	0	0	0	0	24	1		
7088	GRID 8		6-12	UN	US	FR	N	4	4	2	0	0	0	1	1		
7089	GRID 6		0-6	UN	US	FR	N	4	4	2	0	0	0	2	1		
7090	HABITATION			LB	SH	FR	N	4	4	1	0	0	1	7	1		
7091	GRID 2			UN	US	FR	N	4	4	1	0	0	0	3	1		
7092	GRID 3		0-6	MP	PR	FR	N	0	4	1	0	0	0	18	1		
7093	GRID 3		0-6	UN	US	FR	N	4	4	1	0	0	0	24	5		
7094	GRID 3		0-6	UN	US	FR	N	4	4	2	0	0	0	12	3		
7200	HABITATION			CL	CO	CO	R	5	5	0	0	0	0	83	1		
7201				SEP	CO	CO	N	5	5	0	0	0	0	3	1		
7202	HABITATION			LB	FR	FR	N	5	5	0	0	0	0	239	250		
7203				CRN	FN	FR	N	5	5	0	0	0	0	44	1		

CN	GRID	LETTER	DEPTH"	ELE	POR	SEG	SD	PF	DF	BURN	FRACT	CARV	CUT	MASS (g)	QTY	X	Y
7204				CRN	US	US	N	5	5	0	0	0	0	53	1		
7205				SED	CO	CO	N	5	5	0	0	0	0	2	1		
7206				MUN	CO	CO	N	5	5	0	0	0	0	73	2		
7207				LB	FR	FR	N	5	5	2	0	0	0	44	67		
7208				LB	FR	FR	N	5	5	1	0	0	0	48	48		
7209				RB	BL	FR	N	5	5	0	0	0	0	26	1		
7210				UN	US	US	N	5	5	0	0	0	0	50	32		
7211				RB	BL	FR	N	5	5	0	0	0	0	37	2		
7212				MT	SH	FR	N	5	5	0	0	1	0	85	1		
7213				MC	DSS	CO	R	5	4	0	1	0	0	75	1		
7214				LB	FR	FR	N	5	5	0	1	0	0	76	4		
7215				PHT	CO	CO	N	5	5	0	0	0	0	30	1		
7216				FB	FR	FR	N	5	5	0	0	0	0	24	1		
7217				UN	US	US	N	5	5	1	0	0	0	72	250		
7218				UN	US	US	N	5	5	2	0	0	0	96	250		
7219	GRID 3		surface	CRN	HC	FR	N	5	5	0	0	0	0	10	1		
7220	GRID 3		surface	CRN	HC	FR	N	5	5	0	0	0	0	25	1		
7221	FIRE PIT			UN	US	US	N	5	5	0	0	0	0	165	175		
7222	FIRE PIT			UN	US	US	N	5	5	1	0	0	0	46	20		
7223	FIRE PIT			UN	US	US	N	5	5	2	0	0	0	47	22		

FETAL BISON DATA

CN	GRID	DEPTH	ELE	POR	SIDE	MLEN (mm)	MDL (mm)	MAPDD (mm)	MTDD (mm)	MASS (g)	CUT	CARV	BURN
7095.1	TT-3	6-12	RD	CO	L		62.66	11.86	8.11	5.1	0	0	0
7096.1	R-38.2I3	17	MP	CO	N	42.75				1.2	0	0	0
7097.1	GRID12		HM	CO	L		54.32	10.49	9.5	4.6	0	0	0
7098.1	GRID4	12-18	FM	CO	L		55.45	10.01	10.16	3.8	0	1	0
7098.2	GRID4	12-18	RB	CO	N	58.78				0.5	0	0	0
7098.3	GRID4	12-18	RB	DS	N	48.37				0.3	0	0	0
7099.1	GRID4	18-24	SC	CO	L	74.57				3.7	1	0	0
7099.2	GRID4	18-24	SA	CO	A	41.65				2.8	0	0	0
7099.3	GRID4	18-24	RB	BL	N	57.99				0.4	0	0	0
7099.5	GRID4	18-24	MT	CO	N	62.49				2.6	0	0	0
7099.6	GRID4	18-24	RD	PRS	R		39.69	5.92	8.78	1.6	0	0	0
7100.1	GRID5	12-18	RD	DSH	L		68.04	9.05	12.33	5.1	0	0	0
7100.2	GRID5	12-18	MP	CO	N	62.55				2.5	0	0	0
7100.3	GRID5	12-18	RB	CO	N	63				0.6	0	0	0
7100.4	GRID5	12-18	FM	CO	L		47.45	7.11	6.86	2.3	0	0	0
7100.5	GRID5	12-18	VT	UN	A	17.5				0.3	0	0	0
7100.6	GRID5	12-18	VT	CN	A	12.27				0.3	0	0	0
7101.1	TT-3	6-12	RD	CO	L		60	7.47	10.81	4.8	0	0	0
7101.2	TT-3	6-12	IM	IL	L	40.64				2.4	0	0	0
7101.3	TT-3	6-12	IM	IL	N	27.48				1.1	0	0	0
7101.4	TT-3	6-12	RB	BL	N	27.67				0.2	0	0	0
7101.5	TT-3	6-12	UN	UN	N	37.84				0.5	0	0	0
7102.1			IM	IS	R	32.85				1.5	0	0	0
7102.2			CL	CO	L	21.54				0.9	0	0	0
7103.1	TT-2		TA	CO	L		72.45	10.86	11.81	8	0	0	0
7103.10	TT-2		UN	UN	N	44.74				3.4	0	0	0
7103.11	TT-2		TA	CO	L		33.16	4.92	5.9	0.8	0	0	1
7103.12	TT-2		MC	SH	N	43.98				1.6	0	0	0
7103.13	TT-2		MT	DS	N	43.18				2	0	0	0
7103.14	TT-2		HM	CO	L		25.76	6.06	5.37	0.9	0	0	0
7103.15	TT-2		TH	DSP	A	39.79				0.4	0	0	0
7103.16	TT-2		RB	BL	N	27.9				0.2	0	0	0
7103.17	TT-2		RB	PR	N	37.19				0.3	0	0	0
7103.18	TT-2		RB	PR	N	48.61				0.4	0	0	0
7103.2	TT-2		RB	CO	N	88.72				0.9	0	0	0
7103.3	TT-2		TH	DSP	A	44.58				1.1	0	0	0

CN	GRID	DEPTH	ELE	POR	SIDE	MLEN (mm)	MDL (mm)	MAPDD (mm)	MTDD (mm)	MASS (g)	CUT	CARV	BURN
7103.4	TT-2		TH	DSP	A	45.67				0.7	0	0	0
7103.5	TT-2		SC	CO	R	50.77				3.7	0	0	0
7103.6	TT-2		HM	DSS	L		18.64	4.81	4.27	0.4	0	0	2
7103.7	TT-2		MP	DSH	N	46.62				1.3	0	0	0
7103.8	TT-2		UL	PRS	R		51.55	4.47	3.22	1.2	1	0	0
7103.9	TT-2		UN	UN	N	33.03				0.6	0	0	1
7104.1	GRID4	12-24	RB	CO	N	73.79				0.5	0	0	0
7105.1	GRID2		TA	CO	R		64.28	7.91	10.93	4.7	0	0	0
7106.1	GRID7	6-12	FM	CO	R		60.81	10.14	10.24	6.1	0	0	0
7106.10	GRID7	6-12	RB	PR	N	48.91				0.6	0	0	0
7106.2	GRID7	6-12	MT	CO	N	48.43				1.9	0	0	0
7106.3	GRID7	6-12	TH	DSP	A	50.04				0.8	1	0	0
7106.4	GRID7	6-12	HM	DSH	L		50.62	10.71	9.3	4.5	0	0	1
7106.5	GRID7	6-12	IM	IL	N	48.48				2.9	0	0	0
7106.6	GRID7	6-12	MT	CO	N	40.76				0.9	0	0	0
7106.7	GRID7	6-12	CRN	SKO	N	37.23				1.7	0	0	0
7106.8	GRID7	6-12	VT	UN	A	15.88				0.1	0	0	0
7106.9	GRID7	6-12	RB	CO	N	68.59				0.3	0	0	0
7107.1			SC	CO	L	70.5				3.9	0	0	0
7107.10			MP	DS	N	43.1				1.4	0	0	0
7107.11			MP	CO	N	45.07				1.2	0	0	0
7107.12			RB	CO	N	67.12				0.6	0	0	0
7107.2			MT	CO	N	48.32				1.5	0	0	1
7107.3			TH	DSP	A	43.41				0.6	0	0	0
7107.4			TH	DSP	A	31.15				0.4	0	0	0
7107.5			SN	CO	A	22.99				1.1	0	0	0
7107.6			IM	CO	L	35.29				1.3	0	0	0
7107.7			TA	PRS	L	40.13				1.9	0	0	0
7107.8			FM	PRS	L		57.93	11.47	12.21	5.6	0	0	1
7107.9			IM	ILD	N	25.89				1.2	0	0	1
7108.1	GRID7	24-30	RB	BL	N	41.25				0.3	0	0	0
7108.2	GRID7	24-30	MP	CO	N	48.97				2.1	0	0	0
7108.3	GRID7	24-30	TH	DSP	A	36.78				0.4	0	0	0
7108.4	GRID7	24-30	VT	AEP	A	16.72				0.2	0	0	0
7109.1	GRID1	18-24	RB	CO	N	71.21				0.5	0	0	0
7110.1	R-23.2/4		MC	CO	N	46.01				2.1	0	0	0
7110.2	R-23.2/4		TFR	CO	N	15.81				0.7	0	0	0
7110.3	R-23.2/4		MT	CO	N	58				2.1	0	0	0
7111.1	GRID6	0-6	RB	DS	N	48.86				0.2	0	0	0

CN	GRID	DEPTH	ELE	POR	SIDE	MLEN (mm)	MDL (mm)	MAPDD (mm)	MTDD (mm)	MASS (g)	CUT	CARV	BURN
7111.2	GRID6	0-6	UN	UN	N	19.41				0.7	0	0	0
7112.1	GRID3	0-6	RD	CO	L		43.14	5.73	8.64	2.2	0	0	1
7113.1	GRID3	18-24	TH	DSP	A	26.23				0.4	0	0	1
7114.1	GRID6	6-12	RD	CO	R		60.25	8.22	11.87	4.1	0	0	0
7114.2	GRID6	6-12	RD	CO	L		62.87	7.4	10.83	3.4	0	0	0
7114.3	GRID6	6-12	MT	DS	N	33.23				1	0	0	0
7114.4	GRID6	6-12	MP	CO	N	48.86				1.8	0	0	0
7114.5	GRID6	6-12	MP	CO	N	48.75				1.6	0	0	0
7114.6	GRID6	6-12	RB	CO	N	44.38				0.4	0	0	0
7114.7	GRID6	6-12	MP	DS	N	27.79				0.6	0	0	0
7115.1	GRID1	12-18	UN	UN	N	18.78				0.7	0	0	1
7115.10	GRID1	12-18	RB	CO	N	88.22				0.7	0	0	0
7115.11	GRID1	12-18	RB	PR	N	45.39				0.3	0	0	0
7115.12	GRID1	12-18	RB	CO	N	63.37				0.4	0	0	0
7115.2	GRID1	12-18	UN	UN	N	19.25				0.7	0	0	1
7115.3	GRID1	12-18	IM	IL	L	44.29				2.2	0	0	1
7115.4	GRID1	12-18	MP	DS	N	52.5				1.8	0	0	1
7115.5	GRID1	12-18	MT	CO	N	44.4				0.8	0	0	1
7115.6	GRID1	12-18	TH	DSP	A	42.05				0.8	0	0	0
7115.7	GRID1	12-18	TH	DSP	A	33.94				0.3	0	0	0
7115.8	GRID1	12-18	RB	CO	N	50.81				0.7	0	0	0
7115.9	GRID1	12-18	RB	PR	N	40.04				0.3	0	0	0
7116.1	GRID7	0-6	UN	UN	N	22.68				1	0	0	0
7116.10	GRID7	0-6	TH	DSP	A	34.54				0.4	0	0	0
7116.11	GRID7	0-6	TH	DSP	A	49.32				0.7	0	0	0
7116.12	GRID7	0-6	TH	DSP	A	29.9				0.3	0	0	0
7116.2	GRID7	0-6	RB	PR	R	59.5				0.6	0	0	0
7116.3	GRID7	0-6	FM	CO	L		62.1	11.34	11.08	7.1	0	0	1
7116.4	GRID7	0-6	TA	SH	N	56.93				2.1	0	1	1
7116.5	GRID7	0-6	MP	CO	N	54.24				2.2	0	0	0
7116.6	GRID7	0-6	TA	PRS	L		50.83	9.3	10.59	2.7	0	0	1
7116.7	GRID7	0-6	TA	DSS	L	20.23				0.9	0	0	1
7116.8	GRID7	0-6	TA	PRS	L		46	9.84	11.17	4.3	0	0	0
7116.9	GRID7	0-6	MP	DS	N	28.33				0.9	0	0	0
7119.1	GRID6	12-18	MT	CO	N	44.99				1.1	0	0	0
7119.2	GRID6	12-18	PH	CO	N	10.82				0.3	0	0	0
7121.1	GRID7	12-18	UL	PRS	L		63.06	4.7	3.15	1.7	0	0	0
7121.2	GRID7	12-18	MP	PRS	N	52.17				2.1	0	0	0
7121.3	GRID7	12-18	TH	DSP	A	39.4				0.4	0	0	0

CN	GRID	DEPTH	ELE	POR	SIDE	MLEN (mm)	MDL (mm)	MAPDD (mm)	MTDD (mm)	MASS (g)	CUT	CARV	BURN
7122.1	TT-3	6-12	MP	CO	N	57.19				4	0	0	0
7122.10	TT-3	6-12	TH	DSP	A	43.21				0.4	0	0	0
7122.11	TT-3	6-12	RB	PR	L	55.8				0.4	0	0	0
7122.2	TT-3	6-12	TH	DSP	A	43.57				0.5	0	0	0
7122.3	TT-3	6-12	RB	CO	N	78.02				0.6	0	0	0
7122.4	TT-3	6-12	TH	DSP	A	17.57				0.1	0	0	0
7122.5	TT-3	6-12	CL	CO	L	19.24				0.6	0	0	0
7122.6	TT-3	6-12	RB	PR	N	63.75				0.8	0	0	0
7122.7	TT-3	6-12	MP	SH	N	50.69				1.2	0	0	0
7122.8	TT-3	6-12	MP	SH	N	42.68				1.3	0	0	1
7123.1	GRID7	18-24	SC	GNB	L	69.32				3	0	0	0
7123.3	GRID7	18-24	TH	DSP	A	16.41				0.3	1	0	0
7123.4	GRID7	18-24	HM	CO	L		31.19	6.51	5.62	1.1	0	0	0
7123.5	GRID7	18-24	FM	DS	R	24.09				1.9	0	0	0
7124.1	GRID1	0-12	MT	CO	N	66.32				2.4	0	0	1
7124.2	GRID1	0-12	MT	CO	N	67.16				2.7	0	0	0
7125.1			SC	GNB	R	55.05				3.5	0	0	0
7125.10			CS	UN	N	36.45				0.2	0	0	0
7125.11			RB	BL	N	44.41				0.5	0	0	0
7125.12			MP	DSE	N	12.01				0.4	0	0	0
7125.13			PH	CO	N	10.11				0.2	0	0	0
7125.14			UN	UN	N	20.65				0.6	0	0	0
7125.15			UN	UN	N	16.41				0.2	0	0	0
7125.16			UN	UN	N	16.91				0.4	0	0	1
7125.17			IM	UN	N	34.15				1	0	0	0
7125.2			LB	UN	N	20.9				0.7	0	0	0
7125.3			MT	CO	N	51.62				2.1	0	1	0
7125.4			MC	CO	N	44.86				1.8	0	0	0
7125.5			RD	DSH	L		40.08	7.47	10.58	2.6	0	0	1
7125.7			IM	IL	L	31.47				1.2	0	0	0
7125.8			TH	DSP	A	38.36				0.4	0	0	0
7125.9			TH	DSP	A	41.9				0.5	0	0	0
7126.3	TT-1	LEV 2	RD	CO	R		59.18	7.17	10.29	4.7	0	0	0
7126.4	TT-1	LEV 2	HM	DDS	R		42.47	10.66	9.96	3.1	0	0	0
7126.5	TT-1	LEV 2	FM	PRS	L		51.2	9.33	9.56	3.8	0	0	0
7126.6	TT-1	LEV 2	FM	CO	R		50.13	8.65	9.15	2.7	0	0	1
7126.7	TT-1	LEV 2	FM	PRS	L		55.35	10.45	10.82	4.9	0	0	0
7126.8	TT-1	LEV 2	MT	CO	N	61.56				2.3	0	0	0
7126.9	TT-1	LEV 2	CRN	ZYG	R	33.82				0.4	0	0	0

CN	GRID	DEPTH	ELE	POR	SIDE	MLEN (mm)	MDL (mm)	MAPDD (mm)	MTDD (mm)	MASS (g)	CUT	CARV	BURN
7127.10	TT-1	LEV 1	IM	IL	L	46.67				3.3	0	0	0
7127.11	TT-1	LEV 1	RD	CO	L		56.66	7.25	10.36	4.4	0	0	1
7127.2	TT-1	LEV 1	TA	CO	L		70.48	10.04	11	6.6	0	0	1
7127.3	TT-1	LEV 1	RD	CO	L		41.73	5.59	8.34	1.3	0	0	1
7127.4	TT-1	LEV 1	LB	SH	N	13.41				0.5	0	0	0
7127.5	TT-1	LEV 1	UL	PRS	R		52.98	5.93	2.95	1.4	0	0	0
7127.6	TT-1	LEV 1	SC	GS	R	56.59				3.4	0	0	1
7127.7	TT-1	LEV 1	SC	CO	R	75.66	0	0	0	4.6	0	0	0
7127.8	TT-1	LEV 1	MP	CO	N	57.92				2.3	0	0	0
7127.9	TT-1	LEV 1	TH	DSP	A	40.67				0.6	0	0	0
7128.1	GRID1	24-36	MT	DS	N	44.08				1.2	0	0	0
7128.2	GRID1	24-36	MP	DS	N	17.54				0.3	0	0	0
7128.3	GRID1	24-36	FM	SH	L		45.39	10.37	8.91	1.8	1	0	0
7130.2	GRID8	6-12	HM	DS	R		40.71	7.73	9.28	1.9	0	0	0
7130.3	GRID8	6-12	MP	CO	N	50.47				1.3	0	0	0
7131.1			IM	IL	N	29.78				1.6	0	0	0
7132.1			TA	CO	L		75.28	10.21	11.54	8.2	0	0	0
7133.1	GRID8	12-18	RB	PR	N	89.89				1	0	0	1
7133.2	GRID8	12-18	SA	CO	A	30.65				1.3	0	0	0
7133.3	GRID8	12-18	VT	AEP	A	21.05				0.4	0	0	0
7133.4	GRID8	12-18	CL	CO	R	21.16				1.1	0	0	0
7133.5	GRID8	12-18	CA	CO	A	12.84				0.4	0	0	0
7134.1	GRID1	12-18	FM	DS	L		35.8	9.6	9.32	3.1	0	0	1
7134.2	GRID1	12-18	MP	CO	N	49.35				2.1	0	0	1
7134.3	GRID1	12-18	MP	CO	N	44.03				0.8	0	0	1
7134.4	GRID1	12-18	RB	BL	N	30.98				0.2	0	0	1
7134.5	GRID1	12-18	RB	PR	N	46.23				0.5	0	0	1
7134.6	GRID1	12-18	TH	DSP	A	41.88				0.6	0	0	0

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Radiocarbon Analysis

2013-09-18

Report for:

Christopher Johnston
Colorado State University
Department of Anthropology
Campus Delivery 1787
Fort Collins, CO 80523-1787

Aeon #	Sample	Material	Pretreat	Yield % C	$\delta^{13}C$ ‰	$F^{14}C$	±	^{14}C age Years BP	±
1583	5LR100.5518	bone	gelatin, ufilt	36.2	-12.1	0.9795	0.0030	165	25
1584	5LR100.5519	bone	gelatin, ufilt	28.7	-17.3	0.9643	0.0024	290	20

<u>additional analytical results for 5LR100.5518</u>

wt% carbon	%C	7.51
wt% nitrogen (nominal: >0.1 %)	%N	2.28
carbon-nitrogen ratio (nominal: <11.0)	C:N	3.84
residual gelatin yield (nominal: >0.5 %)	RGY (%)	13.0
wt% carbon, residual gelatin (nominal: 44.0 ± 4.7 %)	%C	43.37
wt% nitrogen, residual gelatin (nominal: 15.8 ± 1.9 %)	%N	16.31
carbon-nitrogen ratio, residual gelatin (nominal: 3.25 ± 0.19 %)	C:N	3.10

<u>additional analytical results for 5LR100.5519</u>

wt% carbon	%C	11.00
wt% nitrogen (nominal: >0.1 %)	%N	3.39
carbon-nitrogen ratio (nominal: <11.0)	C:N	3.78
residual gelatin yield (nominal: >0.5 %)	RGY (%)	14.0
wt% carbon, residual gelatin (nominal: 44.0 ± 4.7 %)	%C	44.02
wt% nitrogen, residual gelatin (nominal: 15.8 ± 1.9 %)	%N	15.99
carbon-nitrogen ratio, residual gelatin (nominal: 3.25 ± 0.19 %)	C:N	3.21

<u>Notes</u>

Item	Description
Aeon #	The unique identifier for each radiocarbon analysis performed by Aeon. Use this number for publication: e.g., “Aeon-137”
Sample	The customer-provided sample identifier.
Material	The type of material targeted for analysis. A sub-sample of this type is selected from the total material submitted to Aeon.
Pretreat	The chemical pretreatment protocol applied to the sub-sample. ABA = acid-base-acid; ABOX = acid-base-strong oxidation
Yield	The percentage of carbon in the sub-sample[1].
$\delta^{13}C$	The relative difference between the $^{13}C/^{12}C$ ratio of the test sample[2] and that of the VPDB standard, expressed in per mille.
$F^{14}C$	The ^{14}C activity ratio[3] (corrected for isotopic fractionation and background activity).
^{14}C age	The conventional radiocarbon age, normalized to -25‰, based on a 5568-year half-life.
±	The 1 uncertainty for the value to the left.

[1] the sub-sample is the pretreated representative selection from the total sample material submitted.
[2] the test sample consists of the carbon extracted from the sub-sample.
[3] relative to “Modern” as defined by the Oxalic Acid I standard.

<u>References</u>

Stuiver, M., Polach, H., 1977. Discussion: Reporting of 14C data. Radiocarbon 19 (3), 355-363.
van der Plicht, J., Hogg, A., 2006. A note on reporting radiocarbon. Quaternary Geochronology 1 (4), 237-240.

Aeon

Radiocarbon Dating Services

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Radiocarbon Analysis

2014-04-04

Report for:

Christopher Johnston
Colorado State University
Department of Anthropology
Campus Delivery 1787
Fort Collins, CO 80523-1787

Aeon #	Sample	Material	Pretreat	Yield %C	$\delta^{13}C$ ‰	$F^{14}C$	±	^{14}C age Years BP	±
1714	5LR100.5516	bone	gelatin	37.0	-14.6	0.9766	0.0027	190	25
1715	5LR100.5532	bone	gelatin	37.2	-11.4	0.9744	0.0032	210	25
1716	5LR100.7095	bone	gelatin	33.4	-12.1	0.9772	0.0029	185	25

Sample	before pretreatment			RGY	after pretreatment		
	%C	%N	C:N		%C	%N	C:N
5LR100.5516	10.58	3.52	3.51	13.0	43.68	16.12	3.16
5LR100.5532	12.30	4.21	3.41	11.1	44.60	16.38	3.18
5LR100.7095	14.11	4.49	3.66	13.9	43.83	16.03	3.19

Notes

Item	Description
Aeon #	The unique identifier for each radiocarbon analysis performed by Aeon. Use this number for publication: e.g., “Aeon-137”
Sample	The customer-provided sample identifier.
Material	The type of material targeted for analysis) A sub-sample of this type is selected from the total material submitted to Aeon.
Pretreat	The chemical pretreatment protocol applied to the sub-sample. ABA = acid-base-acid; ABOX = acid-base-strong oxidation
Yield	The percentage of carbon in the sub-sample[1])
δ13!	The relative difference between the $^{13}C/^{12}C$ ratio of the test sample? and that@of the VPDB standard, expressed in per mille.
$14!	The ^{14}C activity ratio?$@(corrected for isotopic fractionation and background activity).
^{14}C age	The conventional radiocarbon age, normalized to -25‰, based on a 5568-year half-life.
±	The 1σ uncertainty for the value to the left.

[1] the sub-sample is the pretreated representative selection from the total sample material submitted.
? the test @sample consists of the carbon extracted from the sub-sample.
?$@relative to “Modern” as defined by the Oxalic Acid I standard.

References

Stuiver, M., Polach, H., 1977. Discussion: Reporting of 14C data. Radiocarbon 19 (3), 355-363.
van der Plicht, J., Hogg, A., 2006. A note on reporting radiocarbon. Quaternary Geochronology 1 (4), 237-240.