Archaeology of the Upper Crossing Stone Enclosures, Saguache County, Colorado

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by

Mark D. Mitchell and Carl R. Falk

Prepared by
Paleocultural Research Group
P. O. Box 745309, Arvada, Colorado 80006

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Abstract

Upper Crossing is a multi-component archaeological locality covering 11.1 ha (27.4 acres) in western Saguache County, Colorado. The site's features and buried cultural deposits preserve a robust record of the American Indian occupation of the San Luis Valley that spans more than four millennia. However, the site's most conspicuous features are 30 stone enclosures dating to the early Late Prehistoric. The enclosures occur in two discrete groups, the larger of which—designated Cluster 1—was the focus of the research project described in this report.

Stone enclosure sites are scattered throughout a broad swath of Colorado and New Mexico, from the Cimarron River valley in northeastern New Mexico, through the Arkansas River basin in southeastern Colorado and the Rio Grande basin in south-central Colorado, to the Uncompahgre Plateau in western Colorado. However, the concentration of enclosure sites in the Saguache Creek valley is among the largest, rivaled only by site concentrations located on the major southern tributaries of the Arkansas River. Unlike those southeastern Colorado sites, little is known about the precise age or function of the Saguache Creek sites or about their role in regional settlement systems. This project aimed for a better of understanding of when the Upper Crossing structures were occupied and how they were built and used.

The project was a collaborative effort undertaken by Paleocultural Research Group (PCRG), the Bureau of Land Management (BLM), the Rio Grande National Forest, and the University of Colorado (CU). A total of 23 individuals participated in the field investigation, including PCRG staff and volunteers, CU graduate and undergraduate students, BLM archaeologists, and Forest Service archaeologists and interns.

The investigation focused on four of the 20 stone enclosures comprising Cluster 1. A variety of criteria were used to select enclosures for investigation, including the depth and richness of interior cultural deposits, the integrity of the enclosure's foundation, and surface-visible variation in construction techniques. The crew excavated a total of 10.5 m^2, which yielded a total of 1,680 liters (1.68 m^3) of screened sediment. The resulting collection includes 3,577 lithic flakes, 391 stone tool technological cases, 1,513 pieces of animal bone, four modified bone specimens, and three ceramic sherds.

A suite of nine radiocarbon dates, combined with data on 42 projectile points, provide a chronological framework for the analysis. Two primary components occur in Cluster 1: a Late Archaic component that dates to the early first millennium B.C., and a Late Prehistoric component that dates to the late sixth and seventh centuries A.D. Three of the four sampled stone enclosures are directly associated with early Late Prehistoric radiocarbon dates; the fourth is not directly dated, but stratigraphic and other data indicate that it too dates to the early Late Prehistoric.

Although the project was designed to investigate Upper Crossing's stone enclosures, stratigraphic and other data clearly—and unexpectedly—revealed the presence of basin houses at the site. Data on the layout and construction of Upper Crossing's stone enclosures permit a detailed reconstruction of their superstructures. Regional comparative data reveal no clear analogs for the stone structures at Upper Crossing, suggesting that they were built by a local San Luis Valley-based hunting and gathering group.

Analyses of stone tools, flaking debris, and faunal remains indicate that both the Late Archaic and early Late Prehistoric components at Upper Crossing represent residential base camps. Assemblage data, in combination with topographic and other data, indicate that Upper Crossing's stone enclosures were occupied during the cold-season. Similarities between the Late Archaic and early Late Prehistoric components point to long-term adaptive continuity spanning more than a millennium. Project data also point to the short-term adaptive decision making by San Luis Valley hunter-gatherers.

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Acknowledgements

PCRG began collaborative archaeological research projects at the Upper Crossing site in 2009. From the beginning, Rio Grande National Forest Heritage Program Manager Angie Krall has been the driving force behind the work. Thanks to Angie's vision and tenacity, we know a great deal more about San Luis Valley archaeology than we did eight years ago.

Many people contributed to the success of the 2014 field investigation. PCRG Project Archaeologist Chris Johnston served as assistant field director. Bureau of Land Management Archaeologist Brian Fredericks provided critical logistical support and helped supervise the field crew. Additional support and supervision was provided by Forest Service Archaeologist Marcy Reiser. Dr. Douglas Bamforth generously loaned a portion of his University of Colorado archaeology field school to the project, including his outstanding teaching assistants Jen Deats and Lindsay Johansson. Numerous PCRG members, including both professional archaeologists and enthusiastic avocationals, participated in the fieldwork.

Adam Wiewel, a PCRG member and National Park Service Archaeologist, generously performed the photogrammetric analysis. University of Colorado student lab assistants Shelby Magee and Sebastian Wetherbee processed the excavated collections. Magee also coded the flaking debris assemblage. Johnston supervised the lab work, helped create the project GIS, and offered thoughtful suggestions and comments on the analysis. He also provided invaluable feedback on a draft of this report, as did State Historical Fund Archaeological Specialist Katherine Arntzen. Mitch and Reba Hermann generously provided two UAV platforms for aerial mapping and videography. Greg Harlin, of Wood, Ronsaville, Harlin, Inc., created the illustration of the Late Prehistoric occupation at the site. Cody Perry and Ben Saheb, of Rig To Flip, created the project video, "People of the High Mountain Valley: Native American Pathways and Place."

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About the Authors

Mark D. Mitchell is Research Director for Paleocultural Research Group. Previously, he worked for several cultural resource management firms and for the USDA Forest Service in Colorado, Wyoming, and Kansas. Mitchell's research interests center on the archaeology of the northern Great Plains, with an emphasis on the farming villages of the Middle Missouri. He also studies upland land use in the Southern Rockies, Plains Indian rock art, the anthropology of technology, and the history of archaeology. His research has appeared in *Plains Anthropologist*, *Antiquity*, *American Antiquity*, *Southwestern Lore*, *Colorado Archaeology, Quaternary International,* and in a number of book chapters. He is the author of *Crafting History in the Northern Plains: A Political Economy of the Heart River Region, 1400-1750* (University of Arizona Press, 2013) and co-editor of *Across A Great Divide: Continuity and Change in Native North American Societies, 1400-1900* (University of Arizona Press, 2010).

Carl R. Falk is a consulting archaeologist. Formerly with the National Park Service's Midwest Archeological Center and the Department of Anthropology, University of Nebraska-Lincoln, Falk is a co-founder of Paleocultural Research Group. He has over 50 years of professional experience with a primary interest in the North American Great Plains and specialization in the archaeology and zooarchaeology of Late Prehistoric period village horticulturalists living within the Middle Missouri and Central Plains subareas. He has authored and co-authored numerous articles and technical reports, as well as papers presented at national and international conferences.

1

Introduction

Mark D. Mitchell

Upper Crossing is a multi-component archaeological locality that encompasses 11.1 ha (27.4 acres) in western Saguache County, Colorado, near the confluence of Saguache and Sheep creeks (figures 1.1 and 1.2). The site preserves a unique record of American Indian use of the San Luis Valley spanning more than four millennia (Mitchell 2012a). The oldest documented cultural deposits are a complex sequence of superimposed hearth features representing multiple, short-term hunting camps dating to the Middle Archaic. Those deposits are capped locally by at least one basin house dating to the Late Archaic. This structure was occupied for an extended period, and possibly repeatedly, judging by the high density and diversity of associated artifacts and faunal remains. Extensive, but so far unexplored, cultural deposits likely representing additional Archaic-stage occupations also occur at the site.

Intensive use of Upper Crossing continued in the first millennium A.D. The Late Prehistoric component is represented by at least 30 stone enclosures grouped into two clusters. Diagnostic artifacts recovered from subsurface contexts within the larger of the two clusters suggest that the enclosures date to between 500 and 1000. Like the preceding Late Archaic occupation, the Late Prehistoric occupation was a seasonal residential base camp.

American Indian groups continued using Upper Crossing after 1000, but less frequently and less intensively. Taos Plain and Taos Incised pottery vessel fragments recovered from near-surface contexts point to brief occupations by ancestral Puebloan groups between 1100 and 1400. Micaceous pottery recovered from the surface may represent intermittent use by Jicarilla or Pueblo people in the eighteenth or nineteenth centuries. A large grove of culturally modified ponderosa pine trees, along with three possible eagle-trapping pits, attests to

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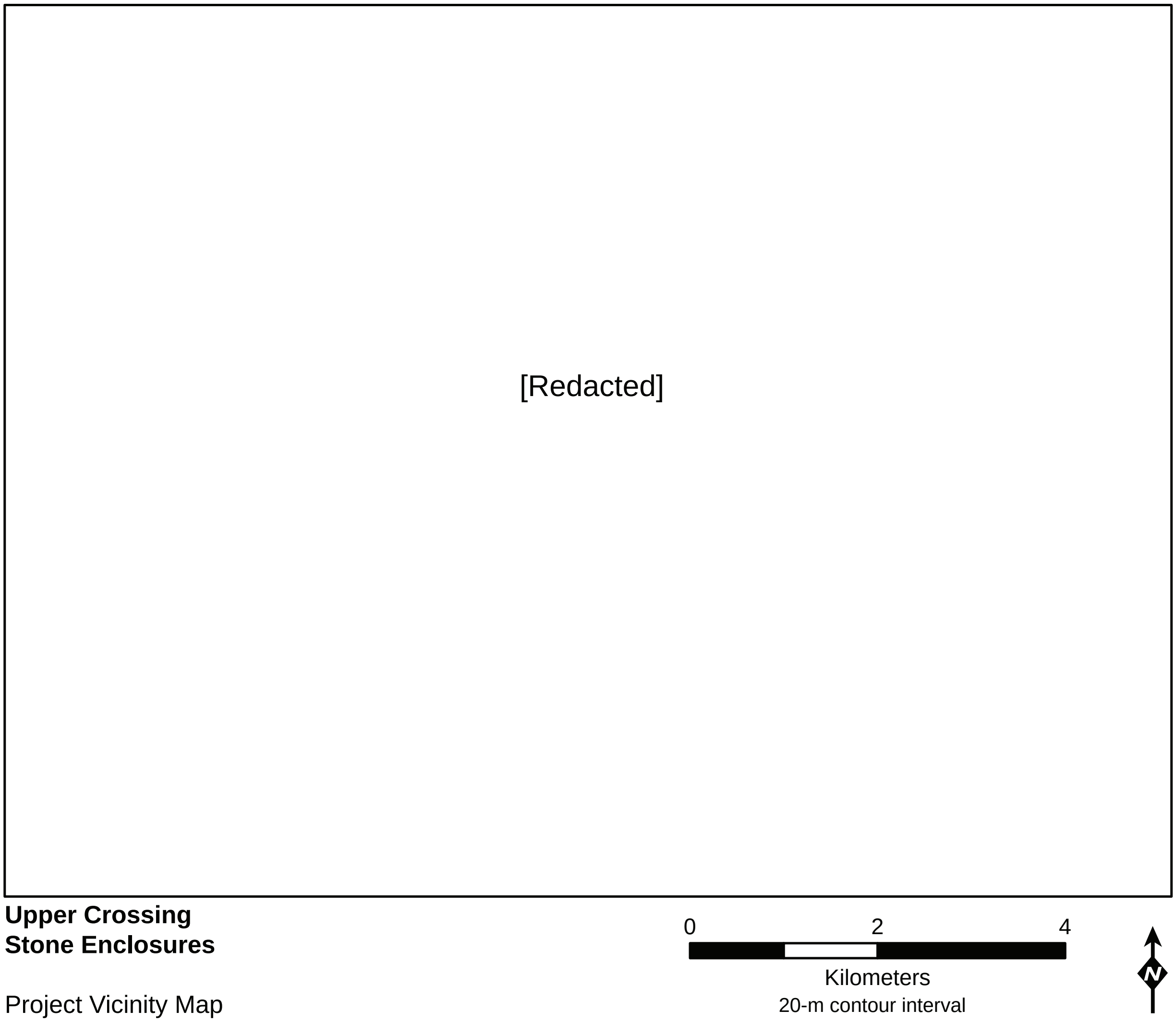

Figure 1.1. Topographic map of the Saguache Creek valley showing the location of the Upper Crossing site.

brief visits made by Utes or other native peoples in the 1700s and 1800s.

The most recent occupation is represented by the existing federal guard station, which was built about 1920. The site was first used as an administrative facility in 1908, when it was the supervisor's office for the Cochetopa Forest Reserve. Upper Crossing became part of the Rio Grande National Forest in 1944, but was transferred two years later to the newly formed Bureau of Land Management.

Project Overview

This report describes the results of a field investigation and subsequent laboratory analyses designed to learn more about Upper Crossing's Late Prehistoric stone enclosures. Enclosure sites occur throughout a broad arc extending from the Cimarron River valley in northeastern New Mexico to the Uncompahgre Plateau in western Colorado, but the cluster of sites in the Saguache Creek valley is among the largest, rivaled only by site clusters on the southern tributaries of the Arkansas River. However, unlike those southeastern Colorado sites, little is known about the precise age or function of the Saguache Creek enclosure sites or about their role in regional settlement systems. This project aims for a better of understanding of when the Upper Crossing structures were occupied and how they were built and used.

The 2014 field investigation was a cooperative effort carried out by Paleocultural Research Group (PCRG), the Bureau of Land Management (BLM),

[Redacted]

Figure 1.2. Photograph of the Upper Crossing site; view to the north.

the Rio Grande National Forest, and the University of Colorado (CU). Funding for the project was provided in part by a History Colorado - State Historical Fund grant awarded to PCRG (No. 2014-M2-005). Additional funding was provided by the BLM and CU.

History of Research

Iconic Colorado archaeologist Etienne B. Renaud (1935) was the first to document the archaeology of the Saguache Creek valley. Renaud described the Upper Crossing site, which he designated site C262, as a campsite and rockshelter. He reported 14 additional sites upstream along Saguache Creek between Upper Crossing and the Stone Cellar Ranger Station, a distance of about 26 km (Renaud 1935:7). At two of those upper valley sites he observed pottery and at several others he noted the presence of "stone fences," which he interpreted as hunting features. Renaud tallied nine more sites downstream in the 33-km middle and lower valley sections between Upper Crossing and the town of Saguache. He described two of those nine sites as rockshelters.

The Upper Crossing site was formally recorded in 1977 as 5SH73 by U.S. Forest Service archaeologists, who described it as a scatter of chipped and ground stone tools, pottery, burned rock, and faunal remains covering about 0.9 ha (2.2 acres). They documented three rockshelters, one stone enclosure, one culturally modified tree, and three dense concentrations of artifacts. They tallied 611 modified stone artifacts on the surface and collected an additional 89 artifacts, 88 of which remain in the site collection. They also collected at least 34 pieces of pottery from the slope adjacent to the stone enclosure and at least 11 more sherds, along with a piece of unmodified animal bone, from the largest of the three rockshelters.

BLM archaeologists revisited Upper Crossing in 1987. Because the original site form for 5SH73 was not available at the time, they re-recorded the site as 5SH134 and retired the previous number. They relocated the largest of the rockshelters documented by the Forest Service crew but did not observe any of the other features identified in 1977. They did not map the site, but the re-evaluation form they produced indicates that the artifacts and features they observed covered roughly 0.5 ha (1.2 acres). They reported that artifacts had been removed from the surface and judged the site to be ineligible for inclusion on the National Register of Historic Places (NRHP).

In 1994, the Forest Service commissioned archaeologists from the National Park Service's Midwest Archeological Center to document and evaluate historic administrative structures on the Rio Grande National Forest, including the Upper Saguache Guard Station, located some 200 m west of the original boundary of 5SH134 (Hartley and Schneck 1996). The guard station, originally recorded as 5SH1469, is now incorporated into the Upper Crossing site (Mitchell 2012a).

Forest Service archaeologists returned to Upper Crossing in 1999 to carry out a limited testing project. They also surveyed a portion of the structural bench west of the original western site boundary, in the process identifying six stone enclosures. In cooperation with the San Luis Valley Archaeology Network, they opened two 1 x 1-m excavation units and one 0.5 x 1-m unit, each located inside one of the six enclosures they mapped. This work documented the presence of intact subsurface cultural deposits containing abundant artifacts, burned rock, and animal bones. Mitchell (2012a) describes the results of their work.

In 2000, the Rio Grande National Forest and the Colorado College (CC) began cooperative investigations at Upper Crossing. That effort, directed by Michael Nowak, focused on mapping the stone enclosures first identified in 1999. The CC crew identified a total of 16 structures and, during a 2001 field investigation, drew large-scale maps of each as well as a smaller-scale sketch map showing the relationships among them. No artifacts were collected during their investigations and a report describing the work was not completed.

Nowak and his students returned to the site in the fall of 2003, this time to document enclosures located on a promontory some 65 m above the previously documented enclosures. They identified 17 structures on the promontory, which they designated 5SH73H, 16 of which they mapped. Nowak and Crocket (2003) summarizes their methods and findings.

PCRG and the BLM began long-term research at Upper Crossing in 2009 with a pedestrian survey to define the site's boundary and an intensive mapping project that documented 29 stone enclosures and two possible enclosures (Mitchell 2012a). The 2009 field effort also included limited testing of the site's Archaic-stage cultural deposits and initial documentation of a sample of the site's culturally modified trees.

Environmental Context

The following sections discuss aspects of the modern effective environment, including climate and available faunal, floral, and stone resources. The discussion then turns to the region's recent historic and ancient climates.

Effective Environment

Saguache Creek rises on the north slope of the La Garita Mountains, east of the Continental Divide. It flows in a narrow valley north and east to a confluence with Fourmile Creek, where it enters a broad, alluvium-filled valley. It terminates in the northern end of the San Luis Valley, the largest of the intermontane basins comprising the Rio Grande Rift, a tectonic depression extending from central Colorado into the state of Chihuahua, Mexico (McCalpin 1996). Most of the San Luis Valley is drained by the Rio Grande, but Saguache Creek is not connected to the Rio Grande watershed. Instead, Saguache Creek braids out as it enters the valley, eventually disappearing into seasonal wetlands and unconsolidated Quaternary deposits.

The Saguache Creek valley can be partitioned into three sections (figures 1.3 and 1.4). Upper Saguache Creek includes the montane section of the valley, above the mouth of Fourmile Creek. Middle Saguache Creek, where the Upper Crossing site is located, runs from Fourmile Creek downstream to the mouth of Ford Creek. This section corresponds roughly to the Middle Saguache watershed, a fifth-level U.S. Geological Survey hydrologic unit (1301000405) (San Luis Valley Public Lands Center 2009:2). Lower Saguache Creek includes the wide valley section from Ford Creek to the eastern terminus of the stream on the floor of the San Luis Valley.

Climate

Each valley section supports a distinctive ecological community, owing to elevation- and topography-dependent differences in temperature and precipitation. Unfortunately, only limited weather station data are available for the region (table 1.1). At the town of Saguache, located in the lower valley section, mean maximum temperature during January is 35.5°F and mean minimum temperature is 4.1°F. (Western Regional Climate Center 2015). Mean July temperatures range from a maximum of 81.1°F to a minimum of 47.6°F. Snowfall is spread evenly during the winter and early spring months (December through April), but 40 percent of the annual precipitation falls in July and August.

Instrumental temperature and precipitation data are not available for the middle and upper valley sections. However, upper valley conditions may be approximated by data from the Cochetopa Creek weather station, located on the west side of the Continental Divide south of Parlin, Colorado at an elevation of 2438 m (8000 ft). January temperatures there range from a mean maximum of 28.0°F to a mean minimum of -5.2°F (Western Regional Climate Center 2015). July temperatures range from 81.1°F to 42.6°F. Mean annual precipitation is just 10.98 in (28 cm), although

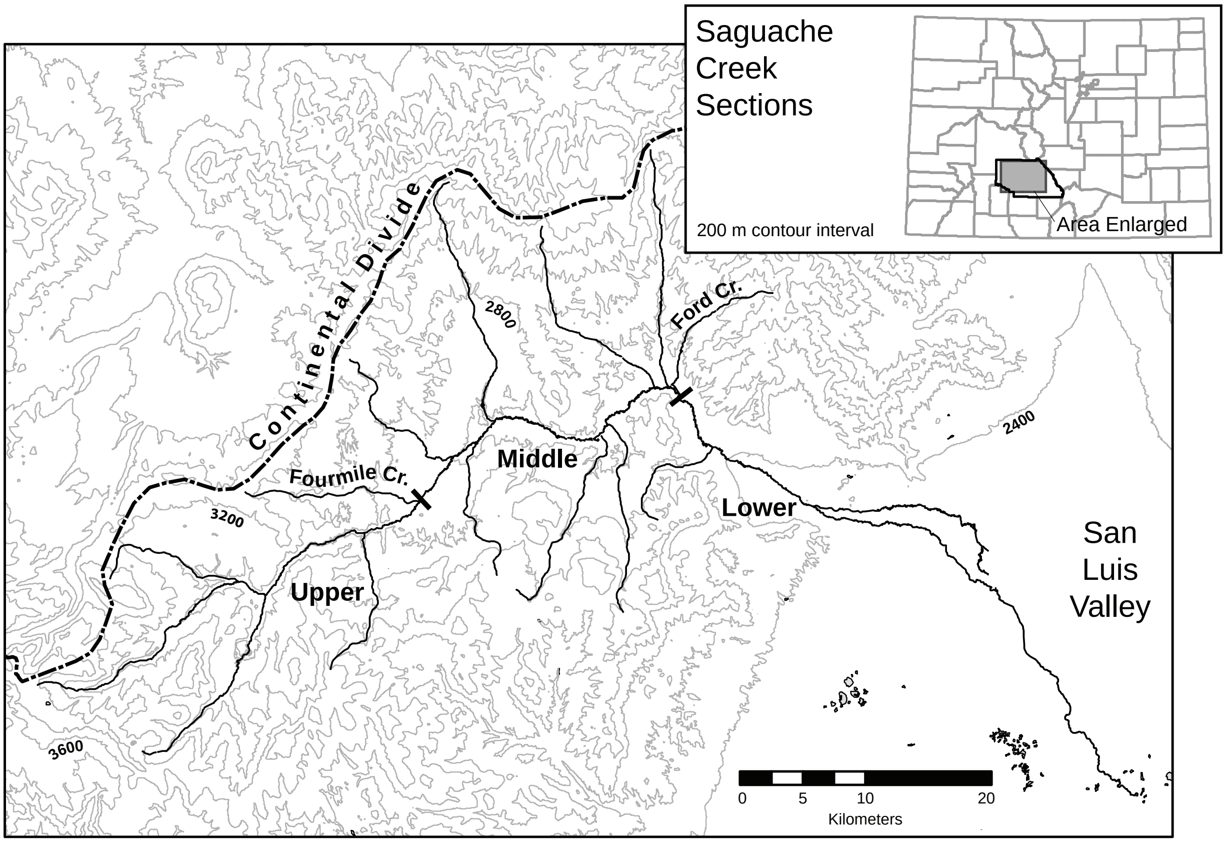

Figure 1.3. Topographic map showing the sections of the Saguache Creek valley.

Table 1.1. Climate records for three weather stations near the Upper Crossing site (Western Regional Climate Center 2015).

	Weather Station		
Variable	Saguache (057337)	Alamosa (050130)	Cochetopa Creek (051713)
Period of Record	1894-2009	1948-2013	1909-2015
Elevation (m)	2368	2298	2438
Mean Annual Max. Temperature (°F/°C)	59.3/15.2	59.4/15.2	55.8/13.2
Mean Annual Min. Temperature (°F/°C)	26.4/-3.1	23.7/-4.6	20.0/-6.7
Mean Annual Total Precipitation (in./cm)	8.27/21.0	7.05/17.9	10.98/27.9
Mean Annual Total Snow Fall (in./cm)	23.5/59.7	31.2/79.2	50.3/127.8

snowfall amounts to 50.3 in (127.8 cm). Estimated precipitation in the middle valley section varies between about 10 in (25.4 cm) at lower elevations and 20 in (50.8 cm) at higher elevations (Colorado Division of Water Resources 2011; San Luis Valley Public Lands Center 2009:24). Precipitation at the highest elevations of the upper valley reaches 30 in (76.2 cm), with snowfall accounting for over half of the annual total. Peak stream flow occurs in the spring when the winter snowpack is melting; minimum stream flow occurs in the fall.

Total annual precipitation accumulation is lower on Cochetopa Pass, located 12 km northwest of Upper Crossing, than elsewhere in the eastern San Juan Mountains and adjacent ranges (NRCS National Water and Climate Center 2015). Table 1.2 lists mean water-year precipitation accumulation values for 13 SNOTEL (Snowpack Telemetry) sites, normalized for elevation. The sites are listed by latitude, with the northernmost at the top of the list. The Park Cone station is approximately 75 km north of Upper Crossing, while the Hopewell station is approximately 160 km south.

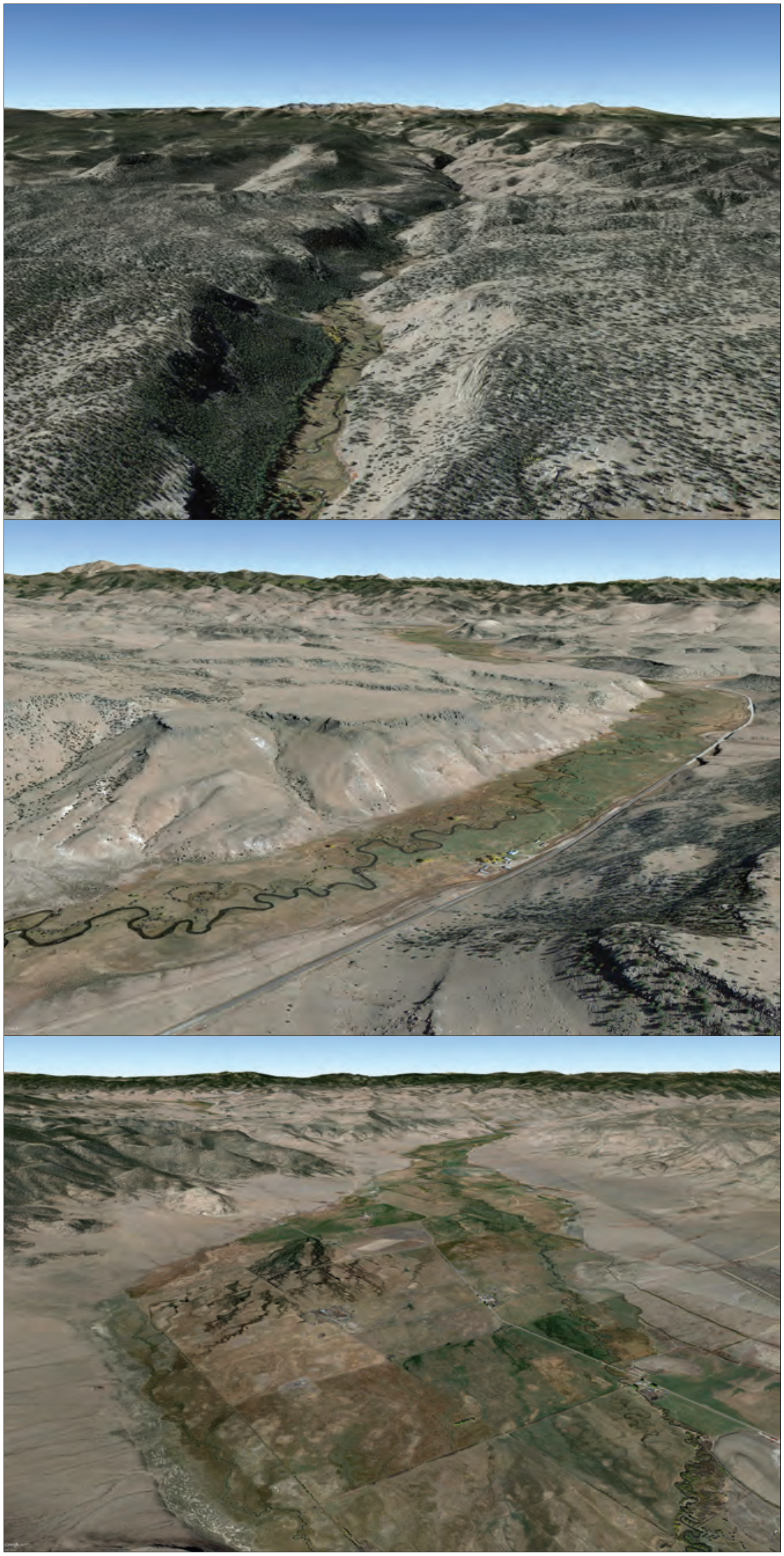

Figure 1.4. Google Earth images of the three sections of the Saguache Creek Valley. Top: upper valley section looking upstream; center: middle valley section looking downstream; bottom: lower valley section looking upstream.

Table 1.2. Precipitation accumulation data for 13 SNOTEL sites in a north-south transect through the eastern San Juan Mountains (NRCS National Water and Climate Center 2015). Park Cone is the northernmost site and Hopewell is the southernmost.

Site	Mean Water-Year Accumulation (cm)	Elevation (m)	Normalized Mean Accumulation (cm/1000 m)	Length of Record (years)[a]
Park Cone	54.1	2926	18.5	30
Saint Elmo	62.7	3213	19.5	7
Porphyry Creek	69.6	3280	21.2	30
Sargents Mesa	62.5	3514	17.8	8
Cochetopa Pass	43.9	3054	14.4	11
Moon Pass	49.5	3395	14.6	5
Grayback	84.1	3542	23.7	10
Upper San Juan	134.6	3109	43.3	30
Wolf Creek Summit	127.3	3353	38.0	25
Lily Pond	83.8	3353	25.0	30
Cumbres Trestle	101.6	3060	33.2	30
San Antonio Sink	50.0	2774	18.0	4
Hopewell	79.0	3048	25.9	30

[a] 30-year values represent climatic and hydrologic normals for 1981-2010.

The normalized value for Cochetopa pass is the lowest among all 13 stations.

Flora and Fauna

The Saguache Creek valley is located in the Southern Parks and Rocky Mountain Range section (M331F) of the Southern Rocky Mountain Steppe-Open Woodland-Coniferous Forest-Alpine Meadow province (M331) (Bailey *et al*. 1994; McNab *et al*. 2005). The forest blanketing the upper valley, as well as the higher elevation portions of the middle and lower valley sections, is a southwest mixed conifer association, with Douglas fir and ponderosa pine dominant. However, stand composition varies and can include a mixture of other species such as aspen, spruce, limber pine, bristlecone pine, piñon, and juniper (San Luis Valley Public Lands Center 2009:29). Associated shrubby vegetation includes mountain mahogany, rabbitbrush, currant, skunkbush, serviceberry, and fringed sage.

Open, treeless portions of the valley are dominated by grasses and forbs with a minor component of woody species, such as sagebrush and snowberry (*Symphoricarpos albus*). Grasses include Idaho fescue (*Festuca idahoensis*), Arizona fescue (*Festuca arizonica*), slender wheatgrass (*Elymus trachycalulus*), bearded wheatgrass (*Elymus canimus*), native bluegrasses (*Poa* spp.), nodding brome (*Bromus anomalus*), mountain brome (*Bromus marginatus*), Letterman's needlegrass (*Achnatherum lettermanii*), pine needlegrass (*Achnatherum pinetorum*), Mountain muhly (*Muhlenbergia montana*), and Parry oatgrass (*Dathonia paryii*). Forb species include lupine, geranium (*Geranium* spp.), groundsel (*Packera streptanthifolia*), and bluebells (*Mertensia* spp.) (San Luis Valley Public Lands Center 2009:12).

The lower slopes and riparian zones of the middle valley support grasses such as Arizona fescue, Idaho fescue, western wheatgrass, and squirreltail, as well as sedges and rushes (*Juncus* spp.). Other grasses include mutton bluegrass (*Poa fendleriana*), other native bluegrasses, needle-and-thread, Indian ricegrass, mountain muhly, Junegrass (*Koeleria* spp.), blue grama, slimstem muhly, and three-awn. Forbs include phlox, mat penstemon (*Penstmon caespitosus*), buckwheat (*Eriogomum* spp.), pussytoes (*Antennaria* spp.), yarrow (*Achillea lamulosa*), aster (*Aster* spp.), daisy (*Chrysanthemum* sp.), and geranium. Shrubby vegetation includes fringed sage, squawbush, big sagebrush, smooth horsebrush (*Tetradymia* spp.), yucca, four-wing saltbrush, and shrubby potentella (*Pentafoloides floribunda*) (San Luis Valley Public Lands Center 2009:12). Lyons (1993) provides a list of plant species available at around 3050 m (10,000 ft) on the west side of the Continental Divide, some 25 km west of the middle Saguache Creek valley. Comestible species currently available in and near Great Sand Dunes National Park and Preserve (GRSA), located some 85 km to the southwest, are listed in table 1.3. Table 1.4 presents a roster of edible plant macrofossils recovered from archaeological contexts in the Gunnison River basin to the northwest.

Table 1.5 lists animal species currently present for all or part of the year in Saguache County. Table 1.6 lists faunal remains recovered from archaeological sites in the Gunnison River valley. Additional data on Saguache

Table 1.3. Edible plants available in the GRSA (adapted from Beuthel [2005], Bevilacqua and Dominguez [2011], Cummings *et al.* [2009], and Machette and Puseman [2007]).

Taxon	Common Name	Occurrence[a]
Asteraceae	Sunflower Family	X
Helianthus sp	Sunflower	
Brassicaceae	Mustard Family	X
Descurainia sp.	Tansy Mustard	
Cactaceae	Cactus Family	X
Echinocereus sp.	Hedgehog Cactus	X
Opuntia sp.	Prickly Pear	
Cheno-Ams	-	X
Amaranthus sp.	Pigweed	X
Atriplex sp.	Saltbush	X
Chenopodium sp.	Goosefoot	X
Monolepis sp.	Poverty Weed	
Sarcobatus sp.	Greasewood	
Cyperaceae	Sedge Family	
Scirpus sp.	Bulrush	X
Poaceae	Grass Family	X
Achnatherum hymenoides	Indian Rice Grass	X
Elymus sp.	Wild Rye	
Hordeum sp.	Barley	
Sporobolus sp.	Dropseed	X
Allium sp.	Onion	
Amelanchier sp.	Serviceberry	
Arctostaphylos sp.	Kinnickinnick	
Artemisia sp.	Sagebrush	X
Asclepias sp.	Milkweed	
Calochortus sp.	Mariposa Lily	
Campanula sp.	Harebell	
Chamerion sp.	Fireweed	X
Cirsium sp.	Thistle	
Claytonia sp.	Springbeauty	
Cleome sp.	Beeplant	
Crataegus sp.	Hawthorn	
Cymopterus sp.	Stemless Cymopterus	
Epilobium sp.	Willowherb	
Eriogonum sp.	Buckwheat	
Fragaria sp.	Strawberry	
Juniperus sp.	Juniper	X
Lactuca sp.	Lettuce	
Lappula sp.	Stickseed	
Linum sp.	Flax	
Mahonia sp.	Oregon Grape	
Oxyria sp.	Sorrel	X
Pinus edulis	Piñon Pine	X
Piptatherum sp.	Littleseed Ricegrass	
Plantago sp.	Plantain	
Polygonum amphibium	Knotweed	
Polygonum bistortoides	American Bistort	
Portulaca sp.	Purslane	X
Prunus sp.	Chokecherry	
Psoralidium sp.	Scurf Pea	
Rhus sp.	Skunkbush	X
Ribes sp.	Currant	
Rosa sp.	Rose	
Rubus sp.	Raspberry	
Rumex sp.	Golden Dock	
Schoenoplectus sp.	Tule	
Maianthemum racemosum	False Solomon's Seal	
Sphaeralcea sp.	Globemallow	
Typha sp.	Cattail	
Vaccinium sp.	Bilberry	
Yucca glauca	Soapweed Yucca	

[a] Occurrence of charred macrofloral remains recovered from archaeological contexts (Beuthel [2005]; Cummings *et al.* [2009]; Machette and Puseman [2007]).

Table 1.4. Charred seeds recovered from archaeological contexts in the Gunnison River basin (data from Stiger 2001:Table 5.1).

Common Species Name	Taxon
Pinon pine	*Pinus edulis*
Juniper	*Juniperus* sp.
Hedgehog cactus	*Echinocereus* sp.
Prickly Pear cactus	*Opuntia* sp.
Goosefoot	*Chenopodium* sp.
Rose family (Serviceberry?)	Rosaceae
Skunkbush	*Rhus* sp.
Ground Cherry	*Physalis* sp.

Creek archaeofauna are presented in chapter 5. The wetland areas in the San Luis Valley, including along Saguache Creek, provide seasonal habitat for migratory waterfowl, not all of which are listed in table 1.5 but which could have been an important food resource in the past. Four native ungulate species occur today in the Saguache Creek valley. Bighorn sheep, a species reintroduced following historic extirpation, occupy the rocky habitat of the Trickle Mountain area. Pronghorn inhabit the lower elevations, in the grasslands and piñon-juniper hill country. Mule deer use the area year round and elk frequently occupy the region based on available food and habitat resources (San Luis Valley Public Lands Center 2009:16). Although bison no longer occur in this area, multiple lines of evidence attest to their abundance in the past.

Figure 1.5 illustrates modern mule deer winter ranges in the Saguache Creek valley and adjacent areas of the San Luis Valley. Two range types are shown: winter concentration areas and severe winter range.

Table 1.5. Selected mammal species currently present in Saguache County (Natural Diversity Information Source 2011).

Common Species Name	Taxon	Abundance
Abert's Squirrel	*Sciurus aberti*	Fairly Common
American Badger	*Taxidea taxus*	Common
American Beaver	*Castor canadensis*	Fairly Common
American Elk	*Cervus elaphus*	Abundant
American Marten	*Martes americana*	Fairly Common
American Pika	*Ochotona princeps*	Common
Bighorn Sheep	*Ovis canadensis*	Common
Bison	*Bison bison*	Extirpated
Black Bear	*Ursus americanus*	Common
Black-tailed Jackrabbit	*Lepus californicus*	Uncommon
Bobcat	*Lynx rufus*	Common
Bushy-tailed Woodrat	*Neotoma cinerea*	Fairly Common
Colorado Chipmunk	*Tamias quadrivittatus*	Fairly Common
Common Muskrat	*Ondatra zibethicus*	Common
Common Porcupine	*Erethizon dorsatum*	Uncommon
Coyote	*Canis latrans*	Common
Deer Mouse	*Peromyscus maniculatus*	Abundant
Desert Cottontail	*Sylvilagus audubonii*	Abundant
Golden-mantled Ground Squirrel	*Spermophilus lateralis*	Fairly Common
Gray Fox	*Urocyon cinereoargenteus*	Rare
Gunnison's Prairie Dog	*Cynomys gunnisoni*	Fairly Common
House Mouse	*Mus musculus*	Abundant
Least Chipmunk	*Tamias minimus*	Common
Long-tailed Vole	*Microtus longicaudus*	Fairly Common
Long-tailed Weasel	*Mustela frenata*	Fairly Common
Masked Shrew	*Sorex cinereus*	Fairly Common
Meadow Vole	*Microtus pennsylvanicus*	Common
Mink	*Mustela vison*	Uncommon
Montane Shrew	*Sorex monticolus*	Common
Montane Vole	*Microtus montanus*	Common
Moose	*Alces alces*	Uncommon
Mountain Cottontail	*Sylvilagus nuttallii*	Fairly Common
Mountain Goat	*Oreamnos americanus*	Casual/Accidental
Mountain Lion	*Felis concolor*	Common
Mule Deer	*Odocoileus hemionus*	Common
Northern Grasshopper Mouse	*Onychomys leucogaster*	Fairly Common
Northern Pocket Gopher	*Thomomys talpoides*	Common
Ord's Kangaroo Rat	*Dipodomys ordii*	Abundant
Pine Squirrel	*Tamiasciurus hudsonicus*	Fairly Common
Plains Pocket Mouse	*Perognathus flavescens*	Fairly Common
Pronghorn	*Antilocapra americana*	Abundant
Raccoon	*Procyon lotor*	Fairly Common
Red Fox	*Vulpes vulpes*	Common
Silky Pocket Mouse	*Perognathus flavus*	Fairly Common
Snowshoe Hare	*Lepus americanus*	Common
Southern Red-backed Vole	*Clethrionomys gapperi*	Fairly Common
Striped Skunk	*Mephitis mephitis*	Common
Thirteen-lined Ground Squirrel	*Spermophilus tridecemlineatus*	Common
Water Shrew	*Sorex palustris*	Uncommon
Western Harvest Mouse	*Reithrodontomys megalotis*	Fairly Common
Western Jumping Mouse	*Zapus princeps*	Fairly Common

Table 1.5 (continued). Selected mammal species currently present in Saguache County (Natural Diversity Information Source 2011)

Common Species Name	Taxon	Abundance
Western Spotted Skunk	*Spilogale gracilis*	Rare
White-tailed Jackrabbit	*Lepus townsendii*	Common
Wyoming Ground Squirrel	*Spermophilus elegans*	Common
Yellow-bellied Marmot	*Marmota flaviventris*	Common

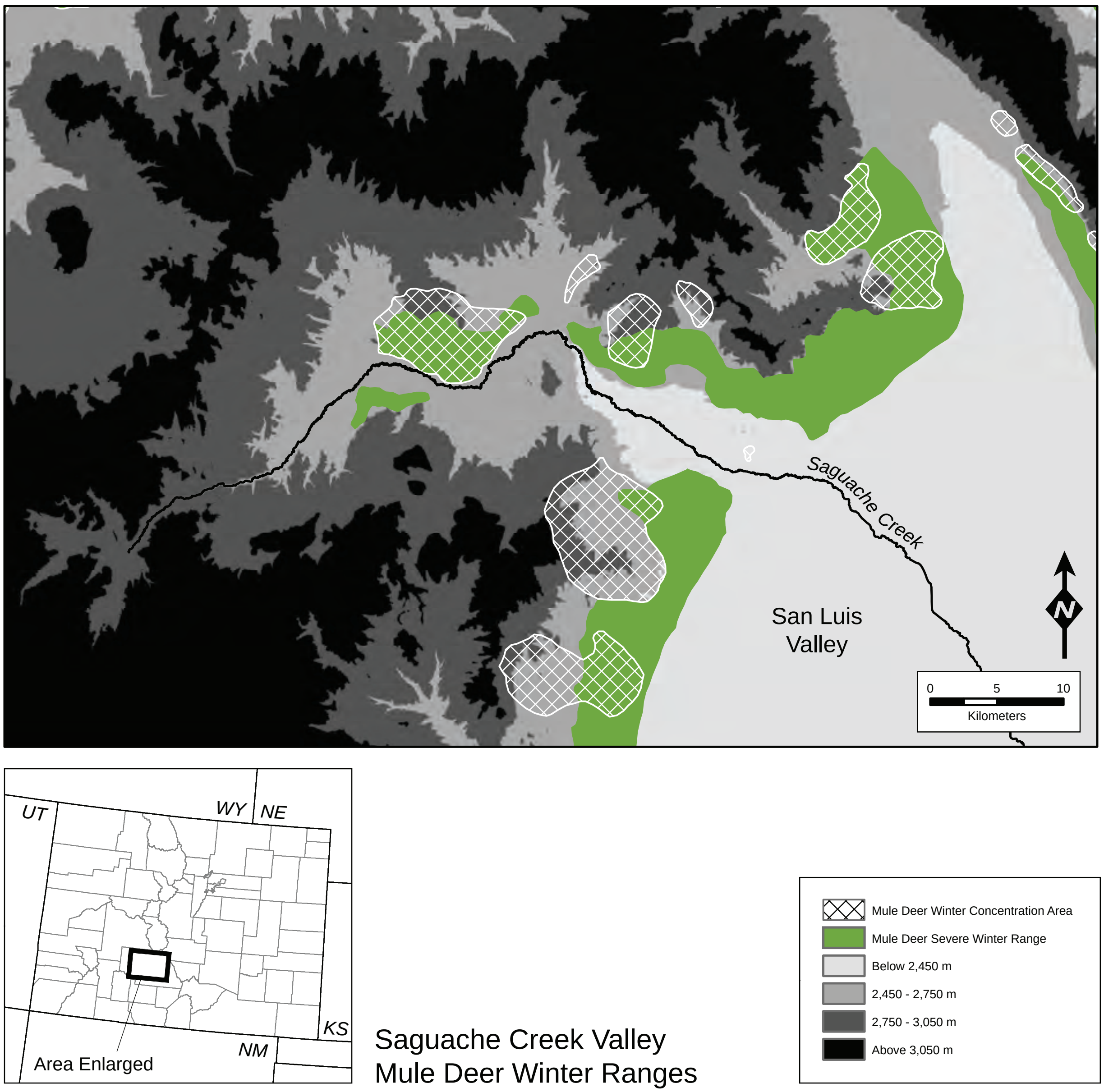

Figure 1.5. Map showing the locations of mule deer winter concentration areas and mule deer severe winter range within and adjacent to the Saguache Creek valley.

Table 1.6. Mammal species recovered from archaeological contexts in the Gunnison River basin (data from Rood and Stiger 2001:Table 4.1).

Common Species Name	Taxon
Cottontail	*Sylvilagus* sp.
Jackrabbit or hare	*Lepus* sp.
Chipmunk	*Neotamias* sp.
Marmot	*Marmota* sp.
Ground Squirrel	*Spermophilus* sp.
Prairie Dog	*Cynomys* sp.
Pocket Gopher	*Thomomys* sp.
American Beaver	*Castor canadensis*
Mouse	*Peromyscus* sp.
Woodrat	*Neotoma* sp.
Vole	*Microtus* sp.
Canid	*Canis* sp.
Bear	*Ursus* sp.
American Badger	*Taxidea taxus*
Elk	*Cervus canadensis*
Mule Deer	*Odocoileus hemionus*
Pronghorn	*Antilocapra americana*
American Bison	*Bison bison*
Bighorn Sheep	*Ovis canadensis*

Winter concentration areas represent "that part of the winter range where densities are at least 200 percent greater than the surrounding winter range density during the average five winters out of ten from the first heavy snowfall to spring green-up" (Data Basin 2015). Severe winter range areas represent "that part of the winter range where 90 percent of the individuals are located when the annual snowpack is at its maximum and/or temperatures are at a minimum in the two worst winters out of ten" (Data Basin 2015). During both average and severe winters, mule deer congregate in the middle section of the Saguache Creek valley close to Upper Crossing, as well as around the margins of the San Luis Valley.

Geology

Bedrock exposed in the middle valley section consists primarily of extrusive igneous formations (figure 1.6). Most prominent are a series of Oligocene-age tuff flows. Mapped flows near Upper Crossing include the Carpenter Ridge Tuff (Tcr), the Fish Canyon Tuff (Tf), and the Tuff of Saguache Creek (Tsc) (Turner 2004). Each flow exhibits a distinctive weathering pattern, which in turn dictates the sizes and shapes of the blocks locally available for constructing stone enclosures.

Other igneous rocks exposed in the valley include flows of andesite and basalt, which are shown in shades of blue in figure 1.6. The Conejos Formation (Tc), which includes andesitic to basaltic flows, breccia flows, and lahars interlayered with sedimentary units composed of reworked ash, sandstone, and conglomerates, outcrops on the north side of the valley, from the confluence of Sheep Creek downstream to Ford Creek (Turner 2004). Sedimentary units of the Conejos Formation (Tcs) outcrop on the south side of the valley. A small, 80-ha exposure of Cretaceous Dakota and Morrison Formation rocks (KJdm, shown in green in figure 1.6) is located northwest of Upper Crossing. The bedrock underlying Cluster 1 at Upper Crossing is the Conejos Formation (undivided). The Fish Canyon Tuff underlies Cluster 2.

Many of the formations exposed in the valley contain rocks suitable for use as raw materials for chipped stone tools. The best-documented nearby source is the Dakota-age Alkali Spring (or Trickle Mountain) Quartzite Quarry (5SH1877), located approximately 2.5 km northeast of Upper Crossing. The documented portion of the quarry covers nearly 1.5 ha, but reconnaissance surveys indicate that knappable stone outcrops over an area several times that size. The quality of the quartzite is moderate; much of the material is coarse and poorly sorted, although finer-grained, better cemented stone also is available. Colors range from white to pink to brown and yellow. Lavender-colored stone is also present. Dark mineral fragments occur in most samples and vugs and other irregularities are common. The stone's cortex is generally buff-colored. Trickle Mountain quartzite can be considered macroscopically distinctive, owing to its characteristic poor sorting and dark mineral fragments. Black (2000), Pitblado and others (2008), and Stiger (2001) describe numerous other quartzite sources located in the Gunnison River basin. These raw materials vary greatly in color and quality, but many are homogeneous and of high quality.

Chert and chalcedony occur as secondary deposits within the region's tuff flows. Chert ranging in color from yellow to olive to black likely occurs in a number of locations in the Saguache Creek valley. At least one small source of this material is located near the Alkali Spring Quartzite Quarry; however, the geologic context of that outcrop is not known. Macroscopically similar material is also widely available across much of the eastern San Juan Mountains. For instance, nearly identical material outcrops on the east face of Uncompahgre Peak, some 90 km to the west, as well as on Snow Mesa, 65 km to the southwest (Mitchell

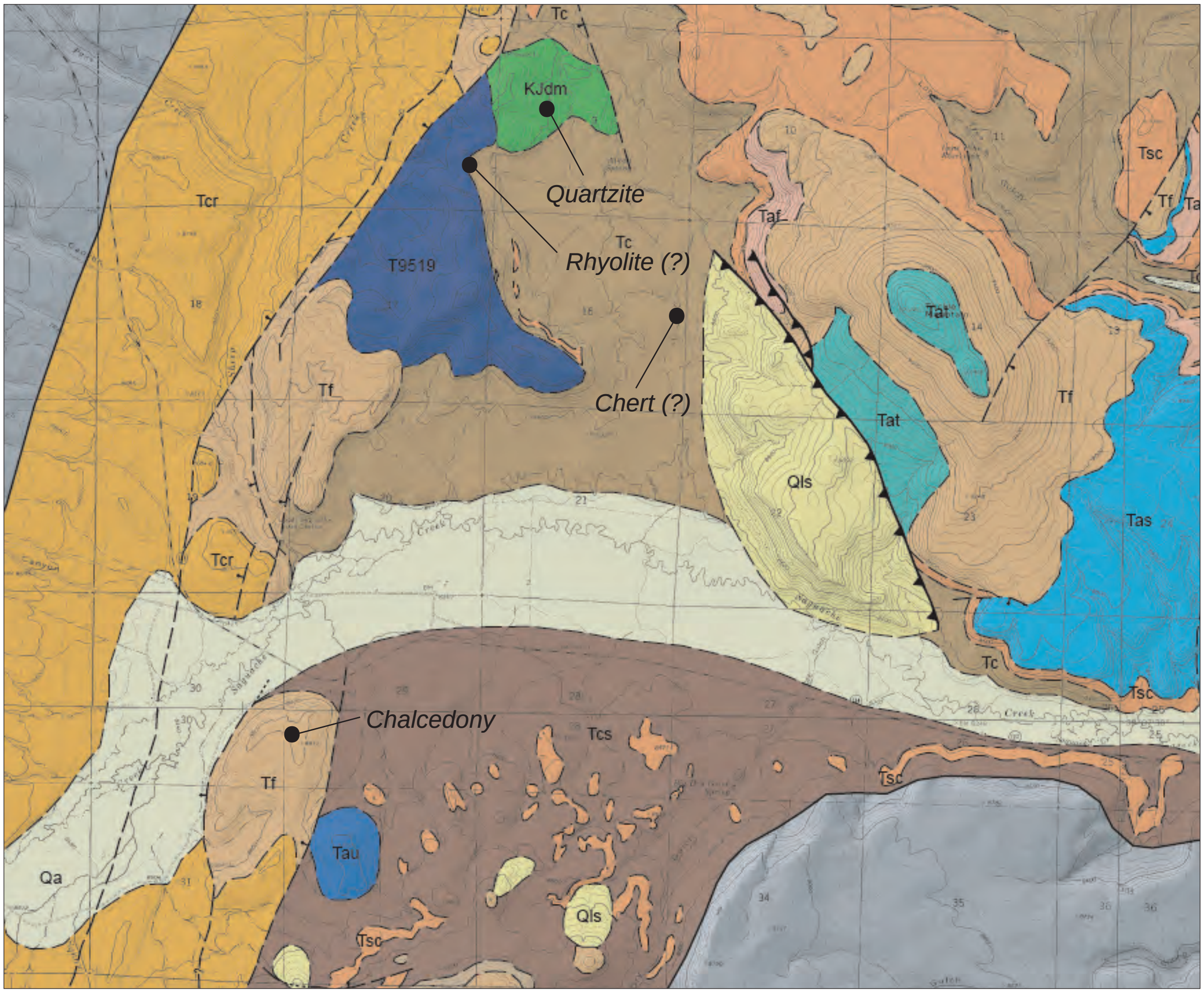

Figure 1.6. Geologic map of the middle section of the Saguache Creek valley; see text for description of formations.

2012b; unpublished PCRG data). Archaeologists have also noted sources of similar stone at several locations in the La Garita Mountains (Wunderlich 2011).

Thin beds of true chalcedony (fibrous silica) occur in the Fish Canyon Tuff just 1.5 km south of Upper Crossing (unpublished PCRG data). Stiger (2001) reports a number of chert and chalcedony sources near Cochetopa Dome, west of the Continental Divide. Black (2000) lists three chert sources in Saguache County, all of them located on the Continental Divide north of Upper Crossing. Numerous high-quality chert sources occur in the Southern Front Range Mountains (South Park Hills), 75 km northeast of Upper Crossing (Black and Theis 2015).

Archaeologists have yet to document outcrops of knappable basalt in the Saguache Creek valley, although some useable stone may be present in the Hinsdale basalt (Turner 2004). However, toolstone-quality basalt sources do occur in the southern end of the San Luis Valley, 150 to 175 km south of Upper Crossing (Black 2007; Wunderlich 2011). Knappable rhyolite occurs close to the Alkali Spring Quartzite Quarry and in other locations in the middle and lower sections of the Saguache Creek valley. The sedimentary units of the Conejos Formation, particularly the conglomerates, may also include scattered cobbles of toolstone.

Small obsidian nodules occur on the flanks of Cochetopa Dome, 25 km northwest of Upper Crossing on the west side of the Continental Divide (Black 2000; Ferguson and Skinner 2003; Stiger 2001). However, obsidian is rare in the Upper Crossing collection and most specimens derive from Jemez sources, located some 250 km to the south.

Past Environments

Narratives penned by explorers and Army officers document aspects of the nineteenth-century climate and environment of the Saguache Creek valley. Longer-term climate reconstructions have been developed from a variety of local and regional proxy records.

Recent Historic Environment

Five different narratives report on the mid-nineteenth-century environment of the Saguache Creek valley (Miller 2012). Three describe transits of the valley made in 1853. The fourth describes an expedition made during the winter of 1857-1858, while the fifth describes an 1858 expedition.

The two earliest narratives are also the most detailed. The first describes Edward Fitzgerald Beale's expedition to identify locations for American Indian reservations in California (Heap 1854). To reach California, Beale elected to follow a possible transcontinental railroad route located between the 38th and 39th parallels, which was known as the central route. Beale's party of 12 camped at the Upper Crossing site on June 18, 1853.

The second transit of the Saguache Creek valley was John W. Gunnison's survey of the same railroad route (Beckwith 1855). Gunnison's large party, which included 20 wagons, passed by the Upper Crossing site on September 1, 1853 (figure 1.7).

Figure 1.7. Map of John W. Gunnison's route across the San Luis Valley and through the Saguache Creek valley.

Both Heap's and Beckwith's accounts describe a lush valley teaming with wildlife. Beckwith, recounting Gunnison's approach to Saguache Creek across the northern end of the San Luis Valley, notes that the party kept

> somewhat to the north to secure a good crossing at Homan's creek [San Luis Creek], on which we are encamped—there being large marshes further to the south, and the dams of the beaver, which are numerous, flowing the water back to some extent. Our march was only six miles to this fine little stream, with a meadow of grass on each side, of a mile in width. Two varieties of currants, a black and a beautiful yellow, grow in and around our camp in great abundance, and are thought very delicious by the party (Beckwith 1855:44).

Beckwith (1855:45) describes the lower section of Saguache Creek as a fast-flowing stream 1 ft deep and 18 ft across, running over a "pebbly bed" and lined with cottonwood and willow. At their August 31 camp in the valley's middle section, they caught several 2-lb trout and noted an abundance of grouse. Deer, Beckwith (1855:45) observed, "were bounding about in every direction, even passing between our wagons, which were separated by but a few yards." The expedition's artist, Richard Kern, sketched the Upper Crossing site as seen from downstream on the south side of the valley (figure 1.8).

Beale's party approached Saguache Creek from the south, skirting the eastern slope of the La Garita Mountains. Heap (1854:36) describes several "excellent springs" along their route. He depicts Saguache Creek as "an abundant stream" that "empties into the lagoon in the San Luis Valley" and is "clothed with nutritious grasses" (Heap 1854:37). In the middle section of the valley he notes "an abundance of water in all the lateral valleys, as well as grass" (Heap 1854:37). With water "reaching to [their] saddles," the party crossed Saguache Creek just below the Upper Crossing site, where they camped on June 18 (figure 1.9).

Heap's description of what he calls "Coochatope Pass" clearly refers to the short gorge above the confluence of Sheep and Saguache creeks, rather than to the low crossing of the Continental Divide that currently bears the name. The pass, he says, "is a wonderful gap, or, more properly speaking, a natural Gate, as its name denotes in the Utah language" (Heap 1854:38). He further observes that

> [a] stream [Sheep Creek] issues from Coochatope Pass and joins the Sahwatch; it is called *Coochumpah* by the Utahs, and *Rio de los Cibolos* by the Mexicans: both names have

Figure 1.8. John Mix Stanley's lithograph of Richard Kern's 1853 sketch of the Upper Crossing site, entitled "Coo-Che-To-Pa Pass." (Used by permission of the Utah State Historical Society.)

> the same signification—*River of buffaloes*. *Coochatope* signifies, in the Utah language, *Buffalo gate*, and the Mexicans have the same name for it, *El Puerto de los Cibolos*. The pass and creek are so called, from the large herds of these animals which entered Sahwatch and San Luis valleys through this pass, from the Three Parks and Upper Arkansas, before they were destroyed, or the direction of their migration changed, by the constant warfare carried on against them by Indians and New Mexicans. A few still remain in the mountains, and are described as very wild and savage. We saw a great number of elk-horns scattered through these valleys; and, from the comparatively fresh traces of buffaloes, it was evident that many had visited the pass quite recently. The abundant pasturage and great shelter found here, even in the severest winters, render them a favorite resort at that season for game of every description. Coochatope Pass is travelled at all seasons, and some of our men had repeatedly gone through it in the middle of winter without meeting any serious obstruction from snow. Many Utahs winter in the valleys lying within the Sahwatch mountains, where Mexican traders meet them to barter for buckskins and buffalo robes (Heap 1854:38-39).

Antoine Leroux, Gunnison's guide through the region, similarly describes the winter climate at Upper Crossing as anomalously mild, noting that "there is not much snow in this pass (the Coochatope,) and people go through it all the winter. And when there is much snow on the mountains on the Abiquiu route (which is the old Spanish trail from Santa Fe to California,) the people of Taos go round this way" (Dana 1856:378; see also Parkhill 1965:52-53).

John C. Fremont, whose self-funded expedition along the proposed central route of the transcontinental railroad was the third of the 1853 transits of the Saguache Creek valley, also remarked on the scant accumulation of snow. Describing the expedition's December 14 crossing of the Continental Divide, Fremont (1854:3)

Figure 1.9. Two illustrations of the Saguache Creek valley from Gwinn Harris Heap's account of Edward Fitzgerald Beale's 1853 expedition. Top: view of the valley's middle section (Heap 1854:Plate VII); bottom: view of the Upper Crossing site and "Coochatope Pass"(Heap 1854:Plate VIII). (Wikimedia Commons.)

notes that "on the high summit lands were forests of coniferous trees, and the snow in the pass was but four inches deep." In a letter to his sponsor and father-in-law Thomas Hart Benton, Fremont (Spence 1984:470) remarks that "[w]e went through the Cochatope Pass [the saddle in the Divide, rather than Heap's "gap"] on the 14th December, with four inches—not feet, take notice, but inches—of snow on the level, among the pines and in the shade on the summit of the Pass." Solomon Nunes Carvalho (Spence 1984:428), the expedition's photographer, noted that the party camped on the evening of December 13 at "the Cochotope," a reference to Heap's gorge at the confluence of Sheep and Saguache creeks where the Upper Crossing site is located (figure 1.10). "That night," Carvahlo (Spence 1984:428) continues, "it snowed on us for the first time. The snow obliterated the wagon tracks of Capt. Gunnison's expedition, but Col. Fremont's unerring judgment conducted us in the precise direction by a general ascent through trackless, though sparsely timbered forests, until we approached the summit, on which grew an immense number of trees, still in leaf, with only about four inches of snow on the ground."

By contrast, Colonel Randolph B. Marcy and his large party composed of 5th Infantry soldiers, mountain men, packers, and guides encountered deep snow on the west side of the Divide in late December 1857 and early January 1858 (Marcy 1866). Marcy provides few environmental details, apart from the fact that snow at least 5 ft deep blanketed the ground

Figure 1.10. Illustration of the Upper Crossing site from the prospectus for John Charles Fremont's *Memoirs of My Life* (1886). The illustration was based on Solomon Nunes Carvalho's now-lost daguerreotype.

between the Gunnison River and Cochetopa Pass—which he describes as "that Mecca of our most ardent aspirations" (Marcy 1866:242). His description further suggests that snow covered the ground between the pass and the lower section of Saguache Creek, although the snow's depth is not stated.

The fifth transit of the valley took place in 1858, when Colonel William W. Loring and a command composed of companies of the U.S. Mounted Rifle Regiment and the 3rd Infantry crossed the Continental Divide above Saguache Creek on an expedition from Camp Floyd, Utah Territory to Fort Union, New Mexico. The party passed Upper Crossing on September 1, 1858. Describing the middle section of the valley, Loring (Hafen 1946:71) notes that "at all the bends in the valley of today, good soil, grass, wood and water. Pine, pinon, and cottonwood found in places."

Tree-ring data provide a longer-term climate context for these observations. The plains of eastern Colorado and the Front Range foothills experienced a localized, but severe drought during the 12-year period from 1845 to 1856 (Woodhouse *et al.* 2002). However, 1853 was the least severe within that 12-year period, particularly in the San Luis Valley (Woodhouse *et al.* 2002:1487, Figure 3). Above-median tree growth resumed in 1857. Thus, despite variable climate across the region in the 1850s, observations on the environment of the Saguache Creek valley made in 1853, 1857, and 1858 likely record typical rather than anomalous conditions.

Heap, Beckwith, and Fremont were proponents of the central route of the transcontinental railroad and their favorable comments about conditions along the route should be understood in that context. Nevertheless, their testimony points to the comparative ease of cool season travel in Saguache Creek. Their observations corroborate the modern SNOTEL data indicating that snow accumulation on the Divide above Upper Crossing is lower that at comparable elevations to the north or south.

Ancient Environment

A variety of local proxy data are available for reconstructing the ancient climate of the San Luis Valley. High-resolution data consist of tree-ring sequences from Great Sand Dunes National Park and Preserve (GRSA), the eastern San Juan Mountains, and the upper Gunnison River basin (National Centers for Environmental Information 2015). Low-resolution data consist of sediment cores from both high- and low-elevation lakes, as well as stratified terrestrial deposits (Carrara 2011; Jodry 1999; Machette and Puseman 2007; Madole *et al.* 2008).

The tree-ring record primarily spans the last 1200 years. High-elevation lake sediment mostly preserves a record of the Pleistocene-Holocene transition and the early Holocene, whereas low-elevation lake sediment and terrestrial strata primarily preserve a late Holocene record. Thus, a significant mid- to late-Holocene gap exists in the paleoenvironmental proxy record for the San Luis Valley. That gap is largely coincident with the use of Upper Crossing as a residential base camp.

However, several regional reconstructions are available for the primary period of intensive residential occupation at Upper Crossing between about 2500 and 1000 B.P. Rhode and others (2010) develop a sequence of paleoclimatic episodes derived from multiple proxy records that spans the Holocene. Their reconstruction uses data from northwest Colorado, northeast Utah, and southwest Wyoming and its applicability to higher elevation locations or to the San Luis Valley specifically has not been tested. Table 1.7 shows the portion of the sequence that falls between 3700 and 1000 B.P. Rhode and others' reconstruction suggests shifts both in precipitation and temperature during the period of interest, beginning with warmer and drier conditions, followed by a wetter and cooler period, and finally a wetter and warmer period.

A multi-proxy reconstruction is also available for eastern Colorado. Gilmore (2008) compiles data on tree-ring widths, cycles of aeolian deposition, and multiple proxies derived from fen and marsh sediment that encompass the period from about 3000 cal B.P. to the mid-nineteenth century. Table 1.8 summarizes the major episodes Gilmore identifies for the period of interest. Gilmore's reconstruction indicates climate shifts during the period, although dry and warm or dry and cool conditions dominate.

Both similarities and differences exist in the two regional reconstructions. Both indicate dry conditions around 3000 B.P., but the northwest Colorado reconstruction points to wet conditions between 2700 and 1500 B.P., while the eastern Colorado reconstruction points to significant episodic droughts during that period. Both reconstructions indicate wetter and warmer conditions between about 1500 and 1000 B.P. and dryer and warmer conditions between 1000 and 500 B.P.

Local proxy data provide additional context for these reconstructions. Data on the position of upper treeline in the San Juan Mountains may point to a cooler period after 3500 B.P. (Cararra 2011), rather than to the warmer period Rhode and others (2010) suggest. Low-elevation lake cores and stratified valley-floor terrestrial deposits in the San Luis Valley record alternating mesic and xeric periods during the late Holocene. Madole and others (2008) infer fluctuations in the water table along Big Spring Creek and in the hydrologic sump west of GRSA. The water table there was 1 to 1.5 m higher than at present between 3000 and 2000 B.P. Jones's (1977) data from 5AL80/81 suggest a much higher water table in the Dry Lakes, south of GRSA, about 1700 B.P. These data seem to align with Rhode and others' reconstruction for the period between 2700 and 1500

Table 1.7. Northwest Colorado climate episodes between 3700 and 1000 B.P. (Rhode *et al.* 2010:Table 16).

Climate Episode (^{14}C yr B.P.)	Precipitation (Relative to Modern)	Mean Annual Temperature (Relative to Modern)	Comments
3700-2700	Increased aridity; dryer	Near or slightly above modern levels; warmer winters?	Local spruce die-off in Flat Tops area possibly related to drought-induced insect infestation
2700-1500	Wetter, with large flood events	Renewed Neoglacial cooling; 0-1º C cooler?	Lodgepole and ponderosa pine move downslope in southern study area; summer monsoon limited to southern area
1500-1000	Wetter, with increased seasonality	Warmer; near modern levels?	Summer monsoon intensifies and expands to north fostering expansion of farming communities
1000-670	Dryer with numerous long droughts	Somewhat warmer than modern levels	Summer monsoon fails; agriculture in region stops

Table 1.8. Eastern Colorado climate episodes between 3000 and 500 cal B.P. (Gilmore 2008).

Climate Episode (cal B.P.)	Climate Interval	Comment
3000-2200	Generally Dry Conditions and Episodic Drought	Persistently warm and dry across the Plains with significant warm and dry intervals
2200-1850	Terminal Archaic Drought	Warm and dry with high variability; among the most severe periods of drought in Arkansas basin fen record
1650-1400	Early Ceramic Drought	Cool and dry with low variability
1400-975	First Millennium Amelioration	Increased effective moisture; increasing temperature from below to above average; low variability
975-500	Medieval Climate Anomaly	Warm and dry with increased spatial and temporal variability

B.P. In addition, the water table at San Luis Lake was 1 to 2 m lower than at present between 900 and 1000 B.P. (Madole *et al.* 2008), during a drier and warmer period in Rhode and others' reconstruction. These lake-level changes may be a sensitive barometer of climate change because, as Madole and others (2008) observe, topographic relief is low on the valley floor and small fluctuations in the water table in the hydrologic sump can produce dramatic changes the extent of surface water and marshes.

Machette and Puseman (2007) identify a sequence of buried paleosols capping aeolian sand units on the northern edge of the San Luis Valley's open basin. The paleosols point to periods of surface stability and higher effective precipitation at about 4800 B.P., 3600 B.P., and 2700 B.P. The latter two episodes bracket Rhode and others' (2010) period defined by warmer and drier conditions.

Few tree-ring sequences extend into the period of intensive occupation at Upper Crossing. However, a composite bristlecone pine chronology developed from three sites located in the headwaters of the Arkansas River provides a reconstruction of regional hydroclimate extending to 1800 B.P. (Woodhouse *et al.* 2011). Although too few samples are available to estimate drought intensity during the early portion of the reconstruction, the timing of drought events is well marked. Droughts occurred repeatedly in the A.D. 300s, in the early A.D. 500s, and from the late A.D. 600s to the early A.D. 800s.

Archaeological Context

Data on the American Indian occupation of the San Luis Valley have accumulated rapidly in the last 15 years, particularly for the eastern portion of the valley around Great Sand Dunes National Park and Preserve (GRSA). However, the region remains among the least studied parts of Colorado. Accordingly, this overview integrates data from adjacent regions, including the Gunnison River basin to the northwest and the upper Arkansas River basin to the east. Table 1.9 summarizes the broad chronological divisions used to organize archaeological data from the Northern Colorado, Arkansas, and Rio Grande basins. The regions discussed in the text are depicted in figure 1.11.

Because this project focuses on Upper Crossing's stone enclosures, the following overview covers only the Archaic and Late Prehistoric stages or eras, especially the period between 3000 and 1000 B.P. Additional background on the region's archaeology can be found in Bevilacqua and others (2008), Bevilacqua and others (2007), Martorano and others (1999), Martorano and others (2005), and Wells (2008).

Archaic Stage

Few Archaic stage sites in the Colorado section of the Rio Grande basin have been investigated intensively. However, a context for the San Luis Valley Archaic can be developed from data and interpretations derived from projects in adjacent regions. The dataset for the Northern Colorado River basin, including the Gunnison River basin immediately northwest Upper Crossing, is the most comprehensive. In the Arkansas River basin to the east, Early Archaic sites are uncommon but Middle and Late Archaic sites are relatively abundant. Data also are available from Archaic sites in the Rio Grande basin in northern New Mexico.

Most researchers working in the Southern Rockies accept the view that the region's Archaic hunter-gatherers practiced a local, year-round, mountain-focused settlement and subsistence system distinct from that of groups living in adjacent regions (Black 1991a). Most researchers also recognize long-term adaptive continuity in the region, beginning as early as the Late Paleoindian period (Metcalf 2011b). Whether this also reflects cultural continuity remains a subject of debate (Stiger 2001), as do the specific attributes that define a mountain adaptation (Reed and Metcalf 1999).

Table 1.9. Chronology of major culture-historical divisions in three Colorado river basins. Ages reported in uncalibrated radiocarbon years before 1950 (B.P.).

Stage, Period, or Era	Arkansas River Basin (Zier and Kalasz 1999)	Northern Colorado River Basin (Reed and Metcalf 1999)	Rio Grande Basin (Martorano *et al.* 1999)
Paleoindian	>11,500 – 7800	11,500 – 8350	11,200 - 7450
Archaic	7800 – 1850	8350 – 1950	7450 – 1450
Late Prehistoric/Formative	1850 – 500	2350 – 650	1450 – 350
Protohistoric	500 – 225	650 – 69	350 – 69

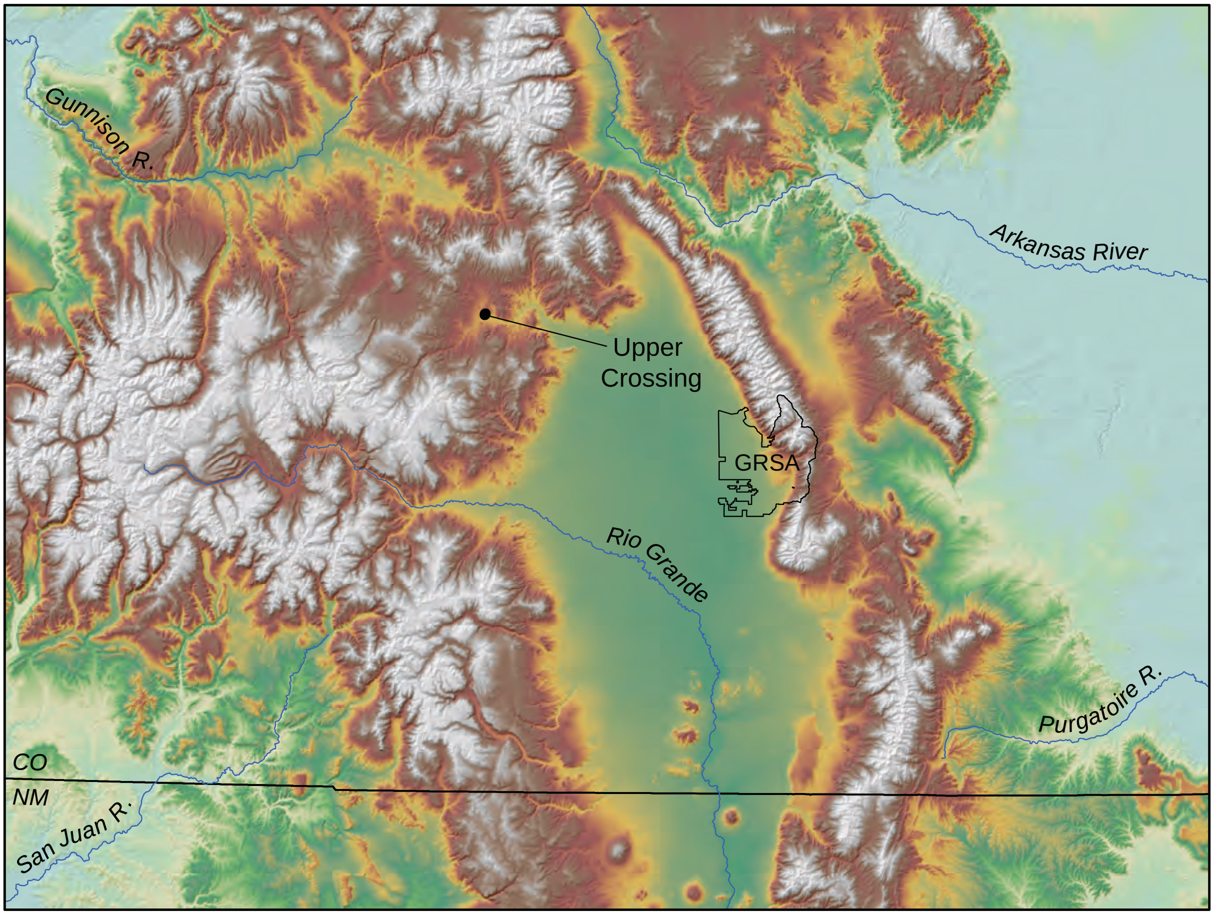

Figure 1.11. Map of the Rio Grande basin showing major rivers in adjacent regions and the location of the Upper Crossing site and Great Sand Dunes National Park and Preserve (GRSA).

Northern Colorado River Basin

Reed and Metcalf (1999) partition the Archaic era in the Northern Colorado River basin into four periods. The earliest, dubbed the Pioneer period (8350-6450 B.P.), marked the initial settlement of the region by full-time residents practicing a seasonal settlement system. During the subsequent Settled period (6450-4450 B.P.), local bands practiced a central-place subsistence strategy that featured logistical moves around strategic habitation areas in the winter coupled with residential mobility in the summer. This basic pattern continued into the Transitional period (4450-2950 B.P.), but was accompanied by increasing material culture variation, more restricted use of higher-elevation life zones, and possibly decreased sedentism. The final Archaic period, the Terminal (2950-1950 B.P.), was a period of subsistence stress that prompted various forms of economic intensification as well as technological change. (Metcalf [2011b] revises the bracketing dates and durations of the Reed and Metcalf [1999] periods and argues for the use of more neutral period names, including the Paleo-Archaic, Early Archaic, Middle Archaic, and Late Archaic.)

Stiger (2001) offers a model of settlement and subsistence change for the Gunnison basin. In Stiger's scenario, people took up full-time residence after 8000 B.P. Their central-place foraging system featured large and small mammal hunting combined with bulk processing and storage of plant resources. Apart from a brief interruption between 5000 and 4500 B.P., this basic pattern continued until about 3000 B.P. After 3000 B.P., central-place residences were replaced by seasonal, special-use sites occupied by groups who wintered outside the basin. This shift coincided with local extirpation of piñon pines.

Exploitation of the tundra ecosystem in the San Juan Mountains, above about 3400 m, occurred primarily during the Archaic (Mitchell 2012b). Intensive use of alpine environments began at least by 5000 B.P. and declined after about 2000 B.P. The frequent occurrence of obsidian from source locations in northern New Mexico indicates that native groups using the San Juan high country maintained strong connections to the northern Southwest. However, the marked diversity of the stone tool raw materials present on many high-elevation sites, including a variety of cherts, orthoquartzites, rhyolites, and basalts, suggests either that a broad trade network linked groups living around the perimeter of the San Juans or that groups from different regions came together in the high country. Most alpine sites in the San Juans are small, suggesting that they represent brief occupations. Assemblage diversity data indicate that high country land-use strategies were generalized, rather than focal.

Arkansas River Basin

In the Arkansas River basin, Middle Archaic sites, dating between 5000 and 3000 B.P., are located in a wide variety of ecological settings, from mid-elevation mountain valleys, to the Plains-foothills ecotone, to canyons and open steppe (Zier 1999). Especially significant are Middle Archaic occupations in rockshelters, including Draper Cave (5CR1), Recon John Shelter (5PE648), Gooseberry Shelter (5PE910), and Wolf Spider Shelter (5LA6197) (Hagar 1976; Hand and Jepson 1996; Zier 1999; Zier and Kalasz 1991). The Dead of Winter site (5LK159) is the most thoroughly investigated Middle Archaic occupation in the mountains (Buckles 1978).

Middle Archaic sites in the Arkansas basin are primarily located near reliable water sources (Zier 1999). Both open and sheltered sites exhibit evidence of regular reoccupation. The diversity of tool types present, along with the frequent occurrence of hearth features, suggests that these sites represent multi-activity residential camps. Floral and faunal inventories point to a broad-spectrum subsistence strategy. Together, assemblage diversity and evidence for reoccupation may reflect a small-group foraging economy. Preservation differences between sheltered and open sites may complicate interpretations of mobility patterns; however, the evidence for a generalized year-round foraging strategy in the Arkansas basin suggests that Middle Archaic occupations there were organized differently than Middle Archaic occupations in the Northern Colorado basin.

Late Archaic (3000 B.P-1850 B.P.) sites also occur throughout the Arkansas River basin, including in the open steppe, in shallow and deep canyons, in the Plains-foothills ecotone, and in high-elevation valleys. Important Late Archaic rockshelter sites include several that also contain Middle Archaic deposits (Recon John, Gooseberry, and Wolf Spider), as well as Two Deer (5PE8), Carrizo (5LA1053), and Medina (5LA22) (Campbell 1969; Zier 1999). Open sites in steppe and shallow-canyon settings are widespread and common, but few have been intensively investigated. Excavated sites in the mountains include the Runberg site on Cottonwood Pass (Black 1986), the Venado Enojado site near Buena Vista (Watkins *et al*. 2012), and site 5LK199 and the Campion Hotel site southwest of Leadville (Zier 1999).

The co-occurrence of both Middle and Late Archaic cultural deposits at many Arkansas basin sites suggests long-term continuity in subsistence practices and mobility patterns (Zier 1999). Late Archaic radiocarbon dates are more numerous than Middle Archaic dates, but this likely is due to preservation and research biases rather than to an increase in population. Late Archaic deposits in stratified rockshelters generally are thicker and richer than Middle Archaic deposits, suggesting an increase in site-use intensity over time. Evidence from sites in upland settings suggests a somewhat greater reliance on logistical organization during the Late Archaic than during earlier periods.

The broad-spectrum subsistence strategy that began in the Middle Archaic continued into the Late Archaic. Late Archaic faunal and botanical assemblages are somewhat more diverse than Middle Archaic assemblages, but it is unclear whether this reflects increased diet breadth or sampling biases. Maize remains definitely occur at three Late Archaic sites, the earliest of which, Gooseberry Shelter, dates to 2600 B.P. However, maize was certainly a minor component of Late Archaic diets and its occurrence did not lead to a real shift in subsistence practices (Zier 1999).

Rio Grande Basin

In the Rio Grande basin, Archaic stage sites frequently are classified according to the periods of the Oshara tradition, a taxonomy that Irwin-Williams (1973) developed to trace the antecedents of Pueblo culture in the northern Southwest. Based on data from the Arroyo Cuervo region, located some 50 km northwest of Albuquerque, the Oshara tradition divides pre-Puebloan archaeology in to five phases spanning the period from about 7500 B.P. to 1550 B.P. These phases include the Jay (7500-6750 B.P.), the Bajada (6750-5150 B.P.), the San Jose (5150-3750 B.P.), the Armijo (3750-2750 B.P.), and the En Medio (2750-1550 B.P.).

In Irwin-Williams's scenario, components of the Jay and Bajada phases represent small-group, short-term residential camps. Jay and Bajada microbands practiced a local, year-round, "mixed spectrum" subsistence strategy (Irwin-Williams 1973:5). Climate, and therefore resource patch productivity, improved during the subsequent San Jose phase, permitting an increase in site-use intensity. Diet breadth increased, especially through the incorporation of more small seeds and other plant resources.

Important subsistence and settlement changes took place during the Armijo phase. Limited quantities of maize are present in Armijo phase botanical assemblages, slightly preceding the appearance of maize in the Arkansas basin. Fall or fall-winter seasonal aggregation sites first appeared during the Armijo, as did specialized-function sites. The final Archaic phase of the Oshara tradition, the En Medio, witnessed an amplification of trends begun during the Armijo. Storage features first appeared during the En Medio phase and groundstone tools became more common and morphologically diverse. Irwin-Williams argues that increases in the number of sites and in the size and intensity of site use reflect population growth during the En Medio phase. Bands began exploiting seasonally productive, but previously untapped, resource patches. This shift may point to either an increasing reliance on logistical organization or to frequent small-group residential mobility punctuated by annual macroband aggregation.

Although Irwin-Williams identifies material similarities between the phases of the Oshara tradition and the Rio Grande complex, which Renaud (1942b, 1944, 1946) defines using San Luis Valley data, the dearth of excavated Archaic-stage sites in the Colorado section of the Rio Grande basin has nevertheless limited the development of region-specific chronologies or settlement models (Hoefer 1999a). All of the published radiocarbon dates come from sites within or immediately adjacent to the GRSA in the east-central portion of the valley, and most of those dates derive from individual features rather than from stratigraphic sequences.

Bevilacqua (2011a) provides data on 57 radiocarbon assays from GRSA contexts. Five are too recent to calibrate. A single assay from a site immediately outside the park can be added to the list (Jones 1977). Among those 53 interpretable samples, 32 date to the Archaic, between 7450 and 1450 B.P. The median date is 2380 B.P. and the mean date is about 2800 B.P. Thus, the latest Archaic contexts—which could be assigned to the Late Archaic period, the En Medio phase, or the Terminal period—are much more abundantly represented in the radiocarbon record than are all other Archaic contexts. Late Archaic components are also more common that Late Prehistoric components in the GRSA record.

Among the most interesting dated Archaic occupations in the San Luis Valley is site 5AL80/81, a multi-function camp located on the valley floor just west of GRSA that produced flaked stone tools, ground stone tools, and a diverse archaeofauna composed of fish, bird, and mammal remains (Farmer 1978; Jones 1977). However, most Archaic sites located around the GRSA consist of concentrations of burned rock and ground stone tools, indicative of intensive processing of plant resources, possibly including Indian ricegrass (*Achnatherum hymenoides*) and piñon nuts (*Pinus edulis*) (Bevilacqua *et al*. 2008; Hendrickson *et al*. 2011; Martorano *et al*. 2005). The attributes of these sites and their associated assemblages point to seasonal, logistical use of this portion of the valley (Andrews *et al*. 2004). The fact that logistical use of the eastern valley margin dates primarily to the mid- to late En Medio lends some support to Irwin-Williams's proposed developmental sequence for the Oshara tradition, which regards the En Medio as a period of population growth and increased logistical mobility.

Archaic Architecture

Architectural features are important elements of the Archaic stage record in the Southern Rockies (Landt and Reed 2014; Pool and Moore 2011; Reed and Metcalf 1999; Rood 1998; Shields 1998; Stiger 2001). Winter-occupied habitation structures appeared in the Northern Colorado River basin as early as the Pioneer period and are well attested through the Transitional period. Most were semi-subterranean with shallow, saucer-shaped floors. Superstructures varied significantly, incorporating upright poles or cribbed logs along with lighter materials in a variety of configurations. Many incorporated adobe plaster. Basin house area and depth appears to have decreased over time following the Settled Archaic. Individual houses appear to have been occupied briefly, although many sites with basin houses were re-occupied.

Just one residential structure dating to the Middle Archaic is known from the Arkansas River context area (5LA2190) (Zier 1999). However, basin houses have been documented immediately north of the Arkansas-South Platte divide in Douglas County, Colorado (Gantt 2007). Habitation structures dating the Late Archaic also are uncommon in the Arkansas basin, but include basin houses at the McEndree Ranch site in Baca County (Shields 1980) and at the Veltri site in the upper Purgatoire River valley (Rood 1990), and, possibly, one or more basin houses at the Venado Enojado site in Chaffee County (Watkins *et al*. 2012).

Archaic-stage architectural features in the San Luis Valley include four possible basin houses at two sites located in the GRSA and one probable basin house at the Upper Crossing site in the middle Saguache Creek valley (Bevilacqua 2011a; unpublished PCRG data). Two of the GRSA basin houses have been excavated, yielding a Middle Archaic date for one structure at the Big Spring site (5SH181) and a Late Archaic date for another at the Little Spring site (5AL10) (Jodry 2002). The probable basin house at Upper Crossing likely dates to the Late Archaic. Hoefer (1999a) assigns some of the Rio Grande basin's stone enclosures to the Archaic, but no radiocarbon dates are available to confirm this. However, rock art panels that may date to the Archaic occur on four sites that also include stone enclosures (Hoefer 1999a:123).

One hallmark of Archaic assemblages from the Southern Rockies is the diversity of associated projectile point styles (Metcalf 2011a; Mullen 2009a; Reed and Metcalf 1999). Many Archaic point styles were produced over long periods of time and many well-dated components incorporate multiple styles. As Reed and Metcalf (1999:86) observe, "broad series show some patterning, but the rule is for diversity within sites and temporal periods." For the San Luis Valley and adjacent mountains, this problem is compounded by the routine use of style names linked to sequences originally developed for sites in other regions, including the northern Southwest, the Great Basin, and the Plains. In view of the chaotic diversity of Archaic point types in the Southern Rockies, it is likely that projectile point morphology there provides little or no information on interregional cultural connections (Stiger 2001). More importantly, this diversity means that the morphologies of projectile points recovered from surface contexts cannot be used to assign sites to particular periods within the Archaic.

In sum, distinct patterns and trends characterize the Archaic in different areas adjacent to the San Luis Valley. The lack of excavation data from sites in the valley makes it hard to know which of those patterns—if any—best fits the Rio Grande basin. Limited data from the GRSA point to trends similar to those described by Irwin-Williams for the Oshara tradition. However, the GRSA possesses a number of unique ecological characteristics and Archaic use of that area may not be representative of basin-wide patterns.

Late Prehistoric Stage

Diversity characterizes the post-Archaic record of the Southern Rockies and adjacent areas.

Northern Colorado River Basin

In the Northern Colorado basin, the transition to the Formative was marked by a set of non-synchronous technological and economic shifts, including the adoption of the bow and arrow and ceramics and subsistence intensification. Intensification took two basic forms: increased diet breadth for most groups and the addition of maize to the diets of some. All of those changes in technology and subsistence took place between about 2500 and 2000 B.P.; Reed and Metcalf (1999) put the beginning of the Formative at 2350 B.P., coincident with the earliest appearance of maize, and the end at 650 B.P. (Reed [2011] revises the beginning and ending dates slightly, from 1700 to 600 B.P.)

The Formative era in the Northern Colorado River basin, which continued until 650 B.P., is partitioned into a set of distinct cultural traditions, including the Fremont, Gateway, Anasazi, and Aspen traditions. All of those traditions share use of the bow and arrow, and exhibit some evidence of economic intensification. Apart from the Aspen tradition, all of the west-central Colorado's Formative groups relied to some extent on maize cultivation, though it was less important to them than it was to the Ancestral Puebloan farmers who lived south of the San Juan Mountains. Formative-era architectural features varied in design and construction technology, both within and between traditions, although many consist of small circular or rectangular surface masonry structures. Manufacture and use of pottery also varied: some groups produced high-quality vessels while others made only limited use of pottery. Settlement systems also varied. In some locations, Formative-era people maintained Archaic-era settlement and subsistence patterns but in others they were tethered to long-term habitation sites near maize fields. Formative-era projectile point styles are less diverse than are those of the Archaic.

Definite Ancestral Puebloan sites occur only on the far southern end of the Northern Colorado context area and Reed and Metcalf (1999:107) regard the concept of peripheral Ancestral Pueblo settlement in west-central Colorado as "untenable."

Fremont sites occur in three areas close to the Colorado-Utah border; the best-documented are located in the Douglas Creek/Dinosaur area (Reed and Metcalf 1999:109-115). A variety of settlement models have been proposed for the long-lasting Fremont tradition in Colorado; most emphasize temporal and spatial variability in settlement systems, especially shifts in mobility and the relative importance of farming and foraging.

A cluster of Gateway tradition sites occurs in western Montrose County and other sites are scattered in San Miguel, Delta and Mesa counties. Reed (1997, 2005) offers a list of material markers for the Gateway tradition, including limited consumption of maize; lack of locally produced pottery but use of imported Fremont and Ancestral Puebloan pottery; circular to rectangular surface masonry habitations and possible use of pit structures; storage facilities in rockshelters and Fremont- and Ancestral Puebloan-influenced rock art. Although some of those attributes may have appeared as early as 2350 B.P., Gateway tradition sites appear to be confined to the two centuries between 1050 and 850 B.P. (900-1100 A.D., or the Pueblo II period in the Four Corners region) (Reed 2005).

Reed and Emslie (2008) observe that Gateway tradition architectural sites are primarily located on high ridges and canyon rims. Site size, as measured by the number of masonry rooms, exhibits a bimodal distribution. Smaller sites incorporate one or two rooms, while larger sites incorporate five to seven. Larger sites are more likely to exhibit evidence of longer or more intensive occupations.

Aspen tradition sites exhibit some of the characteristics of sites assigned to other west-central Colorado Formative traditions, but lack evidence of maize consumption and masonry architecture. Pottery is mostly absent. Architectural features include basin houses and, possibly, spaced-rock rings and wickiups. Various types of pit features are more common on Formative sites, including those of the Aspen tradition, that they are on Archaic sites. That shift likely indicates more intensive resource processing. Aspen tradition sites are distributed throughout the Northern Colorado basin (Reed and Metcalf 1999:Figure 7.9).

Arkansas River Basin

In the Arkansas River basin, Late Prehistoric stage archaeology is partitioned into two periods (Kalasz *et al.* 1999). (Kalasz and others [1999:250-263] also include the Protohistoric period in the Late Prehistoric stage; however, post-500 B.P. archaeology is not covered in this summary.) The beginning of the Developmental period (1850-900 B.P.) was marked by the appearance of the bow and arrow and, perhaps asynchronously, ceramic containers. Small corner-notched arrow points occur at Recon John Shelter as early as 1900 B.P. (Zier and Kalasz 1991). Pottery may be present on several roughly contemporaneous sites and definitely occurs on sites dating to between 1500 and 1700 B.P. (Kalasz *et al.* 1999). However, apart from these undoubtedly important technological changes, Developmental period lithic technology is markedly similar to that of the preceding Late Archaic period, a pattern indicative of local cultural development that began in the Middle Archaic or earlier.

Goosefoot (*Chenopodium* sp.) seeds dominate Developmental period macrofloral assemblages. Other wild plant foods include a variety of cacti and weedy annuals. Remains of maize are consistently, though not ubiquitously, present. However, maize likely was not significant a component of Developmental period diets (Kalasz *et al.* 1999). Developmental period archaeofauna are very diverse and include numerous small mammals in addition to small and large artiodactyls. These data suggest an increase in diet breadth during the Late Prehistoric, as well as a degree of subsistence intensification.

In the Plains, Developmental period architectural features are uncommon and varied. The best-known include two basin houses at the Belwood site, one with a low encircling rock foundation; an enigmatic basin house at the Running Pithouse site; and two stone enclosures at the Forgotten site (Kalasz *et al.* 1999). By contrast, circular to oval basin houses with rock foundations are relatively common in the southern Park Plateau, in the Plains-foothills ecotone.

The succeeding Diversification period (900-500 B.P.) in the Arkansas basin is characterized by increased investment in domestic architecture and by the widespread use of triangular, side-notched arrow points (Kalasz *et al.* 1999). The Diversification period is further partitioned into the Sopris phase and the Apishapa phase. Sopris phase sites are confined to the Park Plateau, both north and south of the New Mexico-Colorado border, while Apishapa phase sites occur throughout a broad arc south the Arkansas River. Sopris phase houses are heterogeneous and include both single- and multiple-room structures built from stone masonry, adobe, and jacal. Apishapa phase houses include single- and multiple-room structures built nearly exclusively from vertical slabs. Stone barrier walls or fences also are common, as are walled or partitioned rockshelters.

Although wild resources continued to be the backbone of Diversification period diets, the consumption of maize clearly increased. Small mammals appear to dominate rockshelter archaeofauna while bison dominate open-site archaeofauna (Kalasz *et al.* 199:218). Interregional interaction increased during the Diversification period, particularly for Sopris phase communities who maintained routine connections with ancestral Puebloans in the Rio Grande basin.

Rio Grande Basin

In the Rio Grande basin the early Late Prehistoric encompasses Irwin-Williams's (1973) Trujillo phase. Trujillo phase groups adopted bow-and-arrow technology and used a modest number of ceramic containers. However, Irwin-Williams detects no change from earlier En Medio phase economic practices. Economic intensification that began during the Armijo phase (3750-2750 B.P.) continued through the En Medio and into the Trujillo. Both En Medio and Trujillo phase sites represent a "strongly seasonal annual economic cycle," although the spatial extent or geographical components of that system are not described in detail (Irwin-Williams 1973:14).

The applicability of Irwin-Williams's (1973) model to the Rio Grande basin in Colorado is not known. Maize horticulture likely was not possible north of the New Mexico-Colorado border. The data available suggest that the San Luis Valley and adjacent foothills and mountains were used both by indigenous hunter-gatherers and by groups who resided outside the valley for much of the year. Late Prehistoric sites occur primarily on the floor of the San Luis Valley, especially along San Luis and Saguache creeks and in the hydrologic sump west of GRSA (Martorano 1999:133). Many are large and exhibit diverse tool assemblages suggestive of central-place foraging camps. A number exhibit evidence of repeated re-occupation.

Use of the San Luis Valley by ancestral Pueblo groups, particularly during the Pueblo II and Pueblo III periods, is attested by data from several sites, including the Mill Creek site (5SH354) and Saguache Shelter (5SH1458) on the northern end of the valley. Cord-marked pottery found sporadically throughout the valley suggests periodic visits by Plains groups as well (Bevilacqua 2011b; Martorano 1999).

The number of people living in the San Luis Valley and adjacent regions peaked during the Late Prehistoric, but the timing of local peaks appears to have varied. In the Northern Colorado basin, population peaked at about 950 B.P then began declining slowly. South of the San Juan Mountains, Ancestral Puebloan population waxed and waned locally, but likely reached a regional peak between 800 and 700 B.P., immediately prior to a sharp decline just prior to 650 B.P. (Lipe and Varien 1999). Radiocarbon data from the San Luis Valley suggest a population peak early in the first millennium, followed by a significant decline. However, all of the available radiocarbon data come from sites located within or adjacent to GRSA and so may not be representative of valley-wide trends. In northern New Mexico, population also may have peaked during the early centuries of the first millennium (Irwin-Williams 1973:12). Population in the Arkansas basin likely rose during the Developmental period and peaked about 750 B.P. in the west and 600 B.P. in the east.

Stone Enclosures in the San Luis Valley

Renuad (1935, 1942a:3) first alerted archaeologists to the presence of stone enclosures in the San Luis Valley, but it was Betty and Harold Huscher (1942, 1943:7) who were the first to attempt a systematic investigation of what they called "non-Pueblo masonry ruins." During three field seasons in 1939, 1940, and 1941 the Huschers documented 35 sites containing more than 200 enclosures, scattered throughout southern and western Colorado and including several sites in the San Luis Valley. In fact, the Huschers' synthesis begins with a detailed description of a prominent site they called "HSH," located close to the town of Saguache (Huscher and Huscher 1943:8). Renaud (1942a:23-27) designated this site "C318" and it is now recorded as 5SH2.

The Huschers (1943:7) firmly believed that the masonry structures they called "hogans," which they expansively define as "circular or curvilinear walls of dry-laid masonry … characteristically built in prominent locations," were the remains of residential structures put up by bands of southward migrating Athapaskans. They marshal multiple lines of evidence to support that interpretation, including architectural data, artifact associations, and historical data, all itemized in comparative trait lists.

Renaud (1942a:47) was skeptical of the Huschers' interpretation, wondering in print whether they were simply affirming the consequent: Navajos build hogans, so ancient hogans must have been built by Navajos. However, Renaud's more circumspect approach was no more productive. Admitting that he could offer no "satisfactory" account of their function or cultural affiliation, Renaud (1942a:46-47) simply notes that the stone enclosures he recorded "all seem eminently fitted to serve as observation posts," and that they were not built by Plains groups, ancestral Puebloans, or Utes.

Although the inventory of surface-documented stone enclosure sites is now much larger than it was when Renaud and the Huschers were working, systematic investigation has only recently begun (Dominguez 2009; Mitchell 2012a, 2015). Recorded stone enclosures in the San Luis Valley occur singly and in groups and range in size from about 1 m in diameter to more than 9 m (Hoefer 1999b). The mean diameter is 4 or 5 m. Mean enclosure area appears to vary systematically among sites containing multiple enclosures. Table 1.10 lists minimum, maximum, and mean sizes of 50 enclosures in five different clusters at four sites. Figure 1.12 illustrates these data. The sample only includes intact structures and a common set of procedures was used to measure the sizes of all 50. The mean sizes of enclosures in each group vary significantly (χ=12.459; df=4; asymptotic sig.=0.014). The largest structures occur at the Mill Creek site, which likely post-dates 1100. The Pole Creek enclosures may be slightly older (Dominguez 2009; Mitchell 2015). The structures at Upper Crossing and Pondo Point are undated, but they may be roughly contemporaneous and older than those on Pole Creek. The size trend illustrated in figure 1.12 therefore suggests a gradual increase in enclosure size over time. Table 1.10 also shows that structures at Upper Crossing vary in size more than structures at other sites.

Enclosure morphologies range from circular to oval to subrectangular. Many are entirely closed but open or semi-circular structures are also common. The sizes of foundation rocks vary, but blocks 50 cm long or larger are common. Foundation heights vary from as low as 10 cm to as high as 80 cm. Some enclosure sites also contain low, meandering walls or one or more cairns.

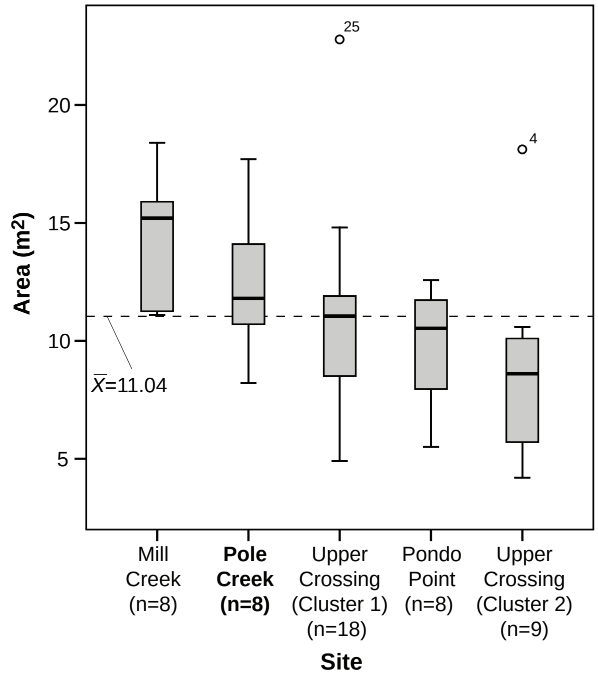

Figure 1.12. Box-and-whisker plot comparing the sizes of enclosures at four sites. Each cluster at Upper Crossing includes a single especially large structure, represented by an open circle. (Mitchell 2015:Figure 2.20).

Mitchell (2015) analyzes survey-level data on a sample of 158 sites with stone enclosures located in the five counties that encompass the San Luis Valley (figure 1.13 [spatial data are not available for nine sites in the sample]). Although functional and temporal variability is evident among the sites in the sample, the most common site consists of a single enclosure associated with few or no artifacts. Fifty-six percent of the sites consist of just one enclosure (figure

Table 1.10. Summary data on the sizes of intact stone enclosures at four sites in the San Luis Valley.

Site	N	Minimum (m^2)	Maximum (m^2)	Mean (m^2)	Std. Deviation (m^2)	Coefficient of Variation
Upper Crossing, Cluster 2 (5SH134)[a]	9	4.2	18.1	8.64	4.26	0.49
Pondo Point (5SH1838)[b]	8	7.5	12.6	9.81	2.46	0.25
Upper Crossing, Cluster 1 (5SH134)[a]	18	4.9	22.8	10.98	3.98	0.36
Pole Creek (5SH3484)	8	8.2	17.7	12.39	2.91	0.23
Mill Creek (5SH354)[b]	7	11.1	18.4	14.14	2.93	0.21
Total	50	4.2	22.8	11.04	3.82	0.35

[a] Data from Mitchell (2012a).
[b] Unpublished PCRG data.

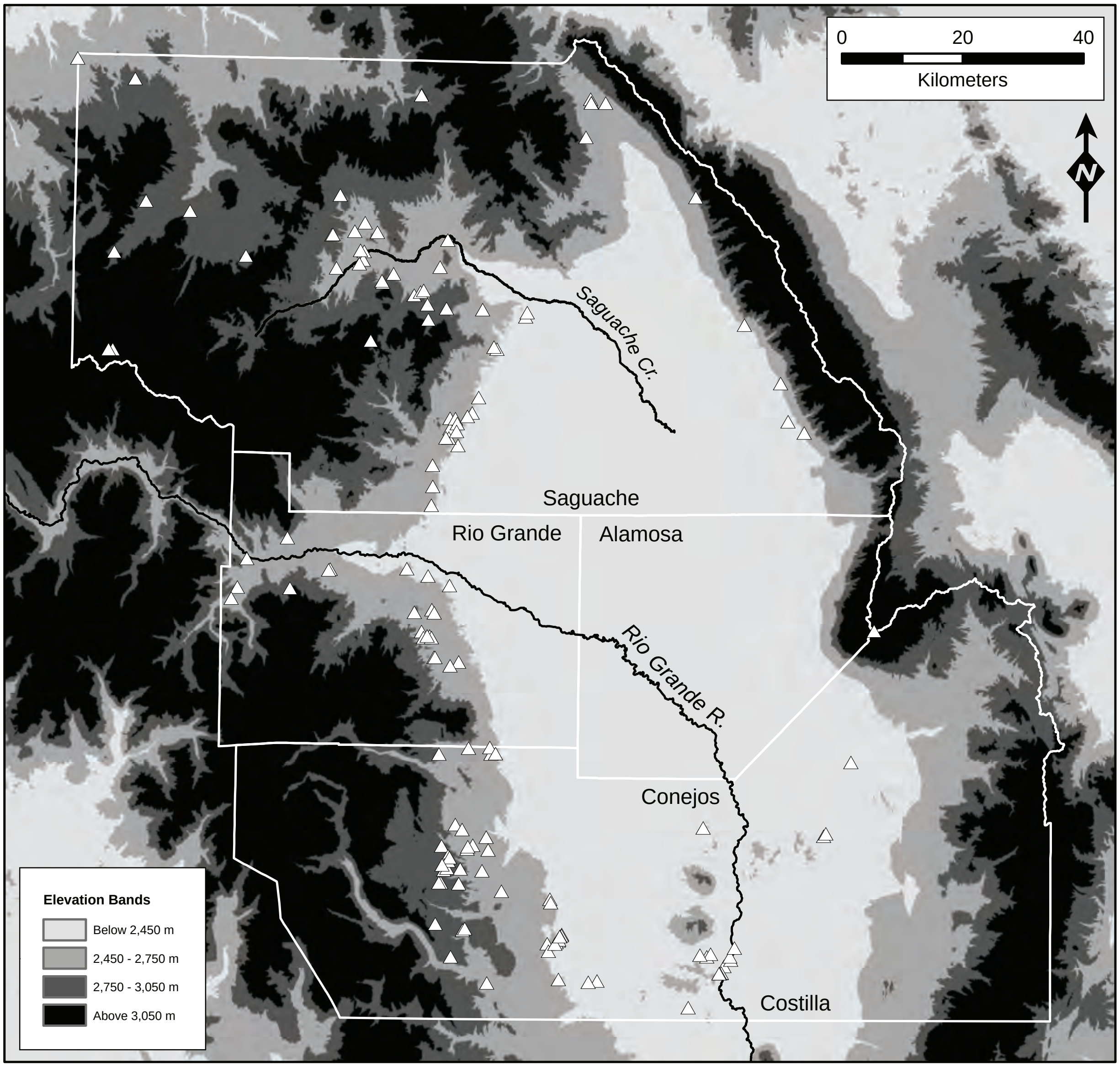

Figure 1.13. Map showing the distribution of 149 architectural sites containing one or more stone enclosures in the five counties encompassing the San Luis Valley. Spatial data are not available for nine enclosure sites. (Mitchell 2015:Figure 3.2).

1.14). The mean number of enclosures per site is 2.8 and the median is one. Just 18 sites include of five or more enclosures. Fifty-two percent of enclosure sites lack artifacts entirely or only have a small, functionally limited assemblage. Just 23 percent have a large, diverse assemblage.

The spatial distribution of enclosure sites is dissimilar to the overall distribution of American Indian sites in the San Luis Valley. Open camps and open lithic scatters are located throughout the valley and adjacent foothills and mountains, whereas enclosure sites are primarily concentrated in the piñon-juniper and lower ponderosa pine belt, between about 2,450 and 2,750 m. That difference in distributions indicates that the marked concentration of enclosure sites is not a function of the location of archaeological inventories but instead reflects a preference for those ecological zones. Enclosure sites may be more common on the west side of the valley than on the east side, although additional data are required to fully evaluate that hypothesis.

The largest sites, as measured by the number of

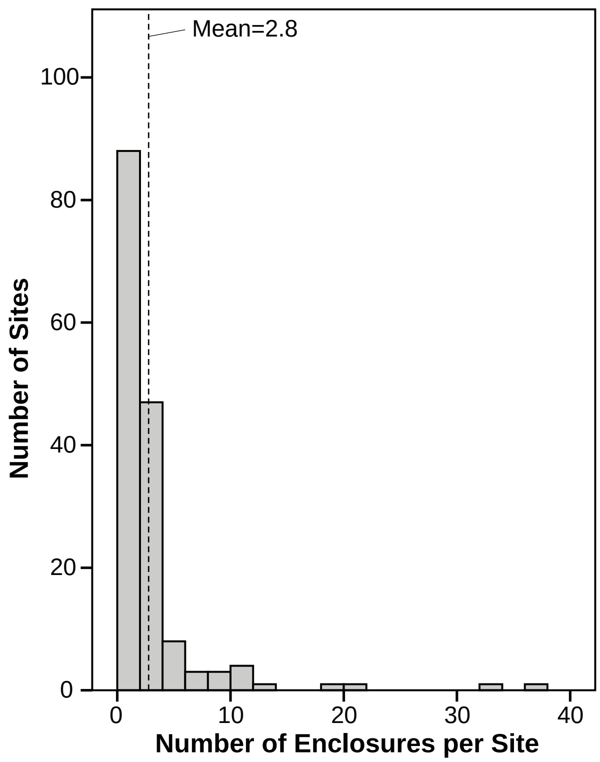

Figure 1.14. Histogram showing the number of enclosures per enclosure site. (Mitchell 2015:Figure 3.5).

enclosures, are concentrated in the Saguache Creek valley (figure 1.15). They include sites with different use-intensities as well as sites of different ages. Site use-intensity varies with respect to site size, but not with respect to elevation or proximity to a permanent water source.

Limited temporal data suggest that many, and perhaps most, of the San Luis Valley's enclosure sites were occupied during the millennium spanning the adoption of the bow and arrow around 1900 years ago. However, radiocarbon and pottery data demonstrate that at least some enclosures were occupied as late as 750 B.P. Together, temporal and use-intensity data point to a peak in the use of enclosure sites as residential base camps, likely during the winter, between about 2500 and 1500 B.P.

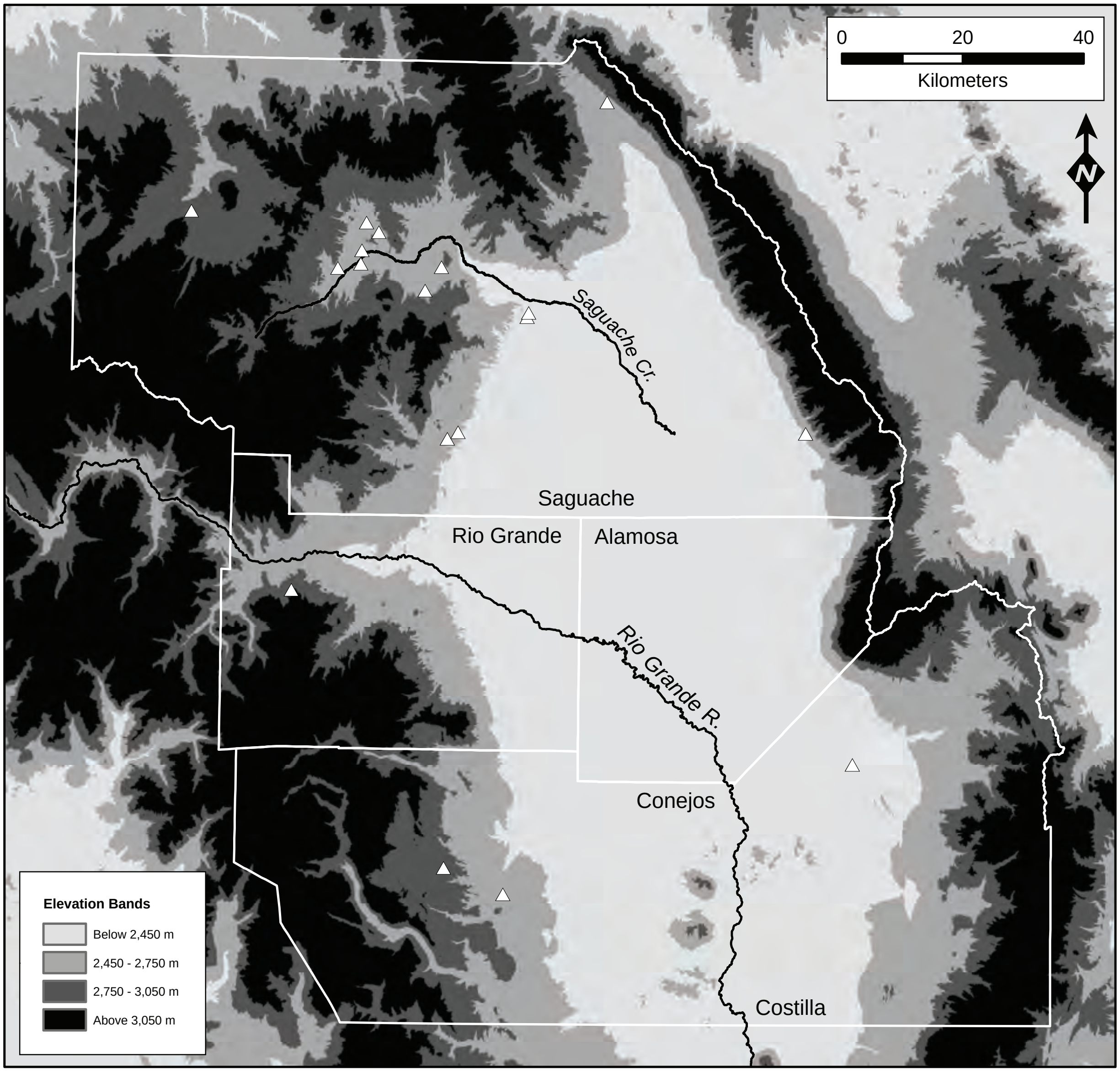

Figure 1.15. Map showing the distribution of 18 architectural sites containing five or more enclosures (Mitchell 2015:Figure 3.6).

2

Field Investigation

Mark D. Mitchell

On June 10 and 11, 2014 PCRG Research Director Mark Mitchell and Rio Grande National Forest Heritage Program Manager Angie Krall established a site grid and selected excavation unit locations. Fieldwork began on June 23 and continued through July 2. The field crew included 23 individuals, who together devoted 1,184 person-hours (148 person-days) to the effort. More than 80 percent of that time (960 person-hours or 120 person-days) was donated to the project. Mitchell served as field director. Assistant field directors were University of Colorado (CU) graduate students Lindsay Johansson and Jen Deats. Bureau of Land Management Staff Archaeologist Brian Fredericks and Forest Service Archaeologist Marcy Reiser helped manage the field investigation. The field crew consisted of PCRG member volunteers, CU undergraduate anthropology students, and Forest Service interns. The CU students were Lora Cannon, Kirsten Jaqua, Jackson Lincoln, Shelby Magee, and Rob Reibold. PCRG volunteers included Ben Bain, Chris Caseldine, Mona Charles, Sara Cullen, Scott Erler, Mary Ann Gabriel, Carla Hendrickson, Dan Jepson, Warren Nolan, Rin Porter, and Alex Wesson. The Forest Service interns were Rhen Hirsch and Margaret Smith.

In early October 2014, a PCRG and Forest Service crew returned to the site to obtain low-altitude aerial images of selected portions of the site. Mitchell and Krall directed the fieldwork and the crew included PCRG Project Archaeologist Chris Johnston, BLM Archaeologist Brian Fredericks, and volunteers Reba and Mitch Hermann, Dan Jepson, Meg Van Ness, and Greg Wolff. Adam Wiewel, PCRG Research Associate and University of Arkansas Ph.D. candidate, later used the aerial images to create a digital elevation model of the site.

The 2014 field investigation focused on four of the 20 stone enclosures that make up Cluster 1, which is located on a structural bench overlooking Saguache

2017 *Archaeology of the Upper Crossing Stone Enclosures, Saguache County, Colorado,* by Mark D. Mitchell and Carl R. Falk, pp. 29-55. Research Contribution 99. Paleocultural Research Group, Broomfield, Colorado.

Creek (figure 2.1). Table 2.1 provides data on the Cluster 1 enclosures. Mitchell (2012a) presents descriptions and plan views of 19 Cluster 1 enclosures; one additional enclosure, designated Feature 35, was identified in 2014.

A variety of criteria were used to select enclosures for testing. Primary criteria included the depth and richness of interior cultural deposits. Fieldwork conducted in 1999 and 2009 showed that the content

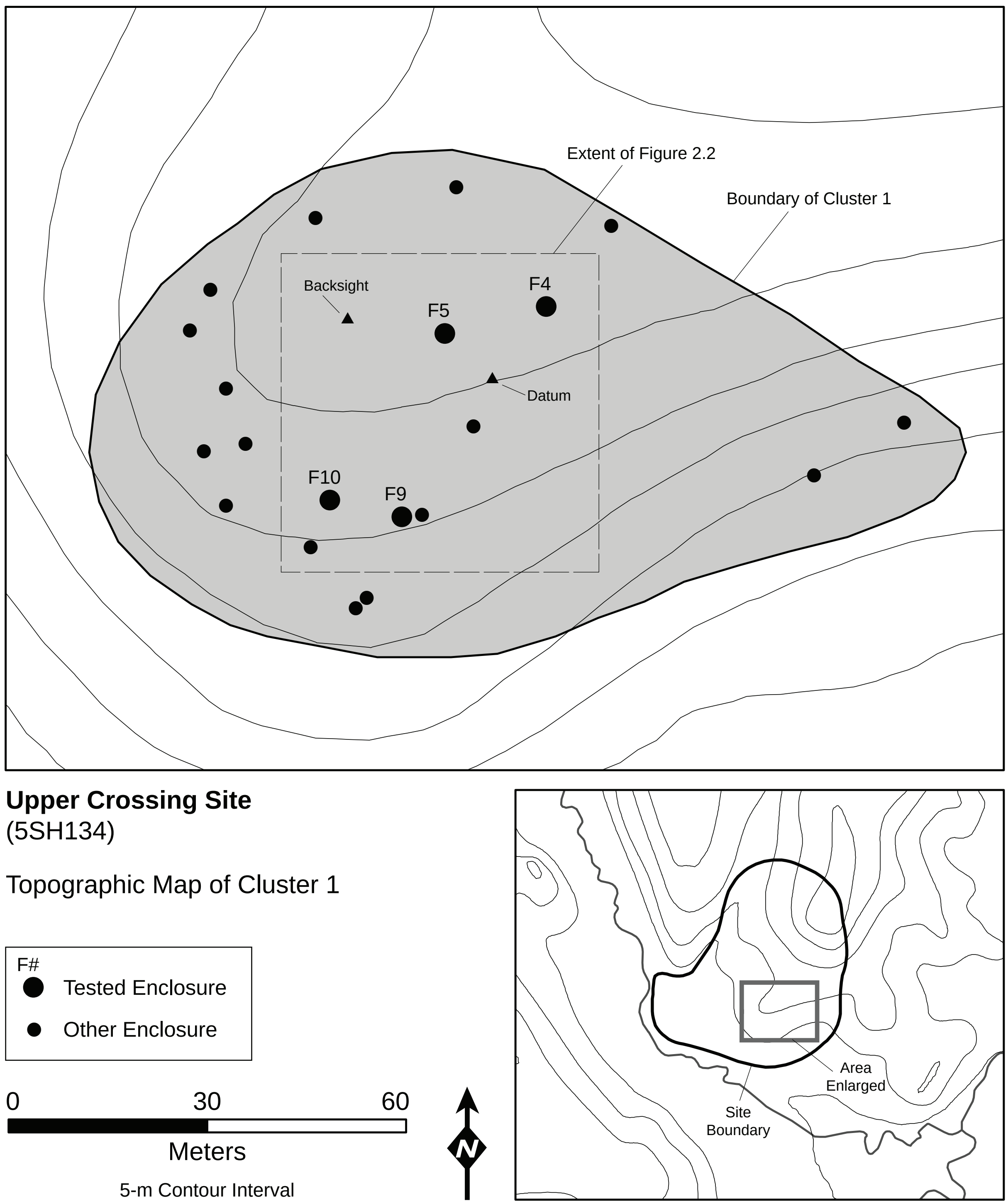

Figure 2.1. Topographic map showing the distribution of stone enclosures in Cluster 1 and the locations of the four tested enclosures.

Table 2.1. Summary data on Cluster 1 stone enclosures (Mitchell 2012a:Table 3.1). Tested enclosures are highlighted.

Feature Number	Field Year[a]	Dimensions (m)[b]	Floor Area (m^2)[c]	Vertical Bedrock	Surface Modification[d]	Entryway[e]
2	1999	3.7x3.7	10.8	NW	fill (SW)	none observed
4	1999	3.0x4.3	10.1	NW	cut (N)	S (?)
5	1999	4.5x3.9	13.8	NW	none	SE
6	1999	3.2x3.4	8.5	NW	fill (SE)	S (?)
7	2001	3.5x4.3	11.8	none	none	no data
9	2001	4.1x4.1	13.2	none	cut (NW, W); fill? (SE)	SE
10	2001	4.1x3.7	11.9	SW	cut (W); fill (E)	NE
11	2001	4.2x4.5 (5.5x5.0)[f]	14.8 (21.6)	N, NE	cut (W)	SE (?)
12	2001	4.2x3.0	9.9	none	cut (W)	none observed
13	2001	2.9x2.8	6.4	S	cut (NW)	no data
15	2001	2.5x2.5	4.9	none	none	SE
16	2001	no data	no data	NW, SE	cut (N, NE)	no data
17	2009	3.9x3.7	11.3	N	none	S (?)
18	2009	3.3x4.5	11.7	none	none	no data
19	2009	2.5x3.1	6.1	none	none	E
21	2009	3.5x4.2	11.5	NW, NE, SE, S	none	no data
22	2009	3.5x6.5	22.8[g]	NW	fill (SE)	none observed
33	2009	4.0x2.0	8.0[g]	E	none	no data
34	1977	4.3x3.0	10.1	N	fill (S, SE)	W (?)
35	2014	4.2x4.2	13.9	none	None	no data

[a] Year first recorded.
[b] See Mitchell (2012a) for explanation of measurements.
[c] Except as noted, the formula for the area of a circle or ellipse was used to calculate structure sizes.
[d] Based on 2009 surface recordation.
[e] *No data* indicates that the wall is too poorly preserved to determine the position of the entryway; *none observed* indicates that the wall is continuous or substantially complete.
[f] Two measurements are given owing to uncertainty about wall alignment.
[g] Rectangular area.

and thickness of interior deposits vary among Cluster 1 enclosures (Mitchell 2012a). In 2014, a 1-inch Oakfield soil probe was used to obtain additional qualitative data on fill depth and richness. The density and types of surface artifacts, both inside and outside to the enclosures, were also considered. Enclosures associated with abundant, diverse surface artifact assemblages were selected over those associated with few artifacts.

Another important criterion was foundation integrity. Although nearly all of the Cluster 1 enclosures are intact, differences exist among them in foundation preservation. In addition, variations in preservation exist within individual enclosures. Enclosures exhibiting the least post-occupation disturbance were selected.

Secondary criteria were then used to further narrow the list of candidate structures and to select specific excavation locations within those structures. The research team wished to document variations in enclosure construction techniques and so structures exhibiting different orientations and sizes of foundation stones were selected. Enclosures exhibiting two different types of pre-construction surface modification were also selected. Finally, one excavation unit was positioned to capture data on a possible ground-level entryway. None of the selected enclosures had been tested previously.

Field Methods

Vertical control for the excavation was provided by a standard northing-and-easting grid system. The primary datum, consisting of an aluminum-capped steel reinforcing rod (arbitrarily designated 300NE600, Z100.000), is located in the southeast quadrant of Cluster 1. This datum point also was used during the 1999 Forest Service field investigation (Mitchell 2012a:67-72). Cobbles and small blocks were piled around the datum to make it more visible. A backsight was established near the crest of Cluster 1, at 309.434NE577.775, Z102.528 (HzA 293°). Like the primary datum, the backsight is marked by an aluminum-capped steel reinforcing rod. The excavation grid is aligned to true north, which during June 2014 was 9° 6' 32" west of magnetic north.

The horizontal position of each excavation block was measured on the site grid. However, the excavation blocks were oriented perpendicular to the axes of the investigated enclosures' foundation, rather than to a specific grid azimuth. For this reason, locational descriptions in this chapter refer to approximate cardinal or intercardinal directions. In addition, because the blocks are not oriented to a grid azimuth, horizontal positions within each block are not easily converted to grid positions. However, depths were measured from local datums tied to the site grid system; those elevations are reported in this chapter as grid elevations.

Each excavation block spanned the axis of an enclosure foundation, with approximately half of the block falling inside the enclosure and half falling outside. Two of the four blocks were later extended by adding an excavation square on the interior of the enclosure. Excavation blocks were assigned numerical designations. Each block was further partitioned into squares or units, each of which was assigned a letter designation. The squares comprising the blocks were excavated separately. A plan map of each block showing rocks exposed on the surface was drawn prior to excavation.

Excavation levels were classified either as "general levels" (GL) if they included material from the entire unit or as "feature levels" (FL) if they only included material from a defined and numbered cultural feature. Excavation was carried out exclusively with trowels, brushes, and other small hand tools. All excavated sediment was dryscreened through ¼-inch hardware cloth; artifacts, bones, and burned rock were picked from the screen by hand and bagged by level. Material class sorting was accomplished in the lab; no sorting was undertaken in the field.

Data on each excavated level were recorded on forms designed for the project. Basic data on these forms include the unit's location and designation, excavation depths, and associated catalog numbers. The forms include spaces for excavators to write short narratives describing the sediment and artifacts they observed and documenting problems they encountered during the course of excavation. A plan map was drawn at the end of each level; in a few cases, maps depicting intermediate depths were also drawn. Profile drawings were made of most of the block elevations. Completed levels were photographed, as were features and profiles. Catalog numbers were assigned in the field to each arbitrary level and all of the objects recovered during the excavation of that level were grouped under that number. Individual items also were plotted and assigned separate catalog numbers. In a few cases, notable items recovered during screening were assigned separate catalog numbers.

The volume of each level was determined by multiplying the mean level thickness by the excavated area exclusive of large rocks. The excavated area was estimated from level plan maps. For each level, each 100 cm^2 block (a 10 x 10-cm map unit) was examined to determine whether a large stone is present. Large rocks included those spanning two or more 10 x 10-cm map units. If 50 percent or more of a map unit is shown as sediment (or small stones) it was included in the area calculation. If less than 50 percent is shown as sediment it was excluded from the calculation. Mean thickness was calculated from five measurements derived from elevation differences in corner and center depths.

The remainder of this chapter describes the course of excavation in each block and the strata and features encountered. A summary of the occupation history and architecture of each structure is included in the block descriptions. Corrected radiocarbon ages are reported in this chapter but discussed in more detail in chapter 3. Throughout this chapter the term *native* is used to describe excavated sediment and stones that retained in their original pre-occupation location. In contrast, the terms *placed* and *emplaced* are used to describe stones and sediment repositioned or redeposited by the site's occupants.

Excavation Results

Figure 2.2 illustrates the locations and orientations of the four excavation blocks. Metric and other data on each block are given in table 2.2. A total of 10.5 m^2 was excavated. The calculated total excavated volume is approximately 1,680 liters. Seven cultural features were exposed. Portions of three of the seven, totaling 54.5 liters, were excavated under separate catalog numbers. Table 2.3 gives excavation volume data for each block and unit. The following sections describe the results obtained in each excavation block. The chapter's final section integrates these results.

Excavation Block 1

Block 1 was a 1 x 2.5-m excavation positioned across the northeastern section of the Enclosure 5 foundation.

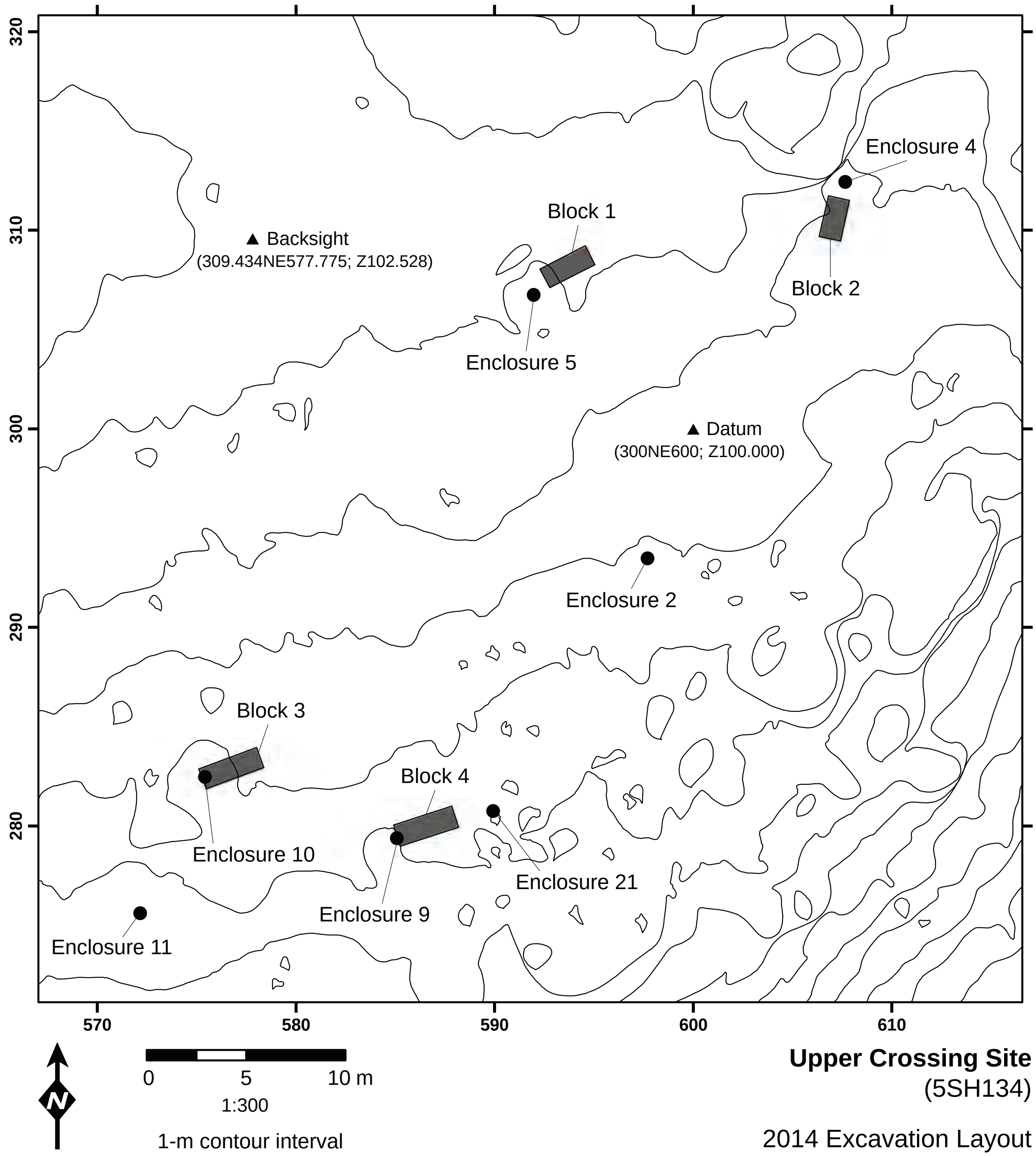

Figure 2.2. Topographic map showing the locations and orientations of the 2014 excavation blocks.

Table 2.2. Summary data on the 2014 excavation blocks.

Excavation Block	Block Size (m)	Local Datum Depth	Number of General Levels	Number of Features
1	1 x 2.5	(1) 101.43	5	1
		(2) 101.78	3	-
2	1 x 2	100.33	8	-
3	1 x 3	98.90	12	5
4	1 x 3	97.90	10	1
Total	10.5 m^2	-	38	7

Table 2.3. Excavation volume data.

Block	Unit	General Level Volume (liters)	Feature Level Volume (liters)	Total (liters)
1	A	57.1		57.1
	B	105.9	47.6	153.5
	C	60.0		60.0
2	A	114.2		114.2
	B	280.3		280.3
3	A	190.4	1.6	192
	B	207.6		207.6
	C	207.1	5.3	212.4
4	A	57.1		57.1
	B	112.9		112.9
	C	236.5		236.5
Total		1,629.1	54.5	1,683.6

Enclosure 5 is a circular to oval structure located close to the center of Cluster 1 that encompasses roughly 13.8 m^2 and incorporates on its northwest side a large, weathered, one-meter-high boulder (figures 2.2, 2.3, and 2.4). Apart from a narrow gap in the southeast, the density of slabs and blocks making up the foundation wall is relatively uniform. Many of the topmost stones are set on end, with interior slabs leaning outward and exterior slabs leaning inward. The foundation's sill blocks mostly are massive and set horizontally. Prior to excavation, charcoal-stained sediment, along with a variety of artifacts, including flaking debris and ground stone tool fragments, was visible on the modern surface both inside and outside the structure.

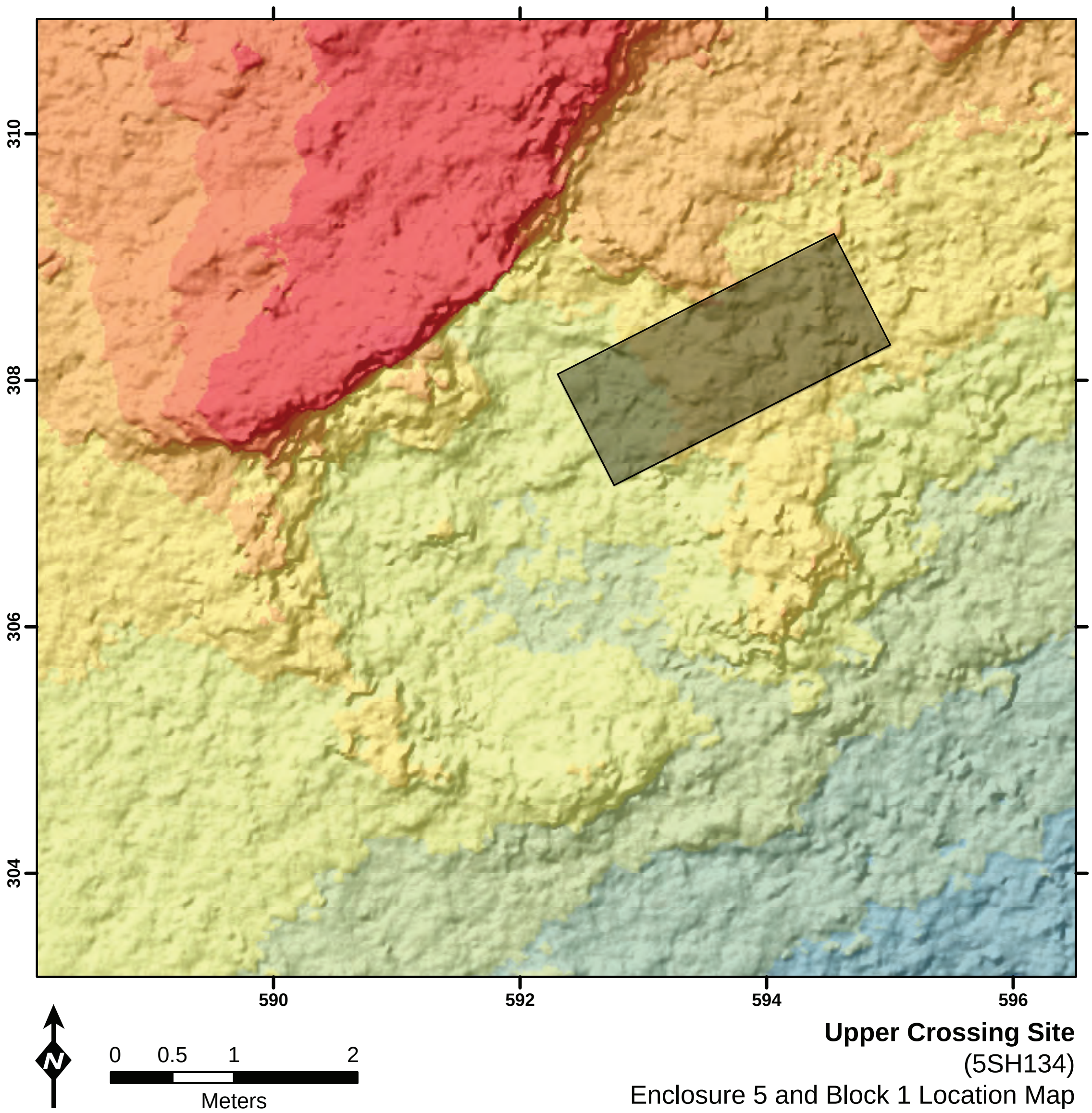

Figure 2.3. Digital elevation model and hillshade map of Enclosure 5 showing the location of Block 1.

Figure 2.4. Photograph of Enclosure 5 prior to excavation; view to the north (L-R: Mark Mitchell, Lindsay Johansson, Jen Deats).

Excavation began outside the enclosure, in Unit 1A. The upper 1 to 2 cm of sediment consisted of loose aeolian silt and sand (figure 2.5). Below that was a compact, dark grayish-brown sand and silt deposit containing burned rock, stone tools, flaking debris, faunal remains, and charcoal flecks. Flaking debris occurred throughout this 5 to 10 cm-thick layer, but burned rock was more abundant near the top. Most artifacts were flat-lying. The darkest sediment and a majority of the artifacts were banked against the outside of the foundation's large sill blocks. Inward-slanting exterior slabs capped this cultural deposit; several of these slabs appeared to have slid downward and to the east, away from the wall.

In the center and on the east side of Unit 1A, a contact between cultural materials and underlying native sediment was observed at 10 to 17 cm below the surface (101.51 to 101.44 m). This contact was marked by the appearance of very compact, brown inorganic sediment containing carbonate flecks and stringers and abundant, interlocking cobbles 5 to 10 cm across. Excavation stopped immediately below this contact at an elevation of 101.43 m (figure 2.6).

The excavation effort then shifted to Unit 1B, located inside the enclosure. As was the case in Unit 1A, the upper 1 to 2 cm of sediment consisted of loose silt and sand. Several tabular foundation stones were lying on or partially buried in that loose sediment. Immediately below the surficial silt and sand layer was a 16 to 18 cm-thick, black cultural deposit containing numerous artifacts, faunal remains, and pieces of burned rock. Two arrowpoint fragments were recovered from this stratum [3186]. One is non-diagnostic, but the other could be a fragment of a side-notched point. The densities of artifacts, charcoal pieces, and bones increased with depth, but no internal stratigraphy was observed. All of the plotted artifacts within this stratum were flat-lying. This stratum was banked against, and therefore post-dates, the tightly interlocking stones forming the lower portion of the foundation (figure 2.7).

The base of that black cultural deposit, which

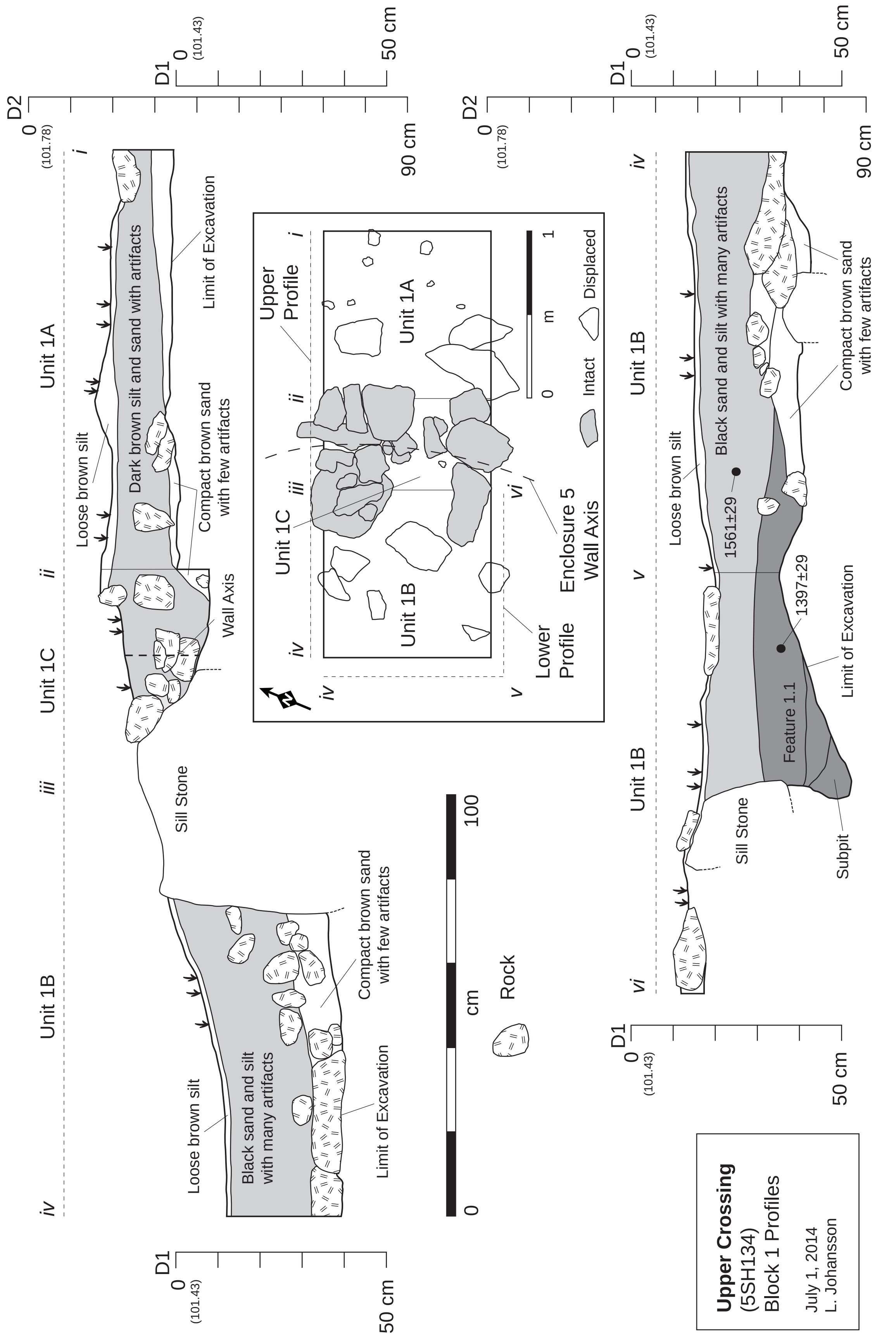

Figure 2.5. Block 1 profiles.

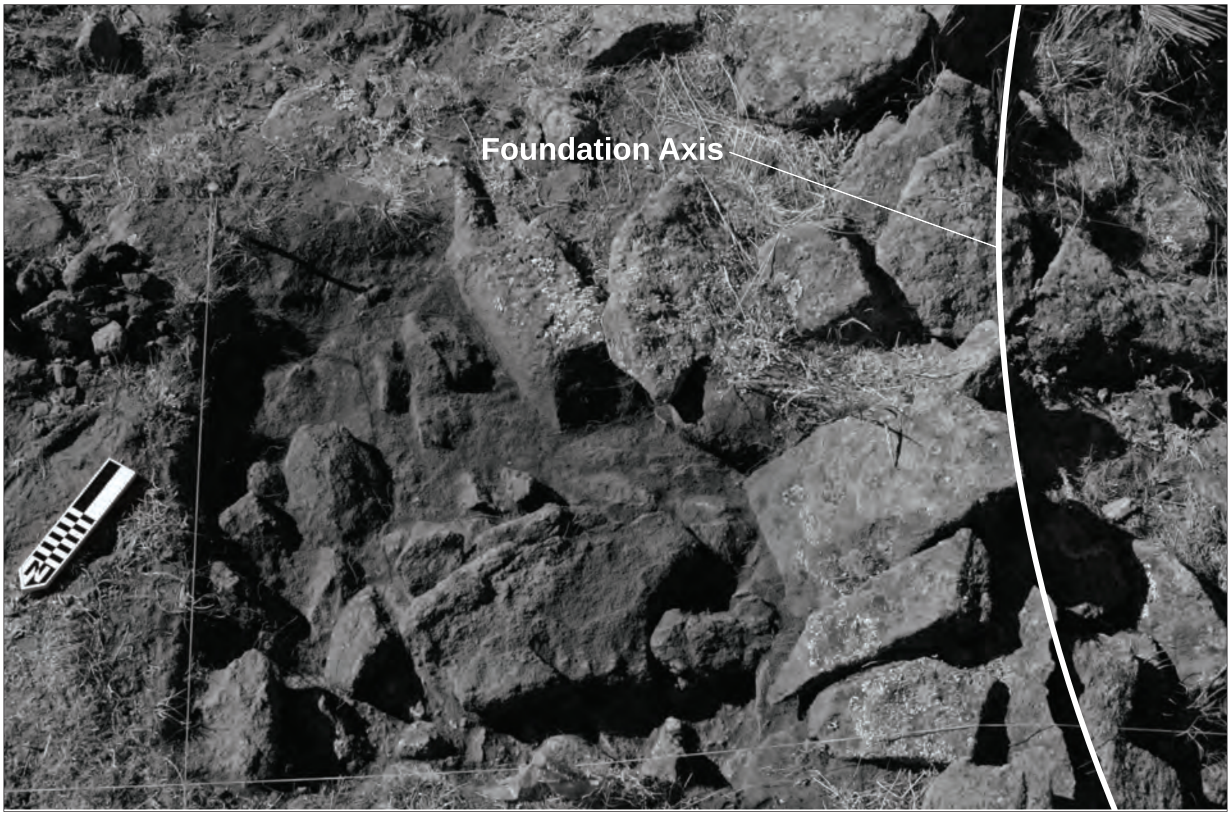

Figure 2.6. Photograph of the base of GL2 in Unit 1A, located outside Enclosure 5.

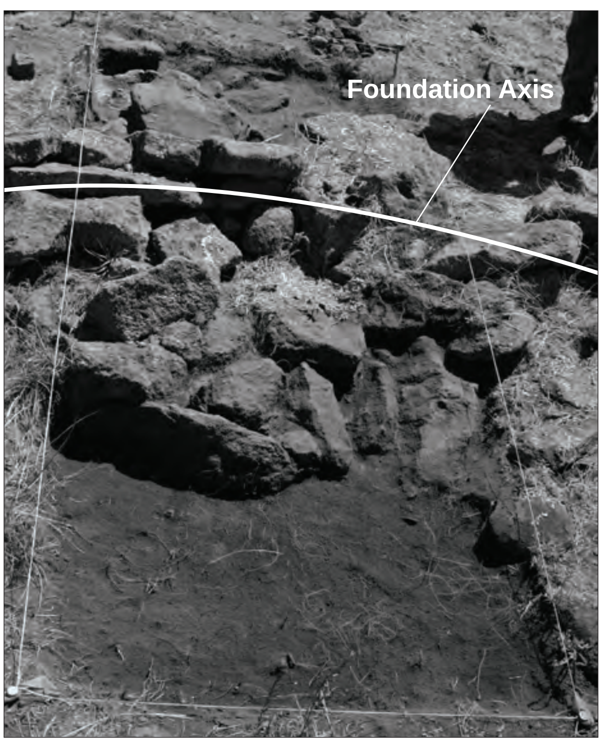

Figure 2.7. Photograph of the base of GL1 in Unit 1B, located inside Enclosure 5.

marked the undulating but essentially flat floor of the enclosure, was encountered between 101.08 and 101.04 m (figures 2.8 and 2.9). Cobbles and small tabular blocks were scattered on and above the floor close to the foundation wall; these may have fallen onto the floor from the top of the foundation wall when the structure collapsed. Beneath the house fill deposit was a lighter, more compact silt and sand layer containing few artifacts and charcoal flecks. This stratum likely represents sediment emplaced by the builders to smooth the floor and fill gaps between exposed native stones. A layer of poorly sorted, light brown silt, sand, and gravel containing decomposing cobbles was encountered below the emplaced floor layer. Calcium carbonate stringers occurred in the light brown layer, but not in the overlying floor layer or in the house fill.

Feature 1.1, a shallow basin hearth, was first defined at about 101.11 m, in the upper portion of GL3 (101.15-101.05 m). The feature originated at the floor of the enclosure and abutted the lower foundation stones. The emplaced floor stratum extends into the basin, indicating that the hearth was integral to the enclosure's initial construction. The feature's fill consisted of loose, charcoal-rich sediment containing abundant

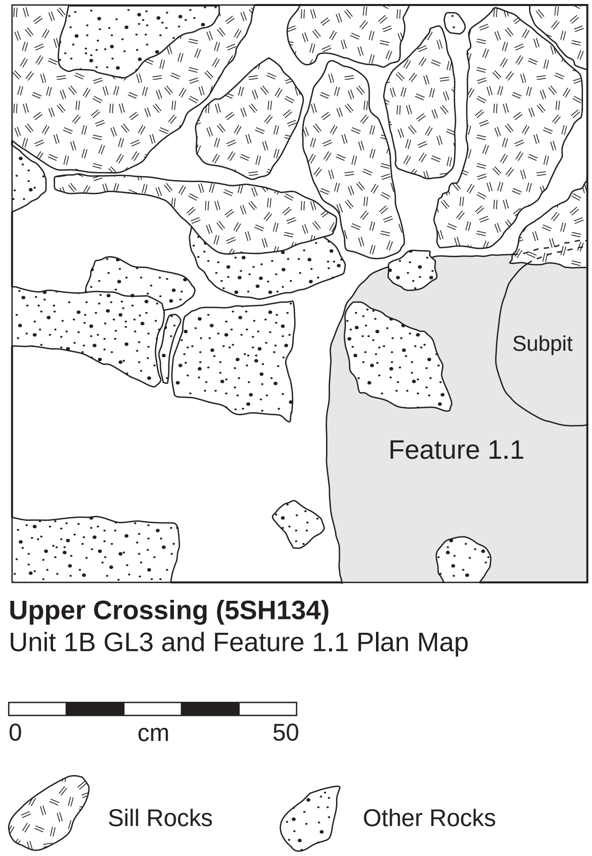

Figure 2.8. Plan map of the base of GL3 in Unit 1B showing the location of Feature 1.1.

flaking debris, faunal remains, and burned rocks; a bulk sample of this fill was collected for botanical analysis [CN3226]. A lens of ashy sediment occurred near the base of the feature. A small bag-shaped sub-pit in the base of Feature 1.1 extended a few centimeters under the lowest foundation blocks. Two charcoal samples, including one from the fill of the structure and one from Feature 1.1, were submitted for AMS radiocarbon dating, yielding ages of 1561±29 and 1397±29 ^{14}C yr B.P., respectively

Work in Block 1 concluded with the excavation of Unit 1C, an approximately 50-cm-wide unit centered on the enclosure foundation and located between Unit 1A and Unit 1B. Excavation primarily involved unpacking and removing foundation stones. The topmost layer of stones consisted of leaning tabular slabs. Most of these measured 20 to 40 cm long, 10 to 30 cm wide, and 3 to 5 cm thick. Beneath that layer of leaning slabs was a tightly packed set of large, flat-lying blocks and slabs. Smaller stones were wedged between those large sill blocks. The cultural layer observed in Unit 1A, outside and beneath the upper foundation stones, extended in Unit 1C to an elevation of about 101.37 m. Below that was mottled sediment containing a small number of flakes, stone tools, and pieces of charcoal. That mottled sediment was packed around and between the blocks and stones forming the foundation wall. The number of artifacts and charcoal flecks decreased with depth.

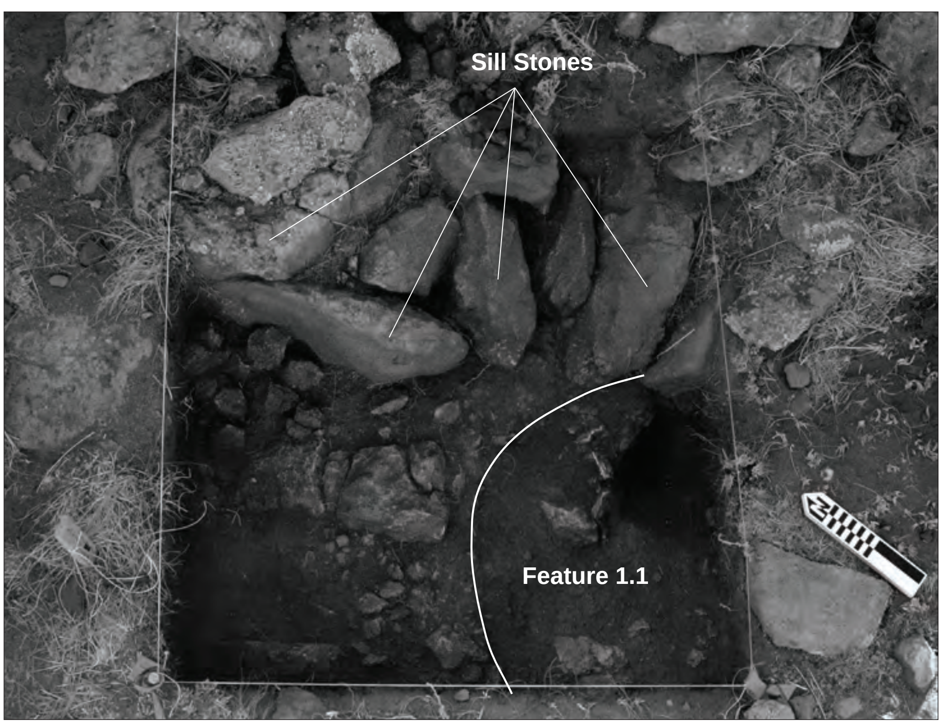

Figure 2.9. Photograph of Unit 1B, showing the foundation wall of Enclosure 5 and the location of Feature 1.1. Photograph was taken after the excavation of Feature 1.1, but before work in GL3 was completed.

At approximately 101.28 m, a very compact, light brown silt and sand layer containing decomposing rock was encountered (figure 2.10). Rocks in that layer were tightly packed and unoriented. The contact between the compact brown sediment and the overlying strata sloped upward to the east, indicating that it represented the base of the pit over which Enclosure 5 was constructed.

Architectural Reconstruction and Occupation History

Stratigraphic and other data from Block 1 indicate that Enclosure 5 represents a single major construction episode. Construction began with the excavation of a slightly oblong pit roughly 5.5 m long, 5 m wide, and 35 to 40 cm deep. Massive blocks and slabs were then set on the edge of the pit at the floor level. The largest of the observed foundation blocks measured 70 cm long, 50 cm wide, and 40 cm high. The close fit between the large blocks indicates that they represent a single episode of construction. Smaller rocks and sediment containing scattered artifacts, representing material present on the site surface prior to construction, was then packed between and behind the large sill blocks.

Discontinuous, flat-lying paving stones were placed on the floor of the basin and sediment was packed around them. The resulting floor of the enclosure was level, rather than sloping, but uneven. A hearth was built into the floor, against the low inner wall formed by the sill blocks.

Although direct evidence for the enclosure's superstructure, in the form of post molds or burned logs, was not observed in Block 1, the arrangement of the uppermost foundation stones indicates that poles forming the building's upper walls were socketed into the top of the inner foundation wall. Layers of tabular stones were then placed against those poles, both on the inside and outside. Fired architectural daub was not present in the house fill. The small size of recovered charcoal suggests that the structure did not burn; however, pockets or layers of fine-grained sediment possibly representing melted daub were not observed, suggesting that the log superstructure was covered with brush, thatch, or hides, or some combination of these materials, rather than earth or clay.

Clear evidence for structure remodeling was not observed in Block 1. However, the fact that artifacts and charcoal-stained sediment occurred beneath the

Figure 2.10. Photograph of Unit 1C, showing the foundation wall of Enclosure 5.

uppermost foundation slabs outside the enclosure suggests that the superstructure may have been rebuilt or refurbished on one or more occasions.

Judging by the thickness and richness of the cultural deposit overlying the structure's original floor, Enclosure 5 may have been occupied either continuously or intermittently for a protracted period. Alternatively, household debris generated by the occupants of other nearby structures may have been deposited in Enclosure 5 after it was abandoned. It is not likely that the interior cultural fill washed into the structure, owing to the height of the surrounding foundation stones, to the number and sizes of the artifacts it contains, and to its lack of internal stratigraphy.

Radiocarbon assays indicate that Enclosure 5 dates to the early Late Prehistoric. No clearly diagnostic projectile points were recovered from Block 1. However, two arrowpoint fragments were recovered, one of which may be a lateral fragment of a side-notched point, suggesting a possible late re-occupation of Cluster 1.

Excavation Block 2

Block 2 was a 1 x 2-m excavation placed across the southern foundation wall of Enclosure 4, an oval structure located east of Enclosure 5 (figures 2.2 and 2.11). Constructed primarily from large vertically set slabs and stacked angular boulders, the foundation of Enclosure 4 abuts the southeast face of a 3.5-m-high bedrock outcrop. The foundation's vertical slabs were set on and supported by underlying courses or layers of blocky and tabular elements. The structure's floor was excavated into the slope on the north side. A small piñon pine has grown through the eastern arc of the foundation wall.

Prior to excavation, extensive cultural deposits containing abundant charcoal, burned rock, and burned and unburned flaking debris and stone tools were visible on the surface immediately outside the foundation to the east. Few artifacts were visible on the surface inside the structure, but soil probe data showed that Enclosure 4 is filled with thick, fine-grained cultural deposits.

Excavation began outside the foundation wall in Unit 2A (figures 2.12). The modern ground surface in the unit dips to the south, away from the enclosure's foundation. Two large angular blocks, one measuring 40 cm on each side and another measuring 50 cm wide, 30 cm high, and 25 cm thick, were removed from the surface prior to excavation. Judging by their location, these stones must originally have been elements of the foundation wall. Charcoal-stained sediment containing abundant chipped stone artifacts and animal bones was encountered immediately beneath a 3- to 6-cm-thick veneer of recent aeolian sand and silt. That cultural fill continued under, around, and between the enclosure's foundation stones. The density of artifacts and faunal remains increased with depth. Two projectile points—a large corner-notched point [CN3205] and a small stemmed-indented point [CN3172]—were recovered from GL3 (99.93-99.83 m). Excavation stopped in Unit 2A at the base of GL3, although the lower limit of the cultural deposit was not reached (figure 2.13).

The crew then moved to Unit 2B, which encompasses most of the enclosure's foundation and a narrow strip of the interior. Work in GL1 and GL2 primarily involved disassembling the foundation, which consisted of tightly interlocking vertical slabs and smaller angular blocks (figure 2.14). A gap in the foundation stones may have represented the location of a post socket. The upper 8 or 10 cm of fill between the foundation stones consisted of brown sand and silt containing relatively few artifacts. Beneath this upper stratum was a black silt and sand layer containing abundant flakes and a few pieces of animal bone. This black cultural layer filled the gaps between foundation stones and extended laterally away from the foundation on both the interior and exterior, where it previously had been observed in Unit 2A. A fragment of a millingstone was incorporated into the lower portion of the enclosure foundation in GL2 [CN3227].

The lower limit of the foundation was encountered in GL4, between 99.83 and 99.78 m, although most of the foundation stones did not extend below 99.88 m (figure 2.15). The lowest layer of foundation stones consisted of horizontally placed tabular blocks. A thin skiff of lighter sediment occurred beneath a few of the foundation stones. However, the dark cultural deposit surrounding the foundation stones continued without obvious interruption beneath them. An unusual halfed drill was recovered from 99.77 m, beneath a large wall stone [CN3243]. A charcoal sample recovered from Unit 2B at an elevation of 99.76 m yielded a radiocarbon age of 2816±30 ^{14}C yr B.P.

Lighter-colored, coarser sediment that had been displaced upward by burrowing insects was encountered in GL5 at 99.71 m. A sharp contact between that lighter sediment, which contained few artifacts, and the overlying black cultural deposit occurred at 99.68 m, near the base of GL5 (figure 2.16). Clay films occur on sand grains and small clasts in the lighter stratum,

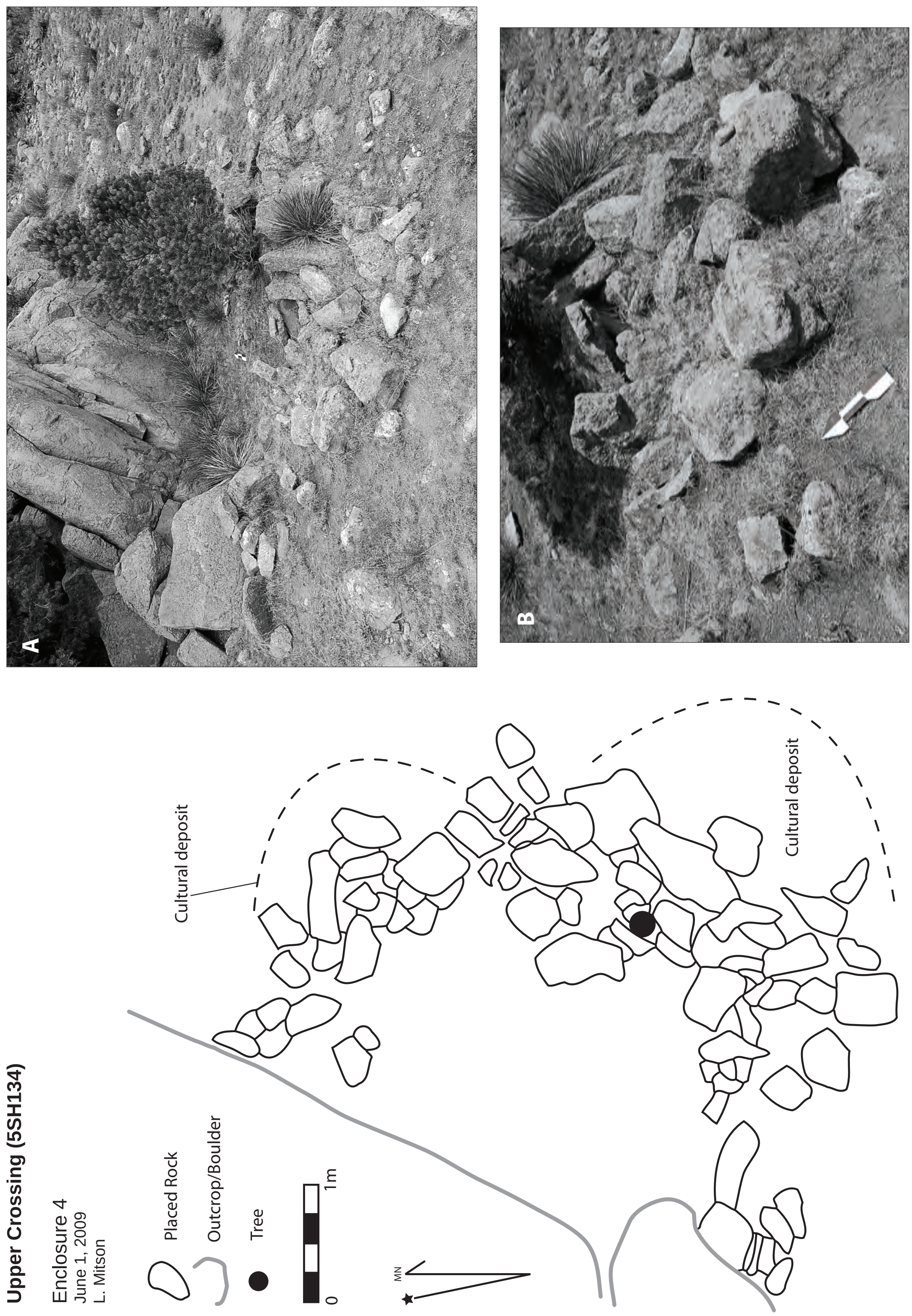

Figure 2.11. Plan map and photographs of Enclosure 4. A: Overview, looking north; B: Wall detail, looking northeast.

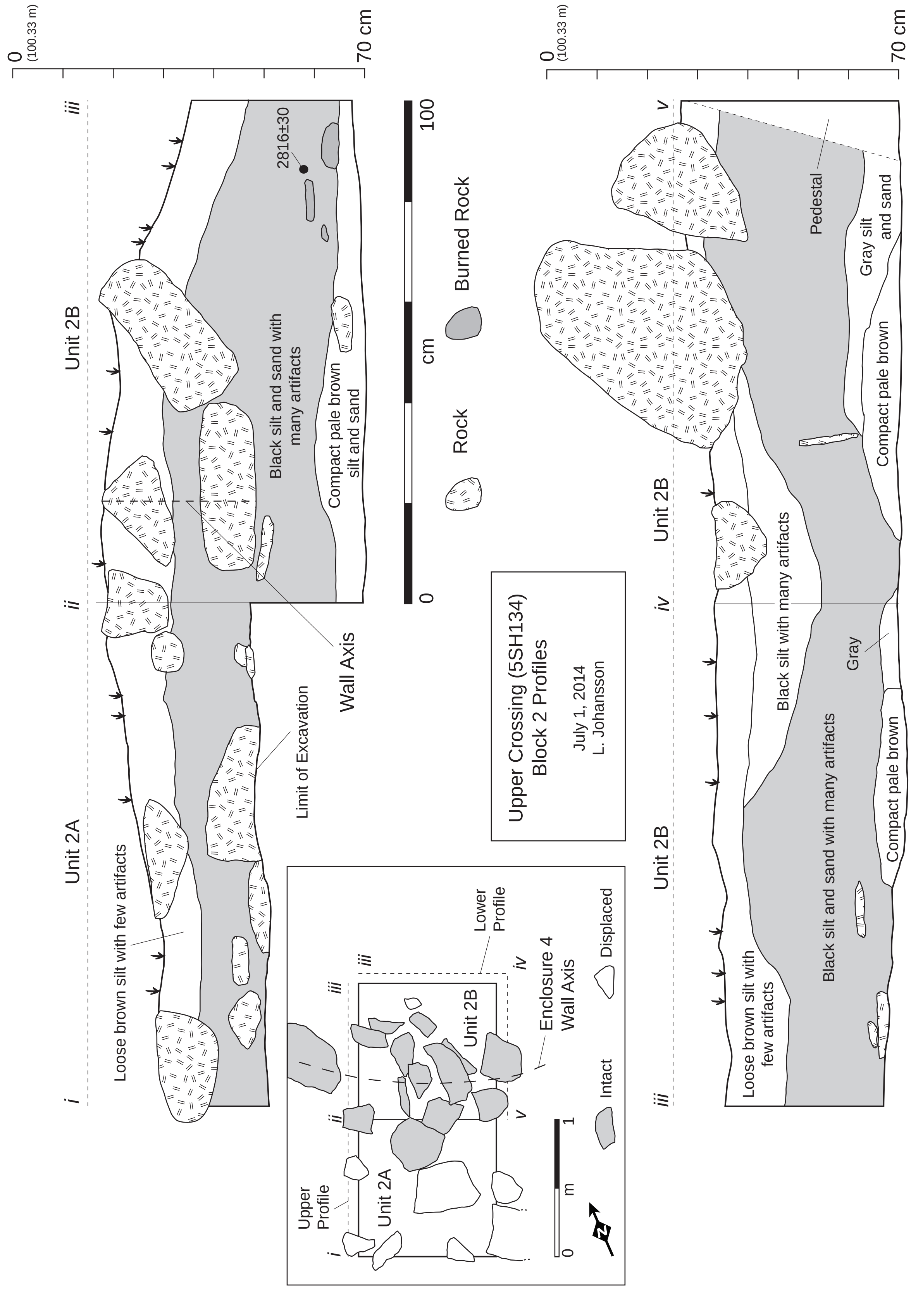

Figure 2.12. Block 2 profiles.

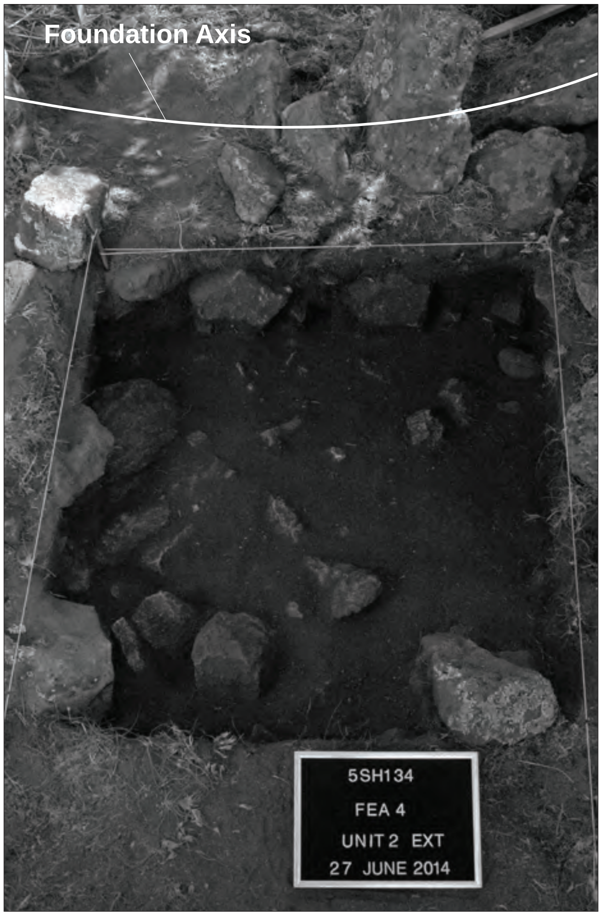

Figure 2.13. Photograph of GL3 in Unit 2A.

suggesting that it represents a truncated B horizon. However, calcium carbonate is not present. Long-axis profiles of Block 2, as well as a short septum profile between Unit 2A and Unit 2B, show that the contact rises gently to the south, away from the enclosure's interior. Several flat slabs rested on the contact, including a heavily burned, shaped rectangular slab 22 cm wide, 27 cm long, and 2 cm thick.

Following the completion of GL5, several large wall stones were removed from the upper portion of the unit profile, the supporting pedestals were removed, and the profiles were cleaned and straightened.

Architectural Reconstruction and Occupation History

Data obtained from the Block 2 excavation clearly show that Enclosure 4 was built on top of extensive preexisting cultural deposits. The presence inside the foundation wall of charcoal-rich fill containing abundant artifacts indicates that older cultural deposits were used to build Enclosure 4. Those older deposits likely derived from the fill of a Late Archaic basin house that underlies Enclosure 4. Intact deposits dated to the Late Archaic were exposed in the lowest two general levels in Unit 2B. Although specific structural elements of an earlier house were not observed in Block 2, the apparent absence of a stone foundation suggests that the superstructure may have consisted of a lightly built, brush- or hide-covered pole framework. The sloping surface of the contact between lighter sediment and overlying black cultural fill, along with the fact that the lighter sediment appears to represent a truncated B horizon, suggests that the earlier structure was built over a shallow basin.

Posts or post molds associated with Enclosure 4 were not observed in Block 2. However, a gap in the foundation stones suggests that elements of the building's superstructure were socketed into the foundation. The notably large size of the foundation stones, including two very large blocks that apparently had fallen to the outside, indicates that the Enclosure 4 superstructure was substantial and may have

Figure 2.14. Photographs showing the foundation of Enclosure 4. Right: exterior; left: interior.

Figure 2.15. Photograph of the base of GL3 in Unit 2B, showing the base of the foundation of Enclosure 4.

Figure 2.16. Photograph of the east profile of Unit 2B, showing the contact between the cultural deposit and the underlying truncated B horizon.

incorporated sizeable timber posts and beams. The enclosure's floor was not defined. No features were identified; however, only a very limited portion of the interior of Enclosure 4 was exposed.

A radiocarbon assay indicates that the cultural deposits underlying Enclosure 4, which likely represent a basin house, date to the Late Archaic. All of the projectile points recovered from within and beneath the Enclosure 4 foundation are fragments of dart points, corroborating an Archaic age for the pre-enclosure deposits. Specific chronological data are not available for Enclosure 4.

Excavation Block 3

Block 3 was a 1 x 3-m excavation that spanned the eastern foundation of Enclosure 10, an oval structure encompassing about 11.9 m^2 that was built on the east side of a large bedrock boulder (figures 2.2 and 2.17). The enclosure's floor was partially excavated into the

Figure 2.17. Photograph of Enclosure 10 prior to excavation; view to the southeast.

slope on the north and northwest and the resulting cut was lined with slabs and large blocks. Opposite the cut, on the structure's southeast side, the foundation consists of a jumble of large blocks and slabs. On the west, the foundation wall extends into a large crevice between two bedrock blocks. Vertically set slabs are uncommon in Enclosure 10 compared to other Cluster 1 structures. Prior to excavation, a gap in the foundation on the northeast was thought to represent an entryway; Block 3 was positioned over the gap to investigate that possibility.

Artifacts are moderately abundant on the surface within and around Enclosure 10 and cultural materials were observed eroding from the base of the southeastern section of the foundation. No signs of rodent activity were observed, but a depression in the center of the interior suggested that the structure may have been disturbed by artifact collectors. Another structure (Enclosure 11) is connected to the opposite side of the large boulder forming the south side of Enclosure 10.

Unit 3A, located primarily outside and east of the Enclosure 10 foundation, was opened first. Four general levels were excavated in Unit 3A, exposing three strata and one feature (figure 2.18). The uppermost stratum consisted of 8 to 15 cm of brown sand and silt containing a moderate number of angular and rounded pebbles ranging in size from 0.5 to 2 cm. A few artifacts and pieces of animal bone were recovered. Mottles of darker sediment appeared in the lower half of the layer. This stratum represents recent material deposited by a combination of wind and slope wash.

The top of a second stratum, consisting of mottled, dark gray, moderately compact sand and silt ranging in thickness from 10 to 16 cm, was encountered between 98.67 and 98.56 m. The number of larger cobbles and blocks (15 to 30 cm in length) increased in this layer. The lower half of the layer also contained a large number of smaller stones. Flecks and pieces of charcoal occurred among the rocks and the density of artifacts increased with depth. A charcoal sample taken from the middle of the layer, and beneath a large slab, yielded a radiocarbon age of 1312±25 ^{14}C yr. B.P.

On the east side of Unit 3A, the top of a third

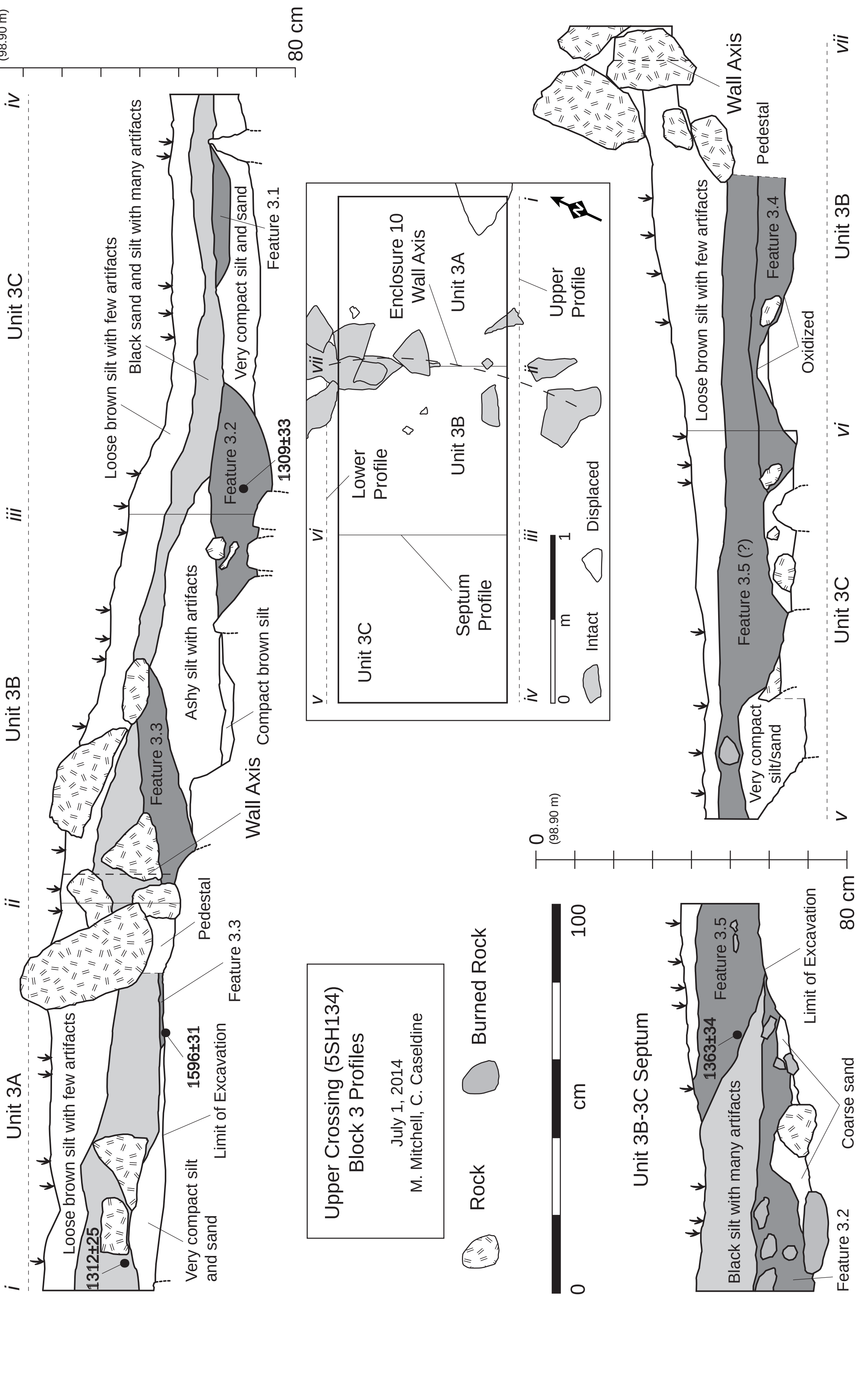

Figure 2.18. Block 3 profiles.

stratum was encountered between 97.53 and 97.51 m. This stratum consisted of very compact brown sand and silt containing abundant decomposing rock fragments. Artifacts and charcoal appeared to be absent from this stratum, which likely represents the original native surface.

In the center and on west side of Unit 3A, the rock-filled dark gray stratum lay directly on **Feature 3.3**, a large pit or basin hearth (figure 2.19). The rock foundation of Enclosure 10 was built on or slightly above this feature. Insufficient time was available to excavate Feature 3.3; however, a 1.6-liter sample of the feature's fill was collected. Oakfield soil probe data suggested that the feature is flat-bottomed. The fill consisted of grayish brown sand and silt containing abundant charcoal, artifacts, and bone pieces. Judging by the portion exposed in Unit 3A, Feature 3.3 was approximately 1.5 m in diameter. (Feature 3.3 extended into Unit 3B, but was not recognized as a discrete feature in that square.) A charcoal sample taken from the fill yielded a radiocarbon age of 1596±31 ^{14}C yr B.P. Eleven charred seeds were recovered from Feature 3.3, including three whole dock or sorrel (*Rumex* sp.) seeds, four whole and two fragmented goosefoot (*Chenopodium* sp.) seeds, and two unidentified seeds.

The stratigraphic and spatial relationships between Feature 3.3 and the strata encountered in Unit 3A suggest that the rock-filled dark gray stratum overlying the feature and native sediment represents the redeposited remains of a stone enclosure foundation wall. The size, angularity, and jumbled arrangement of stones in the stratum further suggest that it was deposited purposefully, rather than by natural processes. The stratum post-dates the construction of Enclosure 10, so the stones in it must represent the remains of another structure originally located nearby.

The crew then turned their attention to Unit 3B, which encompassed the Enclosure 10 foundation wall and a portion of the enclosure's interior. Excavation began by removing the veneer of recent brown sand and silt. This stratum, which dips to the west toward the center of the enclosure and is 5 to 12 cm thick, overlies a compact, dark grayish brown sand and silt layer containing a moderate number of artifacts. That underlying dark grayish brown layer represents fill associated with the occupation of Enclosure 10; the base of the enclosure's foundation wall was approximately coincident with the base of that stratum. A small stemmed to corner-notched arrowpoint (Scallorn) was recovered from the enclosure fill [CN3203].

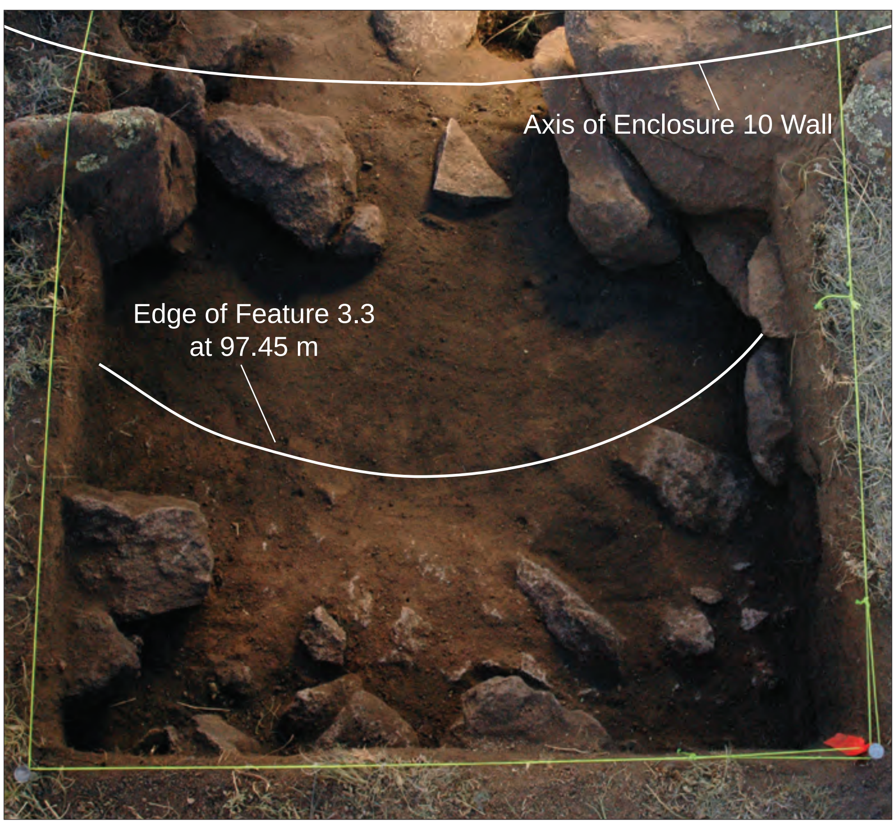

Figure 2.19. Photograph of the base of GL4 in Unit 3A, showing Feature 3.3 and its relationship to the Enclosure 10 foundation.

The foundation consisted of stacked angular blocks and a few vertically-set slabs. Several of the stones had fallen to the west, away from the wall and toward the center of the enclosure. That post-occupation collapse was the cause of the apparent gap in the foundation observed on the surface prior to excavation. One of the foundation stones [CN3219] exhibits smoothing and striations on one face consistent with limited use as a milling slab. Horizontal sill blocks like those present in Enclosures 4 and 5 (discussed previously) and Enclosure 9 (discussed in the following section) were not observed in the Enclosure 10 foundation.

The crew encountered several distinct strata below the base of the foundation. On the east side of Unit 3B, at an elevation of about 98.45 m and immediately beneath the Enclosure 10 wall, the crew exposed a compact sand and silt layer that they believed to be a floor surface. To better define the morphology of this surface, GL3 was shifted from an arbitrary to a natural level. However, following the floor surface westward, into the center of the enclosure, proved to be challenging owing to the presence of multiple features and strata overlying the floor.

An 8-cm-high step occurred in the floor just west of, and below, the enclosure foundation. West of this step the floor was uneven but generally level. On the south side of Unit 3B, the crew exposed an ashy silt deposit. That deposit originally was identified as a feature; however, additional excavation revealed that is was in fact a stratum banked against the step in the floor. The ashy layer extended under Feature 3.3, which in turn underlay the Enclosure 10 wall.

On the north side of Unit 3B, the crew exposed a charcoal-rich deposit, which originally was identified as a house fill stratum but in fact proved to be a basin feature cut into the house fill. This deposit was later designated **Feature 3.5** but was not excavated separately. Feature 3.5 was 8 to 10 cm thick; its plan dimensions could not be determined. A charcoal sample taken from the base of Feature 3.5 produced a radiocarbon age of 1363±34 ^{14}C yr B.P.

To expose a larger section of the floor the crew opened another square, designated Unit 3C and located west of Unit 3B. As was the case in Unit 3B, excavation in Unit3C exposed a complex series of strata and features, including a recent silt and sand layer, an enclosure fill layer, an emplaced floor layer, and a series of small pit features.

The floor surface consisted of discontinuous slabs and massive native stone blocks, between which brown silt and sand containing a few flecks of charcoal had been packed. The resulting floor surface was uneven, but generally level. Three small basin features, designated Features 3.1, 3.2, and 3.4, were set into the floor surface. Of those three features, only the western half of Feature 3.2 (in Unit 3C), was excavated separately (figure 2.20). **Feature 3.2** was an approximately symmetrical basin 15 cm deep and 60 cm in diameter. The fill contained abundant charcoal flecks and chunks and burned artifacts and pieces of animal bone. A charcoal sample from Feature 3.2 yielded a radiocarbon age of 1309±33 ^{14}C yr B.P.

Feature 3.1, located in the southwest quadrant of Unit 3C, was a shallow, oblong basin that was 4 cm thick,

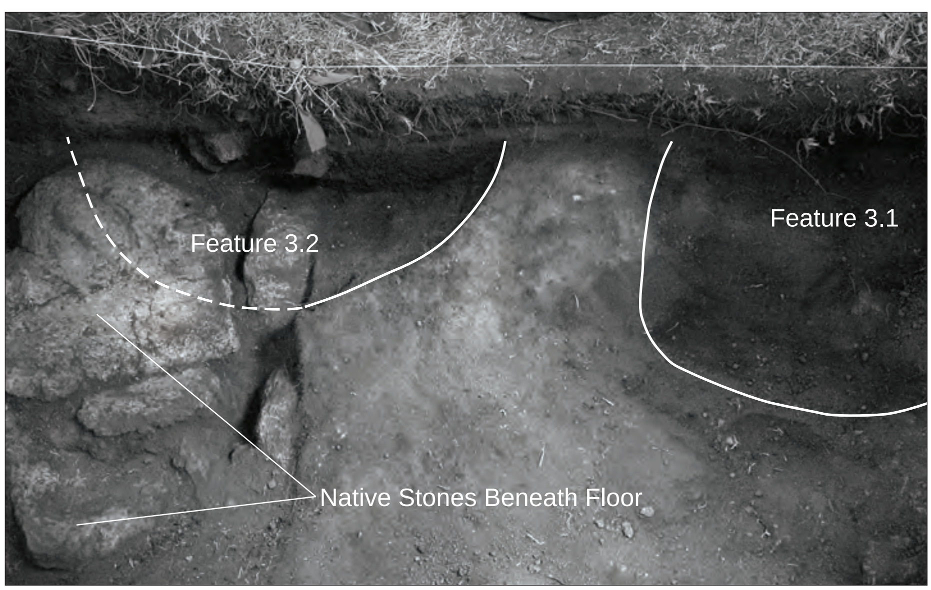

Figure 2.20. Photograph of the south side of Unit 3B, showing the locations of Feature 3.1 and 3.2.

35 cm wide, and at least 50 cm long. The base of the feature consisted of emplaced floor sediment that filled gaps between several large native blocks. **Feature 3.4**, located in the northeast quadrant of Unit 3C and the northwest quadrant of Unit 3B, was similar to Feature 3.1, measuring roughly 9 cm thick and 70 cm long. The width of Feature 3.4 was not recorded. The base of the feature consisted of oxidized floor sediment.

Native sediment exposed in Units 3B and 3C beneath the emplaced floor layer consisted of poorly sorted brown sand and silt lacking artifacts and charcoal but containing small stringers and blebs of carbonate.

Architectural Reconstruction and Occupation History

Data from Block 3 demonstrate that Enclosure 10 was constructed over an older basin house. Only a narrow section of the perimeter of that older house was exposed and so its size and shape could not be determined. However, the absence of a stone foundation suggests that its superstructure was more lightly built than the superstructure of Enclosure 10. The floor of the basin house was below the contemporaneous ground surface, was uneven but approximately level, and contained at least three small basin hearths. Two of those features (Feature 3.1 and 3.4) were somewhat amorphous and it is possible that they were disturbed when Enclosure 10 was built.

After the basin house was abandoned and partially filled, Feature 3.3, a large pit or hearth, was constructed over the former edge of the house. Enclosure 10 was then built on top of Feature 3.3. The cultural stratum associated with Enclosure 10 is thin, suggesting that the occupation of the enclosure was relatively brief. A large, amorphous hearth was built inside the structure after it had been occupied for some time. The rock-filled cultural deposit located outside the Enclosure 10 foundation was emplaced during or after the occupation of that structure.

The foundation of Enclosure 10 consisted primarily of stacked, unoriented blocks along with a few vertically set slabs. Unlike Enclosures 4 and 5, blocky sill stones were not incorporated into the Enclosure 10 foundation. No posts or post molds associated either with the basin house or the stone enclosure were observed in Block 3.

Four radiocarbon assays demonstrate that Enclosure 10, as well as the basin house beneath it, date to the early Late Prehistoric. Multiple corner-notched and unfinished arrowpoint fragments were recovered from Block 3.

Excavation Block 4

Block 4 was a 1 x 3-m excavation that spanned the eastern foundation wall of Enclosure 9, a large, massively built circular stone enclosure located on the south side of Cluster 1 (figures 2.2 and 2.21). The structure was excavated into the slope on the north and northeast. The resulting cut was buttressed with large, vertically set slabs and stacked blocks. On the west and southwest, the wall is represented by a broad pile of jumbled cobbles and boulders. A gap in the foundation on the south could indicate the location of an entryway. Several low bedrock boulders are located south of the enclosure, but the foundation wall is not tied directly to them. The floor inside the enclosure slopes down slightly to the west, perhaps indicating the location of prior unprofessional excavation on the west side. The depression could also have resulted from erosion of sediment inside the structure through gaps between the stones comprising the collapsed southern and western wall.

Artifacts and charcoal-stained sediment are eroding from the base of the foundation on the south and west. Observed items include chipped stone tools, ground stone tools, flaking debris, and burned rock. Fine-grained cultural deposits also are present inside the enclosure.

Excavation began in Unit 4A, outside the enclosure. Three general levels were removed from Unit 4A, exposing three strata (figure 2.22). The uppermost stratum consisted of 3 to 4 cm of recent loose sand and silt containing few artifacts. Beneath this was a gray to black moderately compact sandy silt containing charcoal chunks and flecks, chipped stone tools and flaking debris, and bone fragments. This stratum was approximately 9 cm thick and dipped slightly to the south. It extended both between and beneath the slabs and blocks comprising the Enclosure 9 foundation wall, and so was deposited prior to, and perhaps during, the occupation of the structure. A concentration of charcoal and ash was observed immediately east of the wall, banked against the foundation's sill stones and covered by the topmost layer of wall rocks. A corner-notched arrow point was recovered from this stratum and beneath a large sill stone marking the base of the foundation [CN3169]. The point is made from heat-treated white chert. The stem is broken away and the blade may have been resharpened for use as a perforator or drill.

The third strata exposed in Unit 4A was a compact brown sandy silt. The upper few centimeters of this

Figure 2.21. Photograph of Enclosure 9 prior to excavation; view to the south.

stratum may have been intentionally emplaced to fill gaps between and partially cover the tangle of unoriented native blocks, slabs, and cobbles underlying the cultural deposit. A corner-notched to stemmed arrow point, made from heat-treated red chert, was recovered from GL3 (97.60-97.50 m), which spanned the lower portion of the gray to black cultural layer and the upper portion of the underlying brown sandy silt. The point exhibits a pronounced longitudinal curvature and may have been discarded during manufacture. Excavation stopped in Unit 4A at the base of GL3.

Attention then shifted to Unit 4B, located west of Unit 4A and inside the structure. Two strata, including a moderately compact gray to black cultural layer and a compact brown sand and silt layer, were exposed in the two general levels removed from the unit. Excavation began by disassembling the foundation of Enclosure 9. The central core of the foundation was made up of interlocking blocks and slabs, against and over which leaning stones had been placed (figure 2.23). The gray to black cultural stratum observed in Unit 4A extended between and beneath the foundation stones. However, the density of artifacts and faunal remains recovered from that stratum was higher inside the structure than it had been outside. A recycled stemmed dart point was recovered from the top of that cultural stratum on the west side of the unit [CN3179]. It was heat-treated after manufacturing was complete and the post-heat-treatment flaking pattern suggests that it may have been reworked into a small cutting tool.

Brown compact silt and sand was exposed in Unit 4B near the base of GL1, beginning at about 97.58 on the east side of the square beneath the foundation wall. The contact between that brown stratum and the

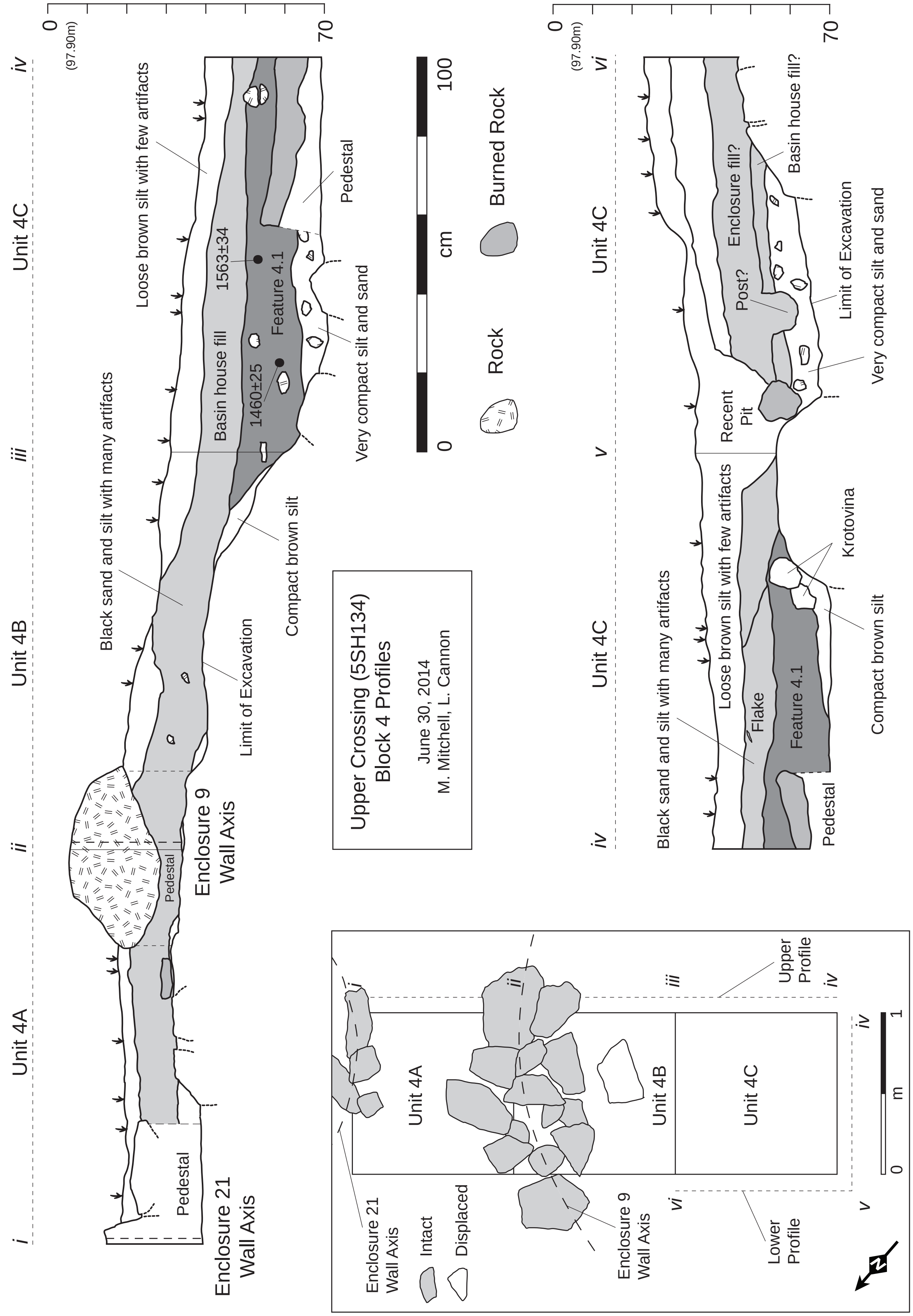

Figure 2.22. Block 4 profiles.

Figure 2.23. Photograph of the foundation of Enclosure 9; view toward the exterior.

overlying gray to black cultural stratum dipped to the west, toward the center of the structure. The character of this contact suggested that it represented a floor surface. In order to follow the contact, the excavation strategy shifted in GL2 from an arbitrary level to a natural level. Several flat slabs had been set into the floor (figure 2.24). A 2- to 3-cm thick layer of brown compact sediment containing sparse charcoal flecks and a few artifacts appeared to have been packed around the flat slabs to create a smoother floor surface. However, the slabs did not appear to have been entirely covered by this emplaced sediment and so would originally have protruded 1 to 2 cm above the floor. From east to west across Unit 4B the floor dipped about 14 cm.

To expose a larger section of the floor, a third excavation square, designated Unit 4C, was added to the block west of Unit 4B. Two arbitrary general levels above the structure floor were removed first. Strata exposed in those levels consisted of the recent brown sand and silt layer containing few artifacts and the upper portion of the gray to black cultural layer. Artifact density increased with depth in GL2 (97.55-97.45 m). In natural level GL3, the crew attempted to follow the structure floor down and to the west. However, this process was complicated by the presence of what was later identified as Feature 4.1, a large basin hearth. Two thin slabs, both heavily burned, were encountered on the east side of the unit at the base of GL3. One, measuring 20 cm wide, 26 cm long, and 5 cm thick, lay

Figure 2.24. Photograph of Unit 4A (background) and Unit 4B (foreground), showing the foundation of Enclosure 9 and slabs set into the floor of the underlying basin house; view to the northeast.

directly on Feature 4.1. This slab may have been shaped. The second slab, measuring 15 cm wide, 36 cm long, and 2 cm thick, lay partly on Feature 4.1 and partly on the sloping floor. A small corner-notched to stemmed arrow point was recovered from GL3 [CN3218]. The point is asymmetrical, made from chalcedony, and is complete and unmodified.

To better define the structure floor and the stratigraphy of the overlying cultural deposits, two additional arbitrary general levels were removed from Unit 4C. Excavation stopped at the base of GL5 (97.20 m) (figure 2.25). Strata exposed in GL4 and GL5 include the fill of Feature 4.1; emplaced sediment forming the floor of the basin house; and unmodified native sediment beneath the floor.

Feature 4.1 is an amorphous, flat-floored basin hearth that originates at the structure's prepared floor (figures 2.22 and 2.27). The redeposited or emplaced native sediment incorporating sparse charcoal flecks and artifacts that forms the floor of the basin house also underlies Feature 4.1, indicating that the feature and the house were built at the same time. The feature's maximum dimension is difficult to estimate owing to its amorphous perimeter. However, it likely was about 1.5 m in diameter. The feature's observed maximum thickness was 15 cm. Numerous rodent krotovina were noted in the feature. A large number of burned cobbles and slabs occur in the fill, including a large slab measuring at least 45 cm wide and 5 cm thick. Charcoal, artifacts, and animal bone fragments are abundant. Two charcoal samples were submitted for radiocarbon dating, yielding ages of 1460±25 and 1563±34 ^{14}C yr B.P.

Architectural Reconstruction and Occupation History

As was the case for Enclosure 10, Enclosure 9 was built over an older basin house lacking a stone foundation wall. That house was cut into the slope on the north and northeast. The floor was discontinuously lined with

Figure 2.25. Photograph of Enclosure 9 and Block 4 after excavation; view to the south.

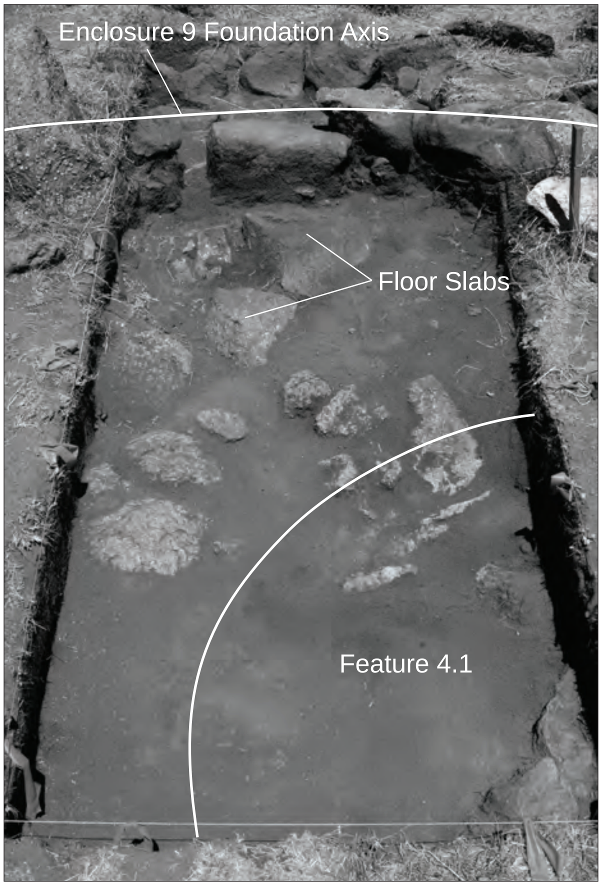

Figure 2.26. Photograph of Block 4, showing the location of Feature 4.1.

tabular stones and a thin layer of sediment was packed around those slabs to smooth the floor. A large, shallow hearth was built into the floor, in the approximate center of the basin. No post molds or other architectural elements related to this basin house were encountered; however, the absence of a foundation wall suggests that the building's superstructure consisted of a relatively light, brush- or hide-covered framework.

A gray to black layer of silt and sand containing abundant artifacts was then laid down, covering the hearth and the original floor of the basin house. It is not known whether that layer, which was approximately 10 cm thick, was deposited during the occupation of the basin house, or whether it represents material deposited intensionally or by natural processes during a hiatus in the occupation of the structure.

The slabs and blocks making up the foundation of Enclosure 9 were then emplaced over this gray to black cultural layer. The first layer of foundation stones, which mostly consists of slabs or angular blocks, likely was placed directly on the cultural layer. Tabular stones were then placed against both the interior and exterior of these sill stones. Post molds were not observed during the excavation, but the orientation and arrangement of leaning wall stones suggests that they were used to brace relatively large, steeply angled wall logs.

An amorphous basin that may represent a hearth or other feature associated with Enclosure 9 was observed intruding into the gray to black cultural layer overlying the original floor of the basin house. That amorphous feature was in turn covered by a thin gray cultural stratum containing a moderate number of artifacts. That uppermost gray cultural stratum was observed on the north side of Block 4, but not on the south side. A small recently excavated pit, possibly made by artifact collectors, was observed in the northwest corner of Unit 4C.

Radiocarbon assays and diagnostic projectile points indicate that the underlying basin house dates to the early Late Prehistoric. Chronometric data are not available for Enclosure 9, but diagnostic projectile points indicate that it too dates to the early Late Prehistoric.

Summary

The 2014 field effort produced important new data on Upper Crossing's stone enclosures and on the site's occupation history. Significant similarities, as well as notable differences, exist among the four sampled stone enclosures. Similar methods were used to build them. In each case, the base of the foundation consists of large angular blocks. In Enclosures 4, 5 and 9 those blocks are set horizontally, while in Enclosure 10 the base of the foundation consists of unoriented angular stones. In each enclosure, the upper layer of stones consists of leaning slabs. In Enclosures 5, 9, and 10 those leaning slabs bracket the core of the foundation, with exterior slabs angled inward and interior slabs angled outward. In Enclosure 4, the vertical slabs are more tightly integrated into the core of the foundation. Many of the basal foundation stones are very large; in Enclosure 5, one sill stone measured roughly 70 cm long, 50 cm wide, and 40 cm thick. Two blocks nearly as large were incorporated into the Enclosure 4 foundation, although their original position in the structure could not be determined. Similarly massive stones were used to construct unexcavated portions of the foundations of Enclosures 9 and 10.

All of the enclosures were semi-subterranean. The floor of Enclosure 5 was excavated into the pre-construction surface roughly 35 or 40 cm. The floor could not be identified in Enclosure 4, although the abundant use of older cultural fill to construct the wall indicates that it too was built over an excavated pit. The floors of Enclosures 9 and 10 consisted of pre-existing cultural material; however, they too were below the surrounding native surface.

The fact that the enclosures were semi-subterranean, coupled with the fact that massive blocks were used to build their foundations, indicates that they were a significant investment for the site's residents. The use of heavy foundations further indicates that the enclosures' superstructures were also heavily built. Taken together, these data suggest that the sampled enclosures, and perhaps all of the enclosures in Cluster 1, represent cool- or cold-season occupations.

As is the case for stone enclosures, both similarities and differences exist among the basin houses exposed in 2014. All appear to have been shallowly semi-subterranean. The floor of the house exposed in Block 4, while a step was present in the floor of the house exposed in Block 3. Both incorporated discontinuous paving stones, around and between which a layer of silt and sand had been packed. Perhaps not coincidentally, the floor of Enclosure 5, which probably was flat, was constructed in a similar manner. All of the basin house floors incorporated hearth features, but their sizes and arrangements appear to have varied.

None of the basin houses appear to have incorporated stone foundations, although only narrow sections of their perimeters were exposed. This is a marked contrast with the enclosures, indicating that the two different types of architecture had very different superstructures.

Data from the four excavation blocks point to a complex occupation history for Cluster 1. Enclosure 4 was built over a much older Late Archaic cultural deposit, which likely represents a basin house with a brush superstructure. Enclosures 9 and 10 also were built over basin houses, but those earlier structures were archaeologically contemporaneous with the more heavily built, log-walled enclosures. Enclosure 5 appears to have been a *de novo* construction, but it likely was built before the basin house beneath Enclosure 10. The occupation durations of different enclosures also appear to have differed. Enclosure 5 contains significant cultural fill and shows evidence of remodeling, possibly indicating a protracted occupation or, perhaps more likely, repeated reoccupation. Enclosures 9 and 10 are associated with relatively little cultural material, suggesting a briefer occupation or perhaps an occupation late in the overall use of Cluster 1. This complex occupation history suggests that, as a whole, Cluster 1 was occupied repeatedly over a lengthy period by small groups of people, perhaps composed of two or three households, rather than briefly by a large group.

Clearly, both brush-covered basin houses and log-walled stone enclosures were built during the early Late Prehistoric at Upper Crossing. The chronometric data are not indicative of a unidirectional architectural transformation from basin houses to stone enclosures. Rather, the decision to build one or the other type of domestic structure may have been influenced by medium-term or conditional factors, such as planned occupation duration, season of occupation, or short-term climate conditions. However, the fact that 20 stone enclosures currently are visible on the surface in Cluster 1, and that the presence of more lightly built basin houses was not suspected prior to 2014, suggests that the most recent domestic structures consisted only of stone enclosures.

3 Collection Chronology, Analytic Units, and Lab Procedures

Mark D. Mitchell

To provide a framework for analysis and comparison, individual excavation proveniences (including general and feature levels as well as piece plots) are grouped into analytic units. The proveniences comprising each analytic unit share spatial, depositional, and temporal attributes. Multiple lines of evidence are combined to establish a chronological structure for the defined analytic units.

Radiocarbon Dates, Site Stratigraphy, and Diagnostic Artifacts

Radiocarbon data are combined with stratigraphic and projectile point morphology data to assess the age of the contexts sampled in 2014. Twenty-four charcoal specimens were recovered from the four excavation blocks, including 18 piece-plotted fragments and six samples hand-picked from bulk sediment samples. Twenty of these samples were analyzed to determine the species represented (Puseman 2014). No chemicals such as alcohol were used in the sample identification process and steps were taken to prevent cross-contamination between samples.

Nine of the 20 identified samples were selected for accelerator mass spectrometry (AMS) radiocarbon dating (table 3.1). Selected samples included small-diameter twigs and the outer rings of larger specimens. Samples of shorter-lived species were preferred when available. Paired samples were selected from Block 1 and Block 4 contexts. A sequential set of samples were selected from Block 3 contexts. Just one sample was available from a Block 2 context. Dr. Herbert Haas carried out sample pre-treatment and dates were obtained from the AMS Laboratory at the University of Arizona. Table 3.2 presents the dating results.

2017 *Archaeology of the Upper Crossing Stone Enclosures, Saguache County, Colorado,* by Mark D. Mitchell and Carl R. Falk, pp. 57-65. Research Contribution 99. Paleocultural Research Group, Broomfield, Colorado.

Table 3.1. Provenience and other data on nine charcoal samples submitted for AMS radiocarbon dating.

				Plot Provenience (cm)				
Sample No.	Catalog No.	Unit	Level	North	East	Datum Depth	Species	Weight (g)
UC-1	3198	1.2B	GL2	9	76	58	*Pinus ponderosa* twig	0.062
UC-2	3226	1.1B	FL2	-	-	-	Rosaceae twig	0.031
UC-3	3242	2B	GL4	85	6	57	*Pinus ponderosa*	0.103
UC-4	3217	3B	GL3	4	34	54	*Populus tremuloides*	0.004
UC-5	3255	3A	GL4	91	68	35	*Pinus ponderosa* twig	0.085
UC-6	3258	3C	FL1	-	-	-	*Populus* sp.	0.095
UC-7	3271	3A	GL4	-	-	-	*Pseudotsuga menziesii*	0.051
UC-8	3230	4C	GL3	78	92	57	*Pseudotsuga menziesii*	0.038
UC-9	3273	4C	GL3	49	100	52	Parenchymous tissue	0.005

Table 3.2. AMS radiocarbon dating results for nine charcoal samples.

Sample No.	Lab No.	Catalog No.	Unit	Feature No.	$\delta^{13}C$	Corrected Age (^{14}C yr B.P.)
UC-1	AA105236	3198	1B		-23.2‰	1561±29
UC-2	AA105237	3226	1B	1.1	-24.4‰	1397±29
UC-3	AA105238	3242	2B		-20.7‰	2816±30
UC-4	AA105239	3217	3B	3.5	-27.0‰	1363±34
UC-5	AA105240	3255	3A		-21.8‰	1312±25
UC-6	AA105241	3258	3C	3.2	-23.7‰	1309±33
UC-7	AA105242	3271	3A	3.3	-19.9‰	1596±31
UC-8	AA105243	3230	4C	4.1	-19.8‰	1460±25
UC-9	AA105244	3273	4C	4.1	-22.7‰	1563±34

Table 3.3 organizes the dated samples in stratigraphic sequence within each excavation block. Samples recovered from the highest stratigraphic units in each block are listed first, with deeper and older samples following sequentially.

Two dated samples come from Enclosure 5. One comes from a lower house fill strata while the other comes from Feature 1.1, a hearth contemporaneous with the constuction or early use of Enclosure 5. The radiocarbon ages of these two samples are not statistically equivalent (table 3.4, upper panel). Because the feature was undisturbed, the younger date more accurately reflects the Enclosure's actual age. In addition, the sample producing the younger date (UC-2) was a twig fragment from a plant in the Rosaceae family, which includes relatively short-lived flowering shrubs such as *Prunus* sp., *Rubus* sp., or *Rosa* sp., all of which occur in the Saguache Creek valley. Thus, the younger radiocarbon age is taken as the approximate age of Feature 1.1. Because Feature 1.1 appears to have been constructed concurrently with Enclosure 5, that radiocarbon age is also taken as the approximate age of Enclosure 5.

Three projectile point fragments were recovered from Block 1. All three appear to represent arrow points, although none is clearly diagnostic of a particular style. One lateral blade fragment may represent a side-notched form. If so, it could indicate a post-900 B.P. re-use of the site.

Just one dated sample comes from Block 2. That sample (UC-4), a piece of ponderosa pine charcoal, was recovered from a point approximately 8 to 10 cm below, and 50 cm north of, the lowest stone in the Enclosure 4 foundation. Several burned and flat-lying tabular stones were located adjacent to the sample, bolstering the conclusion that it came from intact deposits that pre-date the construction of Enclosure 4. The sample came from a cultural deposit filling the basin house beneath Enclosure 4, roughly 6 cm above the house's excavated floor. Thus, the age of sample UC-4 is taken as the minimum age of the Block 2 basin house. The sample also represents the nominal maximum age of Enclosure 4; however, the comparatively recent ages of the other dated enclosures suggest that a long gap occurred between the abandonment of the Block 2 basin house and the construction of Enclosure 4.

Fifteen complete or fragmentary projectile points were recovered from Block 2. Metric and morphological variation within the Block 2 sample support the radiocarbon-based age interpretation, but also point to the possibility of unrecognized mixing of Late Archaic and Late Prehistoric deposits (table 3.5).

Table 3.3. Stratigraphic contexts of AMS radiocarbon dates, sorted by increasing relative age within each block.

Block	Sample No.	Stratigraphic Context	Sample Material	Corrected Age (^{14}C yr B.P.)
1	UC-1	House fill above F1.1; dates use of Enclosure 5	*Pinus ponderosa* twig	1561±29
	UC-2	Fill of F1.1; dates early use of Enclosure 5	Rosaceae twig	1397±29
2	UC-3	Fill below Enclosure 4 wall; pre-dates enclosure, post-dates basin house	*Pinus ponderosa*	2816±30
3	UC-4	Fill of Enclosure 10; post-dates construction of wall	*Populus tremuloides*	1363±34
	UC-5	Below rock fall outside enclosure; post-dates F3.3, pre-dates Enclosure 10	*Pinus ponderosa* twig	1312±25
	UC-7	Fill of F3.3; post-dates basin house, pre-dates Enclosure 10	*Pseudotsuga menziesii*	1596±31
	UC-6	Fill of F3.2; dates use of basin house; pre-dates Enclosure 10	*Populus* sp.	1309±33
4	UC-9	Upper fill of F4.1; dates use of basin house, pre-dates Enclosure 9	Parenchymous tissue	1563±34
	UC-8	Lower fill of F4.1; dates use of basin house, pre-dates Enclosure 9	*Pseudotsuga menziesii*	1460±25

Table 3.4. Comparison of measured radiocarbon ages. T-test results obtained from OxCal 4.2.4 (Bronk Ramsey 2009, 2013).

Block	Corrected Age (^{14}C yr B.P.)	Test Statistics	Test Result
1	1561±29	df=1; T=16.0 (5%=3.8)	Fail
	1397±29		
3	1363±34	df=3; T=61.5 (5%=7.8)	Fail
	1312±25		
	1596±31		
	1309±33		
4	1563±34	df=1; T=6.0 (5%=3.8)	Fail
	1460±25		

Block	Corrected Age (^{14}C yr B.P.)	Test Statistics	Test Result
3	1363±34	df=2; T=1.8 (5%=6.0)	Pass
	1312±25		
	1309±33		

Table 3.5. Gross morphology of projectile points from Block 2 contexts, organized by enclosure construction relationship.

	Enclosure Relationship		
Point Class	Before Construction	Mixed	After Construction
Dart	5	1	-
Arrow	4	4	1
Total	9	5	1

Nine specimens come from contexts thought to predate the construction of Enclosure 4. Five come from contexts that are recognized as mixed based on spatial and stratigraphic data, and one comes from a post-construction context.

Just five of the nine specimens from pre-construction contexts are dart points. If the entirety of the pre-construction deposit exposed in Block 2 is Late Archaic in age, then one would not expect arrow points to be present. Two of the four arrow points are tip fragments from unfinished specimens, while two are finished and nearly complete. Both of the finished specimens exhibit unusual morphologies: one has a relatively broad blade for its length, while the other has a convex base and shallow side notches. Both exhibit forms reminiscent of dart point forms and may represent early attempts at arrow point design. However, the presence of both dart and arrow points in pre-construction contexts in Block 2 suggests that deposits assigned to the Late Archaic may also include specimens dating to the Late Prehistoric.

Four dated charcoal samples come from Block 3. The most recent comes from fill deposited within Enclosure 10, at the base of Feature 3.5, a large but poorly defined pit feature or cultural deposit. The next oldest comes from beneath a layer of angular cobbles likely representing the remains of a dismantled or collapsed stone enclosure that is contemporaneous with, or slightly older than Enclosure 10. A third date comes from a large hearth or pit (Feature 3.3) located beneath the Enclosure 10 wall, but above deposits associated with the Block 3 basin house. The oldest date comes from Feature 3.2, a small basin hearth contemporaneous with the use, and likely the construction, of the Block 3 basin house.

The radiocarbon ages of the four Block 3 samples are not statistically equivalent (table 3.4, upper panel). However, if the anomalously old sample from Feature 3.3 (UC-7) is eliminated, the remaining three ages are equivalent (table 3.4, lower panel). Sample UC-7 was a branch fragment of long-lived Douglas fir and the statistical contemporaneity of the remaining three samples suggests that a significant period of time occurred between the death of the UC-7 sample and its use as fuelwood. The weighted mean age of the remaining three samples is 1324±18 ^{14}C yr B.P. Because the weighted age combines samples from the Block 3 basin house, from deposits post-dating the house but pre-dating the enclosure, and from the fill of Enclosure 10, all of these contexts are considered archaeologically contemporaneous.

Ten projectile points or point fragments were recovered from Block 3. Two come from contexts pre-dating the construction of Enclosure 10, two come from mixed contexts, and six come from post-construction contexts. All ten represent arrow points.

Two dated charcoal samples come from Feature 4.1 in Block 4, which is associated with a basin house that pre-dates Enclosure 9. The ages of these samples are not statistically equivalent (table 3.4, upper panel). As was the case for Feature 1.1 in Block 1, Feature 4.1 appeared to have been undisturbed, suggesting that the more recent date must better reflect the feature's age. The younger sample (UC-8) was a fragment of a Douglas fir branch. A similar Douglas fir sample from Block 3 (UC-7) clearly is older than the context from which it was recovered. However, for the Block 4 sample there is no direct evidence to indicate that a lag occurred between the death of the UC-8 sample and its use as fuelwood. Therefore, the UC-8 age is taken as the age of the Block 4 basin house.

Thirteen points or point fragments were recovered from Block 4. Two come from pre-construction contexts, four come from mixed contexts, and 7 come from post-construction contexts. All but one are arrow points. The single exception is a base fragment of what could be a side-notched dart point with a long haft element. This specimen may represent a re-purposed found object.

Table 3.6 summarizes the dating results and provides calibrated calendar dates for the measured ages. Calibrated dates are illustrated in figures 3.1 and 3.2. The Block 2 basin house, which underlies Enclosure 4, likely was used sometime between 1050 and 900 cal B.C., or earlier. The measured age falls on a minor plateau or reversal in the calibration curve, which yields a relatively lengthy calibrated date interval.

The Block 4 basin house, beneath Enclosure 9, was used between cal A.D. 560 and 646, or slightly later. Enclosure 5, exposed in Block 1, likely was constructed between cal A.D. 600 and 670. The youngest sampled structures, including both Enclosure 10 and the basin house beneath it in Block 3, were used between cal A.D. 655 and 711 or cal A.D. 746 and 764. The measured ages of these structures fall primarily on a steep portion of the calibration curve, yielding relatively precise dates. The 2σ date range of the weighted mean age of Block 3 contexts does clip an early A.D. 700s plateau in the curve.

Thus, two primary occupation components occur in Cluster 1: a Late Archaic component dating to the early first millennium B.C. that is represented by the Block 2 basin house, and a Late Prehistoric component that dates to the late sixth and seventh centuries A.D. and is represented by both basin houses and stone enclosures.

Although the dated Late Prehistoric structures were built and occupied during a relatively brief one- to two-century interval, their measured ages are nevertheless not statistically equivalent. The upper panel of the table 3.7 compares the ages of Enclosure 5, the Block 4 basin house, and Enclosure 10 and the Block 3 basin house. Eliminating the oldest of these three ages (the Block 4 basin house), a pairwise comparison of the ages of Enclosure 5 and the structures in Block 3 also shows that they also are not contemporaneous (table 3.7, middle panel). The radiometric data therefore indicate a series of discrete occupations during the Late Prehistoric, rather than a single occupation. This conclusion is well supported by stratigraphic and other data, which point to structure remodeling and sequential reoccupation.

Table 3.6. Calibrated calendar dates of selected radiocarbon ages. Calibration performed with OxCal Version 4.2.4 (Bronk Ramsey 2009, 2013), using the IntCal13 atmospheric calibration dataset (Reimer *et al*. 2013).

Block	Corrected Ages (^{14}C yr B.P.)	Weighted Mean Age (^{14}C yr B.P.)	1σ Calibrated Date Range (cal B.C./A.D.)	2σ Calibrated Date Range (cal B.C./A.D.)
1	1397±29	-	A.D. 625-A.D. 660 (68.2%)	A.D. 600-A.D. 670 (95.4%)
2	2816±30	-	1004 B.C.-928 B.C. (68.2%)	1052 B.C.-899 B.C. (95.4%)
3	1363±34	1324±18	A.D. 660-A.D. 686 (68.2%)	A.D. 655-A.D. 711 (84.8%) and
	1312±25			A.D. 746-A.D. 764 (10.6%)
	1309±33			
4	1460±25	-	A.D. 585-A.D. 635 (68.2%)	A.D. 560-A.D. 646 (95.4%)

Figure 3.1. Calibrated date distribution of Late Archaic radiocarbon age from Block 2.

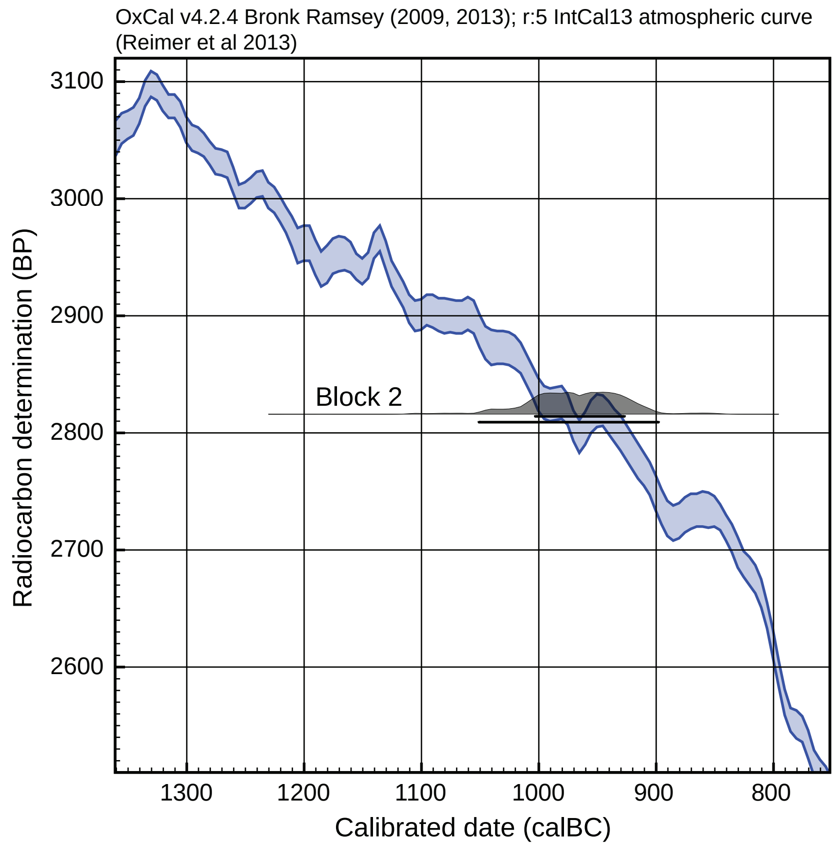

Figure 3.2. Calibrated date distributions of Late Prehistoric radiocarbon ages from Blocks 1, 3, and 4.

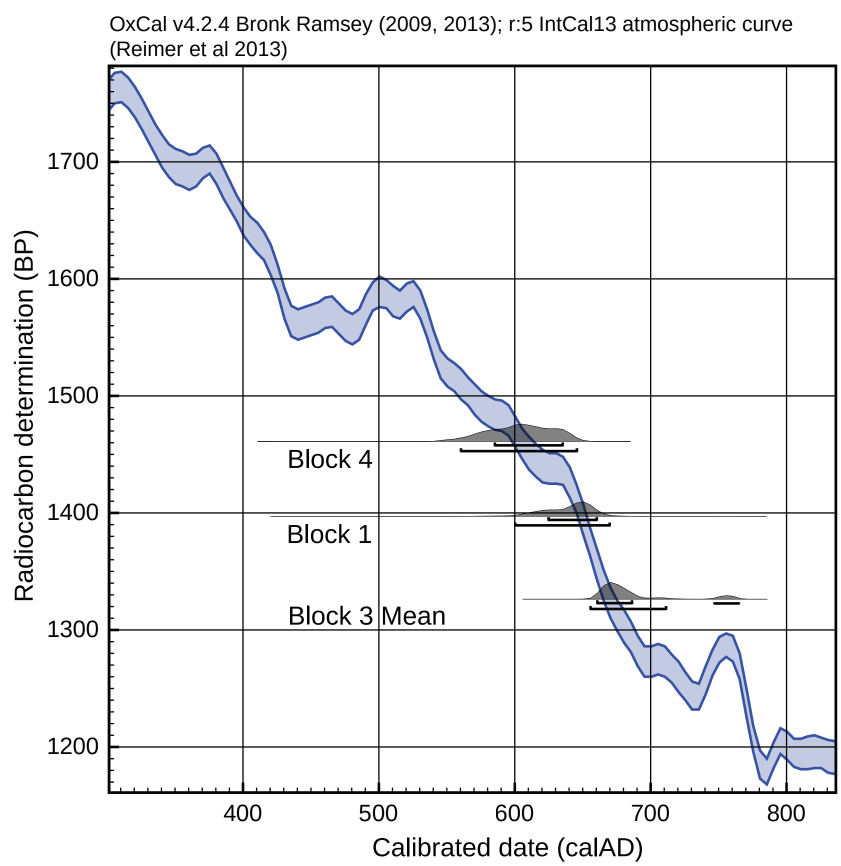

Table 3.7. Comparison of measured radiocarbon ages among architectural contexts. T-test results obtained from OxCal 4.2.4 (Bronk Ramsey 2009, 2013).

Block	Corrected Age (^{14}C yr B.P.)	Test Statistics	Test Result
1	1397±29	df=2; T=20.3 (5%=6.0)	Fail
3	1324±18		
4	1460±25		

Block	Corrected Age (^{14}C yr B.P.)	Test Statistics	Test Result
1	1397±29	df=1; T=4.6 (5%=3.8)	Fail
3	1324±18		

Block	Corrected Age (^{14}C yr B.P.)	Test Statistics	Test Result
1	1397±29	df=1; T=2.7 (5%=3.8)	Pass
4	1460±25		

Late Prehistoric Architectural Sequence

Both of the Late Prehistoric basin houses exposed in 2014, in Block 3 and Block 4, were overlain by stone enclosures. Taken at face value, this finding could suggest that basin houses pre-dated stone enclosures in Cluster 1 as a whole. However, the chronological data reveal a more complex pattern. Enclosure 5 and Enclosure 9 are not contemporaneous, with Enclosure 5 the older of the two (table 3.7, middle panel). Enclosure 5 also is older than the Block 3 basin house. By contrast, Enclosure 5 and the Block 4 basin house are contemporaneous (table 3.7, lower panel). (The weighted mean age of these two structures is 1433±19 ^{14}C yr B.P or cal A.D. 610-644 [1σ] and cal A.D. 593-653 [2σ].) Similarly, the ages of Enclosure 9 and the Block 3 basin house are equivalent (table 3.4, lower panel). Thus, no consistent chronological relationship exists between enclosures and basin houses within the Late Prehistoric component.

Together, these data suggest that both architectural types were constructed during the entire span of the Late Prehistoric occupation of Cluster 1. However, this conclusion should perhaps be tempered by the results of an intensive mapping effort undertaken in 2009 (Mitchell 2012a). No surface evidence of basin houses was recorded during that survey, such as large areas of stained sediment containing artifacts but lacking placed stone elements, although in fairness the presence of basin houses was not suspected at the time. Nevertheless, the fact that the surface-visible architectural features in Cluster 1 consists solely of enclosures may indicate that all of the houses built at the end of the occupation were of that type.

Whether the enclosures and basin houses were used concurrently is not clear; however, contemporaneous use seems likely, given the range of dates assigned to each and the overall brevity of the occupation. Chapter 6 discusses factors that may have influenced decisions to build a particular type of structure.

A Note on the "Old Wood Problem"

The radiocarbon ages obtained for this project demonstrate how intractable the so-called "old-wood problem" can be. The ages of the samples from Block 1—one of which was twig from a potentially short-lived Rosaceae plant (UC-2) and the other of which was a twig from a potentially longer-lived ponderosa pine tree (UC-1)—differ by 166 radiocarbon years. This result suggests that a significant lag occurred between the death of the older ponderosa pine sample and the construction and occupation of Enclosure 5. However, the results from Block 3 show that blanket judgments about an age lag for ponderosa pine samples are not warranted. Sample UC-5, a ponderosa pine twig, is numerically younger than, and statistically equivalent to, a sample of shorter-lived aspen (*Populus tremuloides*) (UC-4) from a more recent stratum. By contrast, a Douglas fir sample (UC-7) is 272 radiocarbon years older than the weighted mean age of the remaining three Block 3 samples. Thus, a lag occurred in the use of the Douglas fir sample, but not in the use of the ponderosa pine sample.

Additional interpretive problems are exemplified by the two Block 4 samples. Both are pieces of Douglas fir branches, a long-lived species. In the semi-arid environment of the Saguache Creek valley, branches and twigs likely can remain on the surface for a long period before decomposition affects their desirability for use as fuelwood. The ages of the two Block 4 samples are not equivalent, despite the fact that both were recovered from a single undisturbed feature context. This suggests that a lag occurred between the death of the older of the two samples, which is 103 radiocarbon years older than the younger sample, and its use as fuelwood in Feature 4.1. However, the question remains: does the younger of the Feature 4.1 samples, which also consisted of Douglas fir, accurately reflect the age of Feature 4.1? The Block 1 results indicate that pine or fir specimens may be older than the contexts in which they are found, but the Block 3 results indicate that an age lag is not inevitable.

Apart from dating short-lived samples, especially those directly tied to the activities of a site's inhabitants such as charred fruit pits or pinon nuts, the most productive approach to the problem is to date multiple samples from the same contexts, or tightly sequenced samples from well-understood, stratigraphically distinct contexts, and then compare and contrast their ages. Such comparisons permit quantitative evaluations of the extent of the old world problem in specific contexts.

Analytic Units

Three variables are used to partition the 2014 collection into analytic units: age, temporal relationship to enclosure construction, and spatial context for samples that post-date enclosure construction. Mitchell and Falk (2012) identify five temporal units for the site as a whole, including *Middle Archaic*, *Late Archaic*, *Mixed Archaic* (Middle and Late), *Late Prehistoric*, and *unclassified* or *indeterminate*. The unclassified temporal unit primarily comprises artifacts collected from the surface, which range in age from about 8000 B.P. to the mid-nineteenth century. Three of those five original temporal units are represented in the 2014 collection: Late Archaic, Late Prehistoric, and unclassified. In contrast to prior collections, artifacts in the 2014 collection that are assigned to the unclassified temporal unit primarily come from mixed Late Archaic and Late Prehistoric contexts. A single surface-collected item also occurs in the 2014 unclassified temporal unit sample.

The second variable used to partition the 2014 collection is each provenience's relationship to the construction of a stone enclosure. As discussed in chapter 2 and in the preceding chronology section, each of the excavation blocks opened in 2014 sampled contexts that pre-dated the construction of the stone enclosure currently visible on the surface. Block profiles and excavation notes were used to assign each excavation level or piece-plotted specimen to one of four enclosure relationship attributes. Those attributes include *before construction*, *after construction*, *mixed*, and *indeterminate*. Specimens included in the before construction group include those that were recovered from strata beneath an enclosure foundation as well as those recovered from within the foundation. Items recovered from within the foundation are presumed to have been inadvertently gathered from surface or near subsurface contexts along with sediment used in the construction of the enclosure. Proveniences assigned to the mixed group include those that incorporate specimens deposited before construction as well as those deposited after. The indeterminate group includes specimens or contexts for which an enclosure construction relationship could not be determined.

The third variable is each provenience's spatial relationship to an enclosure foundation. This variable was only coded for contexts that post-date the construction of an enclosure. The spatial context attributes include *exterior* and *interior*. Samples and specimens recovered from inside an enclosure foundation must by definition pre-date its construction.

A total of about 1,684 liters of sediment was excavated and screened in 2014 (see table 2.3). Tables 3.8 through 3.11 partition that total according to the three analytic unit variables. Late Archaic deposits account for less than 10 percent of the total excavated volume and only occur in Block 2 (table 3.8). Block 2 also produced about four-fifths of the unclassified temporal unit sample.

Approximately one-third of the excavated volume comes from contexts that pre-date the construction of a stone enclosure, while just over 40 percent comes from contexts that post-date enclosure construction (table 3.9). However, the post-construction sample is unevenly distributed among the four sampled enclosures. More than half comes from Block 3, while less than 2 percent comes from Block 2.

Table 3.10 tallies excavated volume by block and enclosure relationship, but omits Late Archaic and

Table 3.8. Excavated volumes in liters, organized by block and temporal unit.

	Temporal Unit			
Block	Late Archaic	Late Prehistoric	Unspecified	Total
1		210.6	60.0	270.6
2	159.8	10.6	224.1	394.5
3		612.0		612.0
4		406.5		406.5
Total	159.8	1,239.7	284.1	1,683.6

Table 3.9. Excavated volumes in liters, organized by block and enclosure construction relationship.

	Enclosure Construction Relationship			
Block	Before	After	Mixed	Total
1	60.0	187.4	23.2	270.6
2	159.8	10.6	224.1	394.5
3	194.1	387.5	30.4	612.0
4	134.3	128.0	144.2	406.5
Total	548.3	713.5	421.9	1,683.6

Table 3.10. Excavated volumes of Late Prehistoric samples in liters, organized by block and enclosure construction relationship.

	Enclosure Construction Relationship			
Block	Before	After	Mixed	Total
1		187.4	23.2	210.6
2		10.6		10.6
3	194.1	387.5	30.4	612.0
4	134.3	128.0	144.2	406.5
Total	328.4	713.5	197.8	1,239.7

Table 3.11. Excavated volumes in liters of post-enclosure-construction samples, organized by block and spatial context.

	Spatial Context		
Block	Exterior	Interior	Total
1	57.1	130.3	187.4
2	10.6		10.6
3	190.4	197.1	387.5
4	17.0	111.0	128.0
Total	275.0	438.5	713.5

indeterminate time period samples. About one-quarter of the Late Prehistoric sample comes from contexts that pre-date the construction of a stone enclosure.

Table 3.11 gives the spatial distribution of samples that post-date enclosure construction. About 60 percent of the sample comes from inside-house contexts, while 40 percent comes from outside-house contexts.

Collection Processing and Quantification

All recovered samples, including screened lots and plotted specimens, were processed in the lab using a single, standardized routine. Because the recovered collection is relatively small, a size-dependent sampling protocol was not used to estimate the content of large screen lots. Screened samples were subjected to three basic processing steps: size-grading over nested screens, washing, and detailed sorting into artifact and material classes. Artifacts or specimens recovered by piece-plotting were individually size-graded and assigned to a sorting class. Together these procedures portioned the recovered specimens into standardized, size-matched sets of artifacts and other materials.

During size-grading, samples were manipulated or shaken over nested screens with three graduated square mesh opening sizes (U.S. Standard Sieve Cloth): grade 1=1.000 in; grade 2=0.500 in; and grade 3=0.223 in. Items smaller than grade 3 are classified as grade 4. To minimize damage, artifacts were manipulated by hand through size grades 1 and 2 screens. Samples were shaken for 15 to 20 seconds over the size grades 3.

Size-grading assists in the efficiency of the sorting process that follows, allowing the sorter to examine batches of specimens that are all approximately the same size. Size-grading also allows use of objective, size-determined cut-off points for the sorting of different types of artifacts. In addition, size distribution data for certain artifact classes are in themselves useful for study of site formation processes as well as the technological history of artifacts. Artifacts with different depositional histories can exhibit differing size distributions (Behm 1983; Sherwood *et al.* 1995). Distinct processing histories, such as distinct stone knapping technologies (Ahler 1989a, 1989b), can be isolated through careful attention to data controlled by size grade.

Quantification and Analysis

Table 3.12 lists the sort classes. Detailed methods of analysis for stone tools and flaking debris are discussed in chapter 4. Chapter 5 discusses faunal analysis methods.

Quantitative and analytic data are stored in a single Microsoft Access (Office 2007) database. Table 3.13 lists the data tables containing coded or quantified information for each artifact or material class. Quantitative information was collected for most material classes.

Provenience data are stored in the *Catalog* table, along with data on sample type and recovery method. Analytic unit and excavated volume data are stored in

Table 3.12. List of collection sort classes and corresponding Access data tables containing coded and measured data.

General Class	Specific Class	Access 2007 Database Table(s)
Pottery	-	[none]
Modified Stone	Stone Tools	Stone Tools
	Flaking Debris	CSFD Mass Data; CSFD IFA
Faunal Remains	Unmodified	Bone Count; Bone Weight; ID Bone
	Modified	[none]
Bulk Sediment	Botanicals	[none]
Charcoal	-	[none]
Fire Cracked Rock	-	[none]
Natural Rock	-	[none]

Table 3.13. Data tables comprising the project's Microsoft Access 2007 database.

Table Name	Content	Fields	Records
Catalog[a]	Provenience, sample type, recovery method, analytic unit variables	21	112
Volume Calculations	Provenience, analytic units variables, excavated volume	12	112
Bone Weight	Weight of unidentified specimens	5	245
Bone Count	Count of unidentified specimens	5	245
ID Bone	Attributes of identified specimens	19	86
CSFD IFA	Individual flake analysis data	14	857
CSFD Mass Data	Mass analysis data	11	892
Stone Tools	Tool attributes	17	391

[a] 2014 catalog entries only; the complete Upper Crossing site catalog incorporates specimens and samples collected in 1977, 1989, 1999, 2006, 2007, 2009, 2010, and 2014 and contains 41 fields and 572 records.

the *Volume Calculation* table. Queries linking provenience and analytic unit data with artifact and specimen data were built as needed to generate the derived data tables necessary for subsequent interpretation. In some cases, data queries developed in Access were compiled in PASW Statistics 17 or Microsoft Excel (Office 2007) for purposes of further analysis and data summation.

4 Analyses of Material Culture

Mark D. Mitchell and Carl R. Falk

This chapter describes and analyzes flaking debris, stone tools, pottery, and modified bone specimens. University of Colorado work-study students Shelby Magee and Sebastian Wetherbee analyzed the flaking debris. They were supervised by PCRG project archaeologist Chris Johnston. PCRG research director Mark Mitchell studied the stone tools and pottery. PCRG research associate Carl Falk analyzed the modified vertebrate remains and wrote the section describing them. Mitchell wrote the balance of the chapter.

Modified Stone

Modified stone specimens were first partitioned into two classes: chipped stone flaking debris and stone tools. A tool is any intentionally shaped object, an item exhibiting use-wear, or a remnant nodule of raw material from which flakes were removed. Intentionally shaped objects range in complexity from simple flakes with retouched edges to items produced by flaking, pecking, grinding, or some combination of those manufacturing techniques. Flakes, by contrast, are detached pieces discarded during lithic reduction. Flakes lack evidence of use or modification other than that produced by transport, tramping, or other post-depositional factors (Shott 2004). The process of separating tools from flaking debris was complicated by the high frequency of burning. By convention, potlids or other specimens with one face fractured exclusively by burning were classified as flakes. Potlids made from coarse rhyolite or other ingenous rocks were classified as burned rock.

The analysis developed in this chapter emphasizes the assemblage's technological, rather than functional, properties. Technological analysis of stone

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tools focuses mainly on how they were manufactured. The most important production variable is technological class (table 4.1). A tool's technological class is defined primarily by the dominant method used to manufacture it and secondarily by the form of the raw material blank (Ahler *et al*. 1994). Manufacturing methods commonly incorporate a sequence of production steps and techniques. Sequences range from simple and expedient to complex and staged. For example, patterned large thin bifaces are produced by sequential soft-hammer percussion flaking and, to a lesser degree, pressure flaking of flake blanks or tabular pieces of stone. Unpatterned flake tools, by contrast, exhibit only simple edge modification, either through use or pressure flaking.

Assessing tool technological class requires a series of interrelated judgments about the actual methods used to manufacture a tool as well as the intended outcome of the manufacturing process. Determinations about manufacturing stage and technological trajectory depend in part on the concept of *pattern*. Patterned tools exhibit bilateral symmetry while the form of unpatterned tools is dictated mainly by the shape of the original input blank. Use-wear traces, though not rigorously quantified in this analysis, provide additional information about whether the production process was complete when an artifact was lost or discarded (use phase).

Two variables are used to capture data on raw material usage. The first is rock type. Eleven types are present in the flaked stone tool assemblage, four of which are dominant: chert, chalcedony, quartzite, and rhyolite. Chert includes opaque cryptocrystalline stone in all colors, while chalcedony includes transparent to translucent cryptocrystalline materials, some of which contain amorphous white to red to light brown

Table 4.1. Stone tool technological class definitions.

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 view and cross section. Includes arrow points, 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 blanks. Patterned flake tools exhibit plano-convex cross sections, but are bilaterally symmetrical in plan view. Includes hides scrapers; a few hafted beak tools designed for wood or bone working also are included in this class.
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.
Coarse Cutting Tool	Produced by free-hand percussion on large cobble blanks of coarse material. Tools are only minimally shaped and the cutting edge outline often is sinuous. Includes choppers, planes, and other unhafted tools.
Non-Bipolar Core	Produced by free-hand, nonbifacial percussion on various blank types. May be irregular or symmetrical. Includes cores and tested cobbles.
Bipolar Core/Wedge	Produced only or mainly by bipolar percussion. Irregular in plan view and cross section. Includes cores used for flake production, punches or wedges fractured during use, and tested cobbles.
Unpatterned Ground Stone	Produced by pecking or grinding or formed by use on various blank types. Irregular in plan view and cross section. Includes abrading tools, hammerstones, and bipolar anvils.
Patterned Ground Stone	Produced by pecking or grinding on various blank types. Blank form is substantially modified during the shaping process. Includes abrading tools, celts, mauls, pipes, beads and other decorative items.
Retouched Plate Tool	Produced by free-hand percussion flaking and pressure flaking on tabular or platy blanks. Tools in this class may exhibit unifacial or bifacial edging, but generally are asymmetrical in plan view. Includes a wide variety of tools used for many different tasks.
Ground Core	Produced by a combination of free-hand percussion flaking, battering, and grinding on irregular nodules. Used for multiple tasks, including flake production, heavy chopping, and abrading.

inclusions. Orthoquartzite is a metamorphic stone composed of cemented sand grains that occurs in a wide range of colors. Rhyolite is an opaque extrusive igneous rock containing distinctive crystals known as phenocrysts. Rhyolite in the Upper Crossing assemblage ranges in color from brown to tan to pink and varies in quality from coarse to lustrous.

Minor toolstone types include basalt, silicified wood, obsidian, argillite (hornfels), quartz, and metaquartzite. Toolstone quality basalt is a fine-grained, homogenous extrusive igneous rock that is opaque, black to dark gray in color, and may contain small but visible crystals. Silicified wood in the Upper Crossing collection is highly variable in color, quality, and opacity, but is identified by traces of its original internal structure or by its characteristic rough cortex. Obsidian in the collection ranges from smooth and transparent to cloudy with small inclusions. Argillite (hornfels) is a homogeneous gray to black metamorphosed shale. Ground stone tools in the collection are made from sandstone, coarse rhyolite (tuff), and unidentified igneous stone. The sandstone used to produce grinding tools is moderately well cemented and fine-grained.

Descriptive group is the second variable used to characterize raw material usage. Groups were derived inductively, based on a previous examination of collections obtained in 1999 and 2009 (Mitchell and Falk 2012). Each descriptive group consists of specimens exhibiting a regular combination of distinctive properties, including color, color pattern, texture, inclusions, cortex type, fracture quality, and so forth. The groups are rather narrowly defined and as a result 40 percent of the flaking debris and 59 percent of the stone tools are not assigned to one of the defined descriptive groups.

The descriptive groups may comprise materials derived from discrete quarry localities. However, the heterogeneity of those potential localities is not known and it seems likely that many of the toolstone sources exploited by the site's inhabitants produced a range of materials that differ in color, nodule size, and quality. It is also likely that visually similar materials derive from different source locations. Nevertheless, the descriptive groups defined for this analysis constitute a starting point for source location surveys. They may also help identify shifts in raw material exploitation over time and help isolate potentially imported raw materials.

Data were also collected on burning, intentional heat treatment, cortex, recycling, and completeness. Evidence of burning includes discoloration or the presence of irregular surface fractures, potlids, or crazing. Heat treatment data were collected only for specimens made from cryptocrystalline silica. Ahler (1983) and Domanski and Webb (2007) discuss the attributes of heat treated stone. Recycled tools include those that were intentionally modified subsequent to initial use. Some recycled tools retain their initial technological class but others were re-manufactured into a different class. Limited functional data were collected to isolate projectile points and scraping and grinding tools.

Technological analysis of the flaking debris aggregate focuses on flake size and weight distributions, on platform type, and on flake type. Two datasets were collected on the flaking debris aggregate. A basic suite of variables was coded for size grades 1 through 3 specimens, which together comprise the *coarse fraction* of the assemblage. Those variables include size grade, raw material type, raw material descriptive group, burning, heat treatment, and cortex. (Descriptive group and the presence of burning and heat treatment were not collected for size grade 4 specimens.) Counts and weights were recorded for each of the resulting sort groups. This dataset was collected to assess raw material procurement patterns, differences in the ways different raw materials were used, and differences among excavated contexts.

An individual-flake analysis was then conducted on a portion of the coarse-fraction aggregate to gather additional data on the technological procedures used to produce and modify stone tools. The studied specimens include those that retain a platform (complete and broken flakes [Sullivan and Rozen 1985]). Variables considered in this phase of the analysis include raw material type and descriptive group, heat treatment, platform type, and flake type. Length, width, and thickness were measured for complete flakes.

Complete lists of the variables and attributes coded in the stone tool and flaking debris studies are provided in appendix A. Additional discussion on the variables and attributes are presented in Ahler (2002), Ahler and others (2003), Ahler and others (1994), Ahler and Toom (1993), and Root and others (1999).

Collection Summary

The flaking debris assemblage consists of 3,577 specimens that together weigh 3,067 grams (table 4.2). The stone tool assemblage consists of 354 specimens. Thirty-seven specimens exhibit two different sequential technological processes, yielding a total of 391 distinct stone tool technological cases (table 4.3).

Table 4.2. Summary data on 2014 flaking debris assemblage, organized by size grade and excavation block.

	Count					Weight (g)				
	Size Grade					Size Grade				
Block	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
1	5	35	299	169	508	16.4	140.0	193.4	20.5	370.3
2	10	139	1,006	562	1,717	292.7	592.3	674.3	90.6	1,649.9
3	5	31	366	285	687	117.1	124.6	249.0	34.6	525.3
4	3	51	348	263	665	70.0	184.0	227.5	40.0	521.5
Total	23	256	2,019	1,279	3,577	496.2	1,040.9	1,344.2	185.7	3,067.0

Table 4.3. Summary data on the 2014 stone tool assemblage, organized by size grade and excavation block.

	Count					Weight (g)				
	Size Grade					Size Grade				
Block	G1	G2	G3	G4	Total	G1	G2	G3	G4	Total
Surface		1			1		4.5			4.5
1	3	26	23		52	122.1	198.7	28.2		349.0
2	26	54	59	3	142	1,983.2[a]	377.5	65.4	0.7	2,426.8
3	5	30	39	8	82	1,056.8[b]	213.4	38.1	1.2	1,309.5
4	6	56	47	5	114	686.5	431.2	64.4	0.9	1,183.0
Total	40	167	168	16	391	3,848.6	1,225.3	196.1	2.8	5,272.8

[a] Excludes a single millingstone fragment weighing about 5,000 g.
[b] Excludes a single millingstone fragment weighing about 7,900 g.

The tool and flaking debris samples are unevenly distributed among the excavation blocks. The largest samples come from Block 2, including 48 percent of the flakes and 36 percent of the tools. The smallest samples come from Block 1, which produced roughly 14 percent of the flakes and 13 percent of the tools. Nearly two-thirds of the stone tool cases are assigned to the Late Prehistoric temporal unit (table 4.4; see chapter 3 for a description of analytic units). Just over one-quarter are assigned to the unclassified temporal unit. About half of the flaking debris comes from Late Prehistoric contexts, while slightly over one-third is assigned to the unclassified temporal unit.

Table 4.4 also gives the sizes of comparative samples that were obtained during testing projects undertaken in 1999 and 2009. Mitchell and Falk (2012) describe and analyze those samples. (Previously collected samples also include specimens assigned to other temporal units, including the unclassified temporal unit; however, specimens assigned to those units are not included in

Table 4.4. Counts of stone tools (upper panel) and flakes (lower panel) comprising comparative samples, organized by temporal unit and collection year.

	Temporal Unit			
Collection Year	Late Archaic	Late Prehistoric	Unclassified	Total
2014	45	243	103	391
1999 and 2009[a]	36	82		118
Total	81	325	103	509

	Temporal Unit			
Collection Year	Late Archaic	Late Prehistoric	Unclassified	Total
2014	482	1,828	1,267	3,577
1999 and 2009[a]	907	947		1,854
Total	1,389	2,775	1,267	5,431

[a] Data from Mitchell and Falk (2012).

the analysis presented in this chapter.) The 1999 and 2009 comparative samples were not size graded and data were collected on a smaller number of variables.

Grade 4 Sample

The values reported in table 4.2 include specimens that fall into four sizes: size grade 1 (items retained in a 1-inch square mesh screen), size grade 2 (½-inch mesh), size grade 3 (¼-inch mesh), and size grade 4 (⅛-inch mesh). Because excavated sediment was dryscreened in the field over ¼-inch hardware cloth, the recovery of grade 4 specimens cannot be considered systematic. The fact that the excavated collection includes 1,279 grade 4 flakes—roughly 36 percent of the total assemblage—is a testament to the field crew's sharp eyes and careful work. However, the extent to which the collected grade 4 fraction is representative of all grade 4 flakes present in the excavation blocks cannot be evaluated. A recent controlled comparison suggests that on average only one-seventh of the size grade 4 flakes present in an archaeological deposit are captured by dryscreening sediment over ¼-in hardware cloth (Johnston 2016). In particular, the collected sample likely underestimates the occurrence of flakes produced during the final stages of tool production or during tool-edge maintenance.

Nevertheless, the grade 4 fraction can be included in certain analyses because the field collection efficiency of grade 4 specimens was roughly equivalent across the four excavation blocks. Table 4.5 shows the observed and expected counts of systematically (grade 1 through 3) and unsystematically (grade 4) collected specimens. The contingency table is significant; however, this primarily is a product of the sensitivity of chi-square statistics to large samples. Although the table shows that grade 4 flakes are overrepresented in Block 3 and underrepresented in Block 2, the proportions of grade 4 flakes are roughly comparable in each of the four block samples. Given that result, grade 4 flakes are included in selected analyses of raw material usage but excluded from technological analyses.

Table 4.5. Comparison of systematically and unsystematically recovered flaking debris samples. Shaded cells indicate standard residual values greater than ±2.0.

Block		Size Grade G1-G3	Size Grade G4	Total	Percent G4
1	Observed	339	169	508	*33.3*
	Expected	326.4	181.6		
	Std. Residual	.7	-.9		
2	Observed	1,155	562	1717	*32.7*
	Expected	1,103.1	613.9		
	Std. Residual	1.6	-2.1		
3	Observed	402	285	687	*41.5*
	Expected	441.4	245.6		
	Std. Residual	-1.9	2.5		
4	Observed	402	263	665	*39.5*
	Expected	427.2	237.8		
	Std. Residual	-1.2	1.6		
Total		2,298	1,279	3,577	*35.8*

Pearson χ^2=22.186; df=3; p=0.000

Raw Material Usage

Four raw materials dominate the flaking debris assemblage: chert, chalcedony, orthoquartzite, and rhyolite (table 4.6). All other materials combined make up less than 2 percent of the assemblage. Potential sources of all four of the dominant material types are located close to Upper Crossing. Table 4.7 provides raw material descriptive group data on the coarse fraction (size grades 1 through 3) flaking debris sample. Recall that descriptive groups are defined inductively and consist of specimens exhibiting regular combinations of distinctive attributes, including color, color pattern, texture, inclusions, cortex type, fracture quality, and so forth. Descriptive groups may represent materials derived from discrete quarry localities.

A specific source locality for the single most abundant raw material, dark red chert, has not been identified. However, a source almost certainly occurs in the immediate vicinity, given the abundance of this distinctive material in the assemblage, its generally low quality, and the comparatively large sizes of cores in the tool assemblage. The Trickle Mountain (Alkali Creek) quartzite quarry is located 2.5 km to the northeast (figure 1.6). Jasper occurs in many localities in the eastern San Juan Mountains. However, it definitely occurs in the Alkali Creek valley. Fibrous chalcedony outcrops 1.5 km south of Upper Crossing, although it almost certainly outcrops in other parts of the Saguache Creek valley as well. Sources of the siliceous gray and nougat rhyolite have not been located; however, various types of rhyolite occur abundantly in the valley.

These data indicate that the lithic territory exploited by Upper Crossing's residents was primarily confined to the Saguache Creek valley. About 60 percent of the assemblage is made from stone that definitely or probably occurs within an area of no more than 150 km^2, extending from roughly 5 km above Upper

Table 4.6. Raw material distribution of the 2014 flaking debris assemblage, organized by temporal unit. Proportions represent within-temporal-unit values.

	Temporal Unit			
Raw Material Type	Late Archaic	Late Prehistoric	Unclassified	Total
Chert	63.7%	64.1%	51.9%	2,136
Chalcedony	5.0%	10.6%	10.7%	353
Orthoquartzite	18.3%	7.9%	23.3%	528
Rhyolite	12.9%	15.4%	13.4%	514
Basalt	0.2%	1.2%	0.2%	25
Silicified Wood		0.3%	0.1%	7
Obsidian		0.2%	0.2%	6
Unknown			0.1%	1
Argillite		0.1%		1
Metaquartzite		0.1%	0.3%	6
Total	482	1,828	1,267	3,577

Table 4.7. Raw material descriptive group distribution of flaking debris in the 2014 assemblage, organized by temporal unit. Proportions represent within-temporal-unit values.

	Temporal Unit			
Descriptive Group	Late Archaic	Late Prehistoric	Unclassified	Total
Dark Red Chert	26.6%	21.3%	16.8%	467
Trickle Mountain Quartzite	19.1%	8.7%	23.0%	358
Jasper	13.8%	18.6%	13.4%	366
Fibrous Chalcedony	2.2%	3.1%	3.1%	68
Possible Trickle Mountain Quartzite	0.3%		0.2%	3
Non-local Quartzite	0.6%		0.3%	5
Siliceous Gray Rhyolite	4.1%	3.8%	3.1%	82
Nougat Rhyolite	0.3%	2.4%		28
Banded Coarse Quartzite	0.3%	0.2%	0.2%	5
Unspecified	32.8%	42.0%	39.7%	916
Total	320	1,110	868	2,298

Crossing to about 20 km below. In fact, the only specimens made from material that certainly comes from a distant source are the five non-local quartzite flakes listed in table 4.7 and the six obsidian flakes listed in table 4.6. The argillite and basalt flakes listed in table 4.6 also likely represent imported materials.

Tables 4.6 and 4.7 also point to possible differences in raw material usage during different time periods. The most notable difference lies in the greater use of orthoquartzite by Late Archaic flintknappers. In addition, non-local quartzite, likely from the Gunnison basin, only was used during the Late Archaic. Use of chalcedony was lower in the Late Archaic and use of basalt was higher in the Late Prehistoric.

Some of the apparent temporal unit differences may in fact reflect between-occupation patterns rather than longer-term temporal patterns. Table 4.8 compares the 2014 flake assemblage with previously collected assemblages. For both the Late Archaic and the Late Prehistoric samples, chalcedony is much less common in the 2014 sample than in the previously collected samples. Conversely, chert is much more common.

Nevertheless, some of the differences do reflect temporal patterns. Orthoquartzite appears to be more abundant in all Late Archaic samples. Gunnison basin orthoquartzite only occurs in Late Archaic contexts, both in the 2014 sample and in the 2009 sample. Basalt primarily occurs in Late Prehistoric contexts and obsidian only occurs in Late Prehistoric contexts. Although the absolute number of specimens made from non-local stone is small, these data suggest that the lithic territory exploited by Upper Crossing's Late Archaic residents included areas to the west but not to the south, whereas the lithic territory exploited by the site's Late Prehistoric residents included areas to the south but not to the west.

Between-occupation differences can also be examined within the Late Prehistoric sample. Table

Table 4.8. Comparison of raw material distributions of Late Archaic and Late Prehistoric flaking debris assemblages, organized by sample year. Proportions represent within-sample values.

	Late Archaic			Late Prehistoric		
	Sample			Sample		
Raw Material Type	2009	2014	Total	1999	2014	Total
Chert	17.5%	63.7%	466	40.7%	64.1%	1,557
Chalcedony	56.7%	5.0%	538	34.3%	10.6%	519
Orthoquartzite	23.4%	18.3%	300	11.6%	7.9%	255
Rhyolite	1.0%	12.9%	71	9.8%	15.4%	375
Basalt	1.1%	0.2%	11	3.2%	1.2%	52
Silicified Wood	0.1%		1	0.2%	0.3%	8
Obsidian			-	0.1%	0.2%	5
Unknown	0.2%		2	0.1%		1
Argillite			-		0.1%	1
Metaquartzite			-		0.1%	2
Total	907	482	1,389	947	1,828	2,775

4.9 tallies the post-enclosure-construction flaking debris assemblage by excavation block. Differences do not exist in the use of chert and chalcedony among the four enclosures, but strong differences exist in the use of orthoquartzite and rhyolite. Between-enclosure differences also exist in the material group data (table 4.10). Siliceous gray rhyolite occurs primarily in two enclosures, while nougat rhyolite occurs only in one. Fibrous chalcedony is similarly unevenly distributed. All of these materials are locally available and so these differences do not point to regional mobility patterns, but rather to differences in local resource access and procurement scheduling during different Late Prehistoric occupation events. That pattern of between-enclosure differences bolsters the conclusion drawn from stratigraphic and chronometric data that the Cluster 1 enclosures are not contemporaneous.

Table 4.11 gives the raw material distribution of the tool assemblage. The proportions of different raw materials mirror those in the flaking debris assemblage. Taken at face value, that overall similarity of proportions suggests that raw material nodules were transported to Upper Crossing from nearby quarries and tools were manufactured, used, and discarded on-site. A similar pattern is evident in previously collected assemblages (Mitchell and Falk 2012).

There are a couple of exceptions to the overall pattern of raw material similarity between the tool and flake assemblages. The most notable difference is the comparatively large proportions of tools made from silicified wood in all temporal units. That difference is due entirely to the presence of small pieces of unmodified or minimally modified silicified wood in the tool assemblage, which are classified as core

Table 4.9. Raw material distribution of the 2014 post-enclosure construction flaking debris assemblage, organized by excavation block. Cells with standardized residuals greater than ±2.0 are shaded. Proportions represent within-block values.

	2014 Excavation Block				
Raw Material Type	Block 1	Block 2	Block 3	Block 4	Total
Chert	58.6%	53.6%	59.0%	68.4%	635
Chalcedony	9.3%	10.7%	11.5%	11.8%	112
Orthoquartzite	9.6%	26.8%	3.3%	11.2%	89
Rhyolite	20.8%	8.9%	24.9%	6.4%	202
Basalt	.7%		.8%	1.6%	9
Silicified Wood	.5%		.3%		3
Obsidian	.2%		.3%		2
Argillite				.5%	1
Metaquartzite	.2%				1
Total	418	56	393	187	1,054

Table 4.10. Raw material descriptive group distribution of 2014 Late Prehistoric, post-enclosure-construction, coarse-fraction flaking debris samples organized by excavation block. (Block 2 is omitted owing to small sample size.) Proportions represent within-block values.

	Excavation Block			
Descriptive Group	Block 1	Block 3	Block 4	Total
Dark Red Chert	15.7%	23.5%	20.2%	122
Trickle Mountain Quartzite	10.9%	4.3%	11.6%	54
Jasper	13.5%	13.5%	31.8%	108
Fibrous Chalcedony	3.7%	3.9%	2.3%	22
Siliceous Gray Rhyolite	6.4%	6.5%		32
Nougat Rhyolite		10.9%		25
Banded Coarse Quartzite			0.8%	1
Unspecified	49.8%	37.4%	33.3%	262
Total	267	230	129	626

Table 4.11. Raw material distribution of stone tools in the 2014 assemblage, organized by temporal unit. Proportions represent within-temporal-unit values.

	Temporal Unit			
Raw Material Type	Late Archaic	Late Prehistoric	Unclassified	Total
Chert	57.8%	70.8%	68.0%	268
Chalcedony	6.7%	2.5%	4.9%	14
Orthoquartzite	15.6%	6.2%	9.7%	32
Rhyolite	6.7%	7.0%	10.7%	31
Basalt		0.8%	1.9%	4
Silicified Wood	4.4%	9.1%	1.9%	26
Obsidian	2.2%	0.4%		2
Sandstone	2.2%	1.2%	1.0%	5
Unknown	2.2%	1.2%		4
Schist		0.8%		2
Unknown Igneous	2.2%		1.9%	3
Total	45	243	103	391

fragments. All, or nearly all, of that material comes from geological strata exposed within the boundaries of the site. Another difference between the tool assemblage and the flaking debris assemblage is the comparatively small proportion of rhyolite tools. This may indicate that a disproportionate share of the rhyolite tools made at Upper Crossing were transported and used off-site. Finally, one obsidian tool is present in the Late Archaic sample, whereas no obsidian flakes occur in the Late Archaic flake assemblage.

However, descriptive group data suggest that the organization of lithic technology was more complex than is suggested by the raw material data alone (table 4.12). Approximately 60 percent of the tool assemblage falls into the unspecified group, while just 40 percent of the flakes fall into that group. That difference suggests that a comparatively wide variety of raw materials, including stone from sources not located close to Upper Crossing, were used to make the tools recovered there, a circumstance which suggests that some of the tools were made off-site. A disparity in the proportions of flakes and tools in the unspecified group was also observed in previously collected assemblages (Mitchell and Falk 2012).

Table 4.13 compares the raw material distribution of the 2014 stone tool sample with prior samples. The between-sample differences mirror those observed in the flaking debris samples (table 4.8). As is true of the flaking debris, two aspects of raw material variability are represented: broad differences between the Late Archaic and the Late Prehistoric and short-term differences among occupation events within each temporal unit.

Table 4.14 gives the distribution of descriptive groups for post-enclosure-construction contexts in three excavation blocks; specimens from Block 2 are

Table 4.12. Raw material descriptive group distribution of stone tools in the 2014 assemblage, organized by temporal unit. Proportions represent within-temporal-unit values.

	Temporal Unit			
Descriptive Group	Late Archaic	Late Prehistoric	Unclassified	Total
Dark Red Chert	15.6%	9.5%	11.7%	42
Trickle Mountain Quartzite	11.1%	4.9%	6.8%	24
Jasper	15.6%	20.6%	14.6%	72
Fibrous Chalcedony	2.2%	0.8%	1.0%	4
Possible Trickle Mountain Quartzite		0.8%		2
Non-local Quartzite	4.4%		1.0%	3
Siliceous Gray Rhyolite		2.1%	1.9%	7
Nougat Rhyolite		1.2%		3
Banded Coarse Quartzite		0.4%	1.0%	2
Unspecified	51.1%	59.7%	62.1%	232
Total	45	243	103	391

Table 4.13. Comparison of raw material distributions of Late Archaic and Late Prehistoric stone tool assemblages, organized by sample year. Proportions represent within-sample values.

	Late Archaic			Late Prehistoric		
	Sample			Sample		
Raw Material Type	2009	2014	Total	1999	2014	Total
Chert	27.8%	57.8%	36	51.2%	70.8%	214
Chalcedony	38.9%	6.7%	17	29.3%	2.5%	30
Orthoquartzite	16.7%	15.6%	13	8.5%	6.2%	22
Rhyolite	8.3%	6.7%	6	7.3%	7.0%	23
Basalt			-	1.2%	0.8%	3
Silicified Wood		4.4%	2	2.4%	9.1%	24
Obsidian	2.8%	2.2%	2		0.4%	1
Sandstone	5.6%	2.2%	3		1.2%	3
Unknown		2.2%	1		1.2%	3
Schist			-		0.8%	2
Unknown Igneous		2.2%	1			-
Total	36	45	81	82	243	325

omitted due to the small sample size. As is the case for the flaking debris aggregate (table 4.10), between-enclosure differences exist in the usage of different descriptive groups, suggesting that different local sources were used during different Late Prehistoric occupation events. It is notable that nougat rhyolite flakes only occur in Block 3 but nougat rhyolite tools only occur in Block 4.

Summary

The dominant conclusion to be drawn from the raw material and material group data is that the lithic territory exploited by the groups who occupied Upper Crossing was tightly circumscribed. The majority of the materials come from source localities within the Saguache Creek valley itself. Limited data suggest that tools made of stone obtained from somewhat more distant sources may have been brought to the site; however, a large share of the tools used on-site were also manufactured there using stone from nearby sources. That pattern testifies to the abundance and variety of easily obtainable toolstone located close to Upper Crossing.

The small number of obviously imported specimens points to temporal shifts in mobility patterns. Orthoquartzite from the Gunnison basin only occurs in Late Archaic contexts, while stone from southern sources, including obsidian and basalt, occurs almost exclusively in Late Prehistoric contexts. The most important difference between Late Archaic and Late Prehistoric raw material use is the modest preference of Late Archaic flintknappers for orthoquartzite.

Significant within-temporal-unit differences in raw

Table 4.14. Raw material descriptive group distribution of 2014 Late Prehistoric, post-enclosure-construction stone tools, organized by excavation block. (Block 2 is omitted due to small sample size.) Proportions represent within-block values.

	Excavation Block			
Descriptive Group	Block 1	Block 3	Block 4	Total
Dark Red Chert	20.5%	8.7%	6.7%	15
Trickle Mountain Quartzite	9.1%	2.2%	3.3%	6
Jasper	15.9%	32.6%	20.0%	28
Possible Trickle Mountain Quartzite	4.5%			2
Siliceous Gray Rhyolite	4.5%	4.3%		4
Nougat Rhyolite			6.7%	2
Unspecified	45.5%	52.2%	63.3%	63
Total	44	46	30	120

material usage point to different quarry exploitation patterns during different occupation events. Differences among different occupation events within the Late Archaic or Late Prehistoric likely reflect decisions residents made about the direction and scheduling of logistical forays.

Stone Tool Technology

Table 4.15 partitions the 2014 stone tool cases by technological class and temporal unit. Table 4.16 combines 2014 data with previously collected data. Both the Late Archaic and the Late Prehistoric assemblages are diverse, but differences exist between them. Large patterned bifaces are more common in the Late Archaic assemblage and unpatterned bifaces are more common in the Late Prehistoric. Those differences suggest that Late Archaic flintknappers produced more multi-function, transportable tools. The Late Prehistoric assemblage also includes more patterned flake tools (end scrapers), indicating that hide working or woodworking was more common during that period than previously.

Because the Late Archaic tool assemblage is relatively small, the analysis presented in the following sections focuses primarily on the Late Prehistoric assemblage.

Raw Material Preferences

Table 4.17 shows the relationship between technological class and raw material type for the Late Prehistoric assemblage. The vast majority of tools are made from chert. However, a slight preference for fine-grained materials is apparent among small patterned bifaces, relative to the overall raw material distribution (table

Table 4.15. 2014 stone tool technological cases organized by temporal unit. Shading indicates significantly higher values discussed in the text. Proportions represent within-temporal unit values.

	Temporal Unit			
Technological Class	Late Archaic	Late Prehistoric	Unclassified	Total
Small Patterned Biface	17.8%	17.7%	11.7%	63
Large Patterned Biface	22.2%	6.2%	10.7%	36
Unpatterned Biface	4.4%	9.5%	9.7%	35
Patterned Flake Tool	2.2%	5.3%	5.8%	20
Unpatterned Flake Tool	13.3%	16.0%	22.3%	68
Coarse Cutting Tool		0.4%		1
Non-bipolar Core	28.9%	38.3%	29.1%	136
Bipolar Core/Wedge	4.4%	1.2%	3.9%	9
Unpatterned Ground Stone	4.4%	2.1%	4.9%	12
Patterned Ground Stone	2.2%	1.6%	1.0%	6
Retouched Plate Tool		1.6%	1.0%	5
Total	45	243	103	391

Table 4.16. Comparison of tool technological class distributions between Late Archaic and Late Prehistoric assemblages. Includes 1999, 2009, and 2014 collections. Shading indicates significantly higher values discussed in the text. Proportions represent within-temporal-unit values.

	Temporal Unit		
Technological Class	Late Archaic	Late Prehistoric	Total
Small Patterned Biface	11.1%	21.2%	78
Large Patterned Biface	24.7%	9.5%	51
Unpatterned Biface	2.5%	8.9%	31
Patterned Flake Tool	1.2%	5.5%	19
Unpatterned Flake Tool	23.5%	16.9%	74
Coarse Cutting Tool		0.3%	1
Non-bipolar Core	23.5%	32.0%	123
Bipolar Core/Wedge	2.5%	1.2%	6
Unpatterned Ground Stone	8.6%	1.5%	12
Patterned Ground Stone	1.2%	1.2%	5
Retouched Plate Tool		1.5%	5
Ground Core	1.2%		1
Total	81	325	406

4.18). Coarse-grained materials are overrepresented among large patterned bifaces, unpatterned bifaces, and patterned flake tools. Those preferences conform to general functional and technological expectations. However, the distribution shown in table 4.18 is not significant.

Heat Treatment

Late Prehistoric flintknappers at Upper Crossing made extensive use of heat treated stone (table 4.19). Among all chipped stone tools, roughly half were made from unheated stone, while one-third were made from possibly or definitely heated stone. (One-fifth of the assemblage was made from materials that are not improved by heat treatment, or are too burned to determine whether they were heat treated.) Surprisingly, heat treated stone was used to produce every class of chipped stone tool. In assemblages where heat treated stone is common it was used primarily or exclusively for tools produced by pressure flaking (Ahler 1983; Domanski and Webb 2007; Mitchell 2013).

Heat treated flakes are less abundant than heat treated tools, primarily because larger proportions of the flaking debris consist of non-cryptocrystalline materials or specimens too burned to determine whether they were heat treated. If these two categories are eliminated, roughly equivalent proportions of tools and flakes were heat treated, with 40 percent possibly or definitely heat treated and 60 percent unheated. That equivalency of proportions suggests that heat treatment mostly took place on-site. A wide variety of input blanks were heated treated, including flakes, cores, and recycled tools.

Tool Recycling

Recycling is defined in this study as re-manufacturing, rather than simply as re-sharpening. Tool re-sharpening also is evident in the assemblage but was not quantified. Roughly 11 percent of the Late Prehistoric tool specimens were recycled into another tool (table 4.20). About 60 percent of the recycled items were re-manufactured into the same technological class, while 40 percent were converted to a new technological class. Many of the tools recycled into the same technological class were used until exhausted or broken, then heat

Table 4.17. Technological class distribution of 2014 Late Prehistoric stone tool assemblage, organized by raw material type. Ground stone tool classes omitted. Proportions represent within-tool-class values.

	Raw Material							
Technological Class	Chert	Chalcedony	Orthoquartzite	Rhyolite	Basalt	Silicified Wood	Obsidian	Total
Small Patterned Biface	86.0%	2.3%	4.7%	2.3%		2.3%	2.3%	43
Large Patterned Biface	80.0%		6.7%	13.3%				15
Unpatterned Biface	73.9%	4.3%	21.7%					23
Patterned Flake Tool	76.9%		23.1%					13
Unpatterned Flake Tool	82.1%		7.7%	7.7%	2.6%			29
Coarse Cutting Tool				100.0%				1
Non-bipolar Core	64.5%	4.3%	1.1%	9.7%		20.4%		93
Bipolar Core/Wedge	100.0%							3
Retouched Plate Tool	25.0%				25.0%	50.0%		4
Total	172	6	15	16	2	22	1	234

Table 4.18. Collapsed raw material distribution of selected Late Prehistoric chipped stone tool classes in the 2014 collection.

	Collapsed Raw Material		
Technological Class	Fine Grained	Coarse Grained	Total
Small Patterned Biface	93.0%	7.0%	43
Large Patterned Biface	80.0%	20.0%	15
Unpatterned Biface	78.3%	21.7%	23
Patterned Flake Tool	76.9%	23.1%	13
Unpatterned Flake Tool	82.1%	17.9%	39
Non-bipolar Core	89.2%	10.8%	93
Total	86.3%	13.7%	226

treated and re-manufactured into a new tool. The effects of heat treatment make this type of recycling readily apparent; however, even in the absence of heat treatment, within-class recycling can be identified by careful examination of flaking patterns and the relationships between flake scars and use-wear traces.

For tools recycled into a different technological class, the second class often is a cutting or scraping tool produced by abrupt pressure flaking along one edge of an exhausted core or discarded biface.

Tool Fragmentation and Burning

The 2014 tool collection contains relatively few complete tools (table 4.21). Most of the size grade 1 chipped stone tools are complete or nearly so, but more than half of the assemblage consists of size grade 3 specimens, four-fifths of which are end, medial, or margin fragments. The assemblage also includes 136 non-bipolar cores and core fragments, but just 13 percent of them fall into size grade 1, most of which are exhausted. The remainder consists of fragmented cores or small, unusable nodules of raw material.

About 22 percent of the 2014 assemblage is burned. Burned tools are unevenly distributed among the excavation blocks, with Block 2 exhibiting the highest proportion at 31 percent and Block 4 the lowest at 10 percent. Burn tools are also unevenly distributed among size grade classes. About 35 percent of the size grade 1 tools are burned, while just 13 percent of the size grade 4 tools are burned.

Core Reduction

More than one-third of the 391 stone tool technological cases consist of cores or core fragments. However, just 13 percent of those falls into size grade 1 and only two of 136 specimens are classified as complete and usable. Another six specimens are complete but exhausted and 49 are nearly complete but exhausted. Just four specimens weight more than 100 g. The remaining 79 cases consist of size grade 2 and size grade 3 fragments.

Between-raw material differences exist in core size and completeness. Just one size grade 1 core is made from silicified wood and 20 of the 23 silicified wood core fragments fall into size grade 3 or size grade 4. By contrast, five of the 11 rhyolite cores fall into size grade 1. Both of the cores that are classified as usable are made from rhyolite. In addition, all three of the quartzite cores are nearly complete and fall into size grade 1. Cores made of chert include large, complete or nearly complete specimens (48 percent) as well as small fragments (52 percent).

Table 4.19. Distribution of heat treatment classes among Late Prehistoric tool technological classes in the 2014 collection. Ground stone tool classes omitted. Proportions represent within-tool-class values.

	Collapsed Heat Treatment Class			
Technological Class	Unheated	Possibly or Definitely Heated	Unknown or Not Applicable	Total
Small Patterned Biface	30.2%	55.8%	14.0%	43
Large Patterned Biface	46.7%	33.3%	20.0%	15
Unpatterned Biface	30.4%	43.5%	26.1%	23
Patterned Flake Tool	46.2%	30.8%	23.1%	13
Unpatterned Flake Tool	48.7%	23.1%	28.2%	39
Coarse Cutting Tool			100.0%	1
Non-bipolar Core	62.4%	24.7%	12.9%	93
Bipolar Core/Wedge	33.3%	66.7%		3
Retouched Plate Tool	50.0%	25.0%	25.0%	4
Total	48.3%	33.3%	18.4%	234

Table 4.20. Distribution of tool technological classes among three recycling modes for the 2014 Late Prehistoric tool assemblage. Proportions represent within-tool-class values.

	Recycling Mode			
Technological Class	None	Same Technological Class	Different Technological Class	Total
Small Patterned Biface	90.7%	4.7%	4.7%	43
Large Patterned Biface	86.7%	6.7%	6.7%	15
Unpatterned Biface	91.3%	4.4%	4.4%	23
Patterned Flake Tool	92.3%		7.7%	13
Unpatterned Flake Tool	92.3%	2.6%	5.1%	39
Coarse Cutting Tool	100.0%			1
Non-bipolar Core	84.9%	10.8%	4.3%	93
Bipolar Core/Wedge	66.7%		33.3%	3
Unpatterned Ground Stone	100.0%			5
Patterned Ground Stone	100.0%			4
Retouched Plate Tool	100.0%			4
Total	88.9%	6.2%	4.9%	243

Table 4.21. Size distribution of tool completeness classes. Includes all chipped stone tools, apart from cores, in the 2014 collection assigned to all temporal units. Proportions represent within-size-grade values.

	Size Grade			
Completeness Class	G1	G2	G3	Total
Complete or Nearly Complete	85.7%	57.3%	19.8%	91
End Fragment	14.3%	29.2%	36.4%	74
Medial Fragment		5.2%	10.7%	18
Margin Fragment		7.3%	29.8%	43
Other Fragment		1.0%	3.3%	5
Total	14	96	121	231

Apart from a single Late Prehistoric specimen, all of the cores and core fragments are unprepared and multi-directional. One third of complete or broken flakes from Late Archaic contexts, and nearly 60 percent of complete and broken flakes from Late Prehistoric contexts, exhibit cortical or flat platforms (table 4.22). Dorsal mass reduction is evident on some flakes, but most reflect only limited core preparation or patterning.

The single exception is a conical, unidirectional core made from rhyolite. The specimen weighs 328 g and is

Table 4.22. Cross tabulation of flake types and platform types for Late Archaic and Late Prehistoric assemblages in the 2014 collection. Flakes with crushed platforms are omitted. Proportions represent within-temporal-unit values.

		Platform Type				
Temporal Unit	Flake Type	Cortical	Flat	Faceted, Unground	Faceted, Ground	Total
Late Archaic	Biface Thinning			13.4%	2.4%	13
	Other Simple	6.1%	11.0%	12.2%	1.2%	25
	Other Complex	1.2%	15.9%	32.9%	2.4%	43
	Failed Biface Thinning			1.2%		1
Subtotal		6	22	49	5	82
Late Prehistoric	Biface Thinning			4.3%	1.4%	16
	Other Simple	3.6%	22.7%	10.5%	1.1%	105
	Other Complex	2.9%	28.2%	21.3%	2.2%	151
	Failed Biface Thinning			1.8%		5
Subtotal		18	141	105	13	277

complete and usable. Morphologically, it is reminiscent of what have been called *split cobble tools*, which were used as cores, heavy scraping tools, or both (Black 1991a). The specimen from Upper Crossing is derived from a bedrock source and all of the removed flakes were detached from a single, roughly circular cortical surface. At least ten flakes were struck from the core's conical or polyhedral face. The platform is unprepared and the core shows no evidence of secondary use as a scraping or chopping tool.

Scraping Tools

About 6 percent of the Late Prehistoric tool assemblage consists of patterned flake tools (end scrapers). In addition, four unpatterned flake tools and one the retouched plate tool in the Late Prehistoric assemblage exhibit edge angles and use-wear traces characteristic of scraping tools. Use-wear traces were not systematically documented, but examination of these tools under low-power magnification (7-40x) revealed the presence of both abrasive wear (grinding, blunting, and smoothing) and flaking wear (hinge flaking and crushing) (Ahler 1979). That variation suggests that a range of scraping tasks were performed at Upper Crossing, likely including hide preparation and bone or woodworking.

Biface Production

Roughly three in ten of the bifaces in the Late Prehistoric assemblage consist of production failures, indicating that biface manufacture was an important activity (table 4.23). Production failures are more common among small patterned bifaces and unpatterned bifaces than among large patterned bifaces, suggesting that production was less focused on the latter artifact class.

Table 4.22 compares flake type and platform type for the Late Archaic and Late Prehistoric flake assemblages. Faceted platforms and biface thinning flakes are more common in the Late Archaic assemblage, suggesting that large patterned biface was more commonly produced during that period. That conclusion is supported by the comparative abundance of large patterned specimens in the Late Archaic biface assemblage (table 4.24). Half of the Late Archaic assemblage consists of large patterned bifaces, while they make up less than one-fifth of the Late Prehistoric assemblage.

However, flake data show that a portion of the large patterned bifaces made at Upper Crossing were transported and used, and discarded elsewhere, particularly during the Late Prehistoric. Eighty percent of the large patterned bifaces from Late Prehistoric contexts are made from chert, but just two of the 16 Late Prehistoric biface thinning flakes are made from chert (table 4.25). Similarly, 20 percent of the Late Prehistoric large patterned bifaces are made from orthoquartzite or rhyolite, while 75 percent of the biface thinning flakes are made from those materials. Those differences suggest that large patterned bifaces made from coarse materials were manufactured on-site but used off-site. Thus, the general view that Late Prehistoric lithic technology at Upper Crossing can be characterized as unpatterned may be biased by tool transport practices.

About 60 percent of the small patterned bifaces are classified as projectile points. The balance consists of drills, unpatterned perforators, and small cutting tools. Half of the projectile points are production failures, whereas less than 10 percent of the drills, perforators, and cutting tools are production failures. That difference points to the relative importance of on-site arrow point production. The fact that arrow point production failures occur in all four of the sampled enclosures reinforces that conclusion.

Projectile Points

The 2014 tool collection includes 42 projectile points or point fragments (table 4.26). Four-fifths are classified as arrow points. Nearly two-thirds come from Late Prehistoric contexts. About 40 percent of the projectile point assemblage consists of production failures (Ahler

Table 4.23. Use phase distribution of Late Prehistoric bifaces in the 2014 collection. Proportions represent within-technological class values.

	Use Phase Class				
Technological Class	Unfinished, Usable	Unfinished, Unusable	Finished, Usable	Finished, Unusable	Total
Small Patterned Biface	2.3%	32.6%	9.3%	55.8%	43
Large Patterned Biface		13.3%		86.7%	15
Unpatterned Biface		30.4%	4.3%	65.2%	23
Total	1.2%	28.4%	6.2%	64.2%	81

Table 4.24. Raw material distributions of Late Archaic and Late Prehistoric bifaces. Proportions represent within-class values for each temporal unit.

		Technological Class			
Temporal Unit	Raw Material Type	Small Patterned Biface	Large Patterned Biface	Unpatterned Biface	Total
Late Archaic	Chert	75.0%	60.0%	50.0%	13
	Chalcedony	25.0%	10.0%		3
	Orthoquartzite		20.0%	50.0%	3
	Rhyolite		10.0%		1
Subtotal		8	10	2	20
Late Prehistoric	Chert	86.0%	80.0%	73.9%	66
	Chalcedony	2.3%		4.3%	2
	Orthoquartzite	4.7%	6.7%	21.7%	8
	Rhyolite	2.3%	13.3%		3
	Silicified Wood	2.3%			1
	Obsidian	2.3%			1
Subtotal		43	15	23	81

Table 4.25. Raw material distributions of Late Archaic and Late Prehistoric complete and broken flakes, organized by flake type. Flakes exhibiting crushed platforms are excluded. Proportions represent within-temporal unit values.

		Flake Type				
Temporal Unit	Raw Material Type	Biface Thinning	Other Simple	Other Complex	Failed Biface Thinning	Total
Late Archaic	Chert	6.1%	12.2%	32.9%		42
	Chalcedony	3.7%	3.7%	4.9%	1.2%	11
	Orthoquartzite	6.1%	9.8%	11.0%		22
	Rhyolite		4.9%	3.7%		7
Subtotal		13	25	43	1	82
Late Prehistoric	Chert	0.7%	19.1%	34.3%	0.4%	151
	Chalcedony	0.7%	5.8%	7.2%	0.4%	39
	Orthoquartzite	2.9%	4.7%	4.0%	0.4%	33
	Rhyolite	1.4%	5.8%	9.0%	0.7%	47
	Basalt		1.4%			4
	Silicified Wood		0.7%			2
	Metaquartzite		0.4%			1
Subtotal		16	105	151	5	277

Table 4.26. Temporal unit distribution of dart and arrow points.

	Temporal Unit			
Type	Late Archaic	Late Prehistoric	Unclassified	Total
Arrow Point	4	26	4	34
Dart Point	5	1	2	8
Total	9	27	6	42

1992) (table 4.27). Half of the assemblage consists of finished and discarded items.

The single possible dart point from strata assigned to the Late Prehistoric temporal unit is a proximal (haft element) fragment of what may be a side-notched style (CN3215). The tool is too fragmented to determine the blade base width or the distal haft element width. However the proximal haft element width is greater than 18.1 mm. It could represent a found object, possibly recycled into a cutting tool. Alternatively, it could represent the base of a T-shaped drill.

Four points recovered from Late Archaic deposits are classified as arrow points, based on a variety of factors including production technique, overall size, distal haft element width, and blade base width (Mullen 2009b; Shott 1997). Two consist of distal fragments of unfinished points; both exhibit the technological characteristics of arrow points, but because they are production failures it is possible that they were designed to be small cutting tools. The other two

Table 4.27. Use phase distribution of projectile points, organized by temporal unit.

	Use Phase				
Temporal Unit	Unfinished, Usable	Unfinished, Unusable	Finished, Usable	Finished, Unusable	Total
Late Archaic		3		6	9
Late Prehistoric		13	2	12	27
Unclassified	1	1		4	6
Total	1	17	2	22	42

were finished and are discussed later in this section. The occurrence of arrow-size points in Late Archaic strata may indicate natural or cultural disturbance of archaeological deposits that was not recognized during the field investigation. (See chapter 3 for additional discussion on the stratigraphic distribution of dart and arrow points in Block 2.)

The point assemblage is morphologically diverse and few specimens exhibit the attributes of recognized, named types. Figures 4.1, 4.2, and 4.3 illustrate selected specimens. Additional data on the illustrated assemblage are presented in table 4.28. Measurement definitions are taken from Ahler (1971).

Figure 4.1 illustrates two side-notched dart points made from coarse-grained materials. Both exhibit broad notches and a slightly convex base. Specimen CN3236 (figure 4.1[b]) was recovered from Late Archaic deposits in Block 2 and is made from Trickle Mountain (Alkali Creek) quartzite. The base is heavily ground. Specimen CN2065 (figure 4.1[a]), which is made from reddish-gray rhyolite, was recovered from the surface in Cluster 1. The base is not ground and the blade exhibits primarily unifacial resharpening.

Dart points with side notches set close to the base (low side-notched forms) like the specimens illustrated in figure 4.1 are generally classified as Elko Side-

Table 4.28. Nominal and metric data on illustrated projectile points. Measurements in millimeters.

Figure No.	Catalog No.	Temporal Unit	Type	Use Phase	Length	Width	Thickness
4.1a	2065	Unclassified	Dart	Finished, Unusable	-	-	7.7
4.1b	3236	Late Archaic	Dart	Finished, Unusable	-	-	-
4.2a	3172	Unclassified	Arrow	Finished, Unusable	27.0	18.5	4.8
4.2b	3253	Late Prehistoric	Arrow	Finished, Usable	26.0	-	3.6
4.2c	3263	Late Archaic	Arrow	Finished, Unusable	-	16.1	5.2
4.2d	3236	Late Archaic	Dart	Unfinished, Unusable	-	-	4.6
4.2e	3179	Late Prehistoric	Arrow	Finished, Unusable	-	17.8	5.7
4.3a	3236	Late Archaic	Arrow	Finished, Unusable	21.8	15.4	3.5
4.3b	3169	Late Prehistoric	Arrow	Finished, Unusable	24.6	17.5	4.1
4.3c	3218	Late Prehistoric	Arrow	Finished, Usable	20.1	11.5	1.9
4.3d	3233	Unclassified	Arrow	Unfinished, Usable	29.6	18.4	4.2
4.3e	3199	Late Prehistoric	Arrow	Unfinished, Unusable	26.3	18.8	4.5

Figure No.	Proximal Haft Width	Distal Haft Width	Distal Haft Length	Blade Base Width	Blade Length
4.1a	19.5	14.0	8.9	-	-
4.1b	19.0	14.1	5.6	-	-
4.2a	11.3	10.3	6.7	18.8	18.9
4.2b	7.8	8.0	3.7	-	23.1
4.2c	11.9	11.1	6.4	15.9	-
4.2d	-	-	-	-	-
4.2e	-	9.6	8.5	17.8	-
4.3a	10.4	6.3	4.2	15.4	16.9
4.3b	-	-	-	17.5	22.2
4.3c	-	3.9	5.6	11.5	14.0
4.3d	-	-	-	-	-
4.3e	-	-	-	-	-

notched. The Elko series was defined for the Great Basin, although Mullen (2009a) identifies both Elko Side-notched and Elko Corner-notched points in a large assemblage from northwestern Colorado.

Other specimens recovered from Late Archaic strata include those illustrated in figure 4.2[c] (CN3263), figure 4.2[d] (CN3236), and figure 4.3[a] (CN3236). The point shown in figure 4.2[d] was made from white to yellow dendritic chalcedony and is unfinished. The weakly side-notched point shown in figure 4.2[c] is made from heat-treated local red chert. The point was made on a flake and the base is not ground. An impact fracture is present on the tip and one blade margin exhibits limited unifacial re-sharpening. Although the morphology of this specimen is reminiscent of some dart points, the proximal half element width is 11.9 mm and the blade base width is 16.1. Those dimensions suggest that it is an arrow point rather than a dart point (Mullen 2009b; Shott 1997).

The final illustrated specimen from a Late Archaic depositional context is the well-made corner-notched point shown in figure 4.3[a]. The point is made from translucent to light brown chalcedony and exhibits deep, symmetrical corner notches and a slightly concave, lightly ground base. The tip and one blade margin exhibit limited re-sharpening. The proximal haft element width is 10.4 mm and the blade base width is 15.4 mm. Those dimensions suggest that this specimen is an arrow point (Mullen 2009b; Shott 1997).

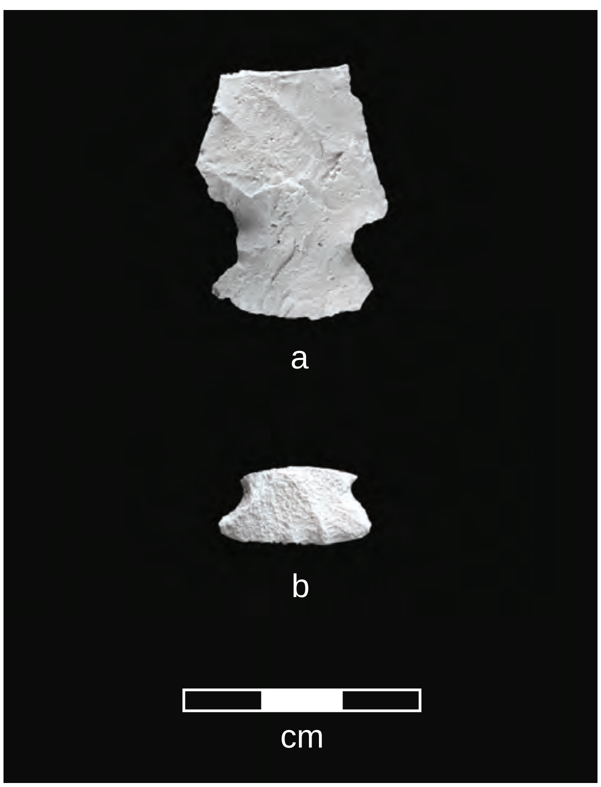

Figure 4.1. Selected projectile points in the 2014 assemblage. See table 4.28 for metric and other data.

Two illustrated specimens come from unclassified contexts. The stemmed specimen shown in figure 4.2[a] (CN3172) is made from red chert with chalcedony inclusions. The base is straight and unground. Bifacial re-sharpening is present on the tip and one blade margin and potlids are present on both faces, indicative of post-use burning. Although the morphology of this specimen is reminiscent of Archaic stemmed-indented base points, the blade base width is 18.5 mm and the proximal haft element width is 11.3 mm, measurements indicating that it could be a large arrow point or a small dart point (Mullen 2009b; Shott 1997).

The other specimen assigned to the unclassified temporal unit is shown in figure 4.3[d]. This well-made unfinished arrow point is made from heat-treated yellow chert. This point apparently was lost before it could be finished.

The remaining five illustrated specimens were recovered from strata assigned to the Late Prehistoric. One of the five, shown in figure 4.3[e] (CN3199), is an unfinished and discarded arrow point made from unheated yellow chert. Among the four finished points, only two exhibit morphometric attributes commonly associated with mid-first-millennium projectiles. One specimen, shown in figure 4.3[c] (CN3218), is made from non-local (non-fibrous) chalcedony that may have been heat treated. One side of the symmetrical stem is broken away. A portion of one barb is also broken away, although the blade likely was asymmetrical originally. The point is unburned and has not been re-sharpened.

Small corner-notched arrowpoints of this type occur in mid- to late-first millennium assemblages throughout Colorado. Specimens from the Pinon Canyon Maneuver Site fall into the Small Expanding Stemmed Point class, particularly categories P59, P60, and P61 (Anderson 1989, 1990). In the southern Plains, similar points are sometimes called *Scallorn* (Gunnerson 1987). Kalasz and others (1995:107-108) note that Scallorn points are common throughout the Plains-foothills ecotone. Irwin-Williams and Irwin (1966) group points of this style at the Magic Mountain site into their types MM34 and MM35. Gilmore (1999:272) notes a degree of patterned variation in haft width among similar points from the Bayou Gulch site. In the Great Basin, similar small corner-notched points are assigned to the morphologically variable Rose Springs

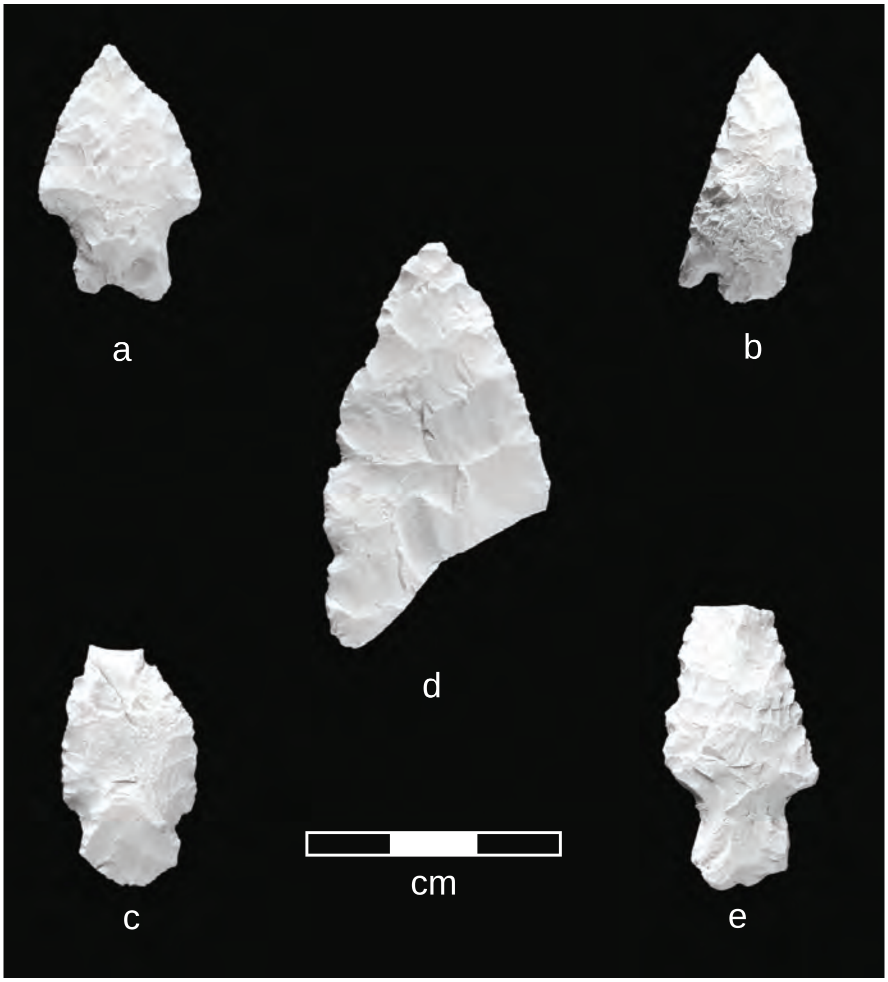

Figure 4.2. Selected projectile points in the 2014 assemblage. See table 4.28 for metric and other data.

type (Holmer 1986; Thomas 1981). Rose Springs points are now combined with Eastgate points in the Rosegate series (Thomas 1981). Rosegate points occur commonly in northwestern Colorado (Mullen 2009a).

The second Late Prehistoric point exhibiting attributes of a recognized type is shown in figure 4.2[b]. It is made from heat-treated red chert. The corner notches are shallow and originate from the base, giving the point a stemmed appearance. The notches are asymmetrical, with the notch below the broken barb deeper than the notch below the intact barb. No trace of the original input blank remains; however, the point's pronounced longitudinal curvature indicates that it was made on a flake. This specimen is similar to many Eastgate points, which, again, are combined with Rose Springs points in the Rosegate series (Thomas 1981).

The remaining two Late Prehistoric specimens are unusual. The corner-notched to stemmed specimen illustrated in figure 4.2[e] is made from unheated red chert with yellow inclusions. Both barbs and both tangs are broken away. The irregular but slightly convex base is ground. The blade base width and the estimated proximal haft width suggest that it is a large arrow or small dart; however, it currently is classified as a arrow point, given its stratigraphic context. After the artifact was no longer serviceable as a projectile point it was heat treated and re-manufactured into a small cutting tool.

The final illustrated specimen from a Late Prehistoric context is shown in figure 4.3[b]. The point is made from white to gray mottled chert. The haft element is not obviously re-worked, although the unusual configuration suggests that it may have been broken and subsequently modified. The tip has been re-manufactured into a drill.

Ground Stone Tools and Ornaments

Ground stone tools make up a notably small proportion of the tool assemblage. The 2014 collection includes just 18 specimens, or about 5 percent of the total (table

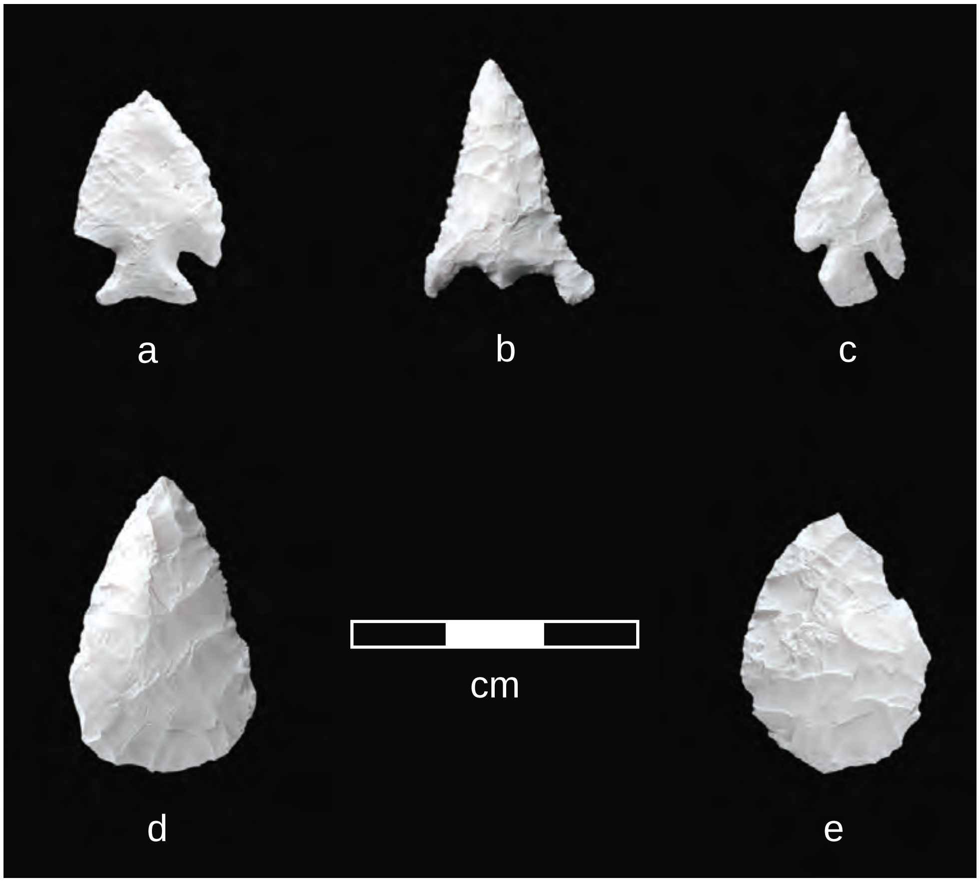

Figure 4.3. Selected projectile points in the 2014 assemblage. See table 4.28 for metric and other data.

4.29). None show evidence of recycling, although two millingstone fragments were re-used as enclosure foundation stones. The Late Archaic assemblage includes a patterned millingstone exhibiting flaked margins and a shallow central basin, a complete handstone exhibiting limited unifacial wear, and a fragment of a tabular, unifacial millingstone. Ground stone tools assigned to the unclassified temporal unit include three handstone fragments, one millingstone fragment, and one unidentified fragment. All exhibit limited use wear. Also assigned to the unclassified unit is a fragment of what may be a stone pipe or tubular ornament (CN3165). The interior surface is broken away, but the exterior is evenly curved and smooth and exhibits faint striations that may represent manufacturing traces. The raw material may be an igneous stone, possibly a fine-grained rhyolite.

Table 4.29. Temporal unit distribution of ground stone tools in the 2014 assemblage, organized by technological class.

	Temporal Unit			
Technological Class	Late Archaic	Late Prehistoric	Unclassified	Total
Unpatterned	2	5	5	12
Patterned	1	4	1	6
Total	3	9	6	18

The Late Prehistoric ground stone tool and ornament assemblage includes nine items. Six of the nine are grinding tools, including four millingstone fragments (one patterned and four unpatterned) and two unidentified fragments. The remaining three items include a stone bead and two possible pipe or ornament fragments. The possible pipe fragments are associated with the basin house beneath Enclosure 10. The interior surface of one is broken away, but the exterior is evenly curved and smooth and exhibits a few faint striations. The raw material is dark gray and may be basalt.

The exterior surface of the second fragment shows many pronounced striations. The interior is pitted. One margin is beveled and smoothed. This specimen may represent the bowl of a pipe or the open end of a tube. The raw material is unknown, but is gray brown in color.

The stone bead is associated with the occupation of Enclosure 10 and was recovered from outside the structure. It is made from a dark gray, platy sedimentary stone and is 5.33 mm in diameter and 1.25 mm thick. The center hole is 1.89 mm in diameter. The bead is very symmetrical and finely crafted.

Spatial and Temporal Variation within the Late Prehistoric Assemblage

No significant variations exist in the mix of technological processes represented by different temporal and spatial subsets of the Late Prehistoric assemblage. Table 4.30 compares the proportions of different technological classes assigned to basin house strata with the proportions assigned to enclosure strata. Comparisons among enclosures are presented in table 4.31. All of the major classes are represented in each subsample. The proportions of different technological classes vary and those variations could point to minor differences in production among different occupations. However, each of the subsamples is relatively small. Overall, the range of production processes associated with enclosures does not appear to be significantly different than the range of processes associated with basin houses. Similarly, the range of processes associated with different enclosures does not appear to vary significantly.

Table 4.30. Comparison of Late Prehistoric pre- and post-enclosure construction stone tool technological class distributions. Proportions represent within-construction-relationship values.

	Enclosure Construction Relationship		
Technological Class	Before	After	Total
Small Patterned Biface	15.7%	20.3%	36
Large Patterned Biface	10.0%	4.9%	13
Unpatterned Biface	10.0%	12.2%	22
Patterned Flake Tool	2.9%	6.5%	10
Unpatterned Flake Tool	14.3%	15.4%	29
Coarse Cutting Tool	1.4%		1
Non-bipolar Core	38.6%	32.5%	67
Bipolar Core/Wedge	1.4%	1.6%	3
Unpatterned Ground Stone	2.9%	2.4%	5
Patterned Ground Stone	2.9%	1.6%	4
Retouched Plate Tool		2.4%	3
Total	70	123	193

Summary

The essential technological characteristic of the Late Prehistoric tool assemblage is its diversity. The full range of tool manufacturing processes is represented, from initial hard-hammer reduction of quarried nodules to biface and flake tool production by soft-hammer percussion and pressure flaking. Although morphological and use-wear data were not systematically collected, it is clear that the assemblage is also functionally diverse. Large and small cutting tools, patterned and unpatterned scraping tools, projectile points, patterned and unpatterned perforating tools, and heavy chopping tools are all present. Handstones and millingstones, although not abundant, also are present. In addition, the assemblage contains non-utilitarian items, including a stone bead and fragments of several pipes or tubes. The absence of major temporal or spatial variations in the technological or functional attributes of the tool assemblage indicates

Table 4.31. Spatial distribution of Late Prehistoric, post-enclosure construction stone tools, organized by technological class. Proportions represent within-enclosure values.

	Enclosure			
Technological Class	5	10	9	Total
Small Patterned Biface	11.4%	19.6%	33.3%	24
Large Patterned Biface	4.5%	6.5%	3.3%	6
Unpatterned Biface	13.6%	8.7%	16.7%	15
Patterned Flake Tool	6.8%	6.5%	6.7%	8
Unpatterned Flake Tool	9.1%	17.4%	16.7%	17
Non-bipolar Core	40.9%	34.8%	20.0%	40
Bipolar Core/Wedge	2.3%	2.2%		2
Unpatterned Ground Stone	4.5%		3.3%	3
Patterned Ground Stone	2.3%	2.2%		2
Retouched Plate Tool	4.5%	2.2%		3
Total	44	46	30	120

that a similar range of activities was carried out during each of the Late Prehistoric occupations.

Upper Crossing's Late Prehistoric inhabitants maximized the utility of the tools they produced (Shott 1996). Maximum utilization is expressed in several different ways. The assemblage is highly fragmented. Most specimens consist of an end or margin fragment. Just 7 percent of the non-core tools are complete, or nearly so, and usable. Thirteen percent are production failures and 80 percent are broken or exhausted and discarded.

Eleven percent of the tools were re-manufactured into another tool, either of the same technological class or a different technological class. Tool re-sharpening rates were not quantified; however, many of the bifaces and flake tools were rejuvenated to extend their use life.

Judging by the presence of soft-hammer biface thinning flakes made of rhyolite and orthoquartzite but the absence of well-made large patterned bifaces made of those materials, a portion of the patterned tools manufactured at Upper Crossing were transported off-site for use elsewhere. That finding complements raw material usage data suggesting that a variety of rhyolite tools were manufactured at Upper Crossing but utilized and discarded at another location.

Flintknappers at Upper Crossing utilized a broad range of materials that vary greatly in quality and abundance. Those materials include moderately well-cemented orthoquartzite from the Trickle Mountain (Alkali Creek) quarry; coarse red chert containing abundant fracture planes; fibrous chalcedony that occurs primarily as plates less than 2 cm thick or nodules less than 5 cm long; lustrous yellow chert that may occur as larger nodules; and siliceous to coarse rhyolite. Broad spectrum use of these materials, with only limited usage differences among technological classes, suggests maximal use of all available raw materials.

However, the assemblage cannot be described as technologically sophisticated. Apart from the projectile points and a few hafted drills, the assemblage includes few patterned tools. Even the patterned flake tools (hafted scrapers) exhibit only perfunctory modification of the original input blank. Even accounting for the fact that some large patterned bifaces were produced on-site but used elsewhere, the greater portion of the assemblage consists of core fragments and unpatterned bifaces and flake tools. Thus, the assemblage exhibits many, but not all, of the characteristics of what is conventionally described as a curated technology (Bamforth 1986).

The projectile point collection includes a wide variety of forms, most of which do not exhibit the attributes of recognized or named types. That variety may reflect the fact that both the Late Archaic and Late Prehistoric occupations at Upper Crossing are elements of a local settlement system. The range of forms may also reflect early and on-going experimentation with bow-and-arrow technology. However, within the combined 1999 and 2014 collections, the most common Late Prehistoric point type is the Scallorn or Rose Springs type (Mitchell and Falk 2012). Corner-notched and low-side-notched dart points are the most common Late Archaic types.

The ground stone tool assemblage consists primarily of unpatterned items. Many exhibit only limited use-wear. Patterned or well-used handstones may have been carried off-site for use elsewhere; however, the lack of millingstones exhibiting extensive use-wear suggests that intensive seed processing was not an important aspect of the subsistence system, either during the Late Archaic or during the Late Prehistoric.

Modified Bone

Four pieces of modified animal bone, including fragments of an unidentified utilitarian tool, a complete bead, a bead or small tube fragment, and a fragment of an unidentified tool or decorative piece, were recovered during the 2014 investigation (table 4.32).

Four pieces of burned, partially calcined bone recovered from Unit 2B appear to be parts of a rod-shaped tool manufactured from thick compact bone taken from a large-bodied mammal. Based on general morphology, a utilitarian tool, perhaps an awl, punch, or flaking tool, is likely represented. Three of the four segments, one from GL3 (CN3228) and two from GL4 (CN3236), refit. A fourth segment (CN3263), found in debris from wall cleaning, is slightly tapered. The three refit pieces are 50.3 mm in length, 7.8 to 8.4 mm in width, and 5.9 to 6.8 mm in thickness. The tapered piece is 21.2 mm in length, 6.2 mm in width, and 5.8 mm in thickness. Faint, nearly parallel, striations are evident on the surfaces of three of the pieces. Three of the pieces are from Late Archaic deposits in Block 2; the fourth piece (CN 3228) is from indeterminate or mixed deposits.

A complete bone bead (figure 4.4) was recovered from the interior of Enclosure 5 (Unit 1B). Specimen length is 4.6 mm and the irregular diameter varies from 5.8 to 6.4 mm. Exterior surfaces and both ends are smoothed and polished. This piece was fashioned from a segment of mammal long bone. Size comparisons

Table 4.32. Summary data on 2014 modified bone specimens.

Block	Unit	Catalog Number(s)	Level	Size Grade	Functional Group	Context	Burned	Time Period
1	1B	3186	GL2	G3	Decorative	Enclosure 5 Interior	?	Late Prehistoric
2	2A	3172	GL3	G3	Unknown	Mixed	Yes	Unclassified
2	2B	3228, 3236, 3263	GL3-GL4	G3	Utilitarian	Late Archaic and Mixed	Yes	Late Archaic
4	4B	3191	GL2	G3	Decorative	Prior to Enclosure 9	Yes	Late Prehistoric

Figure 4.4. Two views of a Late Prehistoric bone bead from Enclosure 5.

Figure 4.5. Bead or small tube from Late Prehistoric basin house deposits below Enclosure 9.

and general morphology suggest the humerus of a small leporid, perhaps Nuttall's (mountain) cottontail (*Sylvilagus nuttallii*), or the desert cottontail (*S. audubonii*). Both species are documented in Saguache County (Armstrong 1972:82-87), although the desert cottontail is known primarily from lower elevations in the eastern and southeastern portions of the county.

A second bead, or small tube (figure 4.5), was found in Late Prehistoric pre-Enclosure 9 deposits in Unit 4B. This incomplete specimen is burned. Length is 10.2 mm, width is 7.7 mm, and thickness is about 1.8 mm. The diameter of the original piece is estimated at 10 to 13 mm. The exterior (convex) surface is smoothed and polished, as is the mark of a transverse cut at one end of the piece, the scar indicating likely manufacture by the groove-and-snap technique. Identification of the original raw material is difficult but the specimen may have been taken from the long bone of a jackrabbit-sized, or slightly larger, mammal. This piece may be part of a decorative tubular bead or a fragment of a larger tube that served an unidentified function.

The fourth and final piece of modified bone in the 2014 collection is a small, burned, rectanguloid piece of compact bone tissue (possibly mammal) from Unit 2A. It exhibits parallel striations on the smoothed and slightly polished opposing faces (figure 4.6). The parallel sides intersect a squared end with rounded corners. The opposite end is broken at an oblique angle. The specimen is thin (1.8 mm) and weakly biconvex in cross-section. The incomplete length is 15.7 mm and the width is 10.1 mm. This fragment may be part of a

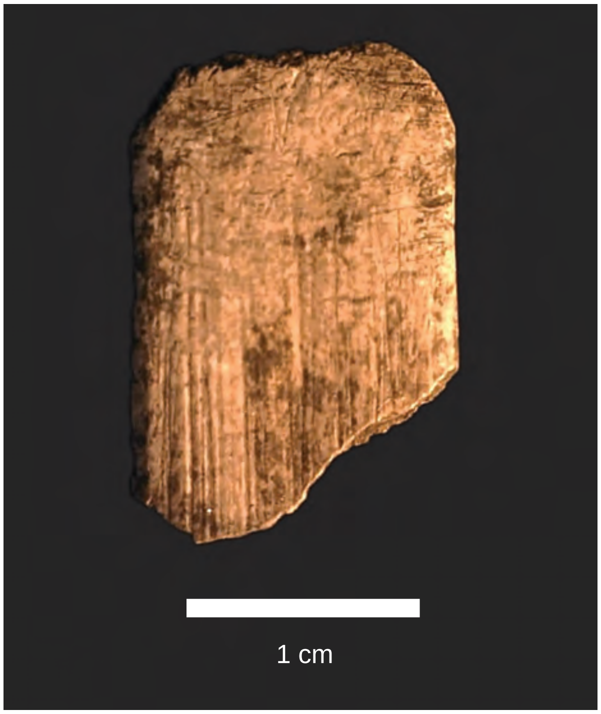

Figure 4.6. Decorative or utilitarian bone object from unclassified deposits in Block 2.

Figure 4.7. Bone bead from 2010 excavations at Upper Crossing.

small decorative object, such as a pendant or pin, or a fragment of an unidentified utilitarian piece.

Although the modified bone sample is small, specimens recovered during the 2014 investigation add both content and diversity to the assemblage of specimens known from the site as a whole. Modified pieces previously reported from Upper Crossing include the distal fragment of a blunt-tipped awl or piecing tool, a distal segment representing a more finely pointed awl, and two tool fragments of indeterminate function (Mitchell and Falk 2012: 101-102). Additionally, an unreported sample of bone from the 2010 investigations of the site includes a small tubular bead fragment along with two indeterminate modified fragments. The bead, illustrated here for comparative purposes (figure 4.7), is 12.4 mm long and 3.7 mm wide and appears to be manufactured from the long bone of a cottontail-sized mammal.

Modified bone is relatively uncommon in reported sites in the general area. Intensive, and extensive, fieldwork at the Tenderfoot site located in the nearby Gunnison basin yielded the distal tip of what is identified as a "bone awl or needle tip" (Stiger 2001:265, Figure H.28) but additional modified pieces are absent. Moving farther afield, Black and others (1991:138-142) report a variety of bone tools from the early Archaic Yarmony site, situated at an elevation of about 2176 m (7140 ft) in northern Eagle County, Colorado (Black 1991b:15). The Yarmony sample includes an elk antler digging tool, five awls or piercing tools manufactured from deer metapodials or pieces of indeterminate large mammal bone, two beads manufactured from "jackrabbit-sized mammal" bone, three pendants, and various pieces of manufacturing discard. The collection also includes 15 polished, ground, or striated tool fragments.

Pottery

Three pottery body sherds were recovered during the 2014 field investigation. All three came from Block 2 and all three are assigned to the unclassified temporal unit. One each came from GL1 and GL2 in Unit 2A, outside Enclosure 4. The third came from GL2 in Unit 2B, inside the enclosure. Although they are assigned to the unclassified temporal unit, they certainly are associated with Enclosure 4 and therefore not intrusive.

All three specimens are size grade 3. All three exhibit plain, but slightly irregular exterior surfaces. The irregularities on two (CN3216 and CN3209) are suggestive of a simple-stamped surface treatment. Two different vessels appear to be represented. Table 4.33 provides nominal and metric data on the specimens.

Mitchell and Falk (2012:102-106) describe the small pottery assemblage previously collected from Upper Crossing. That assemblage includes two body sherds collected in 2009 from the surface several meters north of Enclosure 4. Those two sherds likely came from the same vessel and together are designated Vessel 1. Specimen CN3216, collected in 2014 from GL2 on the interior of Enclosure 4, also appears to be a fragment of that same vessel. Its attributes, including surface treatment, thickness, color, and paste are similar to those of the 2009 specimens (CN2001 and CN2002).

The technological attributes of the second 2014 vessel, represented by specimens CN3209 and CN3165 and designated Vessel 9, differ from those of any of the eight previously identified vessels. The exterior surfaces of both are plain and exhibit manufacturing traces in the form of faint striations. One exhibits light burnishing. The interior surfaces are smoothed and also exhibit faint striations. The vessels walls are compact and the sand temper is well-sorted and evenly distributed. Both are similar in thickness. Both exhibit oxidized exteriors and reduced interiors.

Table 4.33. Metric and nominal data on 2014 pottery vessel fragments.

Vessel Number[a]	Catalog Number	Thickness (mm)	Exterior Color	Interior Surface Texture	Exterior Surface Treatment
1	3216	4.22-5.80	5YR 4-1	Rough	Smooth
9	3209	3.14-3.46	5YR 4/3	Smooth	Plain
	3165	3.57-4.17	7.5YR 4/4	Smooth	Plain

[a] Vessels 1 through 8 are described in Mitchell and Falk (2012).

5

Vertebrate Remains

Carl R. Falk

The 2014 field investigation yielded 1,513 pieces of bone, weighing 679.2 g. Thirty-nine specimens (106.0 g) were piece-plotted but the bulk of the sample (1,327 specimens weighing 540.0 g) was collected from general level fill that was dryscreened over ¼-inch hardware cloth. Small quantities of bone also were recovered from feature levels (36 specimens weighing 9.8 g), flotation samples (71 specimens weighing 7.3 g), and during preparation of excavation profiles (40 specimens weighing 16.1 g).

Bone remains are present in each of the 11 excavation unit samples but are unevenly distributed among units (table 5.1). Volume densities are consistently low in all test units, whether measured by weight (0.4 g per liter) or specimen count (0.9 specimens per liter). Calculated by weight, density values peak in Units 1B, 2A, and 4A, a pattern repeated in the count density values.

At first glance, the vertebrate remains from Upper Crossing seem to be reasonably well preserved and few specimens show the extensive cracking, flaking, and splintering characteristic of more advanced stages of weathering reported by Behrensmeyer (1978). However, bones from the site are consistently fragmented, with some breakage a result of human actions (field processing, food preparation, waste disposal, or trampling) and other damage an outcome of post-depositional processes (cycles of freezing and thawing). Table 5.2 summarizes specimen count and weight information by size grade (see chapter 3 for a discussion of size grading procedures). The size grade 1 (G1) sample, containing the largest pieces collected, is limited to four specimens weighing 40.9 g. Seventy-nine pieces of size grade 2 (G2) bone, weighing 245.8 g, comprise 5.2 percent of the sample by count and 36.2 percent by weight. Size grade 3 (G3) materials make-up 70.8 percent of the sample total by count and 53.3 percent by weight. Deposits were

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Table 5.1. Excavation volume and faunal density values.

Block	Unit	Excavated Volume (liters)	Bone Weight (g)	Density (g/liter)	Specimen Count	Density (count/liter)
1	1A	57.1	1.4	0.02	4	0.07
	1B	153.5	110.9	0.72	244	1.59
	1C	60.0	8.2	0.14	7	0.12
Subtotal		270.6	120.5	0.44	255	0.94
2	2A	114.2	109.9	0.96	130	1.14
	2B	280.3	156.4	0.56	282	1.01
Subtotal		394.5	266.3	0.68	412	1.07
3	3A	192.0	56.2	0.29	92	0.48
	3B	207.6	50.5	0.24	194	0.94
	3C	212.4	28.5	0.13	115	0.54
Subtotal		612.0	135.2	0.22	401	0.66
4	4A	57.1	70.7	1.24	165	2.89
	4B	112.9	25.9	0.23	74	0.66
	4C	236.5	60.6	0.26	206	0.87
Subtotal		406.5	157.2	0.39	445	1.09
Total		1,683.6	679.2	0.40	1,513	0.90

screened over ¼-inch mesh but significant numbers of smaller, size grade 4 (G4) specimens (those smaller than ¼-in) remain in the sample. Some G4 materials may have been intentionally collected during excavation, but it is more likely that most accumulated during the screening process. Size grade 4 materials increase the total count by 358 specimens (23.7 percent of the total) and add 4.4 percent to the total weight.

By count, nearly 70 percent of recorded specimens are burned; the burned percentage is nearly 50 percent by weight (table 5.2). Burned bone can be friable and susceptible to fragmentation, and this characteristic may partly account for higher percentages of burned specimens logged in G3 and G4 samples (see Stiner and Kuhn 1995). Table 5.3 summarizes the distribution of burned specimens. Observed variations in color and staining range from nearly white to very pale brown for unburned specimens and brown, very dark brown, or black for burned specimens. Calcined pieces are white to a light gray or light bluish gray. Burned specimens are well represented in each excavation block. Counts for burned specimens are particularly high in Blocks 2 and 3, where they comprise 90.1 percent and 75.3 percent of the totals, respectively. Percentages for burning in Block 1 (54.5 percent) and Block 4 (52.6 percent) are somewhat lower. Percentage values for weights of burned bone are also moderately high: Block 1 (45.1 percent), Block 2 (57.0 percent), Block 3 (48.4 percent), and Block 4 (41.7 percent).

Table 5.4 summarizes specimen counts by excavation unit and assigned temporal unit (see chapter 3 for a discussion of analytic units). Materials linked to Late Archaic use of the site (n=153, 125.8 g) are from Block 2 deposits underlying Enclosure 4 and may be associated with a basin house. Most (n=128, 83.7 percent) Late Archaic specimens are burned, an observation consistent with high percentages of burning noted for both Lake Archaic and Middle Archaic samples reported from earlier investigations at the site (Mitchell and Falk 2012:100-101). Bone from contexts assigned to the Late Prehistoric occupation of the site comprises 72.4 percent of the sample (n=1096, 406.0 g). By count, 61.5 percent of Late Prehistoric specimens are burned. Seven specimens from Excavation Unit 1C (Block 1) and 257 specimens from Block 2 are from mixed or unassigned deposits and complete the sample; nearly all of those specimens (92.4 percent) are burned.

Table 5.2. Specimen counts and weights by size grade.

		Size Grade				
		G1	G2	G3	G4	Total
Count	Unburned	4	47	288	128	467
	Burned	-	32	784	230	1046
	Total	4	79	1072	358	1513
	Percent Burned	*0.0*	*40.5*	*73.1*	*64.2*	*69.1*
Weight (g)	Unburned	40.9	182.2	107.5	11.3	341.9
	Burned	-	63.6	254.9	18.8	337.3
	Total	40.9	245.8	362.4	30.1	679.2
	Percent Burned	*0.0*	*25.9*	*70.3*	*62.4*	*49.7*

Table 5.3. Counts and weights (g) for unburned and burned bone by excavation block.

		Unburned		Burned			
Block		No Stain or Very Light Stain	Light to Moderate Stain	Dark Stain/Partially Carbonized	Very Dark Stain/ Carbonized	Partially or Completely Calcined	Total
1	Count	7	109	55	28	56	255
	Weight	2.6	63.6	34.4	7.4	12.5	120.5
2	Count	0	41	81	198	92	412
	Weight	0.0	114.4	35.7	83.1	33.1	266.3
3	Count	1	98	62	96	144	401
	Weight	0.1	69.6	17.6	18.2	29.7	135.2
4	Count	2	209	91	74	69	445
	Weight	0.9	90.7	26.3	20.7	18.6	157.2
Total	Count	10	457	289	396	361	1513
	Weight	3.6	338.3	114.0	129.4	93.9	679.2

Table 5.4. Specimen counts organized by excavation unit and temporal unit.

		Temporal Unit				
Block	Unit	Late Archaic	Late Prehistoric	Mixed/ Unassigned	Total	% Burned
1	1A		4		4	*50.0*
	1B		244		244	*54.9*
	1C			7	7	*42.8*
Subtotal			248	7	255	*54.5*
2	2A	4	2	124	130	*91.5*
	2B	149		133	282	*89.4*
Subtotal		153	2	257	412	*90.1*
3	3A		92		92	*46.7*
	3B		194		194	*76.8*
	3C		115		115	*95.6*
Subtotal			401		401	*75.3*
4	4A		165		165	*31.5*
	4B		74		74	*59.4*
	4C		206		206	*67.0*
Subtotal			445		445	*52.6*
Total		153	1,096	264	1,513	*69.1*

Table 5.5 provides additional distributional information for deposits linked to the Late Prehistoric occupations, including specimen counts and weights for areas within and outside each of the four identified stone enclosures, as well as for materials deposited before construction, and for remains from mixed and unassigned contexts. The Late Prehistoric sample from Enclosure 4 consists of only two burned specimens. The Enclosure 5 sample (n=248, 112.3 g) is almost exclusively from the interior of the structure. A small portion (n=33, 20.2 g) of the interior sample is from Feature 1.1, a shallow basin hearth exposed in Unit 1B. Nearly all hearth materials are burned. The sample recovered from the Enclosure 9 tests includes materials from the structure's interior, and a larger sample linked to activities taking place prior to construction of the enclosure. Materials from Enclosure 10 are from interior and exterior contexts, as well as from areas that appear to represent activities prior to enclosure construction. The Enclosure 10 sample includes 23 bone fragments (0.7 g) from Feature 3.2, a small basin feature. With one exception, the Feature 3.2 specimens are burned. Bone was not found in enclosure wall deposits from any of the units tested.

Specimen Identifications

A specimen was considered identifiable when the original element or skeletal part could be determined and the specimen could be referred to an analytically

Table 5.5. Specimen counts and weights (g) by enclosure relationship and spatial context for the Late Prehistoric temporal unit.

Enclosure (Unit)		Before Enclosure Construction[1]	After Enclosure Construction: Outside Enclosure[1]	After Enclosure Construction: Inside Enclosure[1]	Mixed/ Intermediate Deposits[1]	Total[1]
4 (2)	Count		2 (2)			2 (2)
	Weight		1.3 (1.3)			1.3 (1.3)
5 (1)	Count		4 (2)	244 (134)		248 (136)
	Weight		1.4 (0.4)	110.9 (52.7)		112.3 (53.1)
9 (4)	Count	226 (96)		42 (25)	177 (113)	445 (234)
	Weight	93.1 (26.4)		10.8 (7.5)	53.3 (31.7)	157.2 (65.6)
10 (3)	Count	215 (170)	64 (18)	92 (84)	30 (30)	401 (302)
	Weight	53.8 (32.1)	51.3 (4.4)	23.2 (22.1)	6.9 (6.9)	135.2 (65.5)
Total Count		441 (267)	70 (22)	378 (243)	207 (143)	1,096 (675)
Total Weight		146.9 (58.5)	54.0 (6.1)	144.9 (82.3)	60.2 (38.6)	406.0 (185.5)

[1]Burned portion indicated parenthetically.

useful taxonomic group. Eighty-four specimens, representing a minimum of six families, are identified in this study (table 5.6). The fragmented character of the sample is evident in size grade distributions for identified pieces, with G2 (NISP 37) and G3 (NISP 42) specimens comprising over 94 percent of the total. Three G1 and two G4 specimens complete the sample. Seventy-eight paired elements are represented in the collection; 50 of those could not be sided with absolute certainty.

The family Leporidae (hares and rabbits) is represented by four specimens. Three pieces, a distal humerus and two femur diaphysis fragments, are referred to the genus *Sylvilagus*. The humerus is burned and one of the diaphysis fragments shows a deep, transverse tool mark. Two species of cottontail are recorded for Saguache County, Nuttall's cottontail (*S. nuttallii*) and the desert cottontail (*S. audubonii*). Distributional data presented by Armstrong (1972:82-87) favor Nuttall's cottontail in the immediate area of Upper Crossing, with the desert cottontail more likely to be found east or southeast of the site. The fourth specimen, a small, burned edentulous jaw fragment, is classified as leporid.

Table 5.6. NISP by taxon and excavation block.

Identified Taxon	Block 1	Block 2	Block 3	Block 4	Total
Leporidae (hares and rabbits)				1	1
Sylvilagus sp. (cottontail)	1	1		1	3
Sciuridae (squirrels)			2		2
Cynomys sp. (prairie dog)			2	3	5
Erethizon dorsatum (porcupine)		1			1
Artiodactyla-mid-sized/large-bodied		2		1	3
Artiodactyla- smaller-bodied	9	18	20	15	62
Cervus elaphus (American elk)	4			1	5
Antilocapra americana (pronghorn)			1		1
Ovis canadensis (bighorn sheep)				1	1
Total	14	22	25	23	84

The Sciuridae (squirrels) are represented by seven specimens; five (two edentulous maxillary fragments, temporal, proximal ulna, and distal ulna) are identified as prairie dog (*Cynomys* sp.). Four specimens are burned. Gunnison's prairie dog (*C. gunnisoni*) is firmly documented for Saguache County (Armstrong 1972:138-141; Fitzgerald *et al.* 1994:183-185) and Cochetopa Pass is recorded as the type locality for this species (Armstrong 1972:139, 315-316). Two additional specimens, a parietal fragment and a distal radius, are likely also Gunnison's prairie dog, but could not be referred below the family level based on morphology. Both pieces are burned.

The common, or North American, porcupine (*Erethizon dorsatum*) is the only member of the New World porcupines (Erethizontidae) found in Colorado and is distributed throughout the state (Fitzgerald *et al.* 1994:298). Armstrong (1972:252-254) lists two records for Saguache County. A single piece of porcupine bone, a burned edentulous maxilla fragment, is included in the Block 2 sample.

Seventy-two pieces of bone are assigned to the order Artiodactyla (even-toed ungulates). At least six species, representing three families, were native to Colorado during the Holocene epoch. Based on discussion of historic range data presented by Armstrong (1972) and Fitzgerald and others (1994), two members of the family Cervidae (deers and allies), including American elk (*Cervus canadensis*) and mule or black-tailed deer (*Odocoileus hemionus*), would be expected in the Saguache Creek valley. It is doubtful that white-tailed deer (*O. virginianus*) would have been found in the immediate project area, though they may have been available in the Arkansas River basin to the east. The family Antilocapridae is represented by a single species, the pronghorn (*Antilocapra americana*). Formal records are wanting, but it is generally accepted that pronghorn were present in suitable habitats throughout eastern, east central, and northwestern Colorado prior to the modern era (Armstrong 1972:307). Lastly, two members of the family Bovidae (bovids)—bison (*Bison bison*) and bighorn sheep (*Ovis canadensis*)—might be anticipated in Saguache County; only bighorn sheep are documented (Armstrong 1972:311). There seems to be broad agreement that bison "…ranged over much of Colorado" (Fitzgerald *et al.* 1994:403; see also Armstrong 1972:308-310), though direct evidence for Saguache County is lacking. Based on a literature review, Armstrong (1972:310) records the historic presence of bison in Gunnison County to the northwest, El Paso County to the northeast, and Baca County to the southeast. Rood and Stiger (2001) report bison from archaeological contexts in Gunnison County but the evidence is scant.

Collectively, the remains of artiodactyls comprise 85.7 percent of the identified vertebrate sample (table 5.6). Seven specimens are referable to genus or species. Five of these (a proximal radius fragment, two distal phalanx 1 fragments, a distal fragment from phalanx 2, and a complete phalanx 3) are elk. Carnivore tooth marks are recorded for one of the distal phalanx 1 fragments. Pronghorn is represented by a proximal end of phalanx 1. A proximal fragment from phalanx 3 is identified as bighorn sheep.

The remaining 65 specimens were divided into two size-based groups following detailed comparisons with comparative skeletal elements for elk, mule deer, pronghorn, and bison. Bighorn sheep elements were not readily available for this study. The first group includes specimens representing mid- to large-sized artiodactyls. Body weights for elk range from 220 to 450 kg (Fitzgerald *et al.* 1994:383); those for bison range from 410 to 500 kg for females and 725 to 910 kg for males (Fitzgerald *et al.* 1994:402; Jones *et al.* 1983:336). Complete or nearly complete elements for elk and bison are usually identifiable, but distinguishing between the two species can be difficult when only small fragments are available. Three specimens are assigned to this group: a tibia diaphysis fragment, a cranial articular process of a lumbar vertebra, and a tooth fragment. The tibia fragment shows faint tool marks.

Finally, 62 specimens are assigned to a second group representing comparatively small-sized artiodactyls, including bighorn sheep (87 kg), mule deer (98 kg), and pronghorn (48 kg). Average weight estimates for small artiodactyls are from Harestad and Bunnell (1979). Twenty-four of the 62 specimens are burned. Tool marks are recorded for a radius diaphysis found in Block 2, and carnivore tooth marks are noted on a phalanx 1 fragment from Block 4. Small rodent tooth marks are evident on two specimens, a metatarsal diaphysis fragment from Block 4, and a phalanx 1 fragment from Block 3. Counts for specimens assigned to the small artiodactyl group are organized by excavation block in table 5.7

Temporal Distribution of Identified Specimens

Table 5.8 organizes counts for identified specimens by temporal unit. Sixteen specimens are from deposits not assigned to a specific temporal unit (see chapter 3 for a discussion of analytic units). Unassigned remains include the porcupine maxilla fragment from Block 2, and 15 specimens from Block 1 (NISP 3) and Block 2 (NISP 12) representing the small artiodactyls group.

Late Archaic Unit

Nine identifiable specimens are from deposits assigned to the Late Archaic, including a cottontail femur diaphysis and eight pieces of artiodactyl bone (table 5.8). A portion of a tooth and a tibia diaphysis fragment could be either elk or bison. The tibia piece compares well with modern elk, but bison cannot be excluded. Six specimens (a transverse spine from a lumbar vertebra, a radius diaphysis fragment, two femur diaphysis fragments, a tibia diaphysis fragment, and a proximal fragment of an astragalus) are assigned to the small artiodactyl group. The femur pieces could be from the same element. Only the astragalus is burned, a minor surprise given that 83.7 percent of bone from Late Archaic deposits is burned.

Late Prehistoric Unit

Fifty-nine specimens were recovered from deposits linked to occupation of the site during the Late Prehistoric (table 5.8). The sample includes cottontail,

Table 5.7. NISP for the small artiodactyl group by excavation block.

	Block				
Identified Specimen	1	2	3	4	Total[1]
Petrous temporal		1	1		2 (1)
Tooth - P3			1		1
Tooth - m2 crown	1				1
Mandible - alveolar border		1			1
Cervical vertebra – articular process				1	1 (1)
Thoracic vertebra – dorsal spine	1				1
Thoracic vertebra - body			1		1
Lumbar vertebra - transverse spine		1			1
Rib - shaft	1	1			2
Humerus - diaphysis		1	2	1	4
Radius - proximal	1				1
Radius - diaphysis		2	1	1	4 (2)
Ulna - olecranon		1			1(1)
Ulna – lateral facet	1				1
Radial carpal - fragment				1	1
2+3 carpal - fragment		1	1		2 (2)
Metacarpal - proximal				1	1 (1)
Metacarpal - diaphysis			2		2 (1)
Ilium - acetabulum				1	1
Pubis - acetabulum	1				1 (1)
Ischium - spine			1		1
Femur - diaphysis		2	2	1	5
Tibia - diaphysis	1	2	2	1	6 (2)
Astragalus - proximal		1			1 (1)
Calcaneus - distal				1	1 (1)
C+4 tarsal - fragment	1	1			2 (2)
Metatarsal - diaphysis			1	1	2
Phalanx 1 - proximal			1	1	2
Phalanx 1 - distal		1	2	1	4 (4)
Phalanx 2 - proximal				1	1
Metapodial - diaphysis		1	1		2 (1)
Metapodial - distal	1	1	1	2	5 (3)
Total	9	18	20	15	62 (24)

[1]Burned portion indicated parenthetically.

prairie dog, elk, pronghorn, and bighorn sheep. In addition to elk, the large artiodactyl group is represented by one specimen, a lumbar vertebra fragment. Forty-one specimens are assigned to the small artiodactyl group. Table 5.9 orders the Late Prehistoric sample from Enclosures 5, 9, and 10 by enclosure construction relationship and wall relationship variables. Two pieces of burned bone weighing 1.3 g that were recovered from deposits outside Enclosure 4 were not identified beyond the class Mammalia and are not included in table 5.9.

The Enclosure 5 sample is from the structure's interior and consists of 11 specimens, including the distal humerus of a cottontail. Four specimens are identified as elk, including two distal phalanx 1, one distal phalanx 2, and one complete phalanx 3. These specimens appear to be from a single limb but evidence of additional limb elements is absent. Six specimens representing small artiodactyls complete the sample. Two of these, a proximal rib segment and a dorsal spine from a thoracic vertebra, are unique in the collection. Both specimens compare well with elements from late-term fetal or neonatal deer, although deer, pronghorn, or bighorn sheep might be represented. The cottontail humerus and a tibia diaphysis fragment from a small artiodactyl were found in Feature 1.1, a basin hearth. The remaining nine pieces are from GL2 inside the enclosure and adjacent to Feature 1.1.

Twenty-three identified specimens are from Enclosure 9. Those include 12 pieces representing small artiodactyls and single specimens representing elk, bighorn sheep, and an unidentified leporid from deposits pre-dating construction of the enclosure. A tibia diaphysis fragment from a small-bodied artiodactyl is the only identified specimen from the interior of the structure. Seven specimens from mixed or indeterminate Late Prehistoric deposits are recorded. The mixed sample includes a cottontail femur diaphysis with transverse tool marks, burned and unburned prairie dog remains (two maxillae, distal ulna), small artiodactyl remains (proximal metacarpal, distal phalanx 1), and a fragment of the lumbar vertebra of a larger-bodied artiodactyl, possibly elk.

Finally, 25 specimens are recorded for Enclosure 10. Mirroring the distribution pattern noted for Enclosure 9, over half of the identified sample is from pre-construction deposits including a burned cranial fragment from a prairie dog and 12 specimens assigned to the small-bodied artiodactyl group. Eight specimens, including a pronghorn phalanx 1 fragment and seven pieces representing small artiodactyls, are from outside the structure and were deposited after construction. Four burned specimens were found in the structure's interior, including the proximal end of a prairie dog ulna, a distal phalanx 1 from a small artiodactyl, and two pieces from an indeterminate sciurid, likely prairie dog.

Discussion

Vertebrate remains attributed to the Late Archaic occupation of the Upper Crossing site were found only in deposits underlying Enclosure 4 in Block 2. Evidence for procurement of small artiodactyls

Table 5.8. NISP organized by taxon and temporal unit.

Identified Taxon	Late Archaic[1]	Late Prehistoric[1]	Unassigned/Mixed[1]	Total[1]	Percent Burned
Leporidae		1		1	
Sylvilagus sp.	1	2 (1)		3 (1)	*33.3*
Sciuridae		2 (2)		2 (2)	*100.0*
Cynomys sp.		5 (4)		5 (4)	*80.0*
Erethizon dorsatum			1 (1)	1 (1)	*100.0*
Artiodactyla (mid-/large-bodied)	2	1		3	
Artiodactyla (small-bodied)	6 (1)	41 (15)	15 (8)	62 (24)	*38.7*
Cervus elaphus		5		5	
Antilocapra americana		1		1	
Ovis canadensis		1		1	
Total	9 (1)	59 (22)	16 (9)	84 (32)	*38.1*
Percent Burned	*11.1*	*39.1*	*56.2*	*38.1*	

[1]Burned portion indicated parenthetically.

during this period of site use consists of six specimens (table 5.8), including diaphysis pieces representing two femora, a radius, and a tibia, as well as lumbar vertebra and astragalus fragments. The collection is small but contains portions of elements (femur, tibia, and radius) that would, when processed, yield quantities of fat-rich marrow. These same elements, particularly the femur and tibia as well as the lumbar vertebrae, are associated with high to moderate average meat yields for both white-tailed deer, and pronghorn (*e.g.*, Jacobson 2000; O'Brien and Liebert 2014). In addition, the presence of larger bodied artiodactyls is indicated by two specimens, including a tooth fragment and a tibia diaphysis fragment. Finally, presence of cottontail may suggest small game animals were taken when available. Though the sample is small, identified remains from the 2014 test are in harmony with results reported by Mitchell and Falk (2012:101-102) from Middle and

Table 5.9. NISP for identified remains organized by enclosure relationship and spatial context for the Late Prehistoric temporal unit.

			After Enclosure Construction			
Enclosure	Identified Taxon	Before Enclosure Construction[1]	Outside Enclosure	Inside Enclosure[1]	Mixed/Indeterminate Deposits[1]	Totals[1]
5	*Sylvilagus* sp.			1 (1)		1 (1)
	Cervus canadensis			4		4
	Artiodactyla -small			6 (3)		6 (3)
	Subtotal			11 (4)		11 (4)
9	Leporidae	1 (1)				1 (1)
	Sylvilagus sp.				1	1
	Cynomys sp.				3 (2)	3 (2)
	Cervus canadensis	1				1
	Ovis canadensis	1				1
	Artiodactyla – small	12 (2)		1	2 (2)	15 (4)
	Artiodactyla – large				1	1
	Subtotal	15 (3)		1	7 (4)	23 (7)
10	Sciuridae			2 (2)		2 (2)
	Cynomys sp.	1 (1)		1 (1)		2 (2)
	Antilocapra americana		1			1
	Artiodactyla – small	12 (7)	7	1 (1)		20 (8)
	Subtotal	13 (7)	8	4 (4)		25 (11)
	Total Count	28 (10)	8	16 (8)	7 (4)	59 (22)

[1]Note: Burned portion indicated parenthetically.

Late Archaic contexts investigated in 2009. The 2009 sample also includes burned sciurid remains, probably from a prairie dog. Again, specimen counts are low but evidence from the Late Archaic component at the Yarmony site located to the northwest in Eagle County, Colorado suggests a similar use of small fauna along with both elk and smaller artiodactyls (Rood 1991:166-167).

Test excavations of Late prehistoric deposits yielded higher specimen frequencies and a somewhat more diverse sample of small mammals. Cottontail is recorded in Enclosures 5 and 9 and prairie dog in Enclosures 9 and 10. Most of those specimens are burned. A burned porcupine maxilla from Block 2 also can be mentioned, though this piece is from temporally mixed deposits. Burned sciurid (possibly prairie dog) remains also were reported from a Late Prehistoric context investigated in 2009 (Mitchell and Falk 2012:101) and Rood (1991:16-166) lists white-tailed jackrabbit (*Lepus townsendii*) and cottontail for the Late Prehistoric component at the Yarmony site. Taken together, these finding may indicate persistent use of small game resources by peoples living at high altitude in the region; the extent and intensity of such use is unknown.

Returning to the Upper Crossing site, the Late Prehistoric collection also includes five specimens identified as elk and a single vertebra fragment assigned to the large artiodactyl group. The elk sample includes a radius fragment from Enclosure 9 pre-construction deposits and four phalanges from the interior of Enclosure 5. As stated above, the phalanges are probably from the same foot, but additional foot or limb elements are absent. These remains are the first positive identification of elk at Upper Crossing. To date, no evidence for bison has been recorded.

Forty-three pieces of small artiodactyl bone are recorded for the Late Prehistoric sample. This total includes one specimen (a proximal phalanx 1) identified as pronghorn and a second specimen (a proximal phalanx 3) identified as bighorn sheep. The remaining 41 specimens are assigned simply to the small artiodactyl group. Together, small artiodactyl remains constitute 73 percent of the Late Prehistoric sample. Five specimens are burned. Small artiodactyls are also represented in the 2009 Upper Crossing sample (Mitchell and Falk 2012:101), though only three specimens were identified specimens, two of these burned.

Small artiodactyl remains are organized by body (anatomical) region in table 5.10 and provide a general picture of the body parts present in the sample and, by inference, returned to the site by Late Prehistoric hunters. Specimens representing each of the defined regions are recorded. Cranial and axial elements are weakly represented by the single rib and thoracic vertebra fragments from fetal or neonatal animals, and an adult thoracic vertebra fragment. With metapodials considered, 22 long bone specimens comprise 51.3 percent of the total. Fragmented foot bones (carpals, tarsal, and phalanges) add an additional 25.5 percent.

To assess the possible influence of density-mediated destruction on specimen frequency distributions for the Late Prehistoric sample of small artiodactyls, table 5.10 provides average bone mineral density values for standardized scan sites that most closely correspond anatomically to identified Upper Crossing specimens. Acknowledging published discussion concerning scanning methods and accuracy (e.g., Lam *et al*. 2003; Lam and Pearson 2004), scan site locations and bone density values used here are those reported by Lyman (1984:270-279, 1994:240-247) for modern deer, primarily *O. hemionus*. A Spearman's rank correlation coefficient calculated for identified specimen counts and bone density values shows a weak, but positive association between the two variables; however, the correlation is not statistically significant (r_S=0.29, p=0.18). While density-mediated destruction may be a minor factor accounting for specimen frequency distributions for identified remains, other factors might be evaluated. These include choices made by hunters regarding processing and transport of the carcass from kill site to residential camp, food preparation, cooking methods, and disposal practices at the residential site, the impact of scavenging animals, and, of course, sampling error.

Discounting the impact of density mediated destruction, and assuming recovered specimens are an adequate and representative sample of carcass portions returned to the Upper Crossing site during the Late Prehistoric, do these data support an argument that hunters placed a priority on returning butchered units with the highest nutritional return? Table 5.10 also presents economic utility index values (FUI) for caribou (*Rangifer tarandus*) taken from Metcalfe and Jones (1988:492, Table 2) and based on earlier work by Binford (1978). The Upper Crossing sample includes the remains of elements with high to moderately high index values (femur, tibia, rib, and innominate), but also those with low values (metacarpals, carpals, metapodials, and phalanges). In this case, the correlation between FUI values and frequency distributions for identified elements is not statistically significant (r_S=0.016,

Table 5.10. NISP, bone density, and economic utility index values (FUI) for small artiodactyls organized by body region for the Late Prehistoric temporal unit. Pronghorn and bighorn sheep included in totals.

Body Region	Identified Specimen	Total	Average Density	Scan Site	FUI[1]
Head	Tooth	1	n.d.	n.d.	n.d.
	Petrous temporal	2	n.d.	n.d.	235
Axial	Cervical vertebra	1	0.15	CE2	1905
	Thoracic vertebra	2	0.24	TH1	2433
	Rib – shaft	1	0.24	R14	2650
Forequarter	Humerus - diaphysis	3	0.53	HU3	2093
	Radius - diaphysis	2	0.68	RA3	1181
Forefoot	Carpal 2+3	1	0.74	TRAPMAG	653
	Carpal radial	1	0.98	SCAPHOID	653
	Metacarpal - proximal	1	0.56	MC1	461
	Metacarpal - diaphysis	2	0.72	MC3	412
Hindquarter	Ilium - acetabulum	1	0.27	AC1	2531
	Pubis - acetabulum	1	0.46	PU1	2531
	Ischium - spine	1	0.41	IS1	2531
	Femur - diaphysis	3	0.57	FE4	5139
	Tibia - diaphysis	4	0.74	T13	2746
Hindfoot	Metatarsal - diaphysis	2	0.74	MR3	898
	Calcaneus - distal	1	0.33	CA4	1424
Foot	Metapodial - diaphysis	1	0.72	MC3	412
Undetermined	Metapodial - distal	4	0.50	MR6	578
	Phalanx 1 - proximal	3	0.36	P11	443
	Phalanx 1 - distal	3	0.57	P13	443
	Phalanx 2 - proximal	1	0.28	P21	443
	Phalanx 3 - proximal	1	0.25	P31	443
Total		43			

[1]FUI value estimates for diaphysis fragments based on the average of proximal and distal values for each element.

p=0.94). Average meat and marrow gross yields for white-tailed deer (Madrigal 2004:188, Tables 1 and 2) and pronghorn (O'Brien and Liebert 2014:386-387, Tables 2 and 3) were also examined, with values for white-tailed deer based on earlier work by Madrigal and Holt (2002) and Jacobson (2000). These data are not presented here but again significant correlations do not exist between the frequency distributions for identified Upper Crossing specimens and average meat or marrow yields.

Summary and Conclusions

Vertebrate remains were recovered from excavation blocks positioned to examine four stone structures at the Upper Crossing site. The tests yielded 1,513 pieces of bone weighing 679.2 g from general level and feature deposits. Generally well preserved, the recovered vertebrate remains are mostly small pieces with size grade 3 and size grade 4 specimens making up 94.5 percent of the sample. By count, 69.1 percent of the sample is burned and burning may account for much of the observed fragmentation.

Late Archaic deposits yielded few specimens (n=153, 125.8 g) and those were only recovered from Block 2, beneath Enclosure 4. Most (83.7 percent) of the Late Archaic materials are burned. Deposits associated with the Late Prehistoric occupations of the site contributed 72.4 percent of the 2014 sample (n=1096, 406.0 g); the remaining specimens (n=264, 147.4 g) were recovered from mixed or unassigned deposits. The Late Prehistoric samples were found both within and outside defined structures.

Eighty-four specimens were identified and assigned to analytically useful taxonomic groups. Nineteen specimens were identified as follows: indeterminate leporid (1), cottontail (3), indeterminate squirrel (2), prairie dog (5), common porcupine (1), elk (5), pronghorn (1), and bighorn sheep (1). The remaining 65 specimens were divided into two groups based on size comparisons to modern skeletal elements for both large- and small-bodied artiodactyls. Three pieces represent large-bodied artiodactyls, either elk or bison. Sixty-two specimens were assigned to a second group representing small artiodactyls, which includes bighorn sheep, mule deer, and pronghorn.

Identified remains assigned to Late Archaic use of the site are scant but generally consistent with the results of an investigation in 2009 (Mitchell and Falk 2012). Recovered specimens suggest a primary focus on small artiodactyls, along with occasional procurement of large artiodactyls and small game. Both cottontail and prairie dog are represented in the combined samples from investigations in 2009 and 2014.

Bone mineral density values for scan site locations corresponding most closely to element portions for identified small artiodactyl remains for the Late Prehistoric temporal unit are presented. Analysis of the relationships between specimen counts and bone density values did not show a statistically significant correlation. This result implies that bone density was not a major factor in accounting for frequency distributions for archaeologically recovered specimens. Factors that are more significant may include processing and transport decisions by hunting groups at the kill site, cooking methods and patterns of refuse disposal at the residential camp (Upper Crossing), and sampling error. Evidence for destruction or removal of bones by scavenging animals is nearly absent though this factor cannot be discounted.

Based on work to date, Late Prehistoric groups dwelling at Upper Crossing followed a subsistence strategy similar to that of Late Archaic groups, at least with respect to use of vertebrate resources, that was vested heavily in the procurement of small artiodactyls, including bighorn sheep, pronghorn, and mule deer, but also including elk, and small game (cottontail, prairie dog, and perhaps, porcupine). Frequency data for small artiodactyl skeletal elements indicate that bones from all regions of the body are represented in the sample, though numbers for cranial and axial pieces are few, and long bone shaft and foot fragments are more numerous. Many elements represented in the Upper Crossing sample are linked to high economic utility (nutritional value) based on experimental data developed for meat and marrow yields, while others are considered of low utility. However, a statically significant correlation was not shown between published utility index values (FUI) and frequency distributions for small artiodactyl remains in the 2014 sample, or between frequency distributions and average meat and marrow gross yields.

6 Summary and Discussion

Mark D. Mitchell and Carl R. Falk

Upper Crossing is a multi-component archaeological locality covering 11.1 ha (27.4 acres) in western Saguache County, Colorado. The site's features and buried cultural deposits preserve a record of American Indian occupation in the San Luis Valley spanning more than four millennia. The oldest documented deposits contain a series of superimposed hearth features representing multiple, short-term Middle Archaic hunting camps. Basin houses dating to the Late Archaic and representing seasonal base camps occur in at least two parts of the site. Extensive, but so far unexplored, cultural deposits likely representing additional Archaic-stage occupations also occur at the site. Brief Late Prehistoric and Historic period occupations are represented by Puebloan and micaceous pottery from surface or near surface contexts, as well as by an extensive grove of peeled ponderosa pine trees.

The site's most conspicuous surface features are 30 stone enclosures dating to the early Late Prehistoric. The enclosures occur in two discrete groups, the larger of which—designated Cluster 1—is the focus of the research project described in this report.

Stone enclosure sites occur sporadically throughout a broad swath of Colorado and New Mexico, extending from the Cimarron River valley in northeastern New Mexico, through the Arkansas River basin in southeastern Colorado and the Rio Grande basin in south-central Colorado, to the Uncompahgre Plateau in western Colorado. However, the concentration of sites in the Saguache Creek valley is among the largest, rivaled only by site concentrations located on the major southern tributaries of the Arkansas River. Unlike those southeastern Colorado sites, little is known about the precise age or function of the Saguache Creek sites or about their role in regional settlement systems. This project aimed for a

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better of understanding of when the Upper Crossing structures were occupied and how they were built and used.

The project was a cooperative effort carried out by Paleocultural Research Group (PCRG), the Bureau of Land Management (BLM), the Rio Grande National Forest, and the University of Colorado (CU). Funding for the project was provided in part by a History Colorado - State Historical Fund grant awarded to PCRG (No. 2014-M2-005). Additional funding was provided by the BLM and CU. A total of 23 individuals participated in the field investigation, including PCRG staff and volunteers, CU graduate and undergraduate students, BLM archaeologists, and Forest Service archaeologists and interns. Together, project participants devoted 1,184 person-hours to the effort.

The investigation focused on four of the 20 enclosures comprising Cluster 1. A variety of criteria were used to select enclosures for investigation, including the depth and richness of interior cultural deposits, the integrity of the enclosure's foundation, and documented variation in construction techniques. The crew excavated a total of 10.5 m^2, which yielded a total of 1,680 liters (1.68 m^3) of screened sediment. The resulting collection includes 3,577 lithic flakes, 391 stone tool technological cases, 1,513 pieces of animal bone, four modified bone specimens, and three ceramic sherds.

Site Chronology

Nine radiocarbon dates, along with 42 projectile point fragments, provide chronological data on the ages of the sampled contexts. Eight of the nine radiocarbon samples date to the early Late Prehistoric. The ninth sample dates to the Late Archaic. Associated diagnostic projectile points support the radiocarbon-based age determinations. Thus, two primary components occur in Cluster 1: a Late Archaic component that dates to the early first millennium B.C., which is represented in the sampled contexts by the lowest strata exposed in Block 2, and a Late Prehistoric component that dates to the late sixth and seventh centuries A.D., which is represented by a variety of features and deposits exposed in all four excavation blocks. Three of the four sampled stone enclosures are directly associated with early Late Prehistoric radiocarbon dates; the fourth is not directly dated, but stratigraphic and other data indicate that it too dates to the early Late Prehistoric.

Both stratigraphic and radiocarbon data demonstrate that the early Late Prehistoric component encompasses multiple discrete occupation events. Enclosures 9 and 10 were both built over earlier structures. Enclosure 5 likely pre-dates the structure beneath Enclosure 10. The occupation durations of different enclosures also appear to have differed. Enclosure 5 contains significant cultural fill and shows evidence of remodeling, possibly indicating a protracted occupation or, perhaps more likely, repeated reoccupation. Enclosures 9 and 10 are associated with relatively little cultural material, suggesting a briefer occupation or perhaps an occupation late in the overall use of Cluster 1.

Late Archaic deposits in Cluster 1 likely represent a single occupation event, or a series of closely spaced occupation events. However, the site contains additional Late Archaic deposits, located outside Cluster 1, that are not archaeologically contemporaneous with the deposits investigated in 2014, indicating that the site's Late Archaic component also encompasses multiple discrete occupation events (Mitchell 2012a)

That complex occupation history indicates that during both the Late Archaic and the early Late Prehistoric, Upper Crossing was a residential base used recurrently by small groups of people, perhaps composed of two or three households, rather than an aggregation site used sporadically by large groups.

Climate Episodes

Paleoenvironmental data from northwestern Colorado (Rhode *et al.* 2010) suggest that the primary components at Upper Crossing coincided with warmer periods. The Late Archaic component exposed in 2014 likely occurred near the end of a dryer and warmer episode that may have featured warmer winters. The early Late Prehistoric component occurred during a wetter, more seasonal episode when temperatures may have been near modern levels. Those two episodes bracket a cooler episode, for which there currently is little evidence of occupation at Upper Crossing. That pattern suggests that temperature, rather than the timing or amount of precipitation, may have been a factor limiting residential occupation of the Saguache Creek valley.

Reconstructed climate episodes for eastern Colorado do not align as readily with archaeological data from Upper Crossing. As is true of the northwestern Colorado data, the eastern Colorado data point to dryer and warmer conditions, including episodic drought, during the Late Archaic occupation at Upper Crossing. However, the early Late Prehistoric occupation appears to span two different eastern Colorado climate regimes that Gilmore (2008) calls the Early Ceramic Drought and the First Millennium Amelioration, which involved a shift from consistently cool and dry conditions to consistently warmer and wetter conditions.

Architecture

Although the 2014 investigation was designed to investigate the architecture of Upper Crossing's stone enclosures, stratigraphic and other data clearly—and unexpectedly—revealed multiple examples of another type of structure, commonly termed a *basin house*. Scores of basin houses have been documented in western Colorado and southern Wyoming over the past twenty years (Pool and Moore 2011; Reed 2014; Shields 1998). Basin houses vary widely in size, layout, features, and construction techniques but can be distinguished from stone enclosures by the absence of a constructed rock foundation. In general, basin houses consisted of a domed or peaked wooden superstructure built over a shallow, basin-shaped pit.

Owing to the project's focus on stone enclosure architecture, and to the limited extent of the excavation blocks, only a few definitive observations can be made about Upper Crossing's basin houses. However, each meets at least some of the minimum criteria for basin house recognition identified by Reed (2014) (table 6.1).

Stratigraphic data indicate that the floor of the Late Archaic basin house exposed in Block 2 was cut into the B horizon of the pre-occupation soil. The gently sloping walls of the basin were observed in the Unit 2B profiles and flat-lying artifacts were observed on the floor. The surface distribution of artifacts adjacent to the house suggest that it was at least as large as the superimposed stone enclosure (Enclosure 4), which measures 3 by 4.3 m. However, no associated features, posts, or post molds were observed.

Table 6.1. Basin house recognition criteria (Reed 2014).

Criterion
Stratigraphic and spatial data that permit differentiation of the interior of a structure from the undisturbed exterior
Differential distribution of superstructure debris primarily on the interior
A floor area sufficient to permit at least one person to recline; a diameter more than 2 m
Patterned arrangement of perimeter postholes
Interior pit features
Differential distributions of artifacts and ecofacts that permit delineation of structure interior
Evidence of cleaning activities, such as an under-representation of large flakes on a floor surface or within the occupation zone

The floor of the early Late Prehistoric basin house exposed in Block 4, which was superimposed by Enclosure 9, began close to the modern ground surface and sloped gently toward the center of the basin. At its deepest point, the floor was at least 27 cm below the pre-occupation surface east of the structure. On the north, a deeper cut was made into the slope; fill may have been added on the south side of the structure. Paving stones were set sporadically into the floor. An associated central hearth was partially exposed in Unit 4C; however, perimeter post molds were not observed. Given the trend of the floor surface and the position of the slope cut on the north, the basin house likely was similar in size to Enclosure 9, which measures 4.1 m in diameter.

In Block 3, the subterranean floor of the early Late Prehistoric basin house beneath Enclosure 10 was approximately level but slightly undulating and at least 24 cm below the pre-occupation surface. Stone slabs were set irregularly in the floor, which contained three small basin hearths. No posts or post molds were observed. The basin house likely was somewhat smaller than Enclosure 10, which measures 3.7 by 4.1 m.

In sum, the floor of each of the basin houses exposed in 2014 originally was excavated into the pre-occupation surface. The original depth of the floor could not be estimated for the Block 2 basin house, but the floors for the Block 3 and Block 4 basin houses were at least 24 and 27 cm deep, respectively. Even a comparatively shallow excavation would have involved significant effort, owing to the presence of numerous, interlocking cobbles and boulders entrained in the pre-occupation surface.

Interior hearths were exposed in two of the three basin houses; only a small portion of the interior floor was exposed in the third. Foundation stones were not associated with any of the basin houses and so, even though posts or post molds were not observed, the superstructure of each likely consisted of a framework of small-diameter poles. Clay daub was not observed in the fill of the basin houses, suggesting that their superstructures were covered with boughs or hides. Each likely was 3 to 4 m in diameter.

Stone Enclosures

Both similarities and differences in construction technology were documented among the four sampled enclosures. Enclosure 5, which was not built over an earlier structure, presents the clearest example of a characteristic pattern. Construction began with the excavation of a slightly oblong pit with sloping sides that measured roughly 5.5 m long, 5 m wide, and 35 to 40 cm deep. Massive blocks and slabs were then set on the edge of the pit at floor level. The largest of the emplaced foundation stones observed in Block 1 measured 70 cm long, 50 cm wide, and 40 cm high, and may have weighed as much as 400 kg. The close fit between the large blocks indicates that they represent a single episode of construction. Smaller rocks and sediment containing scattered artifacts, which represent material present on the site surface prior to construction, were then packed between and behind the large sill blocks.

Direct evidence for the enclosure's superstructure, in the form of post molds or burned logs, was not observed in Block 1. However, the arrangement of the uppermost foundation stones indicates that poles forming the building's upper walls were socketed into the top of the sill stones making up the foundation. Several layers of tabular stones were then placed against those poles, both on the inside and outside, to support and stabilize them. The sizes of the sill stones as well as the tabular leaners indicate that the upper wall poles were relatively large and may have consisted of aspen boles or trimmed ponderosa pine or cottonwood branches.

Fired architectural daub was not present in the house fill. The small sizes of recovered charcoal pieces suggest that the structure did not burn; however, no evidence of pockets or layers of fine-grained sediment that could represent melted daub were observed, suggesting that the log superstructure was covered with brush, thatch, or hides, or some combination of those materials, rather than earth or clay.

Enclosure 5 was constructed against a large boulder, which forms the northwest side of the structure. That pattern is common among both the basin houses and stone enclosures in Cluster 1. Nearly all the documented structures were set against a boulder ranging in height from 1 to 2 m or were cut into the slope on the north or northwest side (Mitchell 2012a). Consequently, most face to the south or southeast. An apparent gap in the southeast foundation of Enclosure 5, opposite the boulder forming the structure's back wall, may represent the location of a ground-level entryway. However, a similar, through slightly narrower, gap in the foundation of Enclosure 10 proved to be a product of fortuitous wall fall.

The floor of Enclosure 5 was undulating but essentially flat. Silty sand was emplaced on the excavated floor to smooth it and fill gaps between native stones. A hearth was constructed against the stone foundation. The position of the hearth and its relationship to the emplaced floor fill indicates that it was integral to the original construction of the enclosure. Its position and size further suggest that additional hearth features may also be present within Enclosure 5. No posts, post molds, or storage features were encountered in Block 1.

The construction technique used to secure the upper wall posts in Enclosure 5 also was used in Enclosure 9, although the foundation of Enclosure 9 was less substantial. Enclosure 9 was built over an earlier basin house and the enclosure's foundation was perched on the outer rim of the underlying structure, rather than emplaced at the floor level as was the case for Enclosure 5. However, like the foundation of Enclosure 5, the foundation of Enclosure 9 consisted of a basal layer of blocky and tabular sill stones surmounted by leaning slabs positioned to pin the upper wall logs in place. The section of the Enclosure 9 foundation exposed in Block 3 was more lightly built than the section of the Enclosure 5 foundation exposed in Block 1. However, the northern section of the Enclosure 9 foundation, where the structure was excavated into the adjacent slope, incorporates emplaced boulders at least as massive as those observed in Enclosure 5.

Direct evidence for the form of the superstructure of Enclosure 9, such as posts, post molds, or burned timbers, was not observed. However, the similarities between the foundations of Enclosure 5 and Enclosure 9 suggest that the latter also was a substantial timber frame building covered with perishable materials such as brush, thatch, and hides. Unlike Enclosure 5, Enclosure 9 was not built against a large boulder. Instead, the back wall of Enclosure 9 consisted of massive stone slabs set against a cut dug into the slope. The extent and position of the slab-lined cut suggests that it filled the same function as the boulder that formed the back wall of Enclosure 5.

An amorphous basin or stratum overlying the fill above the basin house floor may represent a floor fill unit associated with Enclosure 9. A small pit in that overlying fill unit could represent an interior post. The enclosure's floor consisted of preexisting cultural fill that, like the floor of the basin house beneath it, sloped gently toward the center of the structure.

Like the foundations of Enclosure 5 and Enclosure 9, the foundation of Enclosure 10 was designed to support large wall posts. However, the Enclosure 10 foundation lacked the horizontal sill stones used in Enclosure 5 and Enclosure 9. Instead it primarily consisted of unoriented blocks along with a few vertically set slabs. No posts or post molds were noted. Enclosure 10 was built against a 1.5-m-high boulder. Unlike Enclosure 5, where the boulder is located on the structure's north side, Enclosure 10's back-wall boulder is located on the east side.

Enclosure 10 was built over at least two older occupation surfaces, including a semi-subterranean basin house and a large pit that may or may not have been associated with an architectural feature. The precise relationship between the foundation of Enclosure 10 and the edge of the underlying basin house was obscured by the intervening occupation. However, the foundation probably was positioned approximately on the basin house's outer rim, as was also the case for Enclosure 9.

Only a thin stratigraphic unit was associated with the occupation of the enclosure. An amorphous basin or stratum that was cut into and superimposed on the fill above the floor of the basin house may also have been associated with Enclosure 10. An analogous stratum also was observed in Block 4. The enclosure's floor consisted of preexisting cultural fill, although the available stratigraphic data do not clearly indicate whether it was flat or sloped slightly toward the center of the structure.

The foundation of Enclosure 4 differed somewhat from those of the other three enclosures investigated in 2014. Several thick tabular stones set into the fill of the underlying Late Archaic basin house served as sill stones. Massive, vertically set slabs were then placed above those sill stones. The slabs forming the foundation's exterior generally leaned inward, while those forming the interior leaned outward. However, several of the vertical slabs were set roughly perpendicular to the axis of the foundation. Gaps between the vertical slabs suggest that they were used to anchor the bases of large-diameter wall posts.

The foundation of Enclosure 4 also appears to have included several massive angular blocks, likely weighing at least 100 kg each, that shifted downhill and away from the foundation after the structure was abandoned. Several other foundation stones visible on the surface appear to be at least as large. The incorporation of those large stones in the foundation suggests that the superstructure of Enclosure 4 was especially heavily built. In addition, the rear wall of Enclosure 4 consisted of an approximately 2.5-m-high bedrock boulder. Based on the design of the foundation and the sizes of constituent stones, the roof of the structure must have been roughly the same height.

Summary

The 2014 data reveal variations on a common set of enclosure design parameters and construction methods. Each of the investigated structures enclosed about the same area, roughly 12 to 14 m^2. Most faced toward the south or southeast. The floor of each was excavated below the surrounding native surface. The foundation of each was designed to support substantial wall posts. Each incorporated a bedrock outcrop, large boulder, or slab-lined cut designed to provide an interior thermal mass. A domed, or flat-topped, roof would have been required to incorporate those boulders. Given the inferred sizes of the wall posts, and the need for a domed or flat-topped roof, the tops of the wall posts must have been connected by timber beams. The absence of daub indicates that the walls and roofs were closed with perishable materials, such as grass thatch, willow bundles, and hides, or some combination of those materials. In sum, Upper Crossing's stone enclosures are best described as timber-frame lodges, rather than as pole-and-brush wickiups.

The enclosures investigated in 2014 represent enormous investments in both labor and materials. Although several were built over pre-existing basin houses with semi-subterranean floors, the pit excavated for Enclosure 5 required the removal of about 9 m^3 of compact rock and sediment. Sill stones weighing up to 400 kg were then positioned around the pit's perimeter and clean sand was spread on the floor to fill gaps between native stones. Wall posts and roof beams would then have been cut from nearby ponderosa pines, aspens, or cottonwoods, lashed into a framework, and pinned into position with tabular foundation rocks. In addition to willow bundles or grass thatch, the covering of each would have required several animal hides.

However, data obtained from Cluster 1 in 1999 and 2009 point to variability in enclosure function and construction (Mitchell 2012a). For example, testing in 1999 demonstrated that few artifacts were associated with Enclosure 6. Several other structures, such as Enclosure 7, likely represent relatively insubstantial structures that may only have been partly enclosed. Lightly built structures or structures with small or functionally limited assemblages may have served as non-residential work areas. Alternatively, some of them may have been built and used during the warm season. One unusually small Cluster 1 feature, designated

Enclosure 15, may have been used for above-ground storage.

Regional Comparisons

Apart from the domestic structures found on Basketmaker and Early Pueblo sites, the catalog of excavated architectural features contemporaneous with the early Late Prehistoric basin houses and stone enclosures at Upper Crossing is limited. The most numerous and best-known are associated with southwest Wyoming's Uinta phase (Pool 2015; Reed 2014; Shields 1998; Thompson and Pastor 1995). Uinta phase structures consisted of basin houses, some of which were relatively insubstantial. Many enclosed just 3 or 4 m^2. Floors were shallow and undulating and had irregular perimeters. Interior hearths often were small or absent entirely. Superstructures may have been conical, although few Uinta phase houses preserve postmolds or other evidence of their design. Stone enclosures have not been associated with a Uinta phase occupation.

Data on Upper Crossing's early Late Prehistoric basin houses are too limited to confidently compare them to Uinta phase basin houses. However, the evidence at hand suggests that the houses at Upper Crossing were substantially larger and more deeply excavated. The interior hearths associated with the basin house beneath Enclosure 10 are similar to those described for some Uinta phase structures; however, the large hearth associated with the basin house beneath Enclosure 9 seems atypical of many Uinta phase houses.

Closer to Upper Crossing, excavation at the Elk Creek Village site in the Gunnison River basin revealed a large, roughly circular basin that may represent a domestic structure similar to some Uinta phase basin houses (Rood 1998). The Elk Creek Village house was approximately 3 m in diameter and exhibited an interior hearth; however, no additional architectural details were observed and the size of the associated assemblage was limited. Similarly enigmatic basin houses that may have been contemporaneous with the early Late Prehistoric component at Upper Crossing are sparsely distributed elsewhere in western Colorado (e.g. Creasman 1981). However, unlike those at Upper Crossing, at least some of them appear to have been wattle-and-daub structures.

Also in western Colorado, stone architectural features associated with Puebloan pottery and maize are well documented at Gateway tradition sites (Reed 1997; Reed and Metcalf 1999). Gateway tradition stone architecture includes both circular and rectangular structures, as well as both single- and multi-room structures. Radiocarbon dates from Gateway tradition sites initially suggested that some of them may have been contemporaneous with the early Late Prehistoric occupation at Upper Crossing. However, recent analyses of imported ceramics, as well as new radiocarbon dates on maize remains and bone collagen, now indicate that most or all Gateway tradition sites post-date the stone enclosure occupations at Upper Crossing (Greubel *et al.* 2009; Reed 2005; Reed and Emslie 2008). In addition, the lower walls of Gateway tradition structures were built from stacked or piled masonry, in contrast to the sill-and-leaning-slab architecture of the Upper Crossing enclosures. The presence of rectangular masonry and multi-room structures on some Gateway tradition sites are also clear contrasts with Upper Crossing's circular to oval single-room enclosures.

Only a handful of excavated architectural sites contemporaneous with Upper Crossing's early Late Prehistoric component are known from the Arkansas River basin, where they are assigned to the Developmental period of the Late Prehistoric (Kalasz 1990; Kalasz *et al.* 1999). Developmental period architectural features occur in rockshelters, but those generally consist only of informal partitions composed of stacked rocks (e.g. Campbell 1969; Schiavitti *et al.* 2001). Residential structures at several open sites are more substantial and better documented. Two structures occur at the Belwood site (Hunt 1975). One was circular and featured a stacked-slab foundation that enclosed about half of the structure's perimeter. Eight posts or post molds were documented, along with a hearth and a bell-shaped storage pit. The second structure was a shallow basin house defined by six posts and an extended, east-facing entryway. No rocks were used in its construction.

Two Developmental period residential structures also have been excavated at the Forgotten site, located on the Pinon Canyon Maneuver Site (Loendorf *et al.* 1996). Although significantly disturbed, both structures appear to represent comparable examples of a highly distinctive construction technique. The walls of both houses consisted of two rows of upright slabs set in an excavated wall trench that was filled with clay and fired to increase the clay's strength. Smaller stones were also used as shims to support the wall slabs, some of which stood as high as 70 cm above the modern ground surface. The superstructure may have been conical, with posts set against the base of the wall and braced in some cases by upright slabs set about a meter inside the outer wall. The walls were not continuous and the structures may have been open on one side. The floor of each encompassed approximately 16 m^2. Multiple interior hearths or roasting pits were present in each house; however, associated artifacts were not abundant.

Whether the Forgotten site structures are typical of Developmental period architecture is unclear, although the similarities between the methods used to build them and the methods used to build some later Apishapa phase structures suggests that they may be (Gunnerson 1989). However, limited data from several other tested Developmental period structures are equivocal on that point. An apparent wall trench similar to those at the Forgotten site was observed on a late Developmental period structure at site 5LA6603 (Schiavitti *et* al. 2001). A wall trench was not evident on a Developmental period structure at 5LA7548 (Schiavitti 2003). In any case, the structures at the Forgotten site clearly differ significantly from those at Upper Crossing.

Several Developmental period structures are located along the Purgatoire River west of Trinidad, Colorado (Mitchell 1997). The best-defined consists of a moderately deep pit structure with a ramp entryway, an adobe-collared hearth, and a wall cist. No rocks were used in its construction.

Both pit structures and stone enclosures contemporaneous with those at Upper Crossing have been documented at sites in northern New Mexico. Pit structures and stone enclosures dating to the Plains Woodland period have been documented in the Ancho Canyon Mine area, located in the foothills of the Sangre de Cristo Mountains west of Raton, New Mexico (Biella and Dorshow 1997; Mack 2002). Documented pit structures are ovoid in plan and were mostly were cut into the adjacent slope on the uphill side. Floor areas range from 23 to 48 m^2 and maximum depths range from 36 to 130 cm. Interior features included large central hearths and a variety of small pits. Superstructures may have consisted of post-supported roofs and wood and thatch walls. Most date to the Initial Woodland (A.D. 200-750), although use of such structures continued into the Terminal Woodland (A.D. 750-900).

Masonry structures in the Ancho Canyon Mine area were constructed on the pre-occupation ground surface and are circular to oval. Mean diameter is 4.3 m and mean floor area is 14.5 m^2. The lower walls, which range in height from 21 to 80 cm, consisted of two to five courses of minimally modified horizontal slabs. Floors were basin shaped, with a maximum depth of 12 cm below the wall footings. Data on the design of the structures' roofs and upper walls were not preserved; however, they likely consisted of pole-supported brush. Large interior hearths, masonry wall bins, and large bell-shaped storage pits were documented. Aboveground masonry structures in the Ancho Canyon Mine area date to the Terminal Woodland.

Upper Crossing's early Late Prehistoric structures exhibit only limited similarities with Ancho Canyon Mine structures. Although basin houses or pit structures are present in both contexts, those in the Ancho Canyon Mine area are larger and deeper. The use of horizontal slabs to construct enclosures in the Ancho Canyon Mine area clearly differs from the methods used to construct enclosures at Upper Crossing. However, both groups of enclosures are similar in mean size.

The Sitio Creston site, located near Las Vegas, New Mexico, contains 12 stone enclosures (Wiseman 1975). The enclosures are circular to oval and range in diameter from 2 to 4 m. Foundations consisted of piled blocks and slabs or, in some cases, horizontal masonry. Preserved walls ranged in height from a few centimeters to more than a meter. Several incorporated bedrock exposures. Floors were shallow basins and in a few cases clay was spread on the floor to fill gaps between stones. Three of the eight excavated enclosures contained hearths; no other features were observed. Based on the presence of more than 600 Taos Plain and Taos Incised sherds, the occupation at Sitio Creston was thought to post-date 900 B.P. However, radiocarbon data and a reanalysis of ceramic provenience data now indicate that at least some of the structures may be contemporaneous with Upper Crossing's enclosures (Wiseman 2016). An earlier occupation date is also supported by projectile point data.

Wiseman (1975) presents few data on enclosure construction and does not speculate on the form of the enclosures' superstructures. However, the orientations of foundation stones illustrated in published photographs, including of one of the enclosures now dated to the early Late Prehistoric, suggest intriguing similarities with the Upper Crossing enclosures. Another similarity is suggested by Wiseman's observation that the robustness of the Sitio Creston enclosures varied significantly, as did the extent and diversity of the assemblages associated with them.

Several Early Ceramic sites containing stone structures have been investigated in the South Platte River basin (Gilmore 1999). Small pit structures lacking stone foundations also have been documented (Gilmore 1999: 241; Tucker *et al.* 1992). The stone structures at the Lindsay Ranch site are similar in size to those at Upper Crossing and contain interior hearths and storage pits. However, they are roughly square in plan and Nelson (1971) envisions conical, hide- or thatch-covered superstructures.

At the Valley View site, the most thoroughly investigated enclosure consisted of a shallow basin house surrounded by a stone foundation consisting of loosely piled rocks roughly 50 to 75 cm high (Brunswig 2016). The structure, which was approximately 3.5 m in diameter, contained an interior hearth and featured a projecting wall that defined an open-sided work area. Radiocarbon data suggest that the structure dates to the ninth or tenth century A.D. A seventh-century date was obtained from a nearby feature that Brunswig associates with a cultural stratum underlying the enclosure. Although the enclosure at Valley View exhibits some similarities with those at Upper Crossing, the presence of fired daub in the fill indicates that the superstructure was constructed differently.

A curving wall associated with a small rockshelter at the Three O'Clock Shelter site may have supported leaning posts that were anchored to the shelter wall and covered with hides (Brunswig 1996). Although bedrock or large boulders were incorporated into many of the Upper Crossing enclosures, their superstructures were not simple lean-tos.

Kalasz and Shields (1997) report two enigmatic stone structures at the Magic Mountain site. One exhibited a sandstone slab floor and a partial foundation wall. No post molds or interior features were noted. The feature's exact dimensions could not be determined, but likely were roughly 3 by 4 m. The second enclosure consisted of a 9-m-long semicircular alignment of cobbles and boulders. A gap or opening was present in the alignment. A possible interior basin feature was also noted. Clearly, the structures at Magic Mountain bear no resemblance to those at Upper Crossing.

The structure at the Kinney Spring site, located in the Front Range foothills in northeastern Larimer County, consisted of a piled rock foundation that partly surrounded a shallow basin floor (Gilmore 1999; Perlmutter 2015). The oval structure was 2.5 m wide and 3.7 m long, and likely was open on the northeast and possibly northwest corners. No interior features were documented. The foundation, which was built on the pre-occupation ground surface, was composed of a mixture of small and large blocks and slabs. Direct evidence of the enclosure's superstructure was preserved in the form of burned juniper logs, which by their size indicate that the walls and roof were relatively substantial. In that respect, the Kinney Spring structure is similar to the Upper Crossing enclosures. However, the design of the foundation, as well as the overall form of the structure, appears to have differed.

An entirely different type of structure occurs at the Indian Mountain site in northeastern Boulder County (Cassells and Farrington 1986). Ten roughly circular spaced-rock rings, each composed of 26 to 36 stones and varying in diameter from about 4 to 7 m, were documented at the site. Three of the six excavated structures contained interior hearths. Among all of the stone structures documented in the South Platte basin, none differ more from the enclosures at Upper Crossing than the spaced-rock rings at Indian Mountain.

Summary

Even though comparative data—particularly detailed descriptions of enclosure construction methods—are limited, several general statements can be made about the relationships between Upper Crossing's early Late Prehistoric architecture and domestic structures in adjacent regions. Too little is known about Upper Crossing's basin houses to draw specific comparisons or contrasts. However, the timing of basin house use at Upper Crossing points to several intriguing patterns. Very few Late Archaic basin houses occur in Colorado (Reed 2014; Pastor *et al.* 2000; Shields 1998). Moreover, cold-season residential base camps in the Gunnison River basin, not far from Upper Crossing, were abandoned after 3000 B.P. (Stiger 2001). The regionally anomalous Late Archaic basin houses at Upper Crossing may therefore point to a southward shift in winter residential base camps during that period. The presence of toolstone imported from the Gunnison basin in Upper Crossing's Late Archaic assemblage suggests ongoing connections to the northwest.

By contrast, the early Late Prehistoric basin houses were built during a regional peak in the use of that type of architecture, between about 1750 and 1150 cal B.P. (Reed 2014). Although that peak was much smaller than an earlier peak between 7350 and 5450 cal B.P. it does represent a broad regional pattern.

No clear analogs for Upper Crossing's stone enclosures exist in the regional dataset, apart from possible similarities to the enclosures at New Mexico's Sitio Creston site. Contemporaneous stone enclosures have not been documented in western Colorado. The few Early Ceramic enclosures documented in the South Platte River basin bear little resemblance to Upper Crossing's enclosures, although detailed architectural data are lacking for most South Platte structures.

Detailed architectural data are available for the Forgotten site in the Arkansas River basin and those data reveal clear contrasts with Upper Crossing. Whether the Forgotten site structures exhibit regionally distinctive architectural characteristics is unclear; however, the available evidence suggests that they may. The differences between the enclosures at the Forgotten site and those at Upper Crossing therefore argue against cultural connections between the Developmental period in the Arkansas basin and the early Late Prehistoric in the Rio Grande basin.

In northern New Mexico, several general similarities exist between enclosures in the Ancho Canyon Mine area and enclosures at Upper Crossing. However, the Ancho Canyon structures do not appear to exhibit the distinctive sill-and-slab architecture of Upper Crossing's enclosures. Structures at Sitio Creston may exhibit that type of construction technique; however, additional data will be needed to evaluate that hypothesis.

In sum, regional architectural data suggest that the enclosures at Upper Crossing were built by a local, San Luis Valley-based population, rather than itinerant hunter-gatherers who made periodic visits to the valley.

Lithic Technology

The most prominent characteristic of the Upper Crossing tool assemblage is its diversity. The full range of tool manufacturing processes is represented, from initial hard-hammer reduction of quarried nodules to biface production and maintenance by soft-hammer percussion to flake tool and projectile point manufacturing by pressure flaking. Large and small cutting tools, patterned and unpatterned scraping tools, projectile points, patterned and unpatterned perforating tools, and heavy chopping tools are all present. Handstones and millingstones, although not abundant, also are present. In addition, the assemblage contains multiple nonutilitarian items, including a stone bead and fragments of several stone pipes or tubes.

Differences exist between the Late Archaic and early Late Prehistoric assemblages. Large patterned bifaces are more common in the Late Archaic, while unpatterned or expedient bifaces are more common in the Late Prehistoric, suggesting that multi-function, transportable tools were a more important component of the Late Archaic toolkit. Scraping tools also are more common in the Late Prehistoric assemblage, indicating greater emphasis on hide preparation, woodworking, or bone tool manufacturing.

By contrast, there are no temporal or spatial variations in the technological or functional attributes of the tools associated with early Late Prehistoric basin houses and those associated with stone enclosures. That uniformity suggests that season of residence was the primary difference between the Late Prehistoric basin house occupations and stone enclosure occupations, rather than the activities undertaken or the gender or age composition of the residents.

Stone tool raw material data indicate that the lithic territory exploited by Upper Crossing's early Late Prehistoric residents was tightly circumscribed. Virtually all the raw material came from sources located within the Saguache Creek valley. Most of the tools used and discarded on-site were also manufactured there using stone from nearby sources. Judging by the presence of soft-hammer biface thinning flakes made of rhyolite and orthoquartzite but the absence of well-made large patterned bifaces made of those materials, a portion of the patterned tools manufactured at Upper Crossing were transported off-site for use elsewhere.

The provenance of the few tools made from imported stone suggests temporal shifts in mobility patterns. Orthoquartzite from the Gunnison River basin only occurs in Late Archaic contexts, while obsidian and basalt from the Rio Grande basin occurs almost exclusively in Late Prehistoric contexts. Minor differences in raw material usage among the early Late Prehistoric occupations at Upper Crossing likely reflect contingent decisions residents made about the direction and scheduling of logistical forays.

Upper Crossing's early Late Prehistoric inhabitants maximized the utility of the tools they produced. The assemblage is highly fragmented; most specimens consist only of an end or margin fragment. Just 7 percent of the non-core tools are complete or nearly complete and remain usable. Thirteen percent are production failures and 80 percent are broken or exhausted and discarded.

Eleven percent of the tools were re-manufactured into another tool, either of the same technological class or a different technological class. Tool re-sharpening rates were not quantified; however, many of the bifaces and flake tools were rejuvenated to extend their use life.

Flintknappers at Upper Crossing utilized a broad range of materials that vary greatly in quality and abundance. Broad spectrum use of many different materials, with only limited usage differences among technological classes, suggests maximal use of all available raw materials.

However, the assemblage cannot be described as technologically sophisticated. Apart from projectile points and a few hafted drills, the assemblage includes few patterned tools and in some cases tools nominally classified as patterned in fact exhibit only cursory modification of the original input blank. Even accounting for the fact that some large patterned bifaces were produced on-site but used elsewhere, the greater portion of the assemblage consists of core fragments and unpatterned bifaces and flake tools. Thus, the assemblage exhibits many, but not all, of the characteristics of what is conventionally described as a curated technology.

The projectile point collection includes a wide variety of forms, most of which do not exhibit the attributes of recognized or named types. That variety may reflect early and on-going experimentation with bow-and-arrow technology. It may also reflect the fact that both the Late Archaic and Late Prehistoric occupations at Upper Crossing were components of a local settlement system and not connected to larger systems in the Plains or northern Southwest. Nevertheless, within the combined 1999 and 2014 collections, the most common Late Prehistoric arrow point is the Scallorn or Rose Spring type. Corner-notched and low-side-notched dart points are the most common Late Archaic types.

The ground stone tool assemblage consists primarily of unpatterned items. Many exhibit only limited use-wear. Patterned or well-used handstones may have been carried off-site for use elsewhere; however, the lack of millingstones exhibiting extensive use-wear suggests that intensive seed processing was not an important aspect of the subsistence system, either during the Late Archaic or during the Late Prehistoric.

Subsistence Practices

Early Late Prehistoric animal subsistence at Upper Crossing focused primarily on procurement of small artiodactyls, including bighorn sheep, pronghorn sheep, and deer. However, elk and small game—including cottontail, prairie dog, and, perhaps, porcupine—were also targeted. Frequency data for small artiodactyl skeletal elements indicate that bones from all regions of the body are represented in the sample, although numbers for cranial and axial pieces are few, and long bone shaft and foot fragments are more numerous. Many of the elements represented in the Upper Crossing sample are linked to high economic utility (nutritional value) based on experimental data developed for meat and marrow yields, while others are considered low utility. However, a statically significant correlation was not shown between published utility index values (FUI) and frequency distributions for small artiodactyl remains in the 2014 sample, nor between frequency distributions and average meat and marrow gross yields.

Faunal remains from Late Archaic contexts, although scant, generally conform to the early Late Prehistoric pattern: a primary focus on small artiodactyls along with occasional procurement of large artiodactyls and small game. Both cottontail and prairie dog are represented, as are either elk or bison.

The Upper Crossing archaeofauna is represented primarily by small pieces of fragmented bone. Observed fragmentation could reflect processing for within-bone nutrients, although the strength of this inference is tempered by a number of factors including the density of the skeletal elements represented, local weather regimes and soil conditions, and discard practices. Based on the available data, density-mediated attrition and destruction by scavenging animals do not appear to be major factors in recorded specimen distribution; the effects of other factors such as burning, freeze-thaw cycles, and carcass processing decisions are more difficult to assess. Nevertheless, data on the 2014 archaeofauna suggest that early Late Prehistoric hunters may have placed a priority on returning butchered units with the highest nutritional yield and further that returned bones were processed to acquire within-bone nutrients. Other factors important to early Late Prehistoric processing and transport decisions may have included the need to obtain non-comestible raw materials such as hides or sinew and the distances at which prey were encountered.

Botanical data only were obtained from a single feature fill sample. Recovered specimens include charred seeds of dock or sorrel (*Rumex* sp.), goosefoot (*Chenopodium* sp.), and an unidentified plant. *Rumex* sp. seeds have not previously been identified in San Luis Valley botanical assemblages. The leaves of both golden dock and goosefoot were eaten raw or cooked and the seeds were ground for porridges, breads, and other foods. Roots, leaves, and seeds of many *Rumex* species also were used medicinally.

Occupation Duration and Seasonality

Stratigraphic and chronometric data demonstrate that Upper Crossing was occupied repeatedly, both during the Late Archaic and the Late Prehistoric. Determining how those recurrent occupations fit in regional settlement systems depends on inferences about the duration and season of occupation, which in turn rely on multiple lines of evidence including data on site location and topography, architectural design, lithic technology and raw material use, assemblage size and diversity, site structure, and faunal remains.

Seasonality

Archaeologists studying Archaic-era residential sites in Colorado have developed criteria for identifying season of occupation that can be applied to Upper Crossing (Harrison *et al.* 2014; Metcalf and Black 1991; Moore 2011; Reed 2009b). Diverse criteria are needed because definitive evidence of site seasonality often is lacking. Most of the currently applied criteria were developed by Metcalf and Black (1991) for assessing the seasonality of the Early Archaic Yarmony site. Reed's (2009a) criteria, presented in table 6.2, modify the Yarmony variables by eliminating several that are primarily indicative of long-term occupations, rather than cold-season occupations *per se*. Table 6.2 also summarizes data from Upper Crossing.

Substantial, thermally efficient architecture is a hallmark of Upper Crossing's stone enclosure occupations. As discussed previously, Upper Crossing's enclosures were designed to support timber-frame superstructures that could withstand significant snow loading and that were large enough to provide interior work spaces for several people during inclement weather. Their semi-subterranean floors and enclosed boulders helped retain heat produced by interior hearths. Their position on the landscape clearly reflects a desire to maximize solar exposure: they face to the south or southeast and are elevated above local cold-air drainage.

Upper Crossing's basin houses utilize the same strategies to maximize solar heating and minimize heat loss, although their lighter superstructures suggest that they were designed primarily for cool-season use in the late fall or early spring, rather than for winter-long use.

Mule deer currently congregate in the middle and lower sections of the Saguache Creek valley during the winter, including close to Upper Crossing. Congregation occurs regularly, as defined by winter concentration areas, as well as during the hardest winters, as defined by severe winter range.

Direct evidence of late winter or early spring occupation in the form of artiodactyl fetal bone is associated with an enclosure occupation at Upper Crossing. Fetal bone was not associated with the Late Archaic or early Late Prehistoric basin house occupations, although the extent of the Late Archaic archaeofauna is limited.

The topographic correlates of cold-season occupation may help explain an observation E. B. Renaud made on the locations of San Luis Valley enclosure sites. Renaud (1942:46-47) noted that the valley's enclosures often were positioned on local high points that are "eminently fitted to serve as observation posts." Those high points meet Reed's (2009a) topographic criteria for cold-season occupations, suggesting that many—perhaps most—enclosure sites were occupied during the fall or winter. Bolstering that conclusion is the strong geographic patterning of enclosure sites in the valley. Nearly half of the documented enclosure sites occur in a narrow elevation band between 2450 and 2750 m that roughly corresponds to the pinon-juniper and lower ponderosa pine ecozones (Mitchell 2015). Mule deer winter concentration areas and severe winter range also occurs primarily in those ecozones.

Occupation Duration

Table 6.2. Comparison of Reed's (2009b) expectations for cold-season occupations with data from Upper Crossing.

Variable	Upper Crossing Data
Substantial, thermally efficient architecture	Present; enclosures more substantial than basin houses
Interior hearths, often covering much of the floor	Present in both enclosures and basin houses
Storage features within structures or widely distributed	None observed
Site within large-game winter range	Yes
Site in valley bottom location, but above cold-air drainage	Yes
Site placement to maximize solar exposure	Yes
Artiodactyl fetal bone present	Yes; associated with stone enclosure occupation
Dedicated midden deposits	Yes; both inside and outside structures
Site not necessarily located immediately adjacent to water	Yes

Reed's (2009d) polythetic approach to estimating site occupation duration combines an assessment of anticipated occupation length, as reflected in architecture and site structure, with an assessment of actual occupation length, as reflected in various measures of assemblage size and diversity. Table 6.3 summarizes the attributes Reed identifies for four different types of sites defined by anticipated and actual length of occupation. The two right-hand columns describe expectations for sites that were only intended to be used briefly, while the two left-hand columns describe expectations for sites that were intended to be occupied for a lengthy period. Each of those anticipation categories is then paired in the table with an actual occupation-length category, resulting in site occupation duration groups.

Table 6.4 compares Upper Crossing data to Reed's expectations for a site designed for a protracted occupation that in fact was occupied for a long period (Group 1). Several of Reed's variables, including ceramic labor, botanical diversity, storage feature labor, and site cleaning intensity, could not be assessed due to small sample size or missing data. The data clearly indicate that the residential occupations at Upper Crossing were in fact lengthy. In addition, the attributes both of basin houses and stone enclosures point to

Table 6.3. Variables and attributes of four theoretical site occupation duration categories (adapted from Reed 2009c:Table 25; see also Reed *et al.* 2001).

	Occupation Duration Group			
Variable	Anticipated Long, Actual Long	Anticipated Long, Actual Short	Anticipated Short, Actual Long	Anticipated Short, Actual Short
Structure Labor	High	High	Low	Low
Pit Feature Labor	High	High	Low	Low
Storage Feature Labor	High	High	Low	Low
Ceramic Labor	High	High	Low	Low
Mano Manufacturing Labor	High	High	Low	Low
Metate Manufacturing Labor	High	High	Low	Low
Site Cleaning	High	High	Moderate	Low
Ornaments	Present	Absent	Present	Absent
Debitage Density	High	Low	High	Low
Number of Flaked Tool Classes	High	Low	High	Low
Percentage of Expedient Tools	High	High	Moderate	Low
No. of Economic Seed Species	High	Low	High	Low
No. of Economic Fauna Species	High	Low	High	Low
Degree of Soil Staining	High	Low	High	Low
Group Number	Group 1	Group 2	Group 3	Group 4

Table 6.4. Upper Crossing site occupation duration data. Shading indicates cells that differ from expectations for Group 1 sites.

	Temporal Unit	
Variable	Late Archaic	Early Late Prehistoric
Structure Labor	High	High; enclosures greater than basin houses
Pit Feature Labor	Low	Low
Handstone Labor	Low	Low
Millingstone Labor	Low	Low
Ornaments	Present	Present
Debitage Density	High, but variable	High, but variable
Tool Diversity	High	High
Percent Expedient Tools	High, but lower than Late Prehistoric	High
No. of Fauna Species	Low, but sample size is small	Moderate
Degree of Soil Staining	High	High
Group Number	Group 1 (Anticipated Long, Actual Long)	Group 1 (Anticipated Long, Actual Long)

the residents' intention to remain at the site for a long period. However, that anticipation does not appear to be reflected in the labor devoted to hearth construction or to ground stone tool manufacture. The absence of well-crafted or intensively used handstones could reflect artifact curation practices or, possibly, the use of wooden grinding implements. However, the absence of intensively used millingstones, which surely would have been considered site furniture, suggests that seed processing was not an important activity at Upper Crossing. Either plant foods were processed elsewhere and transported to Upper Crossing in ground form or plant foods were not a primary component of the calories consumed there.

Upper Crossing's Place in the Annual Subsistence Round

Seasonality and occupation duration data indicate that the stone enclosures at Upper Crossing represent cold-season residences provisioned through a combination of logistical forays and stored resources. Whether such central-place foraging was paired with residential or logistical mobility during the warmer months cannot be determined from Upper Crossing data alone. Reed's (2009a) analysis of regional data from northwestern Colorado points to warm-season residential mobility tethered to winter basin-house occupations and a similar scenario is at least plausible for the San Luis Valley and adjacent mountains. However, data from the eastern side of the Valley, in and around Great Sand Dunes National Park and Preserve, reveals the presence of specialized seed processing camps, indicative of logistical mobility, that date to the Late Archaic and early Late Prehistoric (Andrews *et al.* 2004). It may be the case that the topography of the San Luis Valley, and the distribution and density of resource patches present in the region, conditioned a settlement system quite different than that of northwestern Colorado.

Artist's Reconstruction

Figure 6.1 presents Greg Harlin's rendering of Enclosure 5 based on excavation data obtained in 2014 and on logical inferences derived from those data. Evidence from Block 1 demonstrates that the structure's floor was roughly 35 to 40 cm below the pre-construction land surface. The size of the foundation stones indicates that the superstructure was heavily built. The large size and horizontal orientation of the enclosure foundation's sill stones, along with the tent-like arrangement of leaning slabs above them suggests that the wall logs were socketed into the sill stones and braced by the slabs.

Posts or post molds were not encountered during the 2014 fieldwork. However, multiple lines of circumstantial evidence suggest that the superstructure was flat-roofed or gabled, rather than conical. Readily available timbers of a size proportionate to the building's heavy stone foundations include ponderosa pine or cottonwood limbs or aspen boles. The maximum useable lengths of those timbers would seldom have been greater than two or three meters. Given the structure's 4 to 5-m width, a conical or peaked roof would have severely limited the interior headroom. However, a more important consideration is the presence in many enclosures, including Enclosure 5, of a large boulder or bedrock outcrop on the northern or northwestern side. Mitchell (2012a) argues that those boulders acted as a thermal mass that helped maintain the structure's interior temperature. A conical roof would have limited the boulder's exposure to an interior heat source, especially in cases where the boulder was more than one or two meters high.

No evidence of daub was observed in any of the 2014 excavation blocks, suggesting that the structure's log framework was covered with perishable materials rather than earth. Tree bark suitable for that purpose is not readily available and so it seems likely that the covering consisted of willow branches, thatch bundles, animal hides, or some combination of those materials.

A brush wickiup is shown in figure 6.1, behind and to right of Enclosure 5. Stratigraphic and chronometric data indicate that both lightly built wickiups and more heavily built lodges were archaeologically contemporaneous at Upper Crossing. It is not clear whether these two types of structures were occupied concurrently. Different house types may have been built in different years, depending on the season or anticipated duration of the occupation, or on short- or medium-term climate patterns.

The material culture associated both with basin houses and stone enclosures clearly indicates that the early Late Prehistoric occupations at Upper Crossing were long-term residential base camps. A wide variety of activities occurred at the site, including hide preparation, animal butchery, plant processing, and tool manufacture. These activities surely would have been carried out by a variety of people, including younger and older adult men and women. Given the likelihood of a lengthy, perhaps season-long, occupation, it seems certain that children would also have been present. The presence of dogs is speculative; however, the desirability

Figure 6.1. Greg Harlin's reconstruction of the early Late Prehistoric occupation at Upper Crossing.

of animal traction for dedicated collectors seems certain. A few small pottery sherds were recovered from Enclosure 4, but their size and scarcity suggests that ceramic vessels were an uncommon component of the early Late Prehistoric toolkit.

The substantial investment the site's residents made in domestic architecture is suggestive of a cool- or cold-season occupation. That interpretation is bolstered by the structures' location, on a bluff above the cold air lake in the Saguache Creek valley and primarily facing south or southeast, maximizing exposure to the low winter sun. The residents' fitted clothing is appropriate to the season of occupation.

Upper Crossing and the Archaeological History of the San Luis Valley

The findings of the 2014 investigation at Upper Crossing have important implications for reconstructing American Indian history in the San Luis Valley. First, the presence of functionally equivalent Late Archaic and early Late Prehistoric occupations points to long-term adaptive continuity spanning more than a millennium. Although some differences were observed between the two primary components in domestic architecture and lithic technology, both the Late Archaic occupations and the early Late Prehistoric occupations were central-place foraging camps occupied in the cool or cold seasons. Overall similarities between those components in lithic raw material use, activity sets, subsistence practices, occupation duration, and other factors suggest long-term stability in the regional settlement system.

Although an occupational hiatus may have occurred at Upper Crossing—possibly coincident with a cooler and wetter climate episode between 2700 and 1500 ^{14}C yr B.P.—regional data on stone enclosure sites also point to a stable settlement and subsistence system spanning the Late Archaic and the early Late Prehistoric. Mitchell's (2015) analysis of 158 enclosure sites in the five counties encompassing the San Luis Valley points to a florescence of enclosure-site use beginning in the Late Archaic and continuing into the early Late Prehistoric. That pattern is particularly evident among sites with multiple enclosures, which disproportionately feature large, diverse artifact assemblages and therefore likely represent residential base camps. If, as the Upper Crossing data suggest, residential sites with stone enclosures also contain Late Archaic components centered around less archaeologically visible basin houses, then the regional data point not to the antiquity of enclosures but rather to the stability of the settlement system. Surface examination of looted enclosure sites in the Saguache Creek valley suggests that in fact many enclosures were constructed over pre-existing architectural features (unpublished PCRG data).

The second finding with implications for American Indian history in the San Luis Valley is the fact that the superficial resemblance between the Valley's stone enclosures and contemporaneous enclosures elsewhere in Colorado and New Mexico is just that. Architectural data on Upper Crossing's early Late Prehistoric enclosures demonstrate that the methods used to construct them—and by extension similar enclosures documented at other sites in the Saguache Creek valley—are unique, with the possible exception of enclosures at the Sitio Creston site near Las Vegas, New Mexico. That uniqueness suggests that they represent a cultural phenomenon confined primarily or exclusively to the Rio Grande basin. Combined with the inference that Upper Crossing was a product of a stable regional settlement system, the architectural data obtained in 2014 point to the existence of a resident, local hunter-gatherer population in the San Luis Valley during the Late Archaic and early Late Prehistoric.

The third—and perhaps most evocative finding of the 2014 investigation—is the co-occurrence of enclosures and basin houses in the early Late Prehistoric component at Upper Crossing. Although it is not possible with the evidence at hand to demonstrate strict contemporaneity between those two architectural forms, they certainly were archaeologically contemporaneous. The association of different architectural forms with contemporaneous, functionally equivalent occupations at Upper Crossing points to dynamic decision-making by individual households or bands of local San Luis Valley hunter-gatherers, who made architectural choices that reflected the anticipated season and length of their stay at the site. Those choices likely were conditioned by short- or medium-term patterns in climate and resource availability.

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Appendix A:
Coding Formats

Table A.1. Flaking debris mass analysis variables and attributes.

Variable	Description
CN	**Catalog number**
SG	**Size grade**
RAWM	**Raw material type**
1	chert
2	chalcedony
3	quartzite
4	rhyolite
5	basalt
6	silicified wood
7	obsidian
8	sandstone
9	unknown
10	argillite
11	schist
12	Quartz
13	Metaquartzite
14	Unknown igneous
DESC	**Raw material descriptive category**
1	dark red chert with fracture planes
3	Trickle Mountain quartzite
5	yellow chert with chalcedony inclusions
6	fibrous chalcedony
7	homogeneous red quartzite
8	homogeneous maroon quartzite
11	possibly Trickle Mountain quartzite
12	non-local quartzite
13	high-quality gray quartzite
14	nougat rhyolite
15	Banded coarse quartzite
99	unspecified
BURN	**Burning**
0	absent
1	present
HEAT	**Heat treatment**
0	unheated
1	possibly present
2	definitely present
3	suspected but uncertain due to burning
9	not applicable
CORT	**Cortex**
0	absent
1	present
COUNT	**Number of specimens in group**
WEIGH	**Group weight, to 0.1 g**

Table A.2. Flaking debris individual flake analysis variables and attributes.

Variable	Description
CN	**Catalog number**
SG	**Size grade**
RAWM	**Raw material type**
1	chert
2	chalcedony
3	quartzite
4	rhyolite
5	basalt
6	silicified wood
7	obsidian
8	sandstone
9	unknown
10	argillite
11	schist
12	Quartz
13	Metaquartzite
14	Unknown igneous
DESC	**Raw material descriptive category**
1	dark red chert with fracture planes
3	Trickle Mountain quartzite
5	yellow chert with chalcedony inclusions
6	fibrous chalcedony
7	homogeneous red quartzite
8	homogeneous maroon quartzite
11	possibly Trickle Mountain quartzite
12	non-local quartzite
13	high-quality gray quartzite
14	nougat rhyolite
15	Banded coarse quartzite
99	unspecified

Variable	Description
COR	**Cortex**
0	absent
1	present
SRT	**Sullivan and Rozen category**
1	complete flake
2	broken flake
3	flake fragment
4	debris
TYPE	**Flake type**
1	shatter
2	bipolar flake
3	percussion bifacial thinning
4	blade
5	simple flake
6	complex flake
7	bifacial pressure flake
12	Failed bifacial thinning
PLATFORM	**Platform type (SRT 1&2 only)**
1	cortical
2	flat
3	faceted
4	ground
5	crushed
HEAT	**Heat treatment**
0	not present
1	possibly present
2	present
9	not applicable
BURNING	**Burning**
0	not present
1	present
9	not applicable
LENGTH	**Flake length, to 0.1 mm (SRT 1 only)**
WIDTH	**Flake width, to 0.1 mm (SRT 1 only)**
THICK	Flake thickness, to 0.1 mm (SRT 1 only)
WEIGH	Flake weight, to 0.1 g

Table A.3. Stone tool analysis variables and attributes.

Variable	Description
CN	**Catalog number**
SG	**Size grade**
SEQ	**Sequence number within level lot**
CASE	**Multiple records on a single specimen**
RAWM	**Raw material type**
1	chert
2	chalcedony
3	quartzite
4	rhyolite
5	basalt
6	silicified wood
7	obsidian
8	sandstone
9	unknown
10	argillite
11	schist
12	Quartz
13	Metaquartzite
14	Unknown igneous
DESC	**Raw material descriptive category**
1	dark red chert with fracture planes
3	Trickle Mountain quartzite
5	yellow chert with chalcedony inclusions
6	fibrous chalcedony
11	possibly Trickle Mountain quartzite
12	non-local quartzite
13	high-quality gray quartzite
14	nougat rhyolite
15	Banded coarse quartzite
99	unspecified
TECH	**Technological class**
1	small patterned biface
2	large patterned biface
3	unpatterned biface
4	patterned flake tool
5	unpatterned flake tool
6	coarse cutting/scraping tool
7	non-bipolar core
8	bipolar core/wedge
9	unpatterned ground stone
10	patterned groundstone
12	retouched plate tool
14	ground core
FX	**General functional class**
1	projectile point
2	scraping tool
3	Millingstone
4	Handstone
5	Unspecified ground stone
99	not coded
COMP	**Completeness**
1	complete
2	nearly complete; primary part of core
3	distal end
4	proximal end
5	medial segment
6	indeterminate end
7	margin fragment
9	other fragment
USE	**Use-phase**
1	unfinished, usable
2	unfinished, unusable
3	finished, usable
4	finished, unusable

Variable	Description
RECY	**Recycling**
0	none
1	recycled to same technological class
2	recycled to different technological class
BURN	**Burning**
0	absent
1	present
HEAT	**Heat treatment**
0	unheated
1	possibly present
2	definitely present
3	suspected but uncertain due to burning
9	not applicable
CORT	**Cortex**
0	absent
1	present
LENG	**Maximum length, to 0.1 mm**
WIDE	**Maximum width, to 0.1 mm**
THICK	**Maximum thickness, to 0.1 mm**
DHEL	**distal haft element length, to 0.1 mm**
BLADE	**blade element length, to 0.1 mm**
DHEW	**distal haft element width, to 0.1 mm**
PHEW	**proximal haft element width, to 0.1 mm**
BASEWID	**blade base width, to 0.1 mm**
NOTWID	**notch width, to 0.1 mm**
NOTDP	**notch depth, to 0.1 mm**
WEIGH	**Specimen weight, to 0.1 g**

Variable	Description
CRN_GNAW	**Carnivore gnawing**
1	absent
2	present
3	indeterminate
ROD_GNAW	**Rodent gnawing**
1	absent
2	present
3	indeterminate
DIG_COR	**Digestive corrosion**
1	absent
2	present
CONDITION	**Specimen condition**
1	unaltered
2	weathered
3	leached/eroded
4	abraded
5	root etching
6	mineralized
7	carbonate
8	burned/indeterminate
WEATH	**Weathering**
0	none/minimal
1	split line/mosaic cracking
2	flaking, exfoliation
3	extensive splitting/cracking/flaking
4	decaying/decomposing
BRN	burned, indeterminate

Table A.4. Identifiable bone analysis variables and attributes.

Variable	Description
CN	**Catalog number**
SG	**Size grade**
NISP	**Number of individual specimens**
TAXON	**Taxonomic assignment**
ELEMENT	**Skeletal element**
SIDE	**Side**
L	left
R	right
A	axial
U	unsided
PORTION	**Portion present**
PERCENT	**Percent complete**
BURN	**Burning**
1	unburned, unstained
2	burned: charred/calcined
3	stained/discolored, likely heated
TL_MK	**Tool marks**
1	absent
2	present

Table A.5. Analytic unit variables and attributes.

Variable	Description
CN	**Catalog number**
CONTEXT	**Spatial context**
1	Exterior
2	Interior
3	Wall
TP	**Time period**
1	Late Archaic
4	Late Prehistoric
9	Indeterminate or mixed
ENCL	**Enclosure Construction Relationship**
1	Before
2	After
3	Mixed
9	Surface

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Administrative Office and Lab:
555 Burbank Street, Unit A
Broomfield, Colorado 80020
Mailing Address:
P.O. Box 745309
Arvada, Colorado 80006

Phone: (303) 439-4098
E-mail: info@paleocultural.org

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