# ARCHEOLOGICAL INVESTIGATIONS AT SITE 48TE412, STRING LAKE, GRAND TETON NATIONAL PARK, WYOMING

By

James V. Winfrey

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ABSTRACT

In the fall of 1990, archeological investigations were conducted at 48TE412 in advance of visitor facility relocation projects in the Jenny Lake Developed Area, Grand Teton National Park, Wyoming. The site is located at the outlet of String Lake, which is located north of the much larger Jenny Lake.

Previous work at the site recovered worked lithics, animal bone, hearths, and evidence of culturally significant subsurface deposits. The 1990 fieldwork included the mapping and excavation of previously identified hearth features and documentation of several concentrations of worked lithics and fired rock. The radiocarbon dates from the excavation reported here and from earlier work at the site are statistically indistinguishable and suggest a fairly recent, probably Euroamerican, occupation. Diagnostic artifacts recovered during survey and excavation, however, suggest that the site was also occupied during the Late Plains Archaic or the early part of the Late Prehistoric period.

The evidence of prehistoric activity at 48TE412 suggests short-term, seasonal occupations by hunters and gatherers moving through the area. Activities in evidence at the site include the processing of animals for bone grease and the production, use, and maintenance of stone tools.

The site was recommended as eligible for inclusion on the National Register of Historic Places on Feburary 27, 1990. While disturbance of the site will be extensive, portions of the site will remain intact, preserving the site's eligibility status.

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TABLE OF CONTENTS

## LIST OF TABLES



## LIST OF FIGURES

# INTRODUCTION

The String Lake site (48TE412) is located at the outlet of String Lake and along its eastern shoreline (Figure 1). Archeologists from the Midwest Archeological Center (MWAC) conducted excavations at this site between 17 September and 9 October 1990 as part of Package 171B2, which is the reconstruction of the park road from South Jenny Lake to North Jenny Lake. Excavation of the site was the final step in the Section 106 compliance process of the National Historic Preservation Act of 1966 (as amended) for this section of the proposed road reconstruction.

The String Lake site was recommended for inclusion on the National Register of Historic Places on the basis of criteria developed for the Jackson Lake Archeological Project (Connor 1989). The criteria included the potential to refine the cultural history and chronology of the area and contribute to a better understanding of aboriginal settlement and subsistence patterns, the paleoenvironmental sequence, and the extent of trade. The Wyoming State Historic Preservation Officer concurred with the National Park Service on the eligibility of the site on February 27, 1989.

## *Purpose of Fieldwork*

After a large windstorm struck the Jenny Lake Developed Area in November 1973 and damaged a large number of the standing trees, the National Park Service conducted a reevaluation of the area's use patterns. The Jenny Lake Developed Area includes both Jenny and String lakes and their associated visitor facilities. During the reevaluation, several problems were defined, and a planning effort was launched to alleviate them. The primary problems were vehicular congestion and conflicts between hikers, horseback riders, pedestrians, and motorists. As a solution to these problems, the National Park Service (1977) began a construction project that would reroute many of the roads in the area, create new parking areas, and reduce adverse impacts to the natural environment. Construction plans indicated that a large portion of site 48TE412 would be affected (Figure 2).

Work at 48TE412 was conducted in the fall of 1990 in response to these construction activities, which threatened the integrity of the site. While there was no mention of the site in the Development Concept Plan (National Park Service 1977), preconstruction inventories revealed its existence. Wright and Marceau (1977) conducted site testing in 1976 and concluded that 48TE412 represented a special-activity locus from which specific resource procurement activities were conducted. They suggested that the site was occupied intermittently during both the Middle Archaic and Late Prehistoric periods. Partially buried, in situ deposits were detected but not fully excavated.

During an inventory for the realignment of the Jenny Lake road, Connor (1989) reassessed the site in relation to research themes developed for the Jackson Lake Archeological Project (National Park Service 1987) and recommended that the site be considered eligible for

nomination to the National Register of Historic Places. There is a potential for improving our understanding of the past using new data from 48TE412.

For the present analysis, the occupation history of the site was reconstructed, which helped to clarify the Jackson Hole area settlement and subsistence patterns. Determination of the sources of obsidian artifacts from the site helped in reconstructing the occupants' trade spheres of interaction. Pollen analysis and other soil sample analyses clarified subsistence practices, the paleoenvironmental sequence, and the postdepositional environment. Analysis of the lithic material provided information regarding those activities that occurred at the site. Data on tool production, maintenance, and use assisted with identification of site function. In turn, the accumulated information is compared to other sites in the area with similar sets of data, allowing a regional picture to develop.

*Environmental Setting*

Like most places on earth, the environment of Jackson Hole is the result of the various natural forces working within the area (Clark 1981). Geologic forces, weather conditions, abundance of water, soil, and elevation all shape the region's biotic communities. Elevations vary from approximately 2,000 m above mean sea level at the floor of Jackson Hole to 4,220 m above mean sea level on the peak of the Grand Teton (Love and Reed 1971).

Geology

About 10 million years ago, the Jackson Hole area was only mildly affected by the mountain-building events that shaped other portions of northwestern Wyoming (Love and Reed 1971). After that time, volcanism, regional subsidence, and uplift began to create the present geologic features. The Tetons are a fault block mountain range created from a section of the earth's crust that has been uplifted along a normal fault. The fault is located approximately at the foot of the eastern slope of the range. Nearly 10,000 meters of vertical movement along the fault has taken place since the block first shifted. Rock layers buried 7,400 meters below the surface of Jackson Hole on the east side of the fault are the same as those that cap the highest peaks on the western side. Displacement along the fault is still occurring at a rate of about 30 cm every 300 to 400 years (Love and Reed 1971).

Along with the geologic uplift in the area, Jackson Hole has experienced glacial events dating back over 150,000 years. A Middle Pleistocene glacier in the Jackson Hole area filled the valley with ice and terminated against Manger Mountain south of Jackson (Pierce 1979).

The Pinedale glaciation was the last to affect the Jackson Hole area. According to Pierce and Good (1986), it receded from Jackson Hole around 15,000 years ago. This period of glaciation is responsible for many of the topographic features visible on the valley floor today. Alpine glaciers, occurring at the same time as the Pinedale, advanced down the mountain valleys and deposited moraines at the front of the range. These moraines and

glaciers are partly responsible for the series of lakes along the eastern front of the mountains (Love and Reed 1971) and they influenced the development of lower elevation vegetation cover in the Jackson Hole area (Clark 1981).

Volcanic and glacial events in the Jackson Hole region were beneficial to the prehistoric occupants of the valley. Volcanic glass (obsidian) from sources around Jackson Hole was used for tools, as evidenced by the abundance of obsidian in archeological sites throughout the area. Love (1972:39) visited five obsidian sources in the Jackson Hole area, and he believes several others may be in the region. He also discusses the glacial origins of the Precambrian quartzites found throughout the valley floor and represented in most archeological assemblages from the area (Love 1972). Glacial action was also a source of the Tensleep quartzite, which is a fine-grained lithic material used for tools. Landforms created by the glaciers influence vegetation and provide habitats for plant and animal resources. The location of prehistoric sites in close proximity to these landforms indicates that prehistoric inhabitants of the valley exploited these resources (Love 1972; Wright and Marceau 1977; Bender 1983).

Climate

After deglaciation, the area experienced a period during which herbs and shrubs dominated the landscape in a manner reminiscent of the alpine to subalpine meadows common in the higher elevations in the Park today (Barnosky 1988). Around 11,200 years ago, juniper became widespread in well-drained areas, accompanied in some locations by birch and willows. Between 11,100 and 9000 years B.P., a succession of coniferous trees spread through the area, with lodgepole pine dominating by the end of the period. During this time and for another 3,000 years, the regional climate was characterized by warmer and drier summers with increased summer droughts (Barnosky 1988). After 6000 years B.P., the climate appears to have become cooler with relatively moist conditions. This conclusion is supported by the replacement of such fire-adapted species as lodgepole pine, Douglas fir, and aspen with closed pine forests of spruce, pine, and fir (Barnosky 1988).

Today the climate is greatly influenced by the mountains. Prevailing winds are from the west. Data collected at the Moose weather station (1,972 m amsl) from 1959 to 1980 indicate a mean January temperature of -10.3 degrees Celsius, and a mean July temperature of 16.11 degrees Celsius. Mean annual precipitation is 63 cm for the same period (Martner 1986). Most of this precipitation occurs during the winter months in the form of snow (Martner 1986).

Resource Availability

String Lake is one of several lakes at the foot of the Teton range formed about 15,000 years ago after the retreat of the Pinedale and Teton Glaciers. The eastern shoreline of the lake, where 48TE412 lies, is an outwash plain formed during the glacial retreat. Soils in the area developed from porous quartzite sand and gravel deposited by glacial meltwater.

Typically, these soils are nutrient-poor and support a sagebrush-grassland community. Vegetation at the site, however, is characterized by open parkland and lodgepole pine.

This vegetation pattern is apparently a result of increased rainfall at the foot of the mountains (Love 1972). The vegetation community is classified as a transitional life zone with the primary community consisting of low sagebrush, followed by dispersed clumps of lodgepole pine. Plants identified by Wright and Marceau (1977:13) as dominant in July include pussytoes (*Antennaria* sp.), skyrocket gilia (*Gilia aggregata*), and a variety of low grasses (Gramineae). Mammals characteristic of this life zone include mule deer, red squirrel, ground squirrel, prairie-dog, mice, gophers, and rabbits. Larger mammals seen in the vicinity of String Lake include elk and moose.

Throughout much of prehistory the valley is believed to have only been occupied from late spring to early fall (Wright and Marceau 1977; Wright 1984). During that time a succession of plant resources would become available along the north/south temperature gradient as well as along the lower elevations to higher elevations gradient (Love 1972; Wright and Marceau 1977; Wright 1984; Bender 1983). Plant resources that ripen during this season in the vicinity of the site include arrowleaf balsamroot (*Balsamorhiza sagittata*), biscuitroot (*Lomatium ambiguum*), bitterroot (*Lewisia rediviva*), Indian potato (*Orogenia linearifolia*), onions (*Allium*), and wild hyacinth (*Broadiaea* sp.) (Wright and Marceau 1977). There are also several woody species available for tool maintenance.

The position of the site between the mountains and valley enabled its occupants to exploit a variety of resources. In the higher elevations, plant resources would become available later in the season than in the valley (Wright 1984). This delayed season allowed inhabitants of the area an extended period during which they could gather these resources. Plants possibly gathered by prehistoric inhabitants in the higher elevations include mountain sunflower (*Helianthus uniflora*) and spring beauty (*Claytonia lanceolata*), plants which are both abundant and high in protein (Bender 1983).

There are various big game species available in the uplands. These include bighorn sheep, mule deer, and elk, plus a variety of smaller mammals. These species would have been hunted in an opportunistic fashion (Bender 1983). Archeological sites on the southern end of Blacktail Butte contain the remains of bison (Wright and Marceau 1981). Faunal remains were also recovered from archeological contexts around Jackson Lake (Connor et al. 1991). Cannon (1991) reports the remains of large and small mammals, birds, and fish in faunal assemblages from prehistoric sites in the Snake River Delta.

Cutthroat trout, as well as other fish species, may also have been available in String Lake and in Cottonwood Creek. Wright and Marceau (1977) found several historical references to the quality of fishing in Jenny and Jackson lakes. Connor et al. (1991:Figure 5) show a distribution of net weights in the Jackson Lake delta area that suggests that fishing was part of the subsistence strategy. The use of plant fibers in the making of nets is also documented for the area (Wright and Marceau 1977:20), as is the taking of fish with the use

of traps, weirs, and nets (Lowie 1909). Wright and Marceau (1977:19) believe that the concentration of sites along Cottonwood Creek, between the Snake River and Taggart Creek, represents a series of task-specific loci focusing on the procurement of spawning Cutthroat trout.

## PREVIOUS ARCHEOLOGICAL WORK

The archeology of Jackson Hole has been a topic of much research over the last two decades. Until the early 1970s, avocational collectors performed most of the work done in the area. Although their work was destructive, it provided information that enabled Frison (1971) and other researchers to make important inferences about the region's prehistoric inhabitants.

The first documented visit to Jackson Hole by a professional archeologist, Paul Beaubien, occurred during September of 1956 (Beaubien 1956). The first archeological survey of Jackson Hole was conducted in the summer of 1971 by Charles Love, then a graduate student at the University of Wyoming, and was reported in his Master's thesis (Love 1972). In his thesis, Love discusses the seasonally open access routes into the area, the sources of lithic raw material, the floral and faunal resources available in different portions of his research area, and the cultural chronology represented by diagnostic artifacts.

Over the next eight years, Gary Wright of the State University of New York, Albany, studied site location, resource utilization, and adaptation. Much of the data for this research came from preconstruction surveys and inventories within the Grand Teton National Park. From this research, Wright and Bender have developed theories about the settlement patterns in Jackson Hole based on site size, artifact diversity, and site distribution (Wright et al. 1978, 1980; Bender 1983; and Wright 1984). These theories are discussed below.

During the 1980s, MWAC conducted extensive surveys around Jackson Lake during the drawdown of the lake by the Bureau of Reclamation (Connor 1986). Center personnel also conducted preconstruction inventories for smaller projects throughout the Park (Connor 1986, 1987, 1989; Connor et al. 1991).

During regional surveys conducted over the past 17 years, a considerable number of archeological sites have been located, tested, and excavated. From this work the cultural chronology of the area has been defined and the subsistence adaptations and settlement patterns of the prehistoric inhabitants of Jackson Hole have been described. The dominant adaptive pattern is believed to have developed in the area during the Middle Archaic and involved a transhumance based on plant resources that became available through the growing season at increasingly higher elevations. (Wright et al. 1980; Bender 1983; Wright 1984; Bender and Wright 1988).

Combined with this resource-motivated subsistence model, three low-elevation geographic areas, each with a distinct resource, are described. These are: northern Jackson Hole where blue camas (*Camassia quamash*) was the key resource (Wright 1984; Reeve 1976); southern Jackson Hole, south of Blacktail Butte and east of the Snake River, where the key resource was the abundant sego lily (*Calochortus nuttallii*) (Wright and Marceau 1981; Reeve 1976); and western Jackson Hole where spawning cutthroat trout was the key resource (Wright and Marceau 1977).

The subsistence model posits that as these low-elevation resources were depleted, groups moved into the adjacent high country in order to exploit plant resources ripening at higher elevations (Wright 1984; Bender 1983). In all areas, hunting is considered to have been supplemental to the acquisition of the primary plant resource.

These conclusions regarding high-country adaptations have influenced the subsequent research in the area. However, as the data increase for the area, the settlement and subsistence pattern described by Wright (1984) becomes more difficult to support. Surveys around Jackson Lake have recorded 47 new sites in the area with evidence of hunting and animal resource processing (Connor 1987).

Connor (1986:70) interprets the data slightly differently. First, she suggests that the adaptive pattern proposed by Wright and Bender did not exist in its entirety until the Late Prehistoric period. Then, in response to evidence supporting high-country adaptation to plant resources, she argues that projectile points in high-country sites from the earlier period signify the utilization of animal resources as well as plants.

*Site 48TE412*

Site 48TE412 is on the northern shore of String Lake's southeastern arm (Figure 3). The site was first recorded by Charles Love in 1971 (Love 1972) and redocumented by Wright and Marceau (1977:14) in 1975. During their first visit to the site, Wright and Marceau gathered a collection of flakes from the surface and recorded a partially buried hearth. In July 1976, they returned to the site, recorded four more fired-rock scatters in association with debitage, and conducted another surface collection. They excavated a hearth that extended to a depth of 10 cm below surface and contained three obsidian flakes, a quartzite core, and fragments of teeth from a large ungulate. A sample of burnt wood and charcoal fragments from this hearth was dated to 210 B.P. (Wright and Marceau 1977:15). Wright and Marceau's collection consists of 45 specimens, including an obsidian side-notched point fragment, three obsidian bifaces, three obsidian scrapers, one obsidian perforator, three notched flakes, and four retouched flakes.

In 1988, a crew from the MWAC inventoried the road alignment from the Glacier Gulch turnout to North Jenny Lake Junction (Connor 1989). Again 48TE412 was documented and described. While no collection of material was conducted during this inventory, Connor (1989:3) comments on the abundance of material still visible on the surface, despite Wright and Marceau's (1977) extensive collection.

In preparation for planning the realignment of the road and parking areas, Ann Johnson of the Rocky Mountain Regional Office and Robin Gregory, Grand Teton Landscape Architect, visited the site in July 1989. At that time it was believed that the road project would not impact the site, but it was agreed that the site should be surveyed and mapped to determine site

boundaries and the degree of potential impact on the site from the proposed construction project (Neckels 1990).

In June 1990, a field crew from the MWAC conducted a pedestrian survey along the road corridor and in the area of the site. Cultural material was flagged and mapped. Three areas of concentration were observed at the site, with the largest area encompassing approximately 14,851 square meters on both sides of the existing road (Figure 2). The remaining areas, one south of the main concentration along Cottonwood Creek and the other northwest along the proposed right-of-way, are approximately 1,170 sq m and 4,805 sq m, respectively. During mapping, centerline stakes for portions of the proposed realignment were plotted along with the existing road and other landmark features. From the map generated using the points taken during this visit, it was apparent that the proposed right-of-way passed directly over the site area, and that construction would affect 95 to 100 percent of the site area.

*Regional Chronology*

While the construction of regional chronologies based on physiographic areas is a useful means of ordering materials, the resulting boundaries rarely signify aboriginal territories or spheres of interaction. Movement or interaction of groups through or across physiographic barriers is fairly common and is reflected in the presence of exotic trade items and lithic materials in archeological collections. Jackson Hole is no different. Archeological collections from the area reflect influences from the High Plains, Great Basin, and Plateau cultural areas. With all of the work conducted in the recent past, the sequence of occupation for Jackson Hole is fairly complete. The following is a brief description of the chronological periods represented in Jackson Hole.

Paleoindian Period

The cultural chronology for the area of Grand Teton National Park, as reflected in projectile point typologies and absolute-dating methods, begins in the late Paleoindian period. Artifacts diagnostic of the Cody complex, dating to 10,000 years B.P., have been recovered near Jackson Lake and Emma Matilda Lake. Geochemical analysis of obsidian artifacts has determined that Teton Pass was the source for some of the material (Connor 1986). There is also a Clovis point dating to 11,500 years B.P. in the collection of material from the Lawrence site, 48TE509 (Connor et al. 1991). Adaptive strategy for Paleoindians in the area is the use of small, mobile bands of hunters and gatherers specializing in the pursuit of large animal resources. Other dates on late Paleoindian materials from the area range from 9000-7000 B.P., including a stemmed point dating to 7500 B.P. (Svec 1986).

Archaic Period

In the Archaic period, the adaptive strategy shifted from the Paleoindian large game focus to a broader subsistence base focusing on hunting a variety of both large and small

mammals and gathering edible plants. On the basis of shifts in the subsistence strategies occurring through the Archaic period and accompanying shifts in projectile point morphology, the period has been divided into the Early, Middle, and Late Plains Archaic (Connor 1986).

In spite of changes in Plains subsistence practices over time, Frison (1978) argues that several features remained constant, notably an emphasis on hunting bison, communal bison-hunting techniques, and a generalized foraging strategy for augmenting the meat-dominated diet. Wright and Bender (Wright 1984; Wright and Bender 1988) have different ideas on subsistence for the Jackson Hole area. They propose that prehistoric subsistence in Jackson Hole focused on edible plant resources. According to Wright (1984:8), these were exploited throughout the spring and summer as they ripened at different elevations, providing a rich and varied vegetal diet. As with the Plains bison-hunting subsistence strategy, this one is also believed to have been practiced from the Middle Archaic to the Late Prehistoric (Wright 1984).

In Grand Teton National Park, the Early Archaic is represented by sites located around Jackson Lake (Connor 1986). Nine other sites around Jackson Lake have obsidian-hydration dates ranging between 6200 and 3800 B.P. (Connor 1986).

Several factors led Connor (1986) to believe that some Archaic finds from Grand Teton National Park represent a subsistence change leading into the McKean complex of the Middle Archaic. These factors include the appearance of new point types, the appearance of roasting features, and a preference for raw materials from the Obsidian Cliff and Camas/Dry Creek source areas. Since Jackson Lake marks the southern extent of the blue camas range (Wright 1984), and the roasting pits have been ethnographically linked to the processing of this resource (Wright 1984), the occurrence of these features together at the end of the Early Archaic could represent an influx of people.

McKean complex artifacts have been found within the Jackson Hole area. The roasting pits, as discussed above, are still present, as are ground-stone implements, further suggesting a shift in subsistence (Connor 1986). Dates for the Middle Plains Archaic range from 5500 to 3500 B.P. Absolute dates from sites within the Park include the 4440 B.P. date from the roasting feature at the Lawrence site (Wright 1984:Table 3), and obsidian-hydration dates of material collected from 14 sites around Jackson Lake (Connor 1986). Wright (1984) also dated three sites at Blacktail Butte to the Middle Plains Archaic using obsidian hydration.

Some have questioned the accuracy of these obsidian-hydration dates because of the lack of environmental data from collection sites and sources. Strict controls are required to obtain an accurate date, because source-dependent chemical properties and variations in site environment affect hydration rates. It is not known how rigorous Wright (1984) was in collecting samples and data.

Connor (1986) notes that during the Late Plains Archaic (3500-1000 B.P.) a greater emphasis on wild plant procurement developed and that, besides the shift from the McKean complex of projectile points to an emphasis on corner-notched projectiles, little else changed

in the valley. Late Plains Archaic projectile points are fairly abundant within Jackson Hole as surface finds (Connor 1986). There are several roasting pits from around Jackson Lake dated to this period by projectile types and obsidian-hydration band analysis (Connor 1986). Wright (1984) also reports dates from Blacktail Butte and the Moose area that fall into the Late Plains Archaic range.

Late Prehistoric Period

Two technological advances mark the beginning of the Late Prehistoric period: the use of the bow-and-arrow, and the production of ceramic and steatite bowls (Frison 1978). While the method of procurement may have changed, there is still evidence that bison was a main element in subsistence. There is also evidence of increased plant processing and trade during this period (Connor 1986).

There are only two sites documented within the Park bearing ceramic and/or steatite material—the Lawrence site (48TE509) and 48TE1090, both of which are in the Jackson Lake delta area (Connor et al. 1991). Radiocarbon dating, obsidian-hydration dating, and projectile point types place several sites in the Jackson Lake area and several others within the Park into this period (Wright 1984; Connor 1986; Connor et al. 1991).

Protohistoric Period

During the Protohistoric period, the Park may have been visited by several different groups. Wright (1977, 1984) reports that the Jenny Lake II site (48TE576) contains evidence of a post-horse Shoshone occupation. Other than this site, there is very little archeological evidence that the bands moving through the area stayed for any considerable length of time. Other groups which may have visited the area include the Blackfeet, Crow, Gros Ventre, Flathead, and Nez Perce (Connor 1986).

Historic Period

In the early nineteenth century, fur trappers began visiting the area of Jackson Hole to exploit the abundance of pelt-bearing animals. One of the first of these trappers was John Colter who is believed to have been in Jackson Hole in 1808 (Betts 1978).

Even though the fur trade persisted in the valley until the 1840s and sporadically thereafter, records of traders' visits to the area are somewhat incomplete.

The first permanent settlers in the valley arrived in 1884; and after that, the numbers increased slowly until the early 1900s (Betts 1978). The economy of Jackson Hole was based primarily on small-scale ranching and guiding visitors to the region (Betts 1978). In 1929, Grand Teton National Park was created from 96,000 acres to preserve the area's scenic beauty and wildlife from commercial exploitation. Since that time, the Park has increased in size to nearly 300,000 acres.

In the early 1920s, a number of tourist-oriented businesses were located along the eastern shores of Jenny Lake and String Lake. These included dude ranches, a photo studio, stores and cabins, a dance hall, and lodges. Many of these have been removed, but evidence of these features exists in the developed areas of the two lakes.

Within sight of 48TE412 was the Crandall Studio, where Harrison Crandall had a homestead and a photography studio. Danny Ranch (now the Jenny Lake Lodge), which was operated as a dude ranch until 1929 when it was purchased by the Snake River Land Company, is approximately 400 m southeast of the site; and the site of the Square G Lodge, which operated as a tourist resort until its purchase by the Snake River Land Company, is about 400 meters to the northeast of the 48TE412 (National Park Service 1977). Of the three historic sites located in the vicinity of site 48TE412, only the Jenny Lake Lodge remains.

# FIELDWORK

## *Introduction*

At the time of fieldwork planning, construction in the area was to affect as much as 4,000 sq m of the site. We first mapped and collected all surficial flaked lithic material and located fired-rock features. We then noted a concentration of material along the western edge of the site. This area contained five of the suspected hearth features located during the pedestrian survey. Construction of a parking area was to affect most of this concentration of material. Fieldwork focused on this portion of the site for two reasons: 1) it was the most likely area to yield information relating to the research goals set forth in the Data Recovery Plan (National Park Service 1990); and 2) it was going to be impacted by construction and probably later by visitor use.

## *Field Methods*

The pedestrian survey and the subsequent surface collection of flaked lithic material were conducted over the entire site. Survey transects were spaced five meters apart and parallel to the north side of the road. All cultural material was flagged for collection during the mapping portion of the survey (Figure 3). Flagged material included flaked lithics, fired rock, ground stone, and tested cobbles. On the south side of the road, transects were spaced at five- to seven-meter intervals parallel to the road. After the pedestrian survey was completed, mapping stations (datums) were established to piece-plot flagged material.

During this phase of operations, only flaked lithics and ground stone were collected. Fired rock was left in place, flagged, and plotted. Given the high quantity, wide distribution, and low research potential of fired rock, this material class was mapped but not collected. Six mapping stations were situated about the site in areas that could be tied to at least one other station and that were capable of shooting points within or near the site. Three of the stations were used during the initial June 1990 survey and mapping project at the site, and many of the points plotted at that time have been incorporated into the site map presented here. During this survey and mapping, the centerline of the proposed road construction was also located in order to thoroughly examine those areas with the highest potential for disturbance.

Following the initial survey, shovel test transects were situated across the site to determine the occurrence and depth of intact subsurface cultural deposits. All material from the shovel tests was dry screened through 1/4-in hardware cloth.

Excavation blocks were established on an arbitrary grid system centering on Mapping Station D (Figure 4). Three blocks consisting of a total of 22 one-square-meter units were excavated along with three one-square-meter test excavations within this grid. Two excavation blocks (A and B) were placed over hearth features after they were probed to determine the extent of preservation and potential for in situ subsurface deposits. Block C was away from any surface features and in an area of the site with little surficial cultural material. Block C

was purposely located away from features and significant surface materials, in order to increase representativeness of the sample of in situ subsurface deposits.

All excavation was in 10-cm arbitrary levels. Two excavation units located on the southern end of the kettle exceeded 30 cm in depth. Only two levels, or to the depth of the glacial till, were excavated in the remaining units. Photographs recorded the progress of the excavation block by level. Field notes documenting the work completed in each 1-x-1-meter unit were also taken during excavation by a crew member. Features within the excavation units were mapped, profiled, and photographed. When excavated, features were sectioned on two dimensions. Pollen, radiocarbon, constant volume, and flotation samples were taken from features. A constant volume sample and a pollen sample were also taken from each level in the excavation blocks and test units. The provenience of all material collected during fieldwork is recorded in the Field Specimen Log (the dBASE III+ file name is GRTECAT.dbf).

*Excavation Results*

Shovel Tests

Fifty-nine shovel tests were excavated in seven transects crossing portions of the site. These shovel tests were excavated until glacial till was reached. Many of the tests are very shallow (Table 1). This is a result of the formation of the glacial outwash plain upon which the site is located. In the area of the site, there is typically 10 to 15 cm of silt loam mixed with smaller (less than five cm) gravels overlaying a stratum with a much denser concentration of larger clasts. This second stratum usually marked the lower extent of the cultural material and was fairly difficult to penetrate with a shovel.

Transects F and G were oriented to cross a shallow basin northeast of Mapping Station D and southeast of Mapping Station E (Figure 4). These transects were intended to determine the depth of the basin and its origin. The soil in this area is sand with only a few gravel clasts. By using two- and four-meter shovel test intervals it was possible to determine the shape of the lower boundary of the basin. In both the north-south and east-west transects the basin has gradually sloping sides. The depth of the basin remains undetermined. Shovel tests in the central area of the basin extend as deep as 90 cm into the sand without encountering the large clast-on-clast glacial outwash deposits found at a depth of 20 cm across the rest of the site.

The shape of the basin and its depth is more suggestive of a small kettle created during the retreat of the glacier than a historic feature excavated and filled in the recent past. Both the amount and the size of the historic material in the fill suggest that the area was not a dump or a privy. The size and shape of the material do not suggest that it was a foundation, and the fill of almost pure sand suggests that it was filled through natural processes.

The basin is well mixed through bioturbation. More shovel tests in this area produced cultural material than in the other transects. The material from the shovel tests in these

transects is a mixture of prehistoric and historic debris, mostly broken glass, wire nails, fired rock, and obsidian flakes. The mixture of this material can be cited as additional evidence of postdepositional disturbance in the area, with prehistoric obsidian flakes overlying broken bottle glass and wire nails.

Block A

Excavation Block A was 3 x 4 meters, with the southeast corner located four meters north of Mapping Station D (Figure 4). The block was situated over Features 1 and 5. Feature 1 was a surface concentration of fired rock in the 105N/101W unit of the block and extended to a depth of 19 cm (Figure 5). Feature 5 was a basin 24.5 cm deep located 20 cm southwest of Feature 1 and consisted of several pieces of fired rock exposed on the surface. It was sectioned and profiled as part of the stain associated with Feature 1. Cummings (1991) discusses the flotation and pollen samples taken from this area.

During excavation of surrounding units, a large charcoal stain was observed. This stain originated from the area of the Feature 1 fired-rock concentration and was oriented toward the southwest (Figure 6). Portions of the stain were very thin, consisting of only a centimeter or two of dark organic material below the root layer. Other areas within the stain were thicker. All of the stains were treated as fill associated with Feature 1, which is the hearth and the surrounding area. The thicker portions of the stain were mapped and collected as flotation and pollen samples (Figure 6).

Bulk soil samples were collected for radiocarbon dating from the stains associated with Feature 1. One sample from Level 2 of 104N/102W contained sufficient charcoal to date. The radiocarbon age of the sample is 160 ± 80 B.P. (Beta-41161; wood charcoal; $\delta^{13}C$ undetermined). Following Klein et al. (1982), the calibrated date range for this sample is A.D. 1505-1950. The radiocarbon date collected by Wright and Marceau (1977) of 210 ± 80 B.P. (I-9648) using Klein et al. (1982) has a calibrated date range of A.D. 1480-1950.

Block B

The southeast corner of Block B was located two meters north and 14 meters west of Mapping Station D (Figure 4). It was a four-square-meter area situated over Feature 3. The feature was bisected by the two northernmost units of Block B and contains a hearth with a fired-rock concentration.

The hearth in this block was also partially buried (Figure 7). It was approximately 55 cm in diameter and had a depth of 12 cm. Several large fragments of fired rock defined the limits of the hearth, and a small mound of earth was defined within those limits. During excavation of the hearth, a few obsidian flakes and an assortment of historic debris were found. The historic material included wire nails, unidentified metal fragments, portions of a Kerr canning jar, and fragments of melted glass. The jar was also deformed from heat. Once the hearth was determined to have historic/modern origins the excavation block was closed.

## Block C

Block C was not situated over a feature or in an area with a dense surface concentration of prehistoric material. It consisted of six one-square-meter units 39 meters north of Mapping Station D (Figure 4). This block was located away from areas with concentrations of surface material to determine the density of subsurface material. Subsurface material was determined to exist in the area of Block C during the shovel testing phase of the project. Shovel Test Transect C follows the line connecting Mapping Stations D and E.

During excavation of Block C, much of the prehistoric material was recovered from Level 2, which is a 10-cm level between 10 and 20 cm below surface. Directly below this level, Stratum C was encountered. Cultural material recovered from this level included obsidian flakes and fired rock (Figure 8). It is believed that this material may represent what is left of a hearth feature after it has undergone extensive bioturbation.

## Excavated Features

In all, six features were identified during the fieldwork. Three of these (Features 1, 3, and 5) are described briefly above. The other three (Features 2, 4, and 6) were located during the pedestrian survey and later probed to determine depth and cultural affiliation. Results of this probing are discussed here.

Feature 2 was a circular depression one meter in diameter, 44 degrees east of north and 10.35 m from Mapping Station D (Figure 4). This feature was partially excavated. A one-square-meter unit was established over the basin. The southern half of the basin was excavated to a depth of 22 cm. At 10 cm below surface, a distinct charcoal lens was encountered. At 20 cm, charcoal was still present and a basin-shaped depression was apparent. Cultural materials associated with the hearth include wire nails, can fragments (hole-in-cap and sanitary), window glass, and aluminum foil. During excavation, the feature was determined to be modern in nature, and excavation in this location was terminated.

Feature 4 was a circular depression 60 cm in diameter, 29 meters 10 degrees east of north of Mapping Station D (Figure 4). It was found to have no subsurface manifestation. No further excavation was conducted in this location.

Feature 6 consisted of two pieces of fired rock at the edge of a shallow depression 50 cm in diameter. It was located 25.44 m from Mapping Station E and 105 degrees east of north, near the shallow kettle basin discussed previously. During testing of this feature, a shallow lens of charcoal was discovered that contained fragments of green bottle glass, can fragments, and round nails. An excavation unit was placed near this deposit to determine the depth and origin of the kettle depression. Cultural material from this unit included obsidian flakes, wire nails, and glass.

# LABORATORY STUDIES

Samples collected during fieldwork were processed in accordance with the Midwest Archeological Center standards. After this material was cleaned and sorted, it was rebagged and labeled with provenience information. Artifacts, records, photographs, and maps were then entered into the Automated National Catalog System (ANCS) and packaged for curation at the Midwest Archeological Center.

The artifact assemblage from 48TE412 is small (n = 653) and is biased toward lithic artifacts, which make up a majority of the collection (about 60 percent). Analysis of the lithic assemblage focused on tool production and source identification.

The rest of the collection consists of a small amount of faunal material and a few diagnostic historic artifacts. The faunal material was too fragmentary to determine genera and species, but the condition and location of the bone does suggest bone grease processing.

## *Chipped-Stone Analysis*

Analysis of the 1990 String Lake lithic assemblage resulted in identification of tool production methods, production stages, and lithic raw material sources. Attribute analysis of debitage and biface production stages, obsidian sourcing using x-ray fluorescence analysis, and obsidian-hydration dating aided identification and analysis. Use-wear analysis of tools and edge-modified flakes was included in the original analysis of the lithic assemblage, and is discussed below in reference to postdepositional disturbances at the site.

The ability of worked material to retain a good edge, the availability of the material, and the degree of mobility of the group utilizing the material are all factors in determining the lithic reduction strategy employed during the occupation of an archeological site (Chatters 1987). The combination of these factors allows researchers to investigate the way lithic technology was ordered to fulfill the needs of the users. The following analysis focuses on these three aspects of technology to better understand the underlying cultural behavior patterns which produced the assemblage.

### Tool Production

That stone tool production occurred at 48TE412 is apparent from the presence of lithic debitage at the site. Evidence for tool manufacture in archeological sites can include debitage, waste, tool rejects, and discarded tools. The stone tool production debris at 48TE412 reflects two desired goals that are directly related to the material types being worked. The volcanic glasses (obsidian and vitrophyre) represent the largest proportion (80 percent) of the flaked stone assemblage (Table 2). This material is easily worked and produces tools with sharp, brittle edges (Semenov 1964). Quartzite makes up 13 percent of the assemblage, followed by chert (6 percent). Analysis of the lithic assemblage focuses on raw material type and production method.

Two basic means of chipped-stone tool production identified for material from 48TE412 are: 1) the manufacture of flakes, either for immediate use, or to be further worked into formal tools; and 2) the manufacture of bifaces, which may be one type of formal tool produced from the flake blanks. At sites with exhausted cores, which indicate flake manufacture, or unfinished bifaces, indicating biface production, determining the goals of tool production is made easier. When these forms of evidence are limited, the alternative is to determine production goals through the analysis of the debitage, or waste material.

The differences between the two production techniques are identifiable by the debitage created during tool production. The goal of flake production—the production of large, usable flakes—is different from that of biface production. Characteristic debitage from flake production includes the presence of many larger flakes with thick platforms and high exterior platform angles, and fewer small flakes (Sollberger and Patterson 1976; Speth 1981; Dibble and Whittaker 1981). Platform thickness and the exterior platform angle are related, in this case, to the size of the core and the desire to produce large flakes.

The goal of biface production—to control the shape and edge of the piece being worked—requires flaking techniques that result in an increasing amount of small flakes produced as the biface nears completion. Depending on the size of the preform, initial reduction and shaping may involve the use of hard and soft hammer percussion flaking methods (Henry et al. 1976; Doug Bamforth, personal communication 1991). The flakes removed from the preform in these early stages of production get smaller as the biface is worked (Stahle and Dunn 1982). As these flakes get smaller, the exterior platform edge angle becomes more acute, and the platform also becomes narrower (Speth 1981; Patterson and Sollberger 1978; Stahle and Dunn 1982).

The final stages of biface production frequently involve the use of pressure flaking to better control the shape of the biface (Henry et al. 1976; Callahan 1979). Flakes produced during pressure flaking have very acute exterior platform angles, reflecting the thickness of the preform, and narrow platforms, and resulting from the placement of the flaking tool on, or very close to, the edge (Doug Bamforth, personal communication 1991).

While the production sequence of bifaces is typically presented as a series of steps (Callahan 1979) not all the steps need to occur at one time or in one place. Thus, a bifacial tool may have many uses before it is finished or discarded (Kelly 1988; Stahle and Dunn 1982). For this reason, an attempt is made here to identify the production stages occurring at 48TE412. By identifing the stages of production, we will be better prepared to discuss the types of activities conducted at the site and speculate on the type of occupation that occurred there (Stevenson 1985).

Bifacial Production

The implication of a handful of flakes from an archeological site is that at some time in the past someone cracked two rocks together and produced a tool from the material. This

inference is possible through the recognition of cultural patterns in the way the flakes were produced, which is known to be distinct from flakes produced naturally. The recognition of patterns among the flakes not only allows the distinction between cultural and natural flakes, but also allows the identification of a flake produced by a specific method for the production of a specific type of tool. The recognition of patterns resulting from different means of tool production enables researchers to determine what kind of tool or how much of that tool was produced at a site (Callahan 1979; Kelly 1988; Doug Bamforth, personal communication 1991).

To this end, several researchers in the production of stone tools have designed experiments to determine the flake attributes that consistently provide information concerning the production method through which the flakes were derived (Speth 1981; Magne and Pokotylo 1981; Stahle and Dunn 1982; Henry et al. 1976; Patterson 1982, 1990; Sullivan and Rozen 1985). Others have focused on the stages of biface production in order to design better experiments (Callahan 1979; Crabtree 1977; Kelly 1988).

In an experiment to determine the degree to which flake size and platform angle are related to core size, Speth (1981) dropped steel balls on glass prisms set at angles. By changing the weight of the ball, the angle of prisms, and shape of the prisms he was able to conclude that the platform angle (shape of prism) is important in determining the size and shape of the resulting flake. In a similar experiment, Dibble and Whittaker (1981) also found that exterior platform angle and platform thickness played important roles in the formation of other attributes, including flake length, thickness, and termination.

Using an archeologically derived assemblage, Magne and Pokotylo (1981:34) used multidimensional scaling and multiple discriminant analysis to recognize "patterns of sequential variability in lithic debitage." The results of their test indicated that weight was the most important variable to use in determination of reduction stages. Combined with weight, they believe the amount of cortex on both the platform and the dorsal surface of the flake is useful in determining the stage of production (Magne and Pokotylo 1981). They also pointed out that in areas where flakes display bifacial platforms, bifacial production can be inferred (Magne and Pokotylo 1981).

Bifacial reduction produces an exponential curve when flake size is plotted by frequency (Stahle and Dunn 1982; Patterson 1990; and Patterson and Sollberger 1978). The curve shows a decrease in flake size and an increase in number of flakes as a bifacial preform is worked into the final production stages (Stahle and Dunn 1982). This type of curve, when compared to other methods of lithic reduction, appears to be characteristic of bifacial reduction (Patterson 1982, 1990; Patterson and Sollberger 1978; Stahle and Dunn 1982). Flake size analysis is similar to the analysis of flake weight reported by Magne and Pokotylo (1981). Since the weight of a flake is related to its size, either is likely to characterize the biface reduction sequence.

Sullivan and Rozen (1985), using technologically descriptive flake attributes (i.e., complete, proximal, distal, and shatter), designed a test to determine the differences in

frequency of these categories when core reduction and bifacial reduction techniques are compared. Their results indicate that bifacial production produces a higher frequency of broken flakes, and that core reduction results in more complete flakes and more shatter. These results correspond to the goals of each production method discussed above. Bifacial reduction methods are used primarily for tool production, and bipolar reduction method are used primarily for flake production.

Analysis of Bifacial Production Debris

Evidence of the kinds of tool production utilized at 48TE412 can be seen in the presence of bifacial artifacts representing both exhausted and discarded forms and manufacturing blanks. These bifaces are described in terms of Callahan's (1979) stages of production in the following sections. The presence of this material at the site along with the debitage provides an opportunity to investigate the relationship between lithic reduction techniques and debitage attributes. Much of the research discussed above was conducted on experimentally produced assemblages, so applying the results of these experiments directly to an archeological collection may provide additional information.

Flake attributes were recorded during cataloging of the lithic material. From a review of the literature, it is apparent that some of these attributes are better suited to the intended analysis than others. Attributes used for this analysis include weight (measured in .01-g units), flake size (flake diameter measured at 5-mm intervals), and raw material type.

Analysis of the obsidian and vitrophyre flakes indicates that bifacial reduction was the primary means of on-site tool production for these material types. This assessment comes from plotting the size of flakes against the percentage of that size represented in the assemblage of flakes greater than 10 mm in diameter. The curve produced by the distribution of flake sizes at 48TE412 is similar to those described by Patterson (1990) that indicate a bifacial reduction technology (Figure 9). If the production of flakes was the goal of tool production at 48TE412 then the curve in Figure 9 would be irregular with a slight decreasing trend in the size of flakes as reduction of the core progressed (Patterson 1990). There would also be a higher frequency of large flakes compared to small flakes. In the assemblage of flakes from 48TE412, small flakes predominate; fewer large flakes are represented.

Magne and Pokotylo (1981) found that weight was an effective measure of lithic reduction techniques. Using the weight of flakes larger than 10 mm in diameter from 48TE412, frequencies were calculated for 12 weight groups at 0.5-g intervals. A graph of the frequency was plotted, and the resulting curve is very similar to that of flake size. The similarities between the two curves reflect the relationship between size and weight.

The occurence of bifacial production material and debitage provided a means of assessing the ability of flake size and flake weight to identify reduction techniques. Both flake size and weight indicate that bifacial production methods were used and support the conclusions of Patterson (1990) and Magne and Pokotylo (1981). These results, while not

conclusive, favor the hypothesis that flake size and weight attributes of debitage can be used to determine lithic reduction techniques. These findings bolster confidence in the use of the above methods to determine reduction techniques.

The production attributes underlying the curves can also be used to identify biface manufacturing blanks in the assemblage. The production of bifacial tools, like that of any manufactured item advances through a series of stages (Callahan 1979). The stages are points along a continuum through which the biface passes on its way to completion. Callahan (1979) identifies five stages, beginning with the selection of a blank to be worked, its initial edging, primary thinning, secondary thinning, and shaping. Each stage is identifiable by its shape in cross section, flake scar pattern, edge angle, and width/thickness ratio.

Using Callahan's (1979) stage classification for biface manufacture, the assemblage from 48TE412 includes one large Stage I flake blank (FS 412-299; Figure 10a), three Stage II bifaces (FS 412-003, 293, 080), three Stage III bifaces (FS 412-302, 010, 093), one Stage IV biface (FS 412-164), and eight Stage V bifaces (FS 412-210, 046, 208, 050, 002, 264, 297, 121). All execept FS 412-297 and 121 are illustrated in Figure 10. Production failures resulting from impurities in material make up the bulk of the manufacturing blanks.

The occurrence of all five of Callahan's (1979) stages at 48TE412 suggests that, over time, all stages of biface production occurred at the site. While a biface progresses through a series of morphologic changes during manufacture, the production sequence need not occur at one time or place (Callahan 1979; Kelly 1988). Bifaces may be taken out of production at any time for use and finished later as need arises, or discarded (Kelly 1988). The presence of all five production stages at the site suggests that tools were produced there and were used to perform a variety of functions.

Bipolar Production

Bipolar artifacts are produced by positioning a cobble on an anvil and striking the cobble with a hammer (Crabtree 1972). The utility of this technique is in the speed at which hard materials can be reduced to useable flakes, and the quantity of flakes produced (Shott 1989). Evidence for this technology is found in many areas around the world throughout prehistory (Shott 1989). There has been some disagreement in the past over the use of the material produced in this fashion. Shott (1989) discusses the history of this controversy and presents an archeological and ethnographic argument in favor of the interpretation of bipolar cores and debris as byproducts of flake manufacture rather than the production of wedges for the splitting of wood and bone. Parry and Kelly (1987) link bipolar reduction as well as other expedient core technologies to a shift from a highly mobile subsistence strategy to a more sedentary life style in areas where lithic material is abundant. The relationship between subsistence, technology, and lithic source has been discussed previously.

Core attributes used to identify bipolar materials include: 1) the presence of linear platforms extending across the width of the core and flanked by shearing plains where the

flakes have been detached, 2) crushing, 3) step fracturing, and 4) evidence of explosive force. There is also occasionally evidence for flakes to have been detached from both ends of the core (Binford and Quimby 1963). Flake attributes include diffuse and occasionally opposing bulbs of percussion, presence of cortex on dorsal surfaces, and ventral surfaces exhibiting scarring from the force of percussion (Binford and Quimby 1963).

Quartzite artifacts in the assemblage represent the bipolar production of flake tools. Whereas among the obsidian and vitrophyre artifacts, cores for the production of flakes were infrequent (n = 1; FS 412-160), there are five quartzite cores in the assemblage (FS 412-074, 117, 327, 291, 191) out of approximately 30 quartzite artifacts. These cores, as well as many of the flakes, have attributes characteristic of bipolar reduction.

Use Wear

Bifacial artifacts and flakes coded as edge-modified were examined under a binocular microscope for evidence of use wear. It is the intent of this analysis to determine whether or not the edge modification on these items is cultural or the result of postdepositional influences. Edge modification was defined as present or absent and usually included macroscopically visible nibbled or retouched edges. Microscopic evidence of use wear includes polish, striations, edge rounding and grinding, crushing, and flaking in conjunction with the edge modification (Ahler 1977; Odell 1975). Postdepositional damage to obsidian flakes may result from trampling and soil movement. This damage may obscure cultural-use traces or produce similar morphologic traits (Hayden 1977; Knudson 1977; Pryor 1988). The physical location of the evidence on an edge-modified artifact can be used to determine whether or not the evidence resulted from use or postdepositional influences.

Each artifact was cleaned, and the edges were viewed through the binocular microscope at low magnification. Aside from the edge modification, many of the pieces exhibited edge rounding, step fracturing, and striations. The position of this evidence, however, suggests that it is the result of trampling and soil movement rather than use. Edge rounding and grinding, the most frequent trace, was observed on edges as well as on flake scar ridges on the faces of the flakes. Striations were also found on the flake faces well away from the edges, and with no particular orientation.

Experimental pieces that were used to cut wood (75 strokes), drill wood (60 rotations), and scrape leather (60 strokes) exhibited faint evidence of use along the working edges while the unused edges remained very sharp. Flake scar ridges on the experimental pieces also showed no signs of edge grinding or rounding. Further attempts to identify use wear on the flaked stone material were halted when these experimental results were obtained. It was felt that postdepositional influences had introduced such a high degree of erroneous ''wear'' that interpretations of the cultural wear patterns would be unreliable.

*Obsidian Analysis*

Sourcing

The String Lake site flaked-stone materials are primarily volcanic glasses (Table 2). The twenty-two items selected for obsidian sourcing included three projectile points, nine biface fragments, one core, and nine flakes. This sample includes finished and discarded tools, exhausted cores, and production flakes, several of which have cortex on their dorsal surfaces.

The obsidian-hydration samples from 48TE412 represent material from five sources:

| | |
|---|---|
| Teton Pass | n = 14 |
| Teton Pass Variety 2 | n = 5 |
| American Falls Idaho or Mudlake Montana | n = 1 |
| Obsidian Cliff | n = 1 |
| Chesterfield, Idaho | n = 1 |

According to Hughes (1991), the Teton Pass Variety 2 items have the same elements as the Teton Pass samples. But, these elements occur in significantly different concentrations, resulting in the division. Hughes (1991) believes that the differences may represent another source, but more source samples are required for confirmation.

By sourcing this material, we were able to determine that a major portion of the material came from the Teton Pass source area. The Teton Pass samples included tools discarded at the site as well as production debris. Samples from the other three sources included two broken bifaces and one flake. The amount of material from outside the area suggests some material movement between the Obsidian Cliff area; the American Falls, Idaho, area; and the Chesterfield, Idaho, area into the Grand Teton National Park area. The small sample size makes it difficult to determine what percent of the collection is not from the Teton Pass source.

Sourcing and obsidian-hydration dating help to reveal temporal patterns of occupation and source use at the site. Hydration dating was used to determine if materials from a single source were utilized at approximately the same time. Hydration dates, radiocarbon dates, and chronologically diagnostic artifacts can be considered together to determine the age of the site. Unfortunately, only the three projectile points in the sourcing sample are diagnostic.

Hydration Dating

Since most of the obsidian turned out to be from the Teton Pass area, those samples (including Variety 2) were subjected to hydration band analysis. The nineteen samples were sent to Thomas Origer of the Obsidian Hydration Laboratory, at Sonoma State University (Origer 1992). Of the 19 specimens, 13 Teton Pass and 4 Teton Pass Variety 2 specimens produced measurable hydration bands (Table 3).

Hydration band thickness measurements allow calculation of an absolute date representing the time elapsed since the cortex was removed from the obsidian specimen (Davis 1984). An age calculation for an obsidian object using this method depends on an accurate determination of the effective hydration temperature (Davis 1984). The effective hydration temperature represents the environment that influenced the hydration rate of the specimen. An estimate of the effective hydration temperature can be obtained through extended monitoring of the collection sites or by inducing hydration under laboratory conditions (Davis 1984). Without an accurate measure of the effective hydration temperature the calculation of specimen age can be in error (Davis 1984).

Perhaps because the Teton Pass obsidian source is so large or because so many Teton Pass specimens have been recovered from sites in the area, the effective hydration temperature has been calculated for Jackson Hole by inducing hydration in the laboratory (Michels 1981). Michels' effective hydration temperature is used here.

The band thickness measurements for 17 measurable specimens ranged from 0.9 to 1.8 microns. A test was performed to determine if all the specimens were from a normally distributed population of rind measurements. This test was used to determine the occupation history of the site. Raymond (1984) demonstrates the usefulness of such a test to determine the site occupation history of lithic scatters. He uses the Wilk-Shapiro statistic to determine if obsidian specimens from single sources are from normally distributed samples. If the samples are normally distributed, then it can be argued that the sample was created over a short period of time and perhaps represents a discrete occupational episode (Raymond 1984). If, on the other hand, the sample is not normally distributed, then the sample is believed to have been created during more than one occupation (Raymond 1984).

The Wilk-Shapiro statistic ($W_c$) was calculated twice for the sample from 48TE412 following procedures outlined by Raymond (1984) and Conover (1971) using STATISTIX software. The first calculation was conducted with all seventeen specimens. The result was $W_c = 0.8482$, $p < 1/2n$, with $W_p = 0.9100$ at a 0.10 level of significance. This test rejected the null hypothesis that the specimens could have been drawn from a normally distributed population of rind measurements. Rejection of this hypothesis meant that the population was not normally distributed and that the obsidian artifacts could have been produced during more than one occupation.

The second calculation was made without the four specimens identified as Teton Pass Variety 2. The result was $W_c = 0.9058$, $p < 1/2n$, with $W_p = 0.889$ at a 0.10 level of significance. The results of this test failed to reject the null hypothesis, indicating that the sample of thirteen obsidian objects from the Teton Pass source were normally distributed and therefore probably resulted from the same occupational event.

Date of Occupation

After it was determined that the thirteen specimens from Teton Pass could have been produced at the same time, a median obsidian-hydration date was calculated using the effective temperature for Jackson Hole provided by Michels (1981:5). Hydration band thicknesses ranged from 0.9 to 1.8 microns, and the date for each specimen was calculated (Table 4). The median date for this sample is A.D. 236 ± 600. This date may then be used to help estimate the age of the prehistoric component.

*Tool Descriptions*

Of the 393 pieces of flaked stone in the String Lake assemblage, 25 pieces were worked into items falling into one of four categories: projectile points, bifaces, multipurpose tools, and cores (Table 5). The individual artifacts are described below.

Projectile Points

There are two corner-notched projectile points with convex bases; one has been reworked, and one is represented only by the distal portion (Figure 10i,k). They have straight lateral edges and flaring stems with convex bases. Maximum widths are 19.26 and 19.63 mm; maximum thicknesses are 6.93 and 4.65 mm; the lengths are incomplete. The corner notches are deep and wide, the stems are slightly expanding, chipping is fair, edges are retouched, and cross sections are asymmetrical and biconvex. Both points are obsidian (FS 412-208, 210). Although both points are broken, FS 412-208 has had the broken edge retouched, causing the tip to be off the centerline.

One short-stem, notched-base point (FS 412-002) has straight lateral edges, wide shallow corner notches, a wide deep basal notch, and is similar to Yonkee points. The width is 17.06 mm, thickness is 4.62 mm, and the length could not be measured due to breakage (Figure 10m). The shoulders are asymmetrical, with one sloping and the other at nearly a right angle to the lateral edge. The cross section of the point is biconvex and the edges are retouched. The point appears to be fashioned from a flake. The flake scar surface is still present on one surface.

Bifaces

Of the obsidian biface fragments in the assemblage (Table 5), five may be projectile fragments. Included in this subset are three midsections, one basal section, and one tip. Fracture features on one of the midsections appear to be the result of trampling (FS 412-050; Figure 10ℓ). Another fragment, with parallel-oblique flaking on one side, received an impact which removed the opposite surface (FS 412-046; Figure 10j). The remaining midsection has bending fractures on the proximal and distal margins (FS 412-264; Figure 10n). The base is very small, and the exact orientation is difficult to define (FS 412-297). The tip in the collection is too small to describe (FS 412-121).

Three biface fragments are Stage II preforms (Figure 10b-d). Flaking on these specimens is irregular, as are the edges (FS 412-080, 293, 003). Topographic features on their surfaces are suggestive of production failures during thinning attempts and initial shaping. Three other bifaces are Stage III preforms (FS 412-302, 010, 093; Figure 10e-g). Thinning flakes are large and irregular, extending into the middle of the preform. One of the bifaces appears to have had a burin edge struck along a lateral edge (FS 412-093). One specimen is ovoid, with retouch on both surfaces (FS 412-010). The high edge angles along the tool margin suggest use as a scraper more than as a cutting tool. Flaking on this piece appears to have been an attempt to thin the dorsal surface.

The last specimen (FS 412-164) is a Stage IV preform (Figure 10h) and has bend breaks suggestive of trampling. The orientation of these breaks and the irregular tool edge profile render a shape description difficult. Judging from the size of the piece and the low edge angles, it may have been used as a cutting implement. Evidence suggesting that it may have also been a preform is in the irregular flaking and shaping.

There are two other bifaces in the assemblage. One (FS 412-003) is a vitrophyre Stage II biface production failure. The other (FS 412-117) is quartzite, and has bifacial retouch along one margin (Figure 11a).

Multipurpose Tool

There is one multipurpose tool in the assemblage (FS 412-147; Figure 11b). It has bifacial retouch, is a light-colored chert, and has several tool loci.

Cores

There are nine cores in the assemblage: two chert (FS 412-033, 155), one obsidian (FS 412-160), one vitrophyre (FS 3412-003), and five quartzite (FS 412-074, 117, 327, 291, 191). The five quartzite cores (Figure 12b,c,e,g,h) are the product of bipolar reduction strategies and range from 68.36 mm to 42.62 mm in length and from 45 mm to 26 mm in width (also included in the collection are a number of bipolar quartzite flakes). The degree of usage of these cores varies—specimen FS 412-117 appears to only represent a split cobble, while

specimens FS 412-191, 074, 327, and 291 exhibit battered edges, ridge platforms, and multidirectional flake removals.

The chert cores are also small. One (FS 412-155; Figure 12a) is a piece of shatter off a larger core or rejuvenation fragment. The other chert core (FS 412-033) was worked on one side, while on the reverse side a steep keel would have prevented further thinning of the core into a biface (Figure 12f).

The obsidian core (FS 412-160; Figure 12d) is a water-rolled cobble approximately 40 mm in diameter with several flakes removed from one surface. The vitrophyre core was included as a Stage II biface preform because of its irregular flaking and edges. It is also discussed here because of its size, approximately 15 mm thick, and the presence of cortex on one surface. It appears to have broken during thinning. Hughes (1991) sourced the obsidian and vitrophyre cores.

Non-flake Artifacts

Two specimens were collected during site mapping. One is a grinding stone of welded tuff or rhyolite (FS 412-044) with several striations and smooth spots transverse to the long axis on one surface. The other (FS 412-081) is a quartzite hammerstone.

*Soil Samples*

Nine soil samples were submitted for particle-size analysis and soil chemistry evaluation. Samples were taken from the different stratigraphic levels visible in the profiles after excavation in an area was completed. Analysis results reveal differences in the particle-size distribution of different areas of the site and differences in the chemical composition of those soils.

The samples were from the profile of Feature 1 in Block A, the profile of Feature 3 in Block B, and the west wall profile of 142N/75W, a test unit in the kettle feature discussed above. Three samples were taken in each area, representing the different stratigraphic layers visible in the profiles. In Blocks A and B, Stratum A represents the A horizon and has a high frequency of organic material, Stratum B represents the feature fill, and Stratum C represents the sterile soil overlaying the glacial outwash deposits. In the test unit, Stratum A also represents the A horizon, Stratum B is a dark brown loamy sand, and Stratum C is a dark yellowish brown loamy sand. The glacial outwash deposit was not reached in this area.

Particle-size analysis indicates a difference between the two sets of samples from the block excavations and the set from the test unit. In all three sets, the silt and clay content decreases with depth as the sand content increases. There is also a difference in the overall increase in sand in the three areas. The sand may have been deposited with the glacial outwash. Subsequent aeolian deposition of silts and clays may account for the low levels of

materials in this size category at lower depths. Low silt and clay content in the soils in this area may also be representative of the surrounding sagebrush/forest environment and the low volume of litter accumulation (Limbrey 1977). The higher percentage of sand in the kettle area may be related to the filling of this feature with sand either by aeolian or fluvial processes after the ice melted away. The general classification of the soils across the site ranges from a loam on the surface of Feature 1 to sandy loam across much of the site to loamy sand in Strata B and C of the test unit in the kettle.

The chemical analysis reveals fairly constant pH levels across the site (5.2 to 6.38), which do not appear to vary with depth (Figures 5 and 7). These pH levels are acidic and may have affected bone preservation at the site. Poor preservation of bone results from the dissolution of minerals in the bone by acids in the soil (White and Hannus 1983). In damp conditions, bone near the surface of acidic soils is especially vulnerable (Schiffer 1987).

The percentage of organic material in the nine samples is low, ranging from 11 percent of the sample from the surface of Block A to .66 percent in the sample from Stratum C of the test unit. Generally, the percentage of organic material is higher in the top layers and decreases with depth (Figures 5 and 7). Low organic content is one characteristic of ''acid brown'' forest soils and is a result of a combination of reduced forest composition, high rates of leaching, and reduced litter accumulation (Limbrey 1977). Leaching also inhibits the formation of clay minerals in the soils (Limbrey 1977:133).

Summary

The soils at 48TE412 are very thin, between 10 and 25 cm, and have poorly developed A horizons and little structure. They are overlying a clast-on-clast glacial outwash deposit, and the porous conditions of this base material may enhance leaching, causing the soil to be low in plant nutrients (Limbrey 1977). The sandy nature of the soil and its mixture with glacial gravels suggest that its origins are also related to the glacial retreat. Cultural material at the site was recovered throughout this soil, but the features were situated primarily at its surface, suggesting very little deposition of sediment on the site since its occupation.

The determination of the acidic conditions of the soils at the site is of concern to this project. The low frequencies of bone recovered during excavation at the site may be the result of poor preservation. The deterioration of bone may have been accelerated as a result of being exposed on the surface to various mechanical processes and because of the acidic soil conditions (Schiffer 1987).

*Macrobotanical and Pollen Samples*

Seven pollen samples and one macrobotanical sample were submitted for analysis to PaleoResearch Laboratories, Golden, Colorado. Two of the pollen samples were from the present ground surface in the area of the site. The remaining five samples were collected

during excavation in Blocks A and C. Four of the samples (FS 412-108, 109, 169, 170) come from Block A and were selected for analysis because of their association with dark stains in Feature 1 (Figure 6). The flotation sample (FS 412-185) was also taken from Block A (Figure 6). The seventh pollen sample (FS 412-320) was collected during excavation of Block C from an area associated with a concentration of fired rock (Figure 8).

The results of the pollen and macrobotanical analysis of the samples from Block A indicate *Chenopodium* seed processing in the area southwest of the hearth (Cummings 1991). The presence of *Chenopodium* pollen and pollen aggregates in samples FS 412-108, 109, 170 support this interpretation, as does the presence of charred seeds and seed fragments in the flotation sample. The availabilty of this plant for processing either as greens or seeds extends from the spring to fall, suggesting occupation of the site during this period. Other plant species are present in the samples but do not occur in frequencies large enough to suggest prehistoric use (Cummings 1991).

Wood charcoal was recovered in the flotation sample. This material was predominantly from *Pinus contorta*, suggesting the selection of local resources for fuel (Cummings 1991).

The pollen sample from Block C (FS 412-320) was excavated from 20 cm below surface, but pollen frequencies in this sample were similar to those of the present ground surface and sample FS 412-170 (Cumming 1991). The deflated nature of the hearth, the lack of charcoal stain associated with the concentration of fired rock, and the location of the feature in an open area may be factors in this similarity. The lack of a charcoal stain and the deflated nature of the hearth may be the result of bioturbation in the area, which caused an alteration of the pollen distribution. There was a small amount of Cheno-am pollen recovered in this sample, but the amount is not sufficient to determine whether it resulted from plant processing or from the growth of these plants in the area (Cummings 1991).

### *Faunal Material*

A small amount of bone was recovered during the processing of flotation samples. Except for two fish vertebrae, the majority of the bone was from samples taken from Feature 1 in Block A. A great deal of this material is calcined, some is burnt, and all of it is crushed. It was not possible to identify any of the material beyond determining that it was from a medium to large mammal. The two fish vertebrae were recovered from Feature 3, the historic hearth in Block B.

### *Historic Artifacts*

Jenny and String lakes have been the focus of considerable activity in the Historic period. Even before the establishment of Grand Teton National Park in 1929, there was a thriving tourist industry in the region. In the late nineteenth century, a dude ranch was

established about 300 m south of the site identified as 48TE412. Danny's Ranch, as it was originally known, eventually became the Jenny Lake Lodge. Another early structure, the Crandall Studio, was originally built about 400 m to the northeast of the site. The Square G Lodge was also built to the northeast of site 48TE412 at a distance of about 800 m.

Given a century of Euroamerican activity in the near region, it was expected that some historic material would be recovered during the excavation of 48TE412. This was indeed the case. Two historic artifacts were collected from Feature 1. The first is a .22 caliber rimfire cartridge case found on the surface. The headstamp of the cartridge case identifies it as the product of the Peters Cartridge Company (now the Peters Cartridge Division of the Remington Arms Company). The headstamp style dates before 1946 (White and Munhall 1977:28). The other artifact is a roughly triangular-shaped iron fragment that is obviously part of some larger item—perhaps some form of heavy machinery. No further identification has been made.

Only one artifact was collected from Feature 2. This consists of the central part of the end of a hole-in-cap can. The cap itself is unusually small, being only 7/8 of an inch (about 2.25 cm) in diameter. Unfortunately, no other technological indicators of this can were found. The hole-in-cap can was developed circa 1820 and dominated the canning industry until 1903, when the sanitary can was developed (Rock 1984). Even after the development of the sanitary can, however, the hole-in-cap can persisted in use until about 1920. Sanitary can fragments, aluminum foil fragments, a plate glass sherd, and several wire nails were found in Feature 2 but not collected.

Although the sanitary and the hole-in-cap cans overlap from 1903-1920, the presence of aluminum foil in Feature 2 suggests that the hearth feature was used more than once. Aluminum foil was produced as early as the mid-1920s (Smith 1988:202), but it was a specialty item at that time and was used to package cigarettes and food items. The aluminum foil fragments found in Feature 2 were present in sufficient quantities to suggest that they originated in a later period, when aluminum foil was available as a bulk product.

Four sherds of partially melted glass were collected from Feature 3. Rust fragments were also found, but they were not collected. Two sherds possessed the remains of a wide-mouth, external thread, jar finish. The remaining two sherds are apparently from a jar body and have embossed lettering. One of the embossed sherds has a cursive, lower-case letter "r" above two printed, upper-case letters "NG" with quotation marks behind the "G." This appears to be part of a Kerr brand self-sealing mason jar. According to Toulouse (1969:43), the words "self sealing" in small letters and with quotation marks did not become part of the Kerr jar embossing scheme until around 1920. The other embossed sherd has a large, lower-case, printed "e" on it. This is suggestive of the "Presto" brand of mason and fruit jars, which date from 1925-1946 (Toulouse 1969:64). Presumably, the rust fragments found in this feature were all that remained of the lids from these jars.

Two additional historic artifacts were collected on this site. A clear glass sherd with a slight amber discoloration was found in Shovel Test Unit 1G. The amber discoloration is

characteristic of the presence of selenium in the glass. Selenium was widely used as a clarifying agent in glass from 1917-1930 (IMACS 1988). The remaining artifact was a brass tent slip found in Shovel Test Unit 3G. Presently, no time range can be assigned to this artifact.

Summary

The historic artifacts from 48TE412 primarily originated in the early to mid-twentieth century, during which time the area was transformed into a national park. Most of the artifacts are probably associated with camping or picnicking episodes in the String Lake area. It is reasonable to conclude that these activities were associated with the nearby Danny Ranch/Jenny Lake Lodge, Crandall Studio, or Square G Lodge. Other artifacts, such as the large iron object and the plate glass sherd, are suggestive of long-term occupations in the area. In general, the material is very limited, and it is difficult to see any advantage to be gained by further research. However, the possibility exists that there are subsurface features in the area, and an archeologist should monitor any future work here.

## POSTDEPOSITIONAL ENVIRONMENT

A review of postdepositional processes affecting the archeological record at site 48TE412 is presented below in order to develop an understanding of the environmental processes affecting preservation at the site. There is a specific set of conditions governing the preservation of different materials and features within an archeological site. For many materials the governing conditions have been observed both experimentally and ethnographically. For comprehensive overviews of research in the field of postdepositional studies see Schiffer (1987) and Wood and Johnson (1978).

Processes affecting the archeological record at 48TE412 include fire, trampling, and bioturbation. Each of these processes can add to or subtract from the archeological record, and an understanding of their effects is therefore necessary. The following is a brief summary of these processes and the manner in which they influence site integrity.

### *Background*

Fire plays a significant role in the environment of the Jackson Hole area (Clark 1981). Fires start a successional sequence leading to a renewing of the vegetative mosaic, which in turn provides habitats for a greater variety of species (Clark 1981). During the past three centuries, major (crown) fires in the area are known to have occurred infrequently, while ground fires appear to have been quite numerous. While rare, the larger, more intense fires are thought by Clark (1981:68) to have had the greatest effect on the different biological communities in the Jackson Hole area.

The occurence of large fires in the recent past, and the climatic conditions that preceded them, can be investigated and dated using dendrochronology. According to Clark (1981:64-68), tree rings indicate large fires in the 1760s, 1840s, 1850s, and periodically from 1878 through 1898. He believes that much of the extant forest in the valley has developed since burns that occurred between 1856 and 1879.

Forest fires may leave identifiable traces on archeological sites that are distinguishable from cultural fires (Connor et al. 1989). The morphological changes wrought on archeological artifacts by incidental burning are well documented (Connor et al. 1989:Table 1). Only recently has investigation into the effects of fire on archeological sites been undertaken.

The effects on sites, as described by Connor et al. (1989), are manifested in several ways and depend upon burn conditions in the area. These include mosaic burn patterns, morphological changes in artifacts restricted to the burned layer, localized oxidation features, and ash or fired-rock pockets. For a discussion of the mechanisms for producing the above patterns, see Connor et al. (1989).

Trampling may have only played a minor role in the development of the archeological record at 48TE412. It should be noted, however, that prime conditions exist for the

development of a significant trampling effect. In sandy soils mixed with clasts ranging from gravels to boulders, there is ample opportunity for edge damage to develop on lithic materials. Knudson (1977) documents the postdepositional effects of trampling by domestic livestock on glass fragments scattered around a stocktank. She found that the trampling created morphologic attributes on the glass fragments that closely resemble use wear and retouch. Her study illustrates the importance of an awareness of the postdepositional processes affecting an assemblage, and she cautions against the broad application of the terms *use wear* and *retouch.*

Postdepositional rodent disturbance causes considerable damage to archeological sites. Rodent disturbance has been found to size-sort artifacts (Schiffer 1987; Bocek 1986), create artificial and misleading artifact lines (Erlandson 1984), and act as an agent of soil deposition (Wood and Johnson 1978).

Soil deposition by rodents can exceed as much as 20-40 tons per acre annually. In Texas, ground squirrels and gophers are estimated to turn 15-20 percent of the soil surface over per season (Wood and Johnson 1978). Thorp (1949:188) describes the deposition of ''rodent eskers'' in Wyoming, where burrows excavated through snow by rodents are filled with sediment from below-surface burrows. In the spring, these ''eskers'' are deposited on the ground surface, often containing cultural material. In very shallow sediments, such as those at 48TE412, a complete churning of the soil could take place often, completely obliterating soil horizons and archeological stratigraphy (Wood and Johnson 1978).

Size-sorting of artifacts may occur where rodent activity is considerable. Bocek (1986) documented the mechanisms for this in a study of an archeological site in California. She found that rodent activity changes the vertical position of material according to size. Smaller items (less than 2.5 cm) will be pushed upward by the rodents, while larger items remain stationary or settle to the bottom of the rodent activity zone (Bocek 1986; Erlandson 1984).

*Postdepositional Processes at 48TE412*

As stated above, fires are part of the Jackson Hole environment, and there is evidence of large fires in the area over the last three centuries. In a map of vegetation surrounding Jackson Lake area (Brandegee 1899, reproduced in Connor et al. 1989:Figure 3), recent burn locations are identified along the western shore of String Lake. During excavation in Block C, evidence of these fires was found in the form of charred fragments of tree roots intermixed with fired rock. Connor et al. (1989) describe the accumulation of fired rock in the blowdown root cavities, as well as in the root system of dead trees burning below the surface. While these finds do not rule out the existence of a prehistoric or historic hearth in this location, they do provide alternative explanations for the presence of charred wood. Without more data, the task of archeological interpretation on this point is difficult.

Compounding the effects of fire are the effects of rodent activity at the site. As stated above, the soils are very shallow, 10-15 cm in some places, with a very dense clast-on-clast

glacial outwash beneath. In the spring, ''eskers'' are deposited on the surface as evidence of continual burrowing. When walking across the site, it is not uncommon to sink several centimeters as subsurface tunnels collapse. Much of the surface soil is being churned annually.

Rodent churning may account for the buried fired-rock concentration in Blocks A and C. The larger pieces sink to the bottom of the rodent activity zone as new tunnels are created and old ones collapse (Bocek 1986). Extensive rodent disturbance also erases traces of soil oxidation related either to forest fires or to cultural hearths, or to pit features containing macrofloral or pollen specimens. Only in the two hearths associated with historic material was there indication of oxidation and staining. Finally, rodent disturbance increases the rate of weathering on organic materials like bone, and macroflorals.

*Summary*

Extensive rodent disturbance can substantially alter a site by obliterating spatial associations, erasing stains, exposing materials to weathering, and mixing macro- and micro-sediments that may otherwise contain paleoenvironmental and subsistence information. Fortunately, 48TE412 was not disturbed evenly across the site, and we may have obtained undisturbed pollen and flotation samples from Block A.

Site history suggests that a moderate amount of trampling occurred during the historic ranch period, and some has also been caused by recent visitors to the Park. The existence of historic hearths at the site also suggests some recreational use, but the extent of this usage is unknown. The effect of trampling is significant for the analysis of lithic material. Twenty percent of all flakes recovered from the site show signs of edge modification. Edge modification was cataloged as present, absent, or not applicable for tools. This was done in part to avoid the term ''utilized'' as a label for flakes with signs of edge damage and the implication of a cultural origin for the attribute of the flake.

Postdepositional processes at 48TE412 have played a significant role in the formation of the archeological record at the site. The effects of fire, trampling, rodent disturbance, soil chemistry, and the recreational collection of artifacts have resulted in a diminished archeological record at 48TE412. It is nevertheless possible to answer some of the questions put forth in the research design by taking these processes into consideration. There is sufficient lithic material in the collection to analyze for technological indicators, and the diagnostics will aid in the determination of cultural affiliation. Materials collected for pollen analysis, flotation, radiocarbon-dating, and particle-size analysis were from areas where rodent disturbance was minimal and provide absolute-dating and subsistence information. Obsidian sourcing can still be conducted using surficial material from the site. The analysis of tool use through microscopic inspection is seriously handicapped, however, by an inablity to distinguish between cultural modifications and the results of postdepositional trampling or other forms of disturbance. However, even considering the extent of disturbance at the site the amount of information gained from the site will be significant.

# DISCUSSION

Site 48TE412, although extensively disturbed through natural and historic events, is capable of providing information regarding the prehistoric occupation of the String Lake area and Jackson Hole. By using portions of the research design developed for the Jackson Lake Archeological Project (National Park Service 1987) in relation to data recovered from 48TE412, our understanding of the occupation history and the past lifeways in Jackson Hole can be expanded. Although six research objectives were orginally designed for the Jackson Lake Project, only five are applicable to this project: (1) refinement of the cultural history and cultural chronology of the area; (2) definition of subsistence patterns; (3) definition of the aboriginal settlement patterns and determination of site function; (4) investigation into the extent of trade and movement of raw materials; and (5) refinement of the paleoenvironmental sequence.

## *Site Chronology*

Uncertainties remain concerning the cultural history and chronology of occupations at 48TE412, partly because different methods were used in an attempt to determine the dates of occupation. The projectile point typology and the obsidian-hydration dating results suggest a Late Prehistoric occupation, while radiocarbon dates suggest a more recent use.

Two projectile points (FS 412-208, 210) are similar to points recovered from Level 34 of Mummy Cave (Husted and Edgar 1968). These two String Lake projectile points also compare favorably to points recovered from site 48TE1067 on Beach 4 at Jackson Lake (Connor et al. 1991). The third point (FS 412-002) is comparable to material from Level 30 of Mummy Cave.

The uncalibrated radiocarbon dates from three features at 48TE1067 cluster between 1600 and 1700 years ago. These dates are 1615 ± 70 B.P. (A.D. 335; Beta 25728, ETH 4001), 1670 ± 100 B.P. (A.D. 280; Beta 23263), and 1680 ± 80 B.P. (A.D. 270; Beta 24059). A radiocarbon date from Level 34 of Mummy Cave of 2050 ± 150 B.P. (100 B.C.) also dates similar projectile points to a period ranging between 2100 B.P. and 1950 B.P. The calibrated dates (Klein et al. 1982) have an overlap of approximately 160 years and a possible 1000-year temporal duration for the projectile point type and a mid-point span falling into the range of about 100 B.C. to A.D. 400.

The median hydration date for obsidian from 48TE412 is A.D. 236 ± 60 years (Table 4). This compares favorably to the radiocarbon dates reviewed above for certain projectile point types, and a Late Plains Archaic or early Late Prehistoric occupation of the site is indicated.

Radiocarbon dates from 48TE412 suggest a more recent occupation of the site. The material collected from the feature in Block A was dated to 160 ± 80 years B.P. (A.D. 1790;

Beta 41161). The material submitted by Wright from the hearth excavated in 1976 dated to 210 ± 80 years B.P. (A.D. 1740; I-9648).

Radiocarbon results, obsidian-hydration results, and approximate ages of the projectile points indicate two episodes of use during the last 2000 years. The obsidian-hydration dates and the projectile point typology suggest a Late Plains Archaic or an early Late Prehistoric occupation beginning about 2000 B.P., while the radiocarbon dates suggest a more recent use of the area. It has been documented that the site was used as a historic-era picnic site and campground. Perhaps these activities can account for the recent radiocarbon dates. There is, however, no evidence to be found among other sources of information for a very late Prehistoric occupation. More hydration and radiocarbon samples are required to refine further the occupational history of the site.

### *Subsistence and Site Function*

#### Plant Processing

Evidence of plant processing at 48TE412 is present in the form of both pollen and macrobotanical remains recovered in association with the complex charcoal stain around Feature 1 in Block A. Elevated levels of *Chenopodium* pollen, charred seeds, and seed fragments suggest the use of this plant as a food source during occupation of the site (Cummings 1991).

#### Bone Grease Processing

While the faunal remains at 48TE412 constitute a very small portion of the collection, the condition of the bones provides some evidence of activities related to subsistence and site function. Crushed and calcined animal bone is found throughout much of the Northern Plains and is a by-product of rendering bone grease (Vehik 1977). Bone grease is high in fat and also a very concentrated source of energy (Vehik 1977). It also has a long storage life and is a means by which to exploit the more difficult to process parts of a carcass (Vehik 1977). Much of the information regarding the production of bone grease comes from ethnographic sources. Tribes which are cited as producing bone grease include the Cheyenne, Blackfoot, Crow, Chippewa, Ojibwa, and Chukchee (Vehik 1977).

Bone grease was used as an ingredient of pemmican, as a condiment, and to tan hides (Leechman 1951; Vehik 1977). While very few sources indicate the seasonal scheduling of bone grease production among the Crow and Ojibwa, it appears to have been a late autumn and winter activity (Vehik 1977). Leechman (1951:355) also notes the production of bone grease occurring within one day of butchering the animal, to prevent the grease from having a strong taste. While this is in reference to only one ethnographic source and may not be found cross-culturally, it is important to note.

Production is described by both Vehik (1977) and Leechman (1951) as being both a male and female activity. The males crushed the bones into small ''fingernail size'' fragments with stone mauls. The women prepared the bone for crushing and simmered the crushed bone in vessels of water. According to ethnographic sources, simmering was carried out in metal pots, but prehistorically this would have been done in ceramic or skin vessels that were heated using a stone boiling technique or by the direct application of heat (Bonnichsen 1973; Leechman 1951; Vehik 1977). The quantity of grease obtained would be determined by the animal, the bone elements processed, the amount of bone processed, and the time of year (Vehik 1977). Schoolcraft (cited in Leechman 1951:355) describes the process of bone grease rendering and estimates that the bones of two bison are required to render 12 pounds of grease. After the initial production of the bone grease, it could be cooled and formed into cakes, or poured into skin containers for storage of up to three years (Leechman 1951).

Bone grease processing has the capacity to be highly visible archeologically. Evidence of bone grease processing includes burnt and unburnt crushed bone, the presence of hammerstones, mauls, and anvils, and the occurrence of hearths, ceramics, and fired rock. The context in which this material is recovered is also important regarding other aspects of site function (Vehik 1977). Vehik (1977:173) suggests how the context of this material may generally be indicative of either a special-activity area or a base camp. At a special-activity area, the artifactual remains would ideally include only materials related to the activities conducted at the site. The site would have a limited temporal occupation and would be areally confined.

In a base camp, material would be present from a broader range of activities, sites would be larger, and occupation of the site may be longer. The ability to identify activity loci in a base camp setting would be more difficult than in a special-activity camp. Overlap in the spatial organization of activities in base camps would result in a less distinct pattern than that which might be expected at a special-activity camp (Vehik 1977). The pattern at base camps would be further obscured by the dumping of refuse away from the activity areas (Schiffer 1976).

At 48TE412, the context of material remains is somewhat clouded by postdepositional disturbances and by the limited preservation of faunal material. Cultural material recovered from the site, including faunal material, high frequency of fired rock scattered across the site, and broken quartzite cobbles, suggests that bone grease production may have been an activity conducted at the site. Projectile points, broken bifaces, and stone tool production debris suggest hunting, the processing of meat, and tool maintenance activities at the site. As noted above, processing of bone grease was typically carried out in conjunction with the hunt. The patchy distribution of material across the site suggests an occupation history similar to that of a special-activity location rather than a base camp (Vehik 1977). Reoccupation of the site through time may explain the scattered distribution of material.

This interpretation is contrary to that of Wright and Marceau (1977), who rely on negative evidence and describe the settlement and subsistence of Jackson Hole as based on the

harvesting of plant resources and fish, with very little emphasis on hunting. The material recovered from 48TE412 and other sites in the area (e.g., those around Jackson Lake and Blacktail Butte), however, suggests a broader subsistence pattern based on the procurement of meat and meat byproducts, as well as fish and plant resources. The presence of three diagnostic projectile points and several projectile point fragments can also indicate the importance of meat in the diet (Connor 1986).

However, inferring site function from the presence of several tools that are used in a certain activity is almost as difficult as relying on negative evidence to determine site function. The same postdepositional processes that created an environment unsuitable for the preservation of bone would also have made it unsuitable for the preservation of plant remains.

While the interpretation of 48TE412 as a special-activity site may be correct, the nature of the activity is in question. To date, there is no indication that plant resources were targeted in the way suggested by Wright and Marceau (1977). Evidence of plant or aquatic resource utilization would include macrobotanical and fish remains, pollen, and the presence of tools used in the processing or harvesting of plant or aquatic resources. While there is evidence of plant use in the form of charred seeds and pollen, this evidence does not suggest a reliance on this resource for subsistence. On the contrary, it suggests the use of only one plant in a very limited area.

Without detailed use-wear analysis of the tools, it is difficult to assess their function. Furthermore, the plants Wright and Marceau (1977) believe to have been targeted by the site occupants have not been shown to require lithic tools for processing. While evidence for the exploitation of animal resources occurs across the site and is represented by the presence of bone, butchering tools, and projectile points, the degree to which this resource was the primary focus of the site occupants is unknown, because there is no means by which to determine the extent of plant resource use.

Tool Production and Site Use

Analysis of chipped stone from 48TE412 indicates two means of tool production were used that were closely related to the two primary lithic material types on the site. Bifacial production of volcanic glass suggests the existence of an organized and well-maintained tool kit. Bipolar production of quartzite flakes suggests a less organized flake technology.

Binford (1979) refers to flake production for immediate use as an expedient technology. Expedient technologies are made up of tools manufactured, used, and discarded as needed, and assemblages would consist of simple and unpatterned tools (Binford 1979; Parry and Kelly 1987). Bifacial tools are produced to accomplish a variety of functions, and in anticipation of future needs. They generally have a formal shape, are hafted, maintained, and when they can no longer function for their intended purpose, may be recycled to perform another function (Kelly 1988; Parry and Kelly 1987).

Variation in lithic technologies may be related to the degree of organization in the settlement/subsistence adaptation of hunting and gathering groups (Binford 1980). Groups using bifacial technologies are thought to correspond to logistically organized (collector) groups. Groups using flake technologies are thought to be found in conjunction with foragers (Binford 1979). Collectors and foragers differ in that collectors organize the acquisition of resource operations around a semi-permanent base camp, with groups of collectors bringing resources in from special-purpose sites. Foragers move their camp to resources as they become available in a particular area (Binford 1980). Since the production of bifacial tools requires a certain degree of planning and the tools are more apt to be curated, their presence in a site is thought to be indicative of a group practicing a collector strategy. Flake production is linked to the forager strategy because of the expedient nature of the technology (Binford 1979).

Contrary to Binford's interpretation, Parry and Kelly (1987) believe that in highly mobile groups bifacial technologies would be more adaptive, since they require less stone to be carried and provide a fairly adaptive toolkit. They support this position using archeological and ethnographic evidence which documents a shift from bifacial technologies to expedient core technologies, corresponding to shifts from mobile hunting and gathering to more sedentary subsistence strategies.

Another consideration may be the proximity of lithic resources and how that affects the type of technology (Parry and Kelly 1987; Bamforth 1986). Bamforth (1986) documents two factors of biface production, tool maintenance and recycling, as they are related to curation. He provides evidence that the distance from lithic sources influences the amount of maintenance and recycling the toolkits receive. Parry and Kelly (1987) also discuss the differential treatment of stone when it is readily available compared to when it is harder to obtain. They show how biface manufacture is advantagous to mobile groups due to increased portability and the ability to provide more cutting edges for a given weight of stone (Parry and Kelly 1987).

A third factor affecting the differential treatment of stone may be the variation in the tasks performed by tools made from the different materials. At 48TE412, a majority of the formal tools as well as tool fragments are produced from the volcanic glass materials, while the quartzite exhibits very little formal shaping. This same pattern is seen in the assemblage of material from sites around Jackson Lake (Connor 1986; Connor et al. 1991) and sites in Yellowstone National Park (Kenneth Cannon, personal communication 1991). This bias may be the result of differential workability or differences in edge qualities. While the projectile point type classification suggests a specific shape and function (that of a projectile), when hafted, these tools can be and often are used for a variety of light cutting tasks (Kelly 1988). They also require special flaking to reduce their size and to shape them. The edges observed on the quartzite items are not as sharp or refined as those on the obsidian and vitrophyre specimens, but they are sturdier and would hold up longer when used against hard materials, such as wood or bone (Semenov 1964).

The existence of obsidian bifacial production blanks and the evidence derived from debitage analysis suggest that production of bifacial tools was one of the activities occurring at the site. The presence of quartzite bipolar cores, flakes, and debitage at the site suggests that a second means of producing tools was also taking place at the site. According to Parry and Kelly (1987) and Bamforth (1986), the pattern suggested by the use of different technologies linked to different material types, given the availability of those material types in the area, is what might be suspected.

The abundance of quartzite in the area renders it a cheap resource to be used in the production of expedient tools and then discarded. The less accessable volcanic glasses, on the other hand, are curated in the form of bifacial tools, and the presence of biface production at the site is related to proximity of the lithic source. Along the west side of Jackson Hole, obsidian artifact density decreases as distance from the Teton Pass source increases (Wright and Marceau 1977). If Bamforth (1986) is correct in linking curation of tools to availability of lithic materials, then the further the sites are from the sources, the less production will be visible, and more evidence of maintenance and recycling will be present.

The nature of production as it is linked to the different material types also suggests differences in the use of the different tools. The volcanic glasses produce tools with sharp brittle edges that often need to be worked further before they can be used without crushing. Obsidian and vitrophyre are also fairly easily worked into a variety of shapes. Quartzite, on the other hand, is more difficult to work into controlled shapes but produces a sturdy sharp cutting edge, which can be used on a wide range of materials before breaking down. This same pattern is seen throughout the region (Connor et al. 1991; Kenneth Cannon, personal communication 1991).

Knowledge of tool production methods allows us to speculate on the settlement and subsistence pattern for the surrounding area. Hunter and gatherer subsistence patterns have been described as being that of collectors or that of foragers, with a wide range of variation separating the two extremes (Binford 1980; Chatters 1987). Tool use by the two groups has also been discussed, with the intention of discerning patterns in the assemblage from 48TE412. At String Lake, the availability of resources and the types of tools present suggest a mobile hunting and gatherering group. The site may have been occupied on a seasonal basis or only a few times over the span of prehistory.

Tool Use

Lithic materials from the site suggest a wide range of activities. Our inability to distinguish between postdepositional wear and use wear prevents definition of the precise nature of those activities through lithic analysis. All flaked-stone material coded as edge-modified was viewed under low magnification to determine the nature of the edge modification. While many pieces demonstrated edge rounding, grinding, step fracturing, and striations, the location of these attributes were by no means patterned along what would be expected to be a working edge. Dorsal ridges on flakes showed signs of rounding, deep striations were

observed on flat flake surfaces away from working edges, edges were uniformly rounded or ground, and step fractures were inconsistently present along tool edges. The occurence of these attributes in the locations described suggest a high degree of postdepositional damage to the flakes resulting from soil movement and trampling.

Mobility and Trade

Lithic raw material types represented at the site include the volcanic glasses (80 percent), quartzite (13 percent), chert (5 percent), and other (2 percent). The Precambrian quartzite occurs naturally on the site in the form of glacial cobbles and required little transport effort. The reduction of this material using bipolar methods and the high frequency of broken quartzite cobbles at the site suggest expedient use.

Tensleep quartzite, represented by two artifacts, outcrops in Jackson Hole in several areas, the closest of which is the southern end of Blacktail Butte (Love 1972; Wright and Marceau 1977). The occurrence of this material at the site represents the utilization of other areas of Jackson Hole by the site inhabitants. As described by Reeve (1976) and Wright and Marceau (1977), the area south of Blacktail Butte is also a primary source of sego lilies (*Calochortus nuttallii*), an important wild food crop. The proximity of the two resources may be clues to both the scheduling for procurement and the season of occupation at the site.

Chert occurs at the site in low frequencies. The two chert cores have been altered by heat, either intentionally or as a result of natural fires. Without a large comparative sample, source identification is difficult. The chert flakes collected at the site do not appear to be the same material as the cores. The flakes are not hackled from heat treatment and are an orange/buff color, compared to the blue/gray of the cores.

Some of the cherts, as well as some of the volcanic glasses, may be from secondary deposits occurring either in the glacial outwash or the current stream channels. The obsidian core (FS 412-160) had smooth rounded cortical surfaces indicating water tumbling. While none of the cherts had cortical surfaces, there may be sources in the gravel bars of the Snake River for this material type.

Eighty percent of the lithic material at the site is represented by the volcanic glasses. Obsidian sourcing provides a means to investigate the movement of raw materials into 48TE412. Twenty-two pieces of obsidian and vitrophyre were submitted for sourcing to Richard Hughes. The results of this analysis indicated that 77 percent of the material submitted for sourcing was from the Teton Pass source (Hughes 1991).

The lithic material suggests very little trade or mobility, since all of the material, except for 23 percent of the obsidian sourced, can be obtained from within the Jackson Hole area. While lithic material is not the only indicator of trade or mobility, it is the only one available for this analysis. From the data available, neither the extent of trade nor the mobility of the group utilizing 48TE412 can be discerned.

*Summary of Discussion*

Based on the lithic assemblage, the obsidian-hydration dates, and the diagnostic projectile points, the site was most likely occupied by mobile hunters and gatherers between approximately 2000 and 1500 B.P. Its access to resources and the lithic assemblage suggest an emphasis on the procurement and processing of animals. There is also some indication of plant use. The site was a small camp that may have been revisited seasonally for short durations. In the recent past, the site has been used for recreation by park visitors.

# MANAGEMENT SUMMARY

Mitigation of impacts to site 48TE412 is complete. The lack of evidence for significant subsurface material resulted in less excavation than originally planned. Our investigations clearly determined that the site is much larger than originally believed, that it is primarily a surface concentration, and that subsurface material at the site is probably the result of postdepositional processes.

After her visit to 48TE412 in 1988, Connor (1989) recommended that the site be considered eligible for inclusion on the National Register of Historic Places. She made this recommendation based on criteria developed for the Jackson Lake Project, which were partially applicable to 48TE412. The research objectives developed for the Jackson Lake Project (National Park Service 1987) and identified in the Data Recovery Plan (National Park Service 1990) include: (1) definition of the culture history and area chronology; (2) definition of aboriginal settlement patterns; (3) definition of subsistence patterns; (4) refinement of the paleoenvironmental sequence; and (5) determination of the extent of trade.

As this document attests, the research potential of 48TE412 is high. While there may not be subsurface deposits at this location, research questions regarding most of the objectives identified by Connor are still applicable to 48TE412. The existence of areas at the site outside the current project impact area are also capable of containing information regarding the Jackson Lake Project research objectives. In light of the existence of these areas, the status of the site in regard to its eligibility for inclusion on the National Register of Historic Places should not be changed.

## REFERENCES CITED


Ahler, Stanley

1977 Functional Analysis of Nonobsidian Chipped Stone Artifacts: Terms, Variables, and Quantification. In *Lithic Use-wear Analysis*, edited by Brian Hayden, pp. 301-328. Academic Press, New York.

Bamforth, Douglas

1986 Technological Efficiency and Tool Curation. *American Antiquity* 51(1):38-50.

Barnosky, Cathy W.

1988 Late-Quaternary Vegetational and Climatic History of Grand Teton National Park and Vicinity. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Beaubien, Paul

1956 Memorandum to Regional Chief of Interpretation, September 24. Subject: Trip Report, Grand Teton National Park, September 11-12. On file, National Park Service, Midwest Archeological Center, Lincoln.

Bender, Susan

1983 *Hunter-Gatherer Subsistence in a Mountainous Environment: The Prehistory of the Northern Tetons*. Ph.D. dissertation, Department of Anthropology, State University of New York, Albany.

Bender, Susan, and Gary Wright

1988 High-Altitude Occupations, Cultural Process, and High Plains Prehistory. *American Anthropologist* 90(3):619-639.

Betts, Robert

1978 *Along the Ramparts of the Tetons: The Saga of Jackson Hole, Wyoming*. Colorado Associated University Press, Boulder.

Binford, Lewis

1979 Organization and Formation Processes: Looking at Curated Technologies. *Journal of Anthropological Research* 35(3):255-273.

1980 Willow Smoke and Dogs' Tails: Hunter-Gatherer Settlement Systems and Archaeological Site Formation. *American Antiquity* 45(1):4-20.

Binford, Lewis, and George I. Quimby

1963 Indian Sites and Chipped Stone Material in the Northern Lake Michigan Area. *Fieldiana Anthropology* 36(12):277-307.

Bocek, Barbara
1986 Rodent Ecology and Burrowing Behavior: Predicted Effects on Archaeological Site Formation. *American Antiquity* 51(3):589-603.

Bonnichsen, Robson
1973 Millie's Camp: An Experiment in Archaeology. *World Archaeology* 4(3):277-291.

Brandegee, T.D.
1899 Teton Forest Reserve. *U.S. Geological Survey Annual Report 19* (Part 5):191-212. Washington, D.C.

Callahan, E.
1979 The Basics of Biface Knapping in the Eastern Fluted Point Tradition. *Archaeology of Eastern North America* 7:1-180.

Cannon, Kenneth P.
1991 Faunal Remains from Grand Teton National Park. In *Jackson Lake Archeological Project: The 1987-1988 Field Work*, by M. Connor, K. Cannon, S. Matz, D. Carlevato, and C. Winchell, pp. 265-302. Technical Report No. 7. National Park Service, Midwest Archeological Center, Lincoln.

Chatters, James
1987 Hunter and Gatherer Adaptations and Assemblage Structure. *Journal of Anthropological Archaeology* 6:333-375.

Clark, Tim W.
1981 *Ecology of Jackson Hole, Wyoming: A Primer*. Paragon Press, Salt Lake City.

Connor, Melissa A.
1986 Jackson Lake Archeological Project, 1985: An Interim Report. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

1987 Site Testing at Jackson Lake: A Jackson Lake Archeological Project Interim Report. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

1989 Archeological Investigations on the 1988 Realignment Teton Park Road (171B-C). Rocky Mountain Region Archeological Project Report on file, National Park Service, Midwest Archeological Center, Lincoln.

Connor, Melissa A., Kenneth P. Cannon, Stephan E. Matz, Denise C. Carlevato, and Colleen Winchell
1991 *Jackson Lake Archeological Project: The 1987 and 1988 Field Work.* 2 vols. Technical Report No. 7. National Park Service, Midwest Archeological Center, Lincoln.

Connor, Melissa A., Kenneth P. Cannon, and Denise C. Carlevato
1989 The Mountains Burnt: Forest Fires and Site Formation Processes. *North American Archaeologist* 10(4):293-310.

Conover, W.J.
1971 *Practical Nonparametric Statistics.* 2nd ed. John Wiley and Sons, New York.

Crabtree, D.E.
1972 *An Introduction to Flintworking.* Occasional Paper No. 28. Idaho State University Museum, Pocatello.

1977 The Obtuse Angle as a Function Edge. In *Experimental Archaeology*, edited by Daniel Ingersoll, John Yellen, and William Macdonald, pp. 38-51. Columbia University Press, New York.

Cummings, Linda Scott
1991 Pollen and Macrofloral Analysis at 48TE412, Grand Teton National Park, Wyoming. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Davis, Jonathan O.
1984 Tephra Hydration Rinds as Indicators of Age and Effective Hydration Temperature. In *Obsidian Studies in the Great Basin*, edited by Richard E. Hughes, pp. 91-115. Contributions of the University of California Archaeological Research Facility No. 45. Department of Anthropology, University of California, Berkeley.

Dibble, H., and J. Whittaker
1981 New Experimental Evidence on the Relationship Between Percussion Flaking and Flake Variation. *Journal of Archaeological Science* 8(3):283-296.

Erlandson, Jon M.
1984 A Case Study in Faunalturbation: Delineating the Effects of the Burrowing Pocket Gopher on the Distribution of Archaeological Materials. *American Antiquity* 49(4):785-790.

Frison, George C.
1971 Prehistoric Occupations of Grand Teton National Park. *Naturalist* 22:34-37.

1978 *Prehistoric Hunters of the High Plains.* Academic Press, New York.

Hayden, Brian
1977 Discussion: Inferring Worked Materials. In *Lithic Use-Wear Analysis*, edited by Brian Hayden, pp. 283-288. Academic Press, New York.

Henry, Don, C. Vance Haynes, and Bruce Bradley
1976 Quantative Variations in Flaked Stone Debitage. *Plains Anthropologist* 21(71):57-61.

Hughes, Richard E.
1991 Letter to Kenneth P. Cannon dated Dec. 10. Re: X-ray fluorescence of obsidian artifacts from Yellowstone, Grand Teton, Glacier, Canyonlands, and Bryce Canyon. On file, National Park Service, Midwest Archeological Center, Lincoln.

Husted, W.M., and R. Edgar
1968 The Archeology of Mummy Cave, Wyoming: An Introduction to Shoshonean Prehistory. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Intermountain Antiquities Computer System (IMACS)
1988 *User's Guide: Instructions and Computer Codes for Use with the IMACS Site Form.* University of Utah, Salt Lake City.

Kelly, Robert
1988 The Three Sides of a Biface. *American Antiquity* 53(4):717-734.

Klein, Jeffrey, J.C. Lerman, P.E. Damon, and E.K. Ralph
1982 Calibration of Radiocarbon Dates: Tables Based on the Consensus Data of the Workshop on Calibrating the Radiocarbon Time Scale. *Radiocarbon* 24(2):103-150.

Knudson, Ruthann
1977 Inference and Imposition in Lithic Analysis. In *Lithic Use-wear Analysis*, edited by Brian Hayden, pp. 269-281. Academic Press, New York.

Leechman, Douglas
1951 Bone Grease. *American Antiquity* 16(4):355-356.

Limbrey, Susan
1977 *Soil Science in Archaeology.* Academic Press, London.

Love, Charles M.
1972 *An Archeological Survey of the Jackson Hole Region, Wyoming.* Master's thesis, Department of Anthropology, University of Wyoming, Laramie.

Love, J.D., and J.C. Reed, Jr.
1971 *Creation of the Teton Landscape*. Grand Teton Natural History Association, Moose, Wyoming.

Lowie, R.H.
1909 The Northern Shoshone. *Anthropological Papers* 2(2):165-306. American Museum of Natural History, New York.

Magne, Martin, and David Pokotylo
1981 A Pilot Study in Bifacial Lithic Reduction Sequences. *Lithic Technology* 10(2-3):34-47.

Martner, Brooks E.
1986 *Wyoming Climate Atlas*. University of Nebraska Press, Lincoln.

Michels, Joseph W.
1981 *The Hydration Rate for Teton Pass Obsidian at Archaeological Sites in Grand Teton National Park, Wyoming*. Mohlab Technical Report No. 3. State College, Pennsylvania.

National Park Service
1977 *Environment Assessment Summary: Jenny Lake Development Concept Plan, Grand Teton National Park*. Department of the Interior, Denver Service Center, Denver, Colorado.

1987 Jackson Lake Archeological Project Research Design and Data Recovery Plan. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

1990 Package 171B2: Reconstruct Park Road, South Jenny Lake to North Jenny Lake: Archeological Project Research Design and Data Recovery Plan for Site 48TE412. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Neckels, Jack
1990 Section 106 Compliance, Package No. 171B2, Project No. 90-2, Realignment of Teton Park Road, Grand Teton Park, Wyoming. On file, National Park Service, Midwest Archeological Center, Lincoln.

Odell, George H.
1975 Micro-wear in Perspective: A Sympathic Response to Lawrence H. Keeley. *World Archaeology* 7(2):226-240.

Origer, Thomas M.
1992 Letter to Chief, Midwest Archeological Center, dated January 15. Re: Hydration band analysis of 19 obsidian specimens from 48TE412. On file, National Park Service, Midwest Archeological Center, Lincoln.

Parry, William H., and Robert L. Kelly
1987 Expedient Core Technology and Sedentism. In *The Organization of Core Technology*, edited by Jay K. Johnson and Carol A. Morrow, pp. 285-304. Westview Press, Boulder.

Patterson, L.
1982 The Importance of Flake Size Distribution. *Contract Abstracts and CRM Archeology* 3(1):70-72.

1990 Characteristics of Bifacial-Reduction Flake-Size Distribution. *American Antiquity* 55(3):550-558.

Patterson, L.W., and J.B. Sollberger
1978 Replication and Classification of Small Size Lithic Debitage. *Plains Anthropologist* 23(80):103-112.

Pierce, Kenneth L.
1979 *History and Dynamics of Glaciation in the Northern Yellowstone National Park Area*. Professional Paper No. 729-F. U.S. Geological Survey, Washington, D.C.

Pierce, Kenneth L., and John Good
1986 Geologic Setting of the Eight Archeological Sites Investigated in 1986, Jackson Lake, Wyoming. In Jackson Lake Archeological Project, 1986: Interim Report, by Melissa Connor, Appendix 2. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Pryor, John H.
1988 The Effects of Human Trample Damage on Lithics: A Consideration of Crucial Variables. *Lithic Technology* 17(1):45-50.

Raymond, Anan W.
1984 Evaluating the Occupational History of Lithic Scatters: Analysis of Obsidian Hydration Measurements. *North American Archaeologist* 6(2):115-133.

Reeve, Stuart
1976 Plant Resources and Prehistoric Transhumance in Jackson Hole, Wyoming. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Rock, J.T.
1984 Cans in the Countryside. *Historical Archaeology* 18(2):97-111.

Schiffer, Michael B.
1976 *Behavioral Archaeology*. Academic Press, New York.

1987 *Formation Processes of the Archaeological Record.* University of New Mexico Press, Albuquerque.

Semenov, Sergei
1964 *Prehistoric Technology*. Translation into English by M.W. Thompson. Adams and Dart, Bath, England.

Shott, Michael
1989 Bipolar Industries: Ethnographic Evidence and Archaeological Implications. *North American Archaeologist* 10(1):1-24.

Smith, G.D.S
1988 *From Monopoly to Competition: The Transformations of Alcoa. 1888-1988.* Cambridge University Press, England.

Sollberger, J., and L. Patterson
1976 Prismatic Blade Replication. *American Antiquity* 41(4):517-531.

Speth, J.
1981 The Role of Platform Angle and Core Size in Hard Hammer Percussion Flaking. *Lithic Technology* 10:16-21.

Stahle, D., and J. Dunn
1982 An Analysis and Application of the Size Distribution of Waste Flakes from the Manufacture of Bifacial Stone Tools. *World Archaeology* 14(1):22-36.

Stevenson, Marc
1985 The Formation of Artifact Assemblages at Workshop/Habitation Sites: Models from Peace Point in Northern Alberta. *American Antiquity* 50(1):63-81.

Sullivan, Alan, and Kenneth Rozen
1985 Debitage Analysis and Archaeological Interpretation. *American Antiquity* 50(4):755-779.

Svec, E. Christopher
1986 Lithic Material: Jackson Lake Inventory, 1985. In Jackson Lake Archeological Project, 1985: An Interim Report, by Melisa A. Connor, Appendix 3. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Thorp, J.
1949 Effects of Certain Animals that Live in the Soil. *The Scientific Monthly* 68:180-191.

Toulouse, J.H.
1969 *Fruit Jars.* Published jointly by Thomas Nelson, Inc., Nashville, Tennessee, and Everybodys Press, Hanover, Pennsylvania.

Vehik, Susan C.
1977 Bone Fragments and Bone Grease Manufacturing: A Review of Their Archeological Use and Potential. *Plains Anthropologist* 22(77):169-182.

White, E.M., and L.A. Hannus
1983 Chemical Weathering of Bone in Archaeological Soils. *American Antiquity* 48(2):316-322.

White, Henry P., and B.D. Munhall
1977 *Cartridge Headstamp Guide.* H.P. White Laboratory, Inc., Street, Maryland.

Wood, W. Raymond, and Donald Johnson
1978 A Survey of Disturbance Processes in Archaeological Site Formation. In *Advances in Archaeological Method and Theory*, vol. 1, edited by Michael B. Schiffer, pp. 315-381. Academic Press, New York.

Wright, Gary A.
1984 *People of the High Country: Jackson Hole Before the Settlers.* Peter Lang, New York.

Wright, Gary A., and Thomas E. Marceau
1977 Archeological Reconnaissance in Western Jackson Hole. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

1981 Report on Excavations at Blacktail Butte, Grand Teton National Park, Wyoming. Manuscript on file, National Park Service, Midwest Archeological Center, Lincoln.

Wright, G.A., T. Marceau, F.A. Calabrese, and Melodie Tune
1978 *Greater Yellowstone Cooperative Regional Transportation Study: Regional Assessment, Archeological Report.* National Park Service, Midwest Archeological Center, Lincoln.

Wright, Gary, Susan Bender, and Stuart Reeve
1980 High Country Adaptations. *Plains Anthropologist* 25(89):181-197.

Table 1. Summary of shovel test depths and results.

| Shovel Test | Transects | | | | | | |
|---|---|---|---|---|---|---|---|
| | A | B | C | D | E | F | G |
| 1 | 36 | 11 | 15 | 18X | 5 | 40 | 23X |
| 2 | 30X | 25 | 15 | 10 | 10 | 50X | 23X |
| 3 | 36X | 30 | 17 | 15X | 15X | 86 | 53X |
| 4 | 10 | 34X | 20X | 15 | 5 | 70 | 60X |
| 5 | 18 | 22X | 25 | 6 | 8 | 80X | 57 |
| 6 | 18 | 20X | 27X | | | 80X | 40X |
| 7 | 24X | 35 | 25X | | | 90 | |
| 8 | 14X | 33 | 23 | | | 84 | |
| 9 | 21 | 30 | 22 | | | 89X | |
| 10 | | | 26 | | | 70X | |
| 11 | | | | | | 60X | |
| 12 | | | | | | 50 | |
| 13 | | | | | | 36X | |
| 14 | | | | | | 50 | |
| 15 | | | | | | 30 | |

X signifies positive shovel tests.
Depths are measured in centimeters.

Table 2. Lithic raw material frequency at 48TE412.

| Material | Number | Percent |
|---|---|---|
| Obsidian | 294 | 75.0 |
| Vitrophyre | 19 | 4.8 |
| Quartzite | 51 | 13.1 |
| Chert | 23 | 5.6 |
| Other | 6 | 1.5 |
| Total | 393 | 100 |

Table 3. Results of obsidian-hydration band analysis from 48TE412, from Origer (1992).

| Lab No. | Catalog No. | Description | Measurements (microns) | | | | | | Mean* | Source |
|---|---|---|---|---|---|---|---|---|---|---|
| 01 | FS-412-002 | Point fragment | 1.7 | 1.7 | 1.7 | 1.8 | 1.8 | 1.9 | 1.8 | Teton Pass |
| 02 | FS-412-010 | Flake tool | 1.3 | 1.4 | 1.4 | 1.6 | 1.6 | 1.6 | 1.5 | Teton Pass |
| 03 | FS-412-046 | Biface fragment | 1.0 | 1.0 | 1.0 | 1.1 | 1.1 | 1.3 | 1.1 | Teton Pass |
| 04 | FS-412-050 | Biface fragment | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.1 | Teton Pass |
| 05 | FS-412-070 | Debitage | - | - | - | - | - | - | DH | Teton Pass, Variety 2? |
| 06 | FS-412-079 | Biface | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | Teton Pass, Variety 2? |
| 07 | FS-412-095 | Point | - | - | - | - | - | - | NVB | Teton Pass |
| 08 | FS-412-158 | Flake tool | 1.2 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | 1.3 | Teton Pass |
| 09 | FS-412-160 | Core | 1.4 | 1.6 | 1.6 | 1.7 | 1.7 | 1.8 | 1.6 | Teton Pass |
| 10 | FS-412-164 | Biface fragment | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | Teton Pass |
| 11 | FS-412-167 | Debitage | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | Teton Pass |
| 12 | FS-412-208 | Point | 0.8 | 0.8 | 0.8 | 1.0 | 1.0 | 1.1 | 0.9 | Teton Pass |
| 13 | FS-412-210 | Point fragment | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.2 | Teton Pass, Variety 2? |
| 14 | FS-412-257 | Debitage | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | Teton Pass |
| 15 | FS-412-264 | Biface fragment | 1.1 | 1.1 | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | Teton Pass, Variety 2? |
| 16 | FS-412-292 | Debitage | 1.7 | 1.7 | 1.8 | 1.8 | 1.8 | 1.9 | 1.8 | Teton Pass |
| 17 | FS-412-293 | Debitage | 1.1 | 1.1 | 1.1 | 1.1 | 1.2 | 1.2 | 1.1 | Teton Pass |
| 18 | FS-412-299 | Utilized flake | 0.8 | 0.8 | 1.0 | 1.0 | 1.0 | 1.1 | 1.0 | Teton Pass |
| 19 | FS-412-302 | Biface fragment | 1.2 | 1.2 | 1.2 | 1.2 | 1.2 | 1.3 | 1.2 | Teton Pass, Variety 2? |

*DH = diffuse hydration, NVB = no visible hydration band

Table 4. Time calculation on 13 Teton Pass obsidian samples.

The hydration rate equation is $x^2=kt$, where:
*x* is hydration rim thickness, mean measurement in microns
*k* is hydration rate (Michels 1981)
*t* is time in years.

| *x* | *t* |
|---|---|
| 0.9 | 988 |
| 1.0 | 1219 |
| 1.1 | 1476 |
| 1.1 | 1476 |
| 1.1 | 1476 |
| 1.2 | 1756 |
| 1.2 | 1756 |
| 1.2 | 1756 |
| 1.3 | 2061 |
| 1.5 | 2744 |
| 1.6 | 3122 |
| 1.8 | 3951 |
| 1.8 | 3951 |

The time distribution (*t*) has a mean of 2133 years, a standard deviation of 993 years, and a median of 1756 years.

The error is ± 600 years.

The median value is used to determine date; so the sample age is 1756 ± 600 years from the testing date (1992):

A.D. 236 ± 600 years

Table 5. Lithic material distribution for flaked tools.

| | Projectile Point | Biface | Core | Multipurpose/ Composite | Total |
|---|---|---|---|---|---|
| Obsidian | 3 | 9 | 1 | 0 | 13 |
| Vitrophyre | 0 | 2 | 1 | 0 | 3 |
| Quartzite | 0 | 1 | 5 | 0 | 6 |
| Chert | 0 | 0 | 2 | 1 | 3 |
| Totals | 3 | 12 | 9 | 1 | 25 |

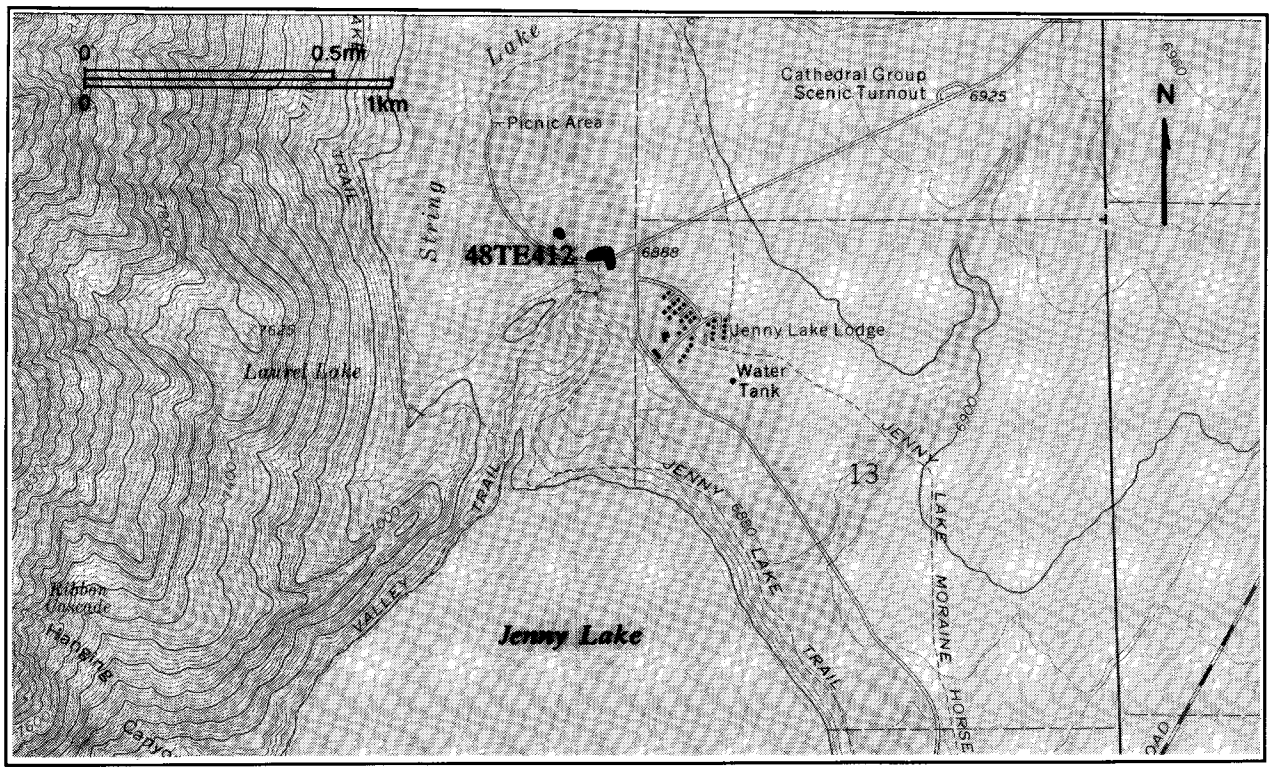


Figure 1. Topographic map showing location of 48YE412, the String Lake site.

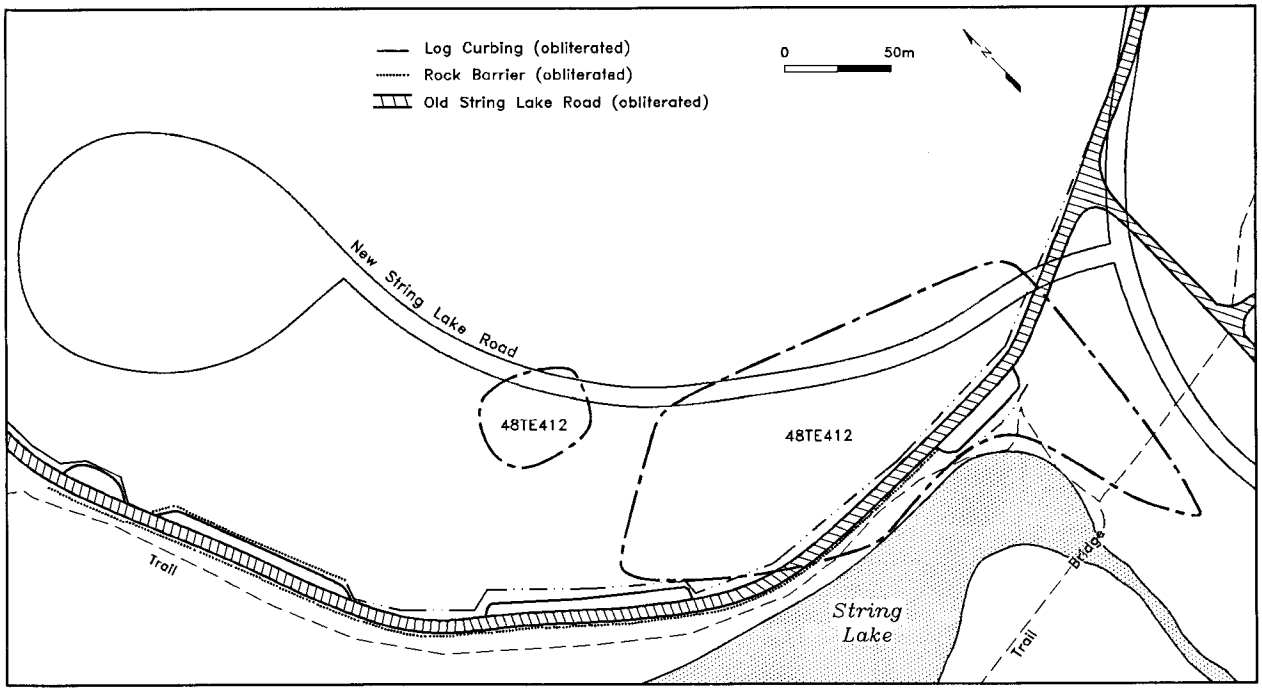


Figure 2. Construction plan map indicating the centerline of the new road, rehabilitation work on the existing road, and the location of the two components of 48TE412, based on the 1992 construction design.

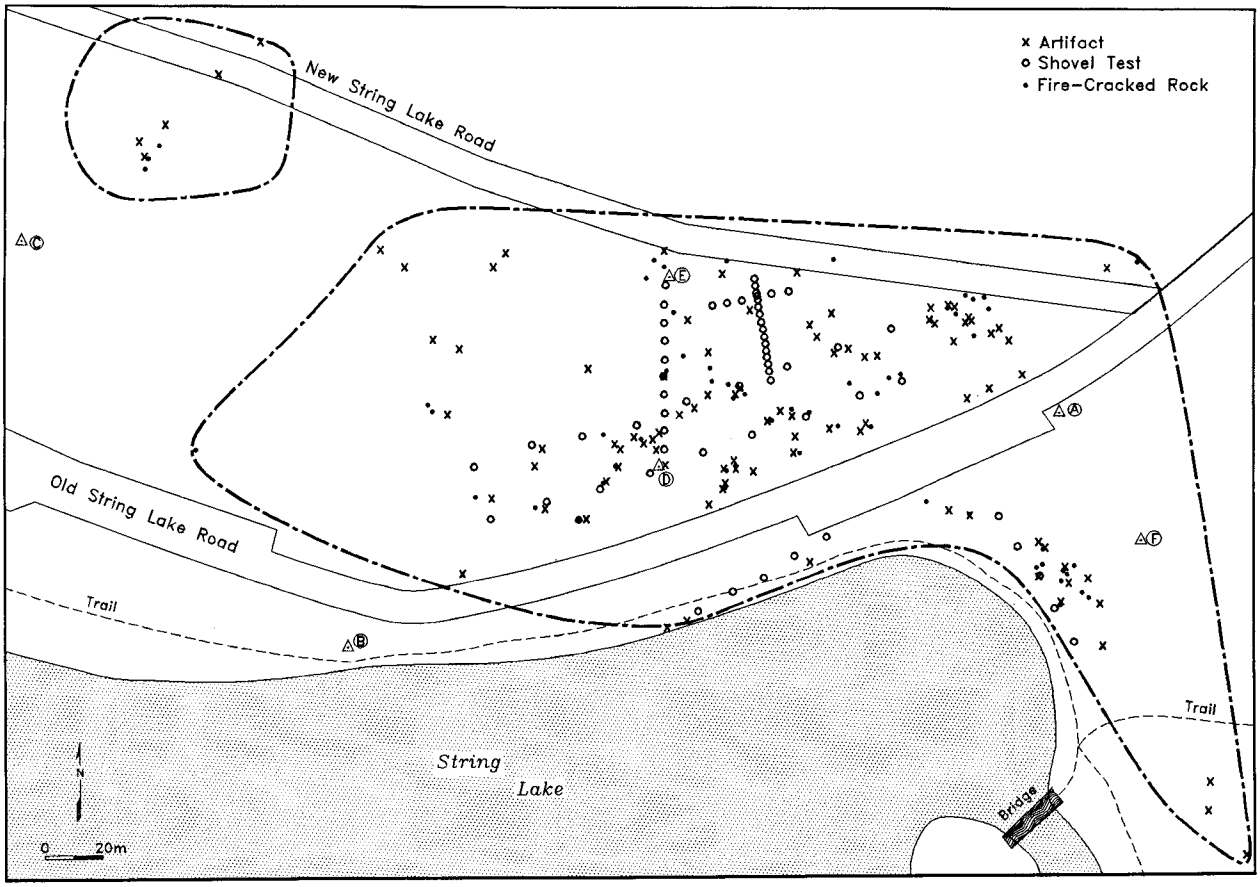


Figure 3. Map of site 48TE412.

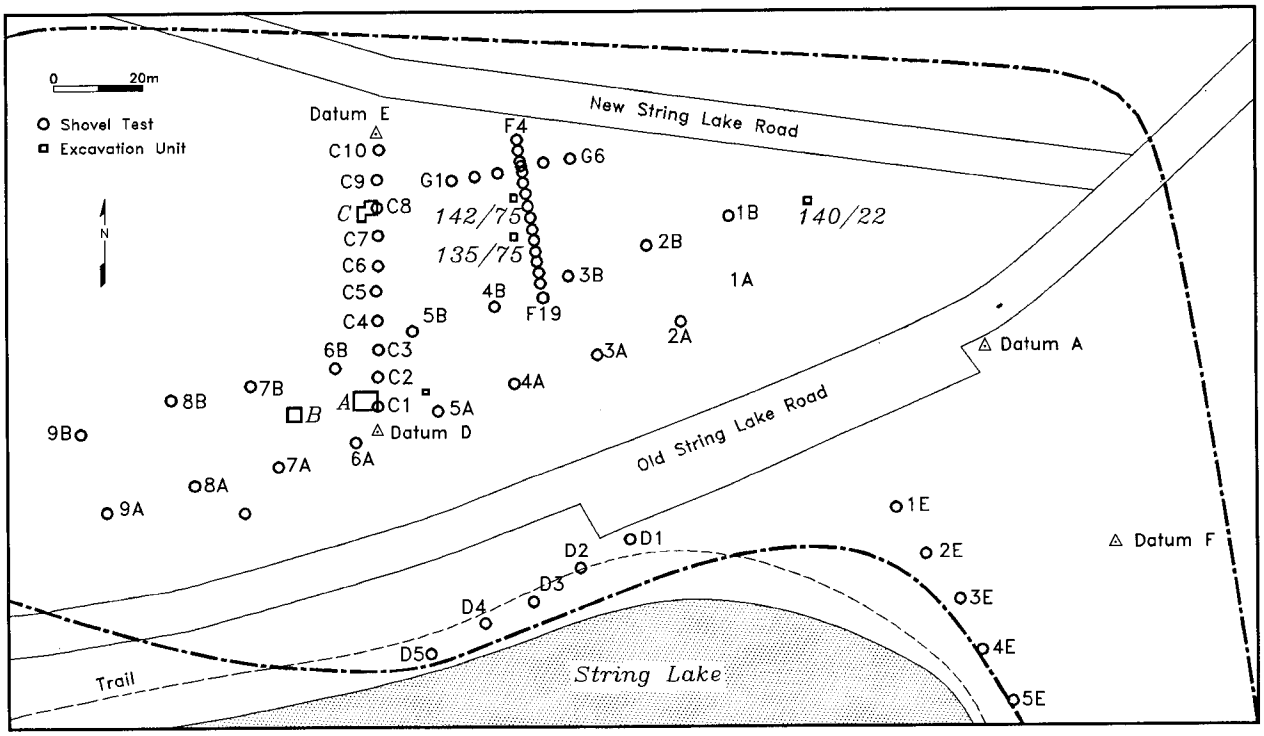


Figure 4. Site map showing the location and orientation of shovel tests at 48TE412.

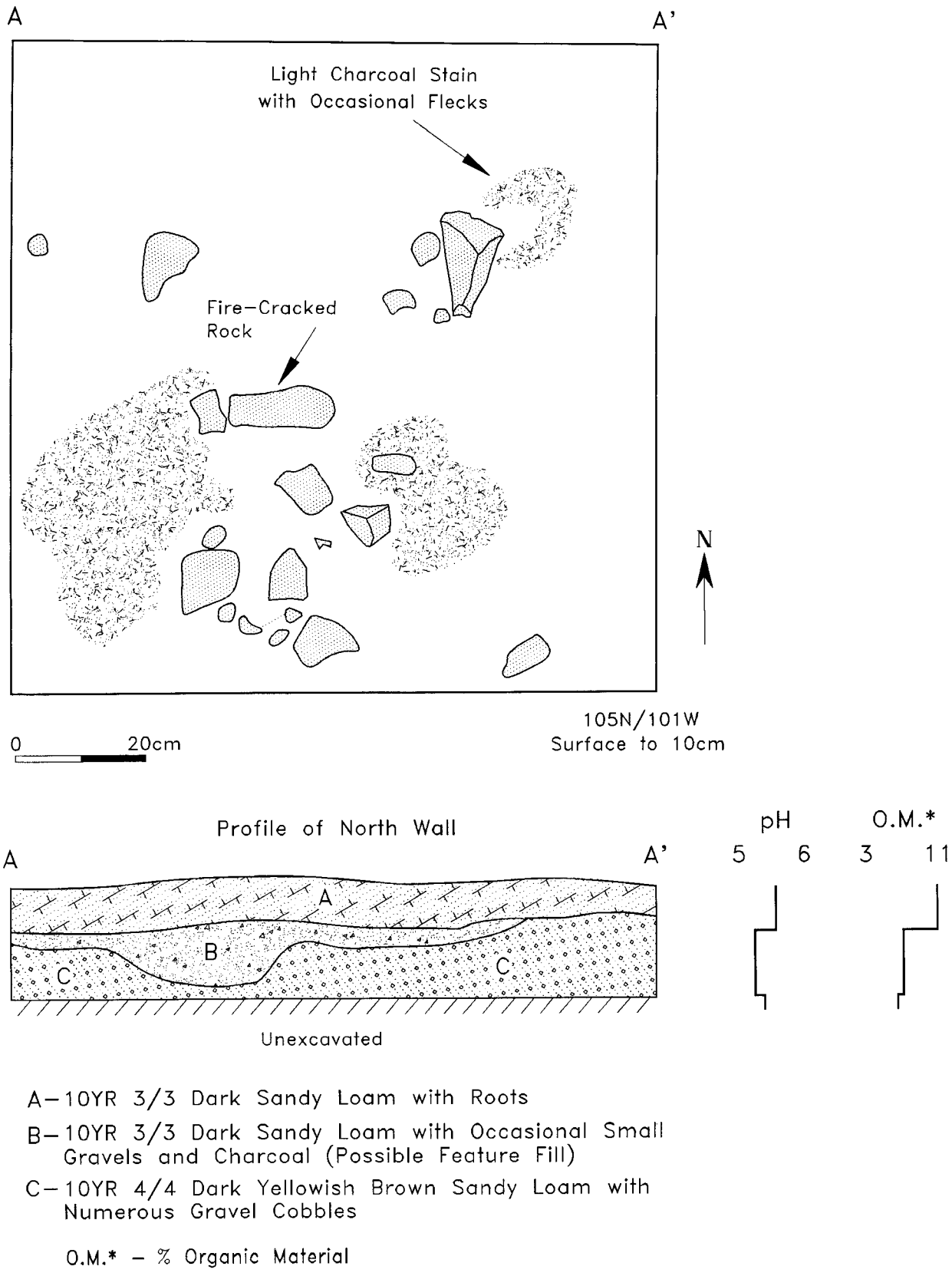


Figure 5. Surface map of unit 105N/101W and the north profile cross section of Feature 1.

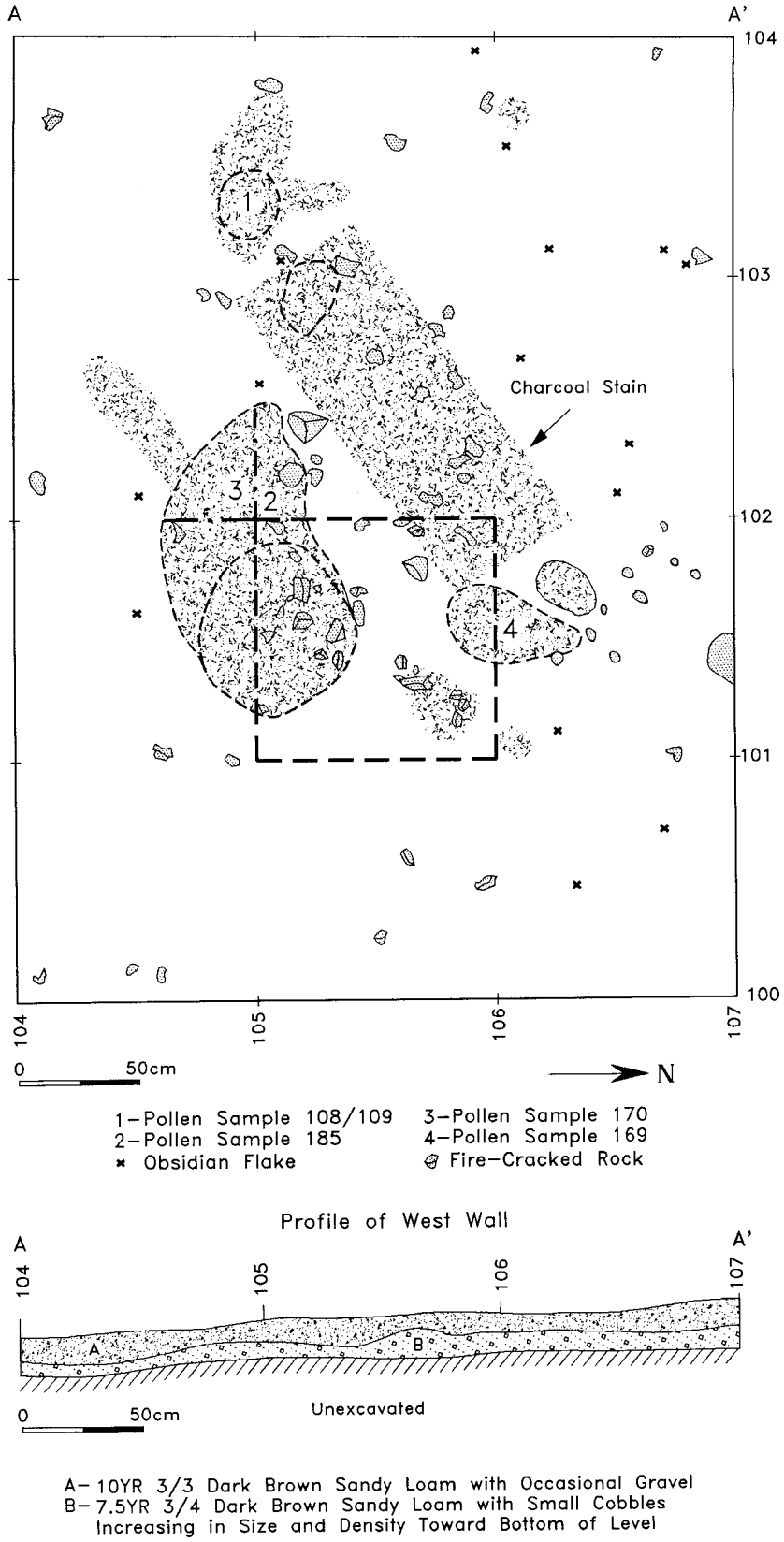


Figure 6. Composite map of Excavation Block A and profile of the west wall of the excavation.

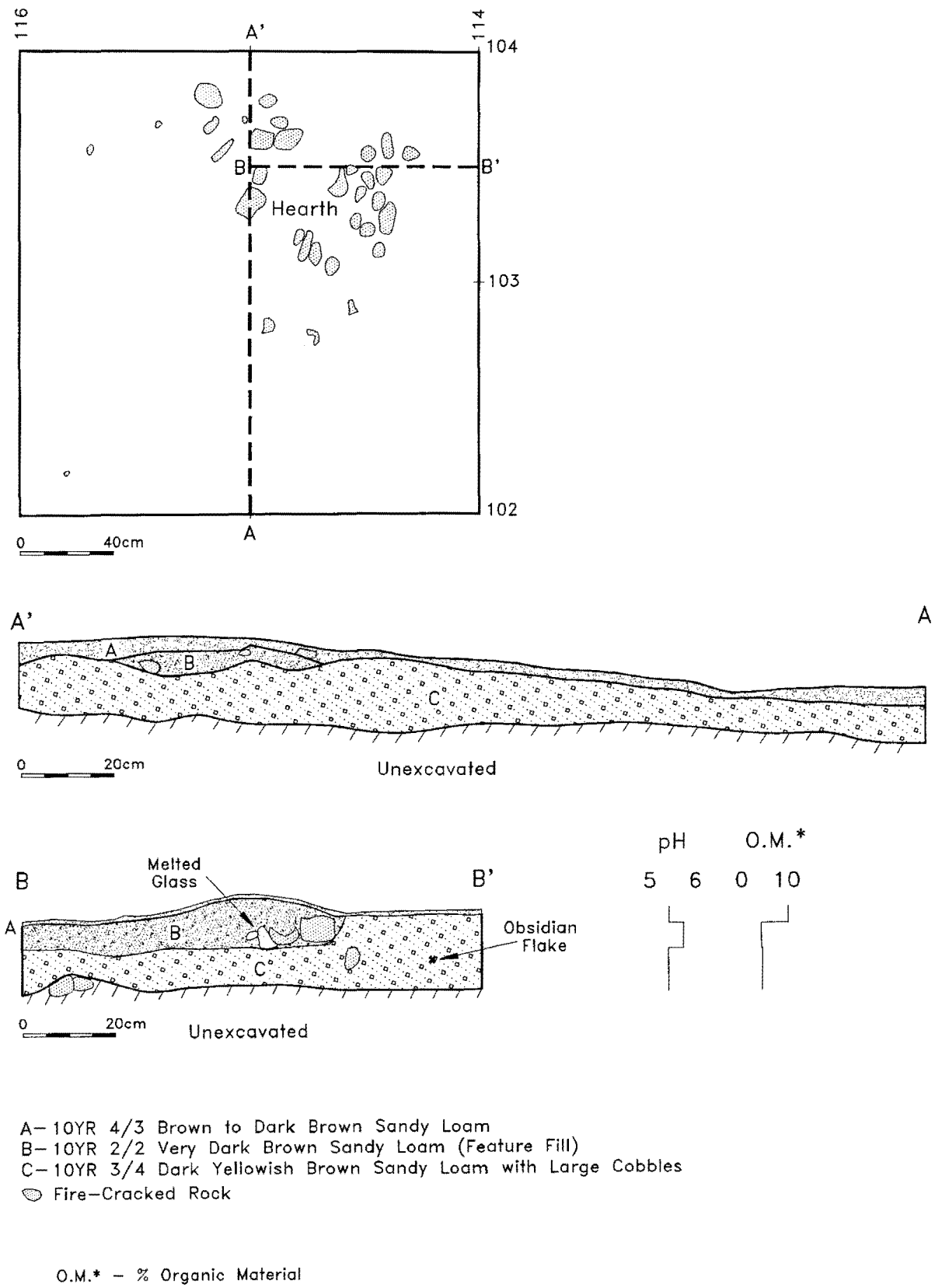


Figure 7. Composite map of Excavation Block B and profiles showing the cross section of the hearth and the west wall of the excavation block.

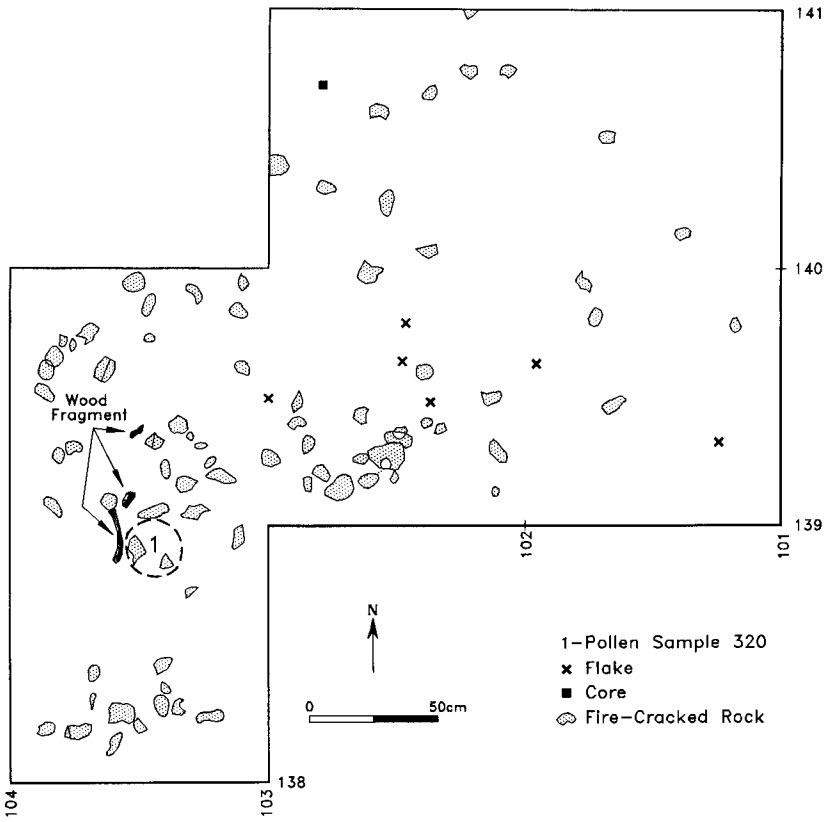


Figure 8. Composite map of Excavation Block C.

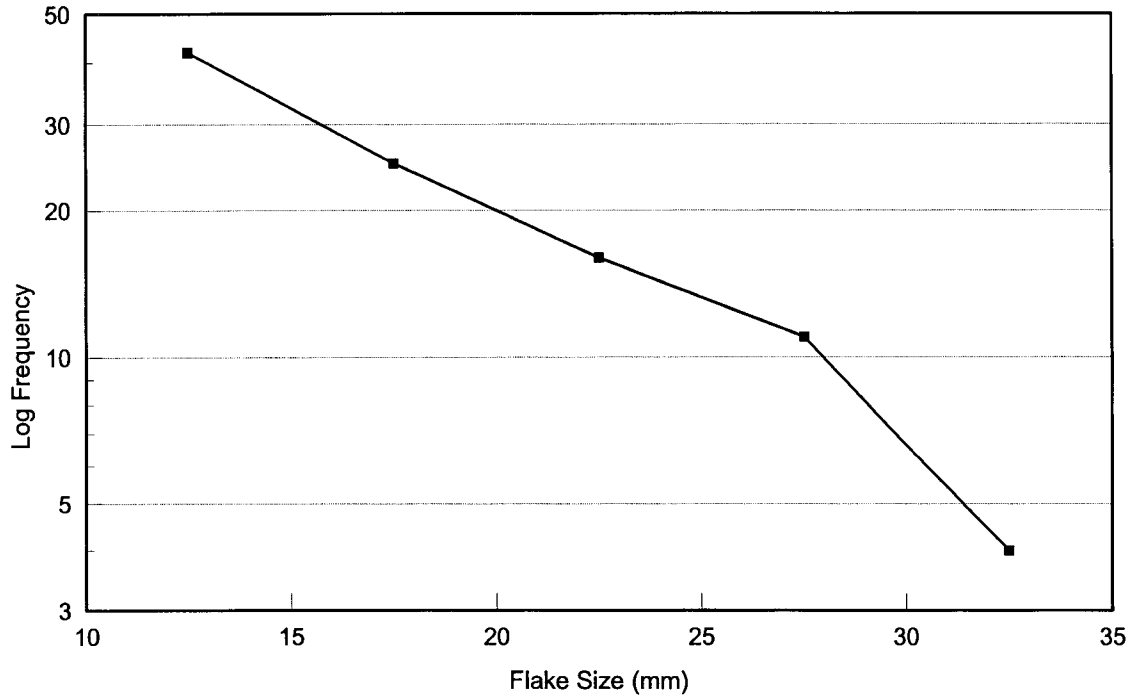


Figure 9. Log frequency of obsidian flake size distribution at 48TE412.

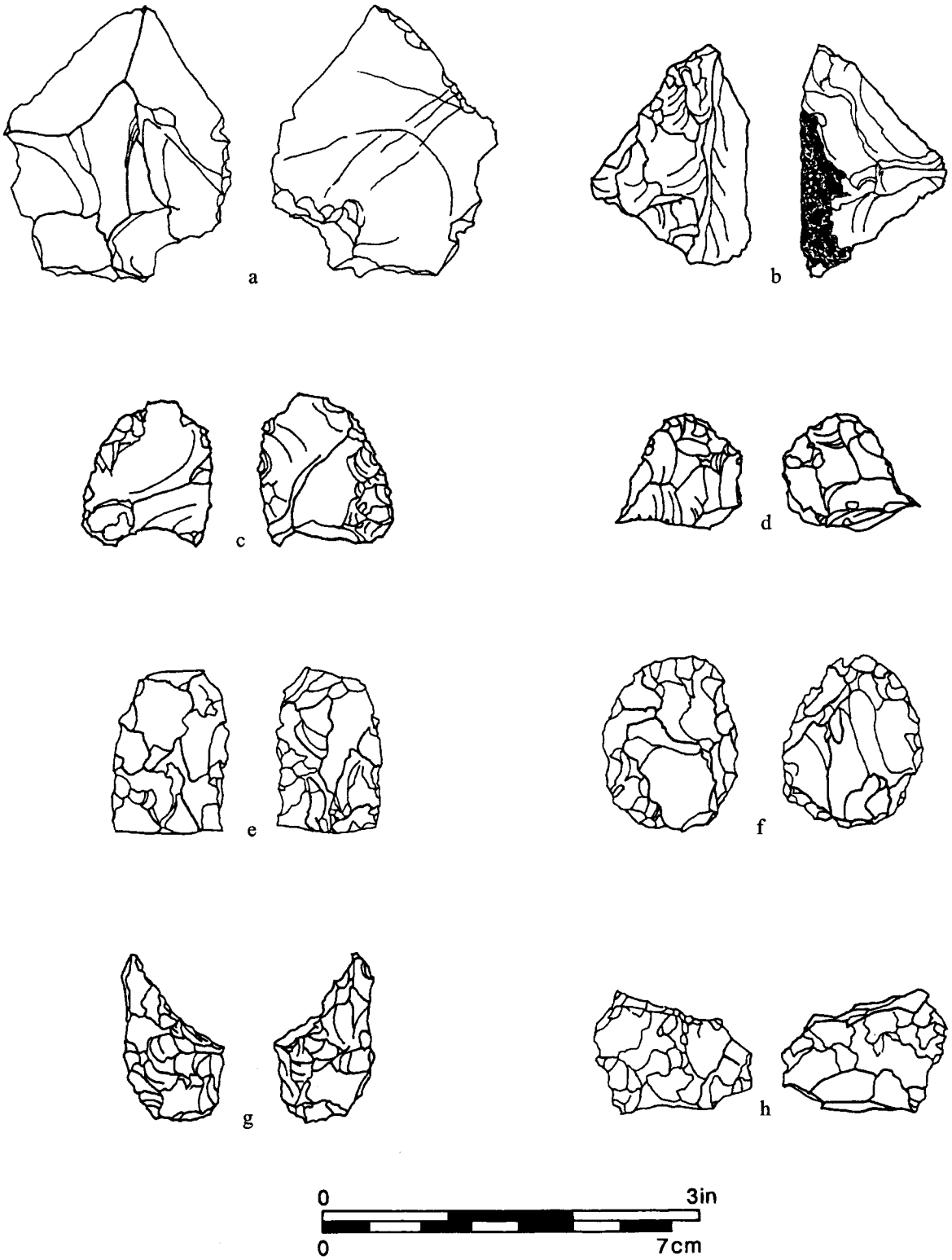


Figure 10. Lithic artifacts representing biface production stages: (a) Stage I, FS 412-299; (b-d) Stage II, FS 412-003, 293, 080; (e-g) Stage III, FS 412-302, 010, 093; (h) Stage IV, FS 412-164; (i-n) Stage V, FS 412-210, 046, 208, 050, 002, 264.

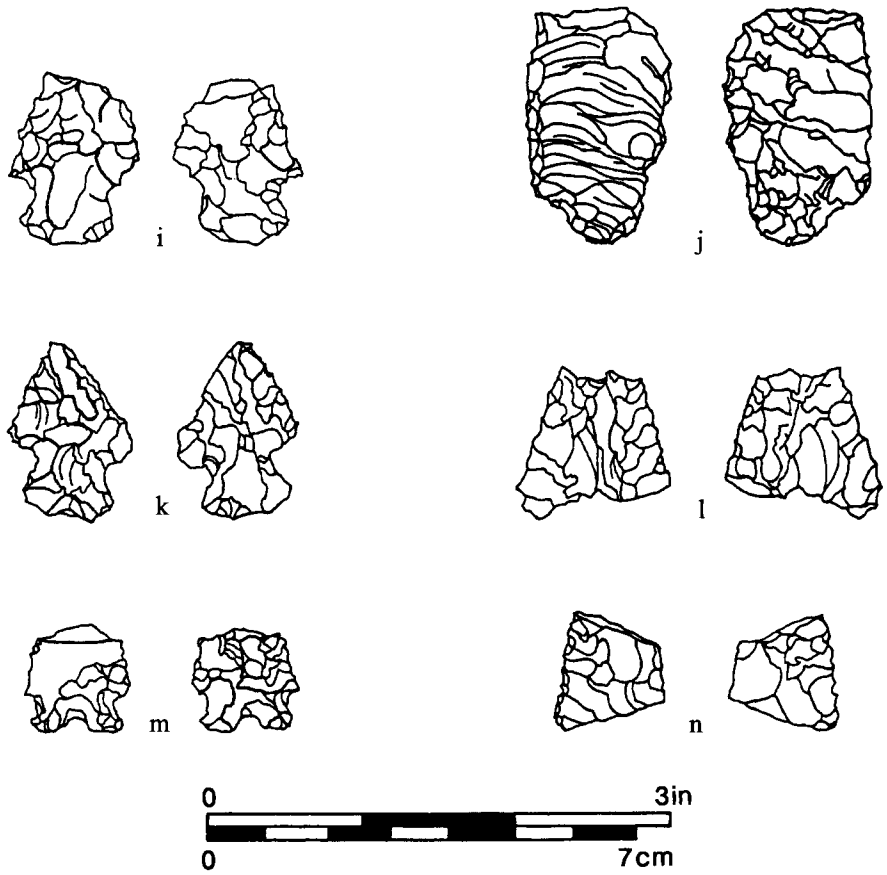


Figure 10, continued.

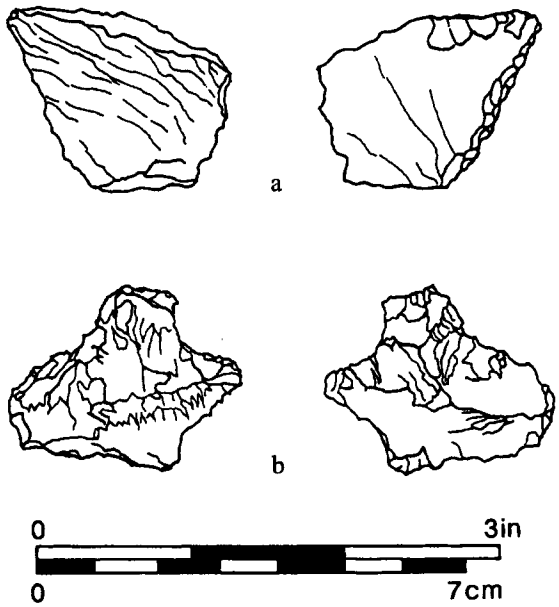


Figure 11. Lithic artifacts: (a) worked quartzite flake tool, FS 412-117; (b) multiple-use chert tool, FS 412-147.

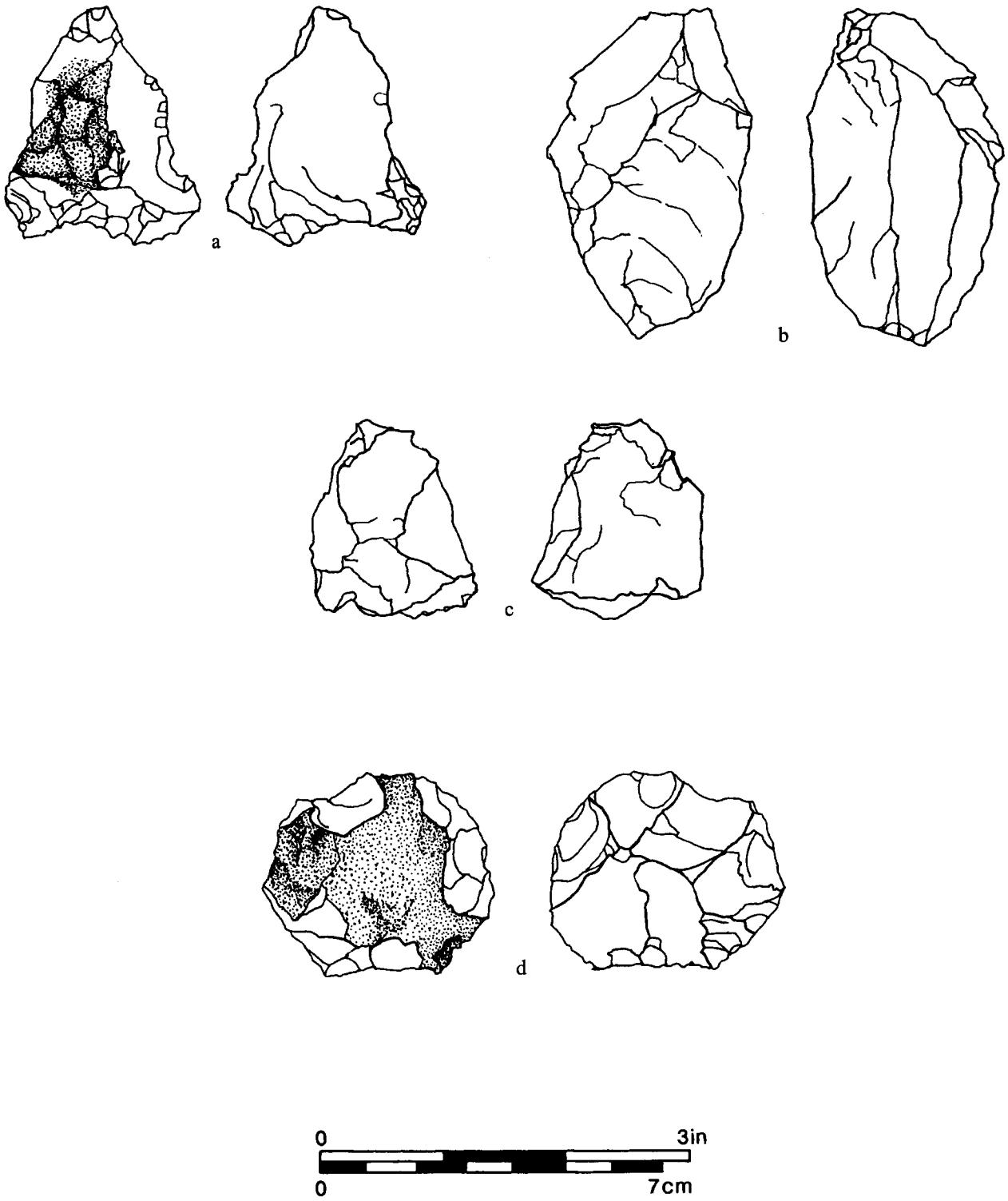


Figure 12. Cores: (a) chert, FS 412-155; (b) bipolar quartzite, FS 412-191; (c) bipolar quartzite, FS 412-291; (d) obsidian, FS 412-160; (e) bipolar quartzite, FS 412-074; (f) chert, FS 412-033; (g) bipolar quartzite, FS 412-327; (h) bipolar quartzite, FS 412-117.

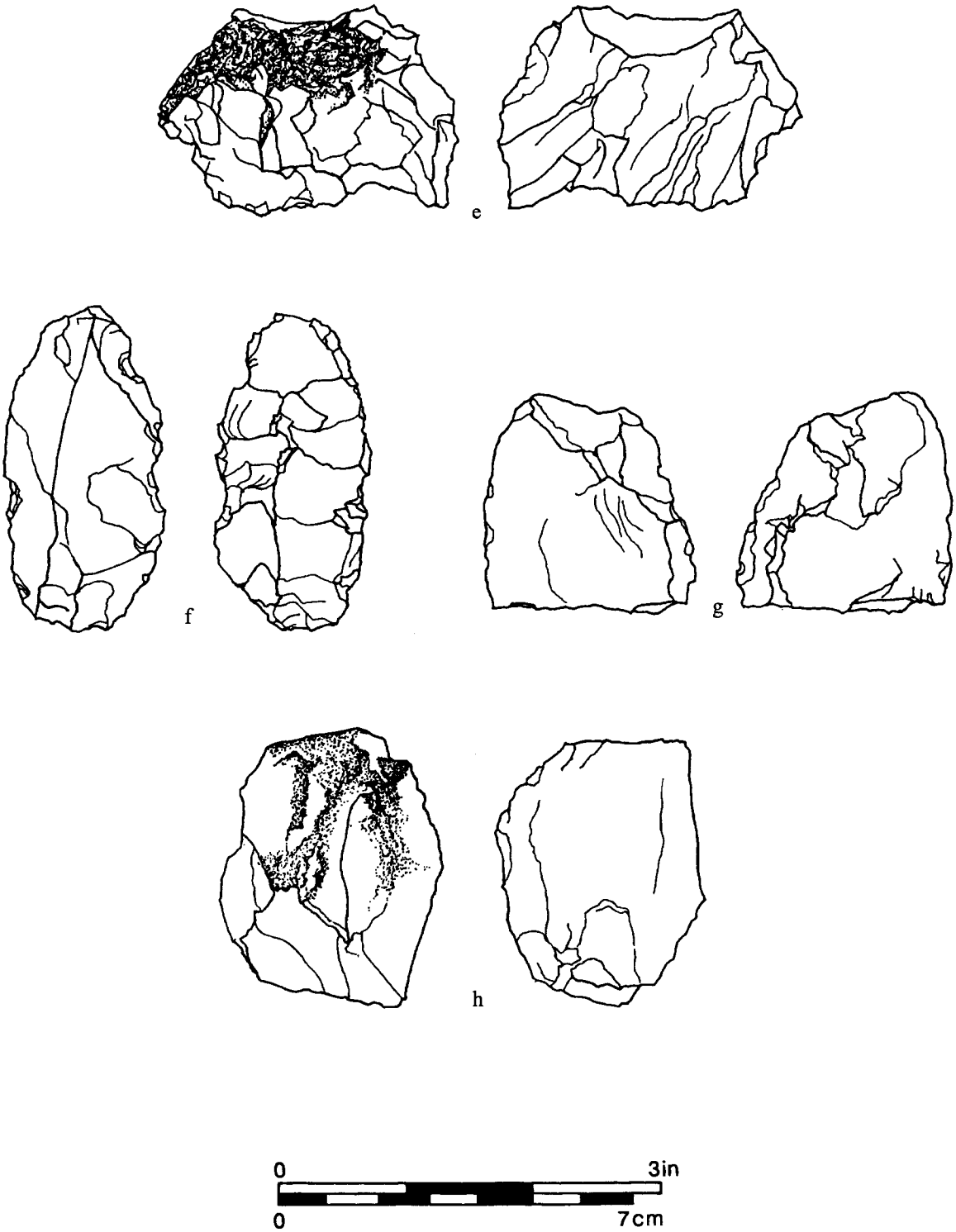


Figure 12, continued.

## REPORT CERTIFICATION

I certify that "Archeological Investigations at Site 48TE412, String Lake, Grand Teton National Park, Wyoming: By James V. Winfrey

has been reviewed against the criteria contained in 43CFR Part 7 (a)(1) and upon recommendation of the Regional Archeologist has been classified as

available.

William W. Schenk
Regional Director

7/26/94
Date

Classification Key Words:

"Available"–Making the report available to the public meets the criteria of 43CFR 7.18 (a) (1).

"Available (deletions)"–Making the report available with selected information on site locations and/or site characteristics deleted meets the criteria of 43CFR 7.18 (a)(1). A list of pages, maps, paragraphs, etc. that must be deleted for each report in this category is attached.

"Not Available"–Making the report available does not meet the criteria of 43CFR (a)(1).