ACKNOWLEDGMENTS

This is the final report to the Oregon State Department of Transportation, Highway Division, of archaeological investigations conducted at Stinkingwater Pass by the Oregon State Museum of Anthropology, University of Oregon.

We all owe a debt of gratitude to the enlightened Highway Division which supported this work from start to finish and cooperated to the fullest with us in making it a success.

In large part the success of this project is due to a truly excellent field crew, which included Doug Bryant, Joan DeCosta, Jim Dodge, Judy Gerrard, Eric Gibson, Linda Goddard, Linda Kent, Jon Loring, Rick Minor, Ken Schoenberg, and Kathy Toepel. Special decorations for bravery are due to those crew members who worked at Stinkingwater Pass in March, 1976, during some of the most brutal weather conditions I have ever experienced in the field.

Thanks go to Eric Gibson and Mark Roe for labelling and cataloguing the artifacts. Jim Farwell did an excellent job of photographing the artifacts for this report and of drafting many of the maps and figures. Jim Wilde drafted many of the remaining maps and figures, and Bob Spear came to my aid when I needed a quick touch-up of Figure 17. Lee Spencer painstakingly sketched all of the projectile points in figures 19 through 21. Phyllis Wells patiently typed two complete drafts of the manuscript, including the final copy.

Finally, I salute David Cole, whose leadership as the original Principal Investigator for the project was instrumental in launching it back in 1975 and in moving it forward through 1976. Mr. Cole also took the photographs in Plate 2, bottom.

Richard M. Pettigrew, November 1978
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INTRODUCTION

Archaeological investigations at sites found in the survey of the Buchanan-Stinkingwater Pass Section of U.S. Highway 20, in Harney County, Oregon, were carried out under a contract between the Highway Division of the Oregon State Department of Transportation and the University of Oregon Museum of Natural History (MNH). The purpose of the work was to salvage as many data as possible from those sites which might have been damaged by construction of the proposed highway relocation project.

The Principal Investigator for the project under the contract with the Highway Division was David L. Cole, Curator of Anthropology, MNH. Richard M. Pettigrew, Research Associate and Survey Archaeologist for Highways, MNH, directed the field work for the salvage phase of the project, performed the laboratory analysis and prepared this report.

The original archaeological survey of the project area was done by MNH personnel on May 18, 23, and 24, 1975 (Cole, Mack and Henn 1975). Thirteen sites were found during the survey, 11 of which were recommended for some salvage work. One of these, 35 HA 64, is in an area where construction was not immediately scheduled; thus, salvage at that site has been postponed to a later date. The remaining ten sites, 35 HA 66, 67, 68, 69, 70, 71, 72, 74, 75, and 76, are those investigated by the salvage project reported here.

The first phase of the salvage operations was done during March 20-28, 1976, with a total work force, including the director, of nine people. At this time systematic surface collection was done at all ten sites, and one-meter test squares were dug at six sites.

The second phase of the salvage work was during June 14-23, 1976, with a work force of seven people. A general surface collection for formed artifacts was carried out at four sites, three test holes were dug into one site with a soil auger, and larger-scale excavations were performed at two other sites.

The cultural debris collected from the project area was labelled and analyzed during the autumn and winter, 1976-77, at MNH, Eugene, Oregon, where this material is permanently deposited.

THE SETTING

The highway project area is located between mileposts 155.7 and 166.4 on U.S. Highway 20, northeast of Buchanan, Harney County, Oregon, in sections 13, 23 and 24 in T. 22 S., R. 33½ E.; sections 3, 4, 5, 7, 8, and 18 in T. 22 S., R. 34 E.; and sections 13, 14, 23, 26, 27, 33, and 34 in T. 21 S., R. 34 E., Willamette Meridian. The project right-of-way extends over Stinkingwater Pass, and varies in elevation from approximately 3700 to 4850 feet above sea level. The highest elevation is at Stinkingwater Pass, and the lowest is at the northeastern end of the project area, adjacent to a small lake called Beede Reservoir (Map 1).

Stinkingwater Pass is situated on the divide between the Harney Basin, a subdivision of the Basin and Range Physiographic Province, to the southwest, and the drainage area of the Malheur River, a part of the Columbia River drainage system, to the northeast. Sites numbered 35 HA 64 through 68 are southwest, and 35 HA 69 through 76 are northeast, of Stinkingwater Pass.

The project area is within the region geologically mapped by Greene, Walker and Corcoran (1972). The earliest geologic deposit of the project vicinity is a rhyodacite of mid-Miocene age (ca. 20 million years old) located in outcroppings one mile northeast of Buchanan. Most of the bedrock visible in the project area is classified as basalt and andesite, overlying the rhyodacite and ranging in age from mid-Miocene to early Pliocene (ca. 12 million years old). Tuffaceous sedimentary rocks are locally interbedded in this deposit, and a thick layer of fine-grained hyalobasalt, a good material for the manufacture of flaked stone tools, is visible in the southwestern portion of the project area (southwest of milepost 138). A late Miocene deposit (ca. 15 million years old) of pumiceous sedimentary rocks is located at Stinkingwater Pass. An early Pliocene deposit of ash-flow tuff is visible in a small area around milepost 158.5. The only Recent sediment seen in the project area, not mapped by Greene, Walker and Corcoran (1972), is a lacustrine deposit encountered in the excavation of Site 35 HA 76, adjacent to Beede Reservoir near the northeastern end of the project right-of-way.
Map 1. Stinkingwater Pass Vicinity, with Locations of Archaeological Sites.
The Stinkingwater Pass area has a dry, continental climate. Mean annual precipitation is less than 30 cm, the average January daily minimum temperature is between -9° and -11° C, and the average July daily maximum temperature is above 31° C (Franklin and Dryness 1973:39-41). This climatic pattern has fostered the growth of a vegetational regime termed Shrub-Steppe by Franklin and Byrnes (1973:234-47), dominated by sagebrush (Artemisia sp.). The only trees growing in the project area are juniper (Juniperus occidentalis) growing in small groves on the east sides of several ridges. The densest of these groves is located in the excavated area of Site 35 HA 69.

A major constraint on the animal population of the project area is the availability of water (Thompson, Hattan, Fortune, and Hutchison 1968:8-10). There are no permanent streams within the area, the closest one being Stinkingwater Creek, two miles east of the north-eastern end of the right-of-way. There is one spring adjacent to the right-of-way, Big Pipe Spring, located at milepost 163.6 at Site HA 72. In the summer, wildlife must depend upon this spring and remnant pools of water left over from winter precipitation.

Large mammals which may occasionally be present in the project vicinity include deer, pronghorn antelope and elk. Of these, elk are probably the least likely to be seen, since the nearest area where they are commonly hunted is near Silvies, 30 miles to the northwest (Thompson, Hattan, Fortune, and Hutchison 1968:9).

ETHNOGRAPHIC BACKGROUND

Stinkingwater Pass is near the northern margin of the area inhabited by the Northern Paiute, or Paviotso. The Paviotso band said to have lived at the heads of the Silvies and Malheur Rivers, and, by inference, around Stinkingwater Pass, was the Vadatoka (Stewart 1939). Paviotso people had a wandering way of life, dominated by the need to move from place to place in order to collect food resources as they became available in different ecological zones throughout the year. Seldom was it possible to gather a large group of people together for a long time, for this required a surplus of food which was not often obtainable. Foodstuffs used included roots such as camas and bitter-root, and a wide variety of seeds and fruits. Among the mammals hunted were antelope, elk, deer, bison, rimrock sheep, and rabbit. Other animals used for food were fish, waterfowl (of which vast numbers flock around Malheur Lake each year), and insects. Although occasionally some of these food items could be very abundant, they lacked the dependability of a regularly harvested staple such as salmon of the Columbia River (Spencer, Jennings et al. 1965:273-82).

The boundary between the areas inhabited by the Paviotso on the south and the Sahaptin whose cultures clustered about the Columbia River to the north is not a clear one. Despite the attribution of the upper reaches of the Malheur River to the Vadatoka, there is good evidence that the Cayuse and Umatilla of the Columbia Plateau traveled to the Malheur River to harvest the salmon run, at least in the 19th and early part of the 20th centuries (Suphan 1974b:166; Theodore Stern, personal communication). It is not known whether this was the pattern in earlier times. It is, however, possible that the drainage area of the Malheur River was used as much by Sahaptin as by Paviotso people in pre-contact time.

It is also important to note that there is good evidence that the Paviotso are relatively recent arrivals in southeastern Oregon. Glottochronological analysis suggests that the time of divergence between Paviotso and other Numic languages (Ute-Chemehuevi and Shoshone) is only about 1000 years (Hale 1958). Many students of this problem believe that the Paviotso migrated into Oregon from the south approximately 1000 years ago from somewhere in southeastern California or Arizona (Lamb 1958, Gunnerson 1962, Hopkins 1968, Goss 1968). Others, on the basis of archaeological data, feel that the ethnographic distribution of Numic speakers is many thousands of years old (Swanson 1966, Corliss 1972), and even linguists are not in agreement on the degree of difference among the Numic languages. There is, nevertheless, the distinct possibility that some cultural group other than the Paviotso inhabited southeastern Oregon prior to 1000 years ago; that group may have been Sahaptin.
PREVIOUS ARCHAEOLOGY IN ADJACENT AREAS

The two basins separated by the Stinkingwater Mountains, the Harney Basin to the southwest and the Malheur River Basin to the northeast, are not well understood archaeologically. Of the two, more archaeological work has been done in the Harney Basin, all of it within the last five years. The Field School in Archaeology of the Malheur Environmental Field Station, directed by Thomas M. Newman of Portland State University, has been conducting a general archaeological survey in the Malheur National Wildlife Refuge since 1972 (Newman, Bogue, Carley, McGilvra, and Moretty 1974). This program has also included some excavation, most of it yet unreported. The survey has recorded 148 sites in or near the Refuge, including burial, pictograph, petroglyph, housepit, rockshelter, and open sites.

The only other site excavations recorded for the Harney Basin are those conducted by John Fagan of the University of Oregon at sites 35 HA B (Hogwallow Spring) and 35 HA 9 (Blitzen Marsh), both on the Donner und Blitzen River south of Malheur Lake (Fagan 1973, 1974). The Hogwallow Spring Site was interpreted as a temporary camp site used for the exploitation of marsh resources and occupied within the last 5000 years. The Blitzen Marsh Site is considered to be a village site, with one house floor C-14 dated at 930 ± 150 B.P. (Gak-3297) and 1110 ± 80 B.P. (Gak-3299) Fagan 1973:94-95. The site is believed to have been used during the last 7000 years, as inferred from the artifact types found there.

One other site in Harney Basin has been intensively investigated, though no excavations were conducted. This is the Riley Site, an obsidian quarry-workshop area several miles southwest of Riley, Oregon (Atherton 1966). Archaeological surveys accomplished thus far include the original survey of Stinkingwater Pass (Cole, Mack and Henn 1975), an extensive survey of the area around Glass Butte by the University of Oregon (Mack 1975), and the survey of the Peterson Ranch-Lake County Line Section of Highway 395 by MNH (Pettigrew and Cole 1977).

The Malheur River Basin has been even less intensively investigated than the Harney Basin. The first survey was done by Douglas Osborne of the Smithsonian Institution River Basins Surveys in 1948, at the proposed Bully Creek Reservoir west of Vale, Oregon (Osborne 1948), and the result was the discovery of three small sites. This reservoir area was surveyed again in 1961 by David L. Cole of MNH, who found two sites (Cole 1961). The third and final investigation of the Bully Creek Reservoir area was done by Thomas M. Newman of Portland State College. Five additional sites were found in the area by Newman, and excavations were carried out at six sites, all of which were interpreted as flaking stations and hunting camp sites used within the past 1000 years by Paviotso people (Newman 1964).

The most recent archaeological surveys in the drainage area of the Malheur River are those of a proposed Bureau of Land Management geothermal leasing area in the Vale area by Mack (1975) and by Rubelmann (1975).

The only site known to have been excavated in the Malheur River Basin within 35 miles of Stinkingwater Pass is Juntura Cave (35 ML 2), located three miles northeast of Juntura, Oregon, on the Malheur River. The site was excavated by John Wells of the University of Oregon in 1957 (Wells 1959), and a very small sample of artifacts was recovered. On the basis of the meager evidence, Wells proposed that the site was first used between 7500 and 4000 B.P., and only sporadically since then.

The most recent excavation in the Malheur River Basin was conducted by a field training class in archaeology from Treasure Valley Community College, led by Edward T. Long, at the Moore Ranch Site (35 ML 66), four miles west of Vale, Oregon (Long, ed. 1974). A large sample of projectile points and grinding stones was recovered from the site, but little interpretation is attempted in the report. Nearly all of the projectile points illustrated, however, have broad necks, a characteristic which suggests that the site is somewhat older than 2000 years (Pettigrew 1977).
METHODOLOGY

The physical setting of the Stinkingwater Pass vicinity is similar to that of other mountainous regions of the Great Basin, and poses problems to the archaeologist that require for their solution the use of several different methods of data collection. First and foremost, because the major mode of deposition in the area is colluvial and because the dry, continental climate discourages the growth of dense vegetation, soil development is very slow and soils in most places are quite shallow. Frequently, as a result of modern alterations such as the construction of roads and highways and overgrazing, drainage patterns have been changed and sod stabilizing the soil surface has been damaged, allowing erosion to remove the topsoil.

There are special areas in the vicinity of Stinkingwater Pass, and presumably also in other places in the Great Basin, where deposition has been more rapid than elsewhere and where erosion has not taken a heavy toll. Stream terraces near the bottoms of deep, sheltered canyons can have deep, well developed soils protected by a cover of Juniper trees and brush. These may even be stratified as a result of alluvial and colluvial deposition. Areas around springs also can have deep soils protected by a relatively dense cover of vegetation. Lake shores in many cases also may have deep soils, but often the vegetation cover is not enough to prevent aeolian erosion of the sands and silts commonly found there. Finally, the lee sides of ridges in mountainous areas are sometimes rather densely forested, with deep soils formed in colluvial and aeolian deposits.

The existence of so many different kinds of potential site locations, with their different conditions of soil deposition, formation, depth, and protection, calls for the application of different modes of archaeological data collection. From this standpoint, there are two kinds of archaeological sites: those with soils formed where there was significant deposition at the time of or since the occupation of the site, whether deposition is ongoing or has ceased; and those with soils formed where no significant deposition has taken place during or since the time of human habitation, or where the soil has eroded away.

The first of these two site types can be expected to have a vertical structure, in which elevational differences between specimens or features at the same horizontal location should have temporal significance. At these sites, the vertical structure, as well as the horizontal structure below the surface, can be investigated only by standard excavation methods. The second of the two site types (those with no deposition) has no true vertical structure, even though some cultural debris may be buried, since any vertical displacement of specimens at such a site is caused, not by the deposition of earth, but by agents of soil disturbance, such as burrowing rodents and tree roots. Samples of cultural debris may be obtained at these sites by excavation, but this method cannot be expected to collect data about anything other than horizontal site patterning, since there is no vertical structure. A much faster and more efficient way to investigate the horizontal structure at such a site is by systematic surface collection, a method consisting of the collection of 100% of the surface cultural debris in each of a number of selected squares in a gridded area.

The methods used in investigating the sites found in the Stinkingwater Pass project area were selected according to the conditions found at each site, with the major goal the gathering of as many data relating to the vertical and horizontal structure, as well as the largest sample of diagnostic artifacts (especially projectile points), as possible with the amount of time and money available. Systematic surface collection of gridded squares was done at those sites and site areas where no vertical structure could be discerned. Since 100% of the cultural debris from each square was collected, the data can be analyzed for information on the horizontal arrangement or pattern of artifacts and other debris at the site, and the density of different kinds of artifacts or raw materials can be compared from site to site with no fear of collector bias.

At those sites where the systematic surface collection resulted in a sample of diagnostic artifacts insufficient for inter-site statistical comparison, and where it could be reasonably expected that additional surface collection might significantly increase the sample of diagnostic artifacts, a general surface collection was undertaken, without a grid or other means of recording horizontal provenience, for the specific purpose of collecting diagnostic artifacts. This method of surface collection requires only a very small investment of time and often results in a substantial body of data, but, because it results in the loss of information about precise horizontal provenience, it was used only at those sites where systematic collection had already been done and the site was threatened by construction activities.
In those cases where a true vertical site structure was considered to be possibly present, test excavations were carried out. These consisted of one or more small (usually one meter) squares excavated to the bottom of the cultural deposit. Only at those sites where the test pits showed the existence of significant subsurface cultural deposits was more extensive excavation undertaken. It was hoped that the sites selected for the more extensive excavation would provide a large sample of cultural items, as well as significant information on the horizontal and vertical structure.

THE SITES

35 HA 66

This site consisted of a surface scatter of flaked debris on a low ridge, about 250 meters west of Pine Creek Road (Map 2), in an area bisected by Highway 20 (see Plate 1, top). The portion of the site within the right-of-way had a surface of deflated gravel with occasional mounds of remnant soil. North of the right-of-way, along the same ridge, the soil was mostly still intact. It was decided, however, to concentrate on the area within the right-of-way.

Accordingly, on March 27, 1976, two collection transects, both ten meters wide, perpendicular to each other in a cross pattern, were laid out north of the road cut. Ten squares, all 10 by 10 meters, were surface-collected. Also, a general sample of debris from the area south of the road cut was collected from the surface. No excavation was attempted, since it was clear that there had been no deposition of soil in the area, and the site had only a horizontal structure.

35 HA 67

Located on the western edge of a small valley (Map 3), this site had been crossed by Highway 20, and flaked debris was visible on both sides of the road, on the surface (see Plate 1, middle).

The initial work at the site was done on March 27, 1976. Three one-meter test squares, two southeast and one northwest of the highway, were dug in order to determine the depth of the cultural deposit. Only Test Pit 2, southeast of the road, was dug as deeply as 60 cm below the surface. The other two test squares, Test Pits 1 and 3, were excavated to 20 cm below the surface. In all three test pits, the density of cultural debris diminished with depth, indicating that the cultural deposit was mainly surficial.

In addition to the test excavations, a controlled surface collection was done on the southeast side of the road, and a general surface collection on the northwest side. The controlled collection transects were both 10 meters wide, perpendicular to each other, in a cross pattern. Ten 10-meter squares were collected in all.

On June 18, 1976, a general collection for formed artifacts only was done at the site in order to increase the sample size. Two lots were gathered, one from northwest and one from southeast of the highway.

35 HA 68

Located in an area where runoff has eroded away large portions of the original soil, leaving remnant mounds, this site is situated at the northern edge of a relatively broad valley, primarily at the bottom of the high ridge which bounds the site on the north, but also on the slope leading up to the ridge top (Map 4). Flaked debris was found mostly on the northwest side of the highway, densely scattered about on the surface, especially near the edges of the eroding hillocks, where it had been sorted from the soil by running water (see Plate 1, bottom).

On March 26, 1976, surface-collection and test excavation was done at the site. Ten-meter squares, 24 in all, were laid out in two transects, one 200 meters long and the other, perpendicular to the first, 50 meters long, forming a cross pattern. A single test pit was dug to a depth of 70 cm below the surface. The density of cultural debris in the test pit diminished with depth, indicating that the site was surficial with no vertical structure.
Map 2. Contour Map, Site 35 HA 66.
Map 4. Contour Map, Site 35 HA 68.
Further work at the site, on June 18 and 22, consisted of a general surface collection for formed artifacts and the excavation of three auger holes. In all the auger holes, most of the cultural debris was found in the top 20 cm, and practically none deeper than 50 cm below the surface.

35 HA 69

This site is very long, extending for approximately one kilometer parallel to the highway, but the area of major surface concentration, in the southern half of the site just to the northeast of a low but prominent ridge, is much smaller. This area is about 350 meters long parallel to the road and at least 100 meters wide (see Plate 2, top). Very little debris was found southeast of the highway or in the northeastern half of the site.

Figure 1. Profile, Site 35 HA 69; Coordinates 44-50N, 50W.
Surface-collection and test excavation were done on March 25, 1976. Two surface transects of ten-meter squares, 16 in all, were laid out in a cross pattern (Map 5) in a deflated area approximately 300 meters northeast of the prominent ridge. Here there was very little vegetation, and the density of debris on the surface, while considerably greater than in the area of the site further to the northeast, was found to be much less than in the area just northeast of the ridge, a sheltered area of dense juniper forest (see Plate 2, bottom).

In March, the ground surface in the forested area was covered in most places by 30 to 60 cm of snow, so no estimate could be made of the relative density of debris on the surface. However, a few specimens of flaked stone were found in several spots uncovered by snow, and the forest cover suggested the possibility of some depth to the soil. Therefore, a one-meter test pit was placed in one of the clear spots, and resulted in the discovery of a dense buried deposit of cultural debris. The test pit was dug to 80 cm below the surface, and was stopped because of time constraints without reaching sterile soil.

More extensive excavation of the forested area of the site was done during the period June 19-22, 1976. The spot adjacent to the test pit was selected for the placement of a trench two meters wide and six meters long (according to the coordinate system, 44-50N/48-50W). Excavation revealed that the deposit had a true vertical structure, but no features were found. In the deepest area, 48-49N, 49-50W, controlled excavation went as deep as 1.24 meters below the surface before our time was exhausted. At this point, the density of cultural debris was diminishing but completely sterile soil had not yet been reached. To find out how much deeper the cultural deposit was, and at what depth bedrock was located, an auger hole was excavated in the bottom of this square. The density of cultural debris continued to decrease with depth in the auger hole, until Stratum 2 was encountered at 1.22 meters below the surface (see profile, Figure 1). Auger excavation below that level revealed that Stratum 2 was sterile except in the zone of contact with Stratum 1. Bedrock was reached at a depth of 2.16 meters below the surface (elevation 98.97).

**35 HA 70**

This site is divided into Area 1 (35 HA 70/1), along the banks and a terrace of an intermittent stream at the bottom of a deep, narrow canyon (Map 6; Plate 3, top); and Area 2 (35 HA 70/2), a cluster of flaked debris near the top of a ridge above and northwest of Area 1 (Map 7; Plate 3, bottom).

On March 24, 1978, a general reconnaissance was made in Area 1, in order to find out if a buried cultural deposit might be present. Much of the ground was covered by snow, but enough cultural debris was found eroding out of the terrain on the northwest side of the stream to suggest a buried deposit there. A one-meter test pit was dug into the terrace to a depth of 110 cm below the surface without finding sterile soil, and flaked debris was dense all the way through.

This certain indication of a buried cultural deposit resulted in the decision to invest time at the site in more extensive excavation. Accordingly, excavation was done there during the period June 15-17, 1976. Three two-meter squares were placed on the terrace, designated 44-46N/48-50W, 46-48N/50-52W and 48-50W/50-52W. At its deepest, excavation reached to 1.19 meters below the surface before the work was terminated (see profile, Figure 2). Sterile soil was not reached, so an auger hole was placed in floor of square 44-46N/48-50W in order to determine the depth of the cultural deposit and of bedrock. Excavation of the auger hole stopped when bedrock was struck at 1.86 meters below the surface. The density of flaked debris diminished with depth, but no completely sterile soil was encountered.

The method used at 35 HA 70/2, on the ridge above Area 1, was systematic surface-collection, since it was clear there could be no depth to the deposit, owing to the deflated nature of the soil and the lack of any source for deposition. On March 24, 1976, two transects of five-meter squares were laid out in a cross pattern, and 17 squares were collected.
Map 6. Contour Map, Site 35 HA 70/1.
Contour interval 20 cm
Datum: rock cairn
Elevation 100.00
R.M.P.
3-24-76

Map 7. Contour Map, Site 35 HA 70/2.
Figure 2. Profile, Site 35 HA 70/1: Coordinates 44-46N, 50W.

35 HA 71

This site consists of a rather dense cluster of flaked debris on the surface of a prominent ridge-top through which Highway 20 has been cut (Map 8: Plate 3, top; Plate 4, top). The deflated surface indicated that there was no depth to the deposit, so a controlled surface-collection was undertaken on March 24, 1976, in the portion of the site southeast of the highway. Two transects, both five meters wide, were laid out in a cross pattern, and a total of 13 squares were collected. Also, a sample (possibly less than 100%) was collected between the edge of the road cut and the 30E line, and another sample (possibly less than 100%) in the area 35-60N/35-55E. A general sample was collected also from the area of the site northwest of the road.
Located on the east side of Highway 20, this site is associated with a running spring. The surface of the ground was littered with a light scatter of flaked debris (see Plate 4, middle). Since spring sites often have buried deposits, two one-meter test squares were excavated on March 22 and 23, 1976. One square, 24-25N/27-26E, was dug to a depth of 80 cm below the surface, and the other square, 20-21N/25-26E, only to 10 cm. The deeper of the two squares was placed on a low mound of earth that was interpreted to be a spring deposit, but the expected buried cultural deposit was not found. Instead, the greatest density of debris occurred in the first 20 cm, and rapidly diminished with depth, so that the soil was practically sterile at 60 cm. It was concluded that the site had no true vertical structure.

At the same time as the test excavation, two transects, both five meters wide, were laid out in a cross pattern for a controlled surface collection (Map 9). A total of 16 squares were collected.

A general surface collection for formed artifacts only was done at the site on June 18, 1976, in order to increase the sample of diagnostic specimens.

Located on a broad, relatively low, ridge top that has been cut by Highway 20, this site has a deflated ground surface, and it was judged unlikely that there was any depth to the cultural deposit, which consisted of a cluster of flaked debris on the surface (see Plate 4, bottom). Thus, no excavation was attempted, and work at the site was made up entirely of surface-collection. On March 23, 1976, two transects, both five meters wide, were extended across the portion of the site on the west side of the highway, in a cross pattern (Map 10). Thirteen five-meter squares were collected. In addition, 100% of the surface debris in four larger areas was collected: 0-15N/35-45E, 0-15N/20-30E, 20-45N/20-30E, and 20-45N/35-45E. General samples of debris (less than 100%) were collected also from the area south of ON, north of 45N, and from the east side of the highway.

On June 14, 1976, a general surface-collection for formed artifacts only was done at the site, in order to increase the sample of diagnostic specimens.

Situated on a gentle slope overlooking Beede Reservoir to the northeast, this site consists of a cluster of flaked debris on the surface, mostly on the west side of Highway 20 (see Plate 5, top). The west edge of the site is at the bottom of a steep slope leading up to a high ridge. The soil is stabilized by a vegetation cover dominated by tall sagebrush and grasses. Many angular rocks are on the surface, probably colluvial in origin.

Work at the site took place on March 23, 1976, when two transects, both five meters wide, were laid out in a cross pattern (Map 11). A 100% sample of surface debris was collected from each of the 17 squares. A general sample was also collected from the area south of ON and from the area north of 60 N.

Located on what appears to be the shore of an ancient lake, this site consists of a scatter of flaked debris on the surface, and its greatest density is southeast of Highway 20. The surface slopes gently down toward the northeast, in which direction a small lake, Beede Reservoir, is visible from the site (see Plate 5, bottom). The lake drains into a short tributary of Stinkingwater Creek, part of the Malheur River drainage system.

The topography at the site is not level, but rather there are two raised or mounded places, separated by a low area which was wet at the time of the investigation, March 21-22, 1976. The sagebrush on the mounded spots was taller and more luxuriant than in the low area.
Map 10. Contour Map, Site 35 HA 74.
Map 11. Contour Map, Site 35 HA 75.
A baseline was laid out across the site parallel to the road, at an angle of N27°E, and was set arbitrarily at 30°E in the coordinate system. Two test pits, 35-36N/22-23E and 41-42N/26-27E, both one meter square, were placed on the mounded area nearer to the lake. Another test square of the same dimensions, 0-1N/30-31E, was dug in the second mounded area, further from the lake. In all three squares, the soil was fairly homogeneous silt, possibly lacustrine in origin. In the two pits nearer the lake the amount of rock found was very low, consisting mostly of pea gravel in the sod zone. However, in the square further from the lake and nearer to the slope to the southwest, the amount of rock was much greater, including even some angular cobbles, indicating the greater influence there of colluvial deposition.

In all three squares, the density of cultural debris was greatest in the top five cm, rapidly diminishing below that. Systematic surface-collection thus appeared the best way to gather data from the site. Accordingly, ten squares were laid out along the original baseline, each 15 meters on a side, and 100% of the surface debris was picked up from each.

DESCRIPTION OF CULTURAL DEBRIS

A summary of the artifacts collected during the field work in the project area is presented in Tables 1 (frequency) and 2 (percentage) by site and artifact class. The entire collection, including detritus, has been grouped according to the following classification:

I. Flaked Stone Tools
   A. Bifacially Flaked
      1. Projectile Points
      2. Formed Bifaces
         a. Blanks
         b. Finished
         c. Crescents
         d. Miscellaneous
      3. Drills
      4. Unformed Bifaces
   B. Unifacially Flaked
      1. Flake Unifaces
      2. Cobble Unifaces
   C. Other Flaked Stone Tools
      1. Burins
      2. Pieces Esquillees
      3. Cores

II. Unflaked Stone Tools
   A. Grinding Tools
   B. Percussion Tools
   C. Anvil Stones
   D. Hopper Mortar Bases

III. Unique Stone Tools

IV. Flaked Stone Detritus

I A 1: PROJECTILE POINTS (Figures 19-21, Plates 6-9). The 213 projectile points found are listed in Table 3 according to their frequency by type and site. Table 4 shows the percentages of classifiable points in each type at each site, with the sites listed in the closest approximation to a seriated order.
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Table 4: Projectile Points: Percentages of Types in Sites, Classifiable Specimens Only

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<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
<th>F</th>
<th>G</th>
<th>H</th>
<th>I</th>
<th>J</th>
<th>K</th>
<th>L</th>
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The sample-sizes of classifiable points in Table 4 are not very large, only three sites having more than 20 points. Nevertheless, a pattern emerges from the seriated table: Types A through E are distributed differently from types F through L. Two sites (HA 72 and 70/1) have only Types A through E, and five sites (HA 76, 73, 71, 75, and 70/2) have only types F through L. Furthermore, the two predominant types in the collection, E and F, appear to vary significantly in their percentages: type E tends to increase from bottom to top of the table, and type F tends to decrease in that direction.

The pattern seen in Table 4 depends a great deal on differences in projectile point neck width. The bimodality of neck width in the collection is shown in Appendix A. Types A and C through E are narrow-necked, and types F through I and L are broad-necked. The influence of neck width in the seriated order of sites is shown more clearly in Table 5, in which the sites are ordered according to their relative percentages of narrow- and broad-necked points. Only points with measurable necks were used to construct the table, which means that Types B, J and K are not considered, and that some points unclassifiable by type, but with measurable necks, are included. The correlation between Tables 4 and 5 in the ordering of sites is very high, and there are more than twice as many broad-necked as narrow-necked points in the collection as a whole.

The significance of the patterns shown in Tables 4 and 5 will be discussed in the following chapter.

The distribution of points by raw material is as follows: 198 (93.0%) are of obsidian, four (1.9%) are of cryptocrystalline silica (CCS), four (1.9%) are of dacite obsidian, one (0.5%) is of basalt, and six (2.8%) are of uncertain material. Of the four CCS specimens, two are from HA 71; of the four dacite specimens, two are from HA 74.

<table>
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<th>Neck Width</th>
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<td>19</td>
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<td></td>
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<td>75.0</td>
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<td>25.0</td>
<td>75.0</td>
<td>4</td>
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<td>20</td>
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<td>100.0</td>
<td>1</td>
</tr>
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<td>HA73</td>
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<tr>
<td>Total</td>
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<td>68.6</td>
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</table>
The ranges of length, width and thickness for measurable points by type are shown in Table 6.

The classifiable projectile points excavated from Site 35 HA 69 number 18. The distribution of these points by type and level (not shown) shows no significant changes in relative proportions from the lower to the upper levels. Only two points were found in the excavation of Site 35 HA 70/1. Thus, the projectile points are not of much help in determining the dates for the beginning and termination of occupation at the only two sites in the project area with buried deposits.

<table>
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<th>Width (cm)</th>
<th>Thickness (mm)</th>
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<td>B</td>
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<td>1.4-3.2</td>
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<tr>
<td>C</td>
<td>2.3*</td>
<td>1.3-1.7</td>
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</tr>
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<td>D</td>
<td>2.7*</td>
<td>1.2*</td>
<td>3*</td>
</tr>
<tr>
<td>E</td>
<td>1.6-3.7</td>
<td>0.9-2.3</td>
<td>2-4</td>
</tr>
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<td>F</td>
<td>2.3-5.3</td>
<td>1.5-2.7</td>
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<td>G</td>
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<td>5-6</td>
</tr>
<tr>
<td>H</td>
<td>4.9-6.5</td>
<td>1.4-2.5</td>
<td>5-10</td>
</tr>
<tr>
<td>I</td>
<td>4.1*</td>
<td>1.9*</td>
<td>6*</td>
</tr>
<tr>
<td>J</td>
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<td>4-8</td>
</tr>
<tr>
<td>K</td>
<td>**</td>
<td>1.9*</td>
<td>5*</td>
</tr>
<tr>
<td>L</td>
<td>3.8-4.8</td>
<td>1.2-2.2</td>
<td>4-8</td>
</tr>
</tbody>
</table>

* one measurable
** none measurable

1A2: FORMED BIFACES (Plates 10 and 11a-11d). These are bifacially flaked artifacts, formed into a distinct, regular shape, and not classed as projectile points or drills. They are divided into four sub-groups: Blanks, Finished, Crescents, and Miscellaneous.

a. Blanks (Plate 10). These are shaped, by percussion methods only, into an ovate or foliate outline, with a lenticulate cross-section. They appear to be unfinished, and may be either preforms for projectile points or finished bifacial forms. The length of the only measurable specimen is 4.6 cm. Width varies from 2.4 to 5.2 cm, and thickness from 4 to 13 mm. All but one item are fragmentary. Of the 16 specimens, 12 are made of obsidian, three of cryptocrystalline silica (CCS), and one of dacite obsidian.
b. Finished. These are nearly the same as the blanks, with the difference that they are pressure flaked in addition to the primary percussion flaking, and they are generally smaller than blanks. There are nine specimens, none of which are measurable for length because all are fragmentary. Width ranges from 1.9 to 2.8 cm, and thickness from 5 to 11 mm. Five specimens are obsidian, three CCS, and one dacite obsidian.

c. Crescenta (Plate 11a-11b). This is a traditional class in Great Basin archaeology. Both specimens are fragmentary enough that their placement in this class may be questionable, but they nevertheless appear to be crescents. Widths are 2.3 and 2.4 cm, and the thicknesses are both 6 mm. One (from Site HA66) is obsidian, the other (from HA68) CCS.

d. Miscellaneous (Plate 11c-11d). In this category are placed specimens not fitting any of the other sub-groups, or not deserving special mention because of unique characteristics. Specimen HA70-Loc3-surf-3 (Plate 11d) is complete, is made of basalt, and has an ovate outline, with overall dimensions of 8.2 by 5.9 by 1.6 cm. One face is heavily patinated, with the exception of some relatively recent flake scars. It is formed by percussion flaking only, and a portion of one side-edge has been retouched into a Type 9 uniface edge (see I B 1: flake Unifaces, below).

Specimen HA74-Loc5-surf-2 is complete, made of obsidian, formed into a discoid from a corticidal flake by crude percussion flaking all around the edge, and has overall dimensions of 5.7 by 3.0 by 1.3 cm.

The distribution of formed bifaces by sub-group and site (not shown) indicates no significant pattern discriminating one site from another.

I A 3: DRILLS (Plate 11e-11k). This is a traditional class, defined here as pointed bifaces with constricted distal ends. Of the 10 specimens, six are made of CCS and four of obsidian. The width of the drill bit varies from 3 to 21 mm, though nine of the ten specimens measure 10 mm or less. The thickness of the bit varies from 2 to 13 mm, though nine of ten specimens measure 6 mm or less. The only complete specimen (HA71-Loc3-surf-10) has a tiny bit on the end of a modified flake. The others are all broken on the distal end, proximal end, or both. Two specimens may be modified projectile points. Obsidian specimens tend to be smaller overall than those made of CCS.

I A 4: UNFORMED BIFACES. These are bifaces whose outlines are irregular or unrecognizable. Some are apparently pieces with a bifacially flaked edge intended only for a temporary use. Others may be fragments of unfinished bifaces or blanks. Of the 31 specimens, 19 are made of obsidian, seven of CCS, three of hard igneous stone, and two of dacite obsidian.

I B 1: FLAKE UNIFACES. This class consists of flakes, one or more edges of which have been unifacially retouched. Because most specimens are flaked on more than one edge, it is considered impractical to use specimens as the units for comparison. Rather, the edges themselves have been classified in a set of nine types on the basis of their configurations, as shown in Figure 3.

The edge types are defined as follows (see Figure 3):
1. concave edge
2. straight edge
3. convex edge
4. edge pointed by the intersection of two edges flaked on the same face
5. convex edge on the end of a flake, polished from use (resembles the edge configuration often called 'end scraper')
6. edge pointed by the intersection of a flaked with an unflaked edge, showing use at the point (distinguished from simple broken unifaces by the presence of minute use scars or polish at the point)
7. notched edge (single notch)
8. edge pointed by the intersection of two flaked edges flaked on opposite faces
9. double-notched edge (notches immediately adjacent to one another)
The percentage of each edge type in each site is shown in Table 7. There appears to be a great deal of uniformity from site to site with respect to these percentages, but some notable exceptions appear. At HA66, Type 1 (23.0%) is far more abundant than in the other sites, and Type 4 (8.0%) unusually scarce. Site HA70/1 is aberrant in its high (15.2%) percentage of Type 8 and low (3.0%) percentage of Type 1. Types 2 (2.4%) and 3 (4.8%) are very scarce at Site HA71. Site HA72 stands out with its high (26.7%) percentage of Type 3. Even with its rather low sample size (N=17), Site HA76 is exceptional with its high (58.8%) percentage of Type 4 and low (11.8%) percentage of Type 6. The ratio of the number of edge types to the number of specimens is unexpectedly high at sites HA67 (2.00) and HA74 2.14. The possible significance of these aberrations will be taken up in a following chapter.
Table 7: Flake Unifaces: Flaked Edges by Percentages of Types Within Sites

<table>
<thead>
<tr>
<th>Site</th>
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<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
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<th>N*</th>
<th>N/Ns**</th>
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<td>27.1</td>
<td>12.5</td>
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<td>HA68</td>
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<td>12.2</td>
<td>10.5</td>
<td>17.9</td>
<td>0.4</td>
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<td>9.2</td>
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<td>11.2</td>
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<td>5.9</td>
<td>11.8</td>
<td>0.0</td>
<td>100.1</td>
<td>17</td>
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<tr>
<td>Total</td>
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<td>9.9</td>
<td>11.4</td>
<td>18.4</td>
<td>0.7</td>
<td>32.7</td>
<td>11.0</td>
<td>4.4</td>
<td>0.6</td>
<td>100.0</td>
<td>842</td>
<td>1.82</td>
</tr>
</tbody>
</table>

* final total includes those sites whose percentages are not shown here because of very small sample size

** Ns = number of specimens
Of the 462 flake uniface specimens, 229 (49.6%) are made of obsidian, 80 (17.3%) of CCS, 152 (32.9%) of hard igneous stone, and 1 (0.2%) of dacite obsidian. Those with only one type of flaked edge constitute 42.6% of the total sample.

I B 2: COBBLE UNIFACES (Plate 12). These are fragmentary or complete, cobble-sized specimens, not made on flakes. Their dimensions range as follows: length 6.6 to 13.2 cm, width 4.5 to 8.9 cm, and thickness 1.8 to 4.2 cm. All are made of dense basaltic stone. They have been divided into five groups on the basis of the configurations of their flaked edges. Group A has convex edges, Group B straight edges, Group C concave edges. Group D is made up of those specimens with more than one flaked edge, and Group E is composed of fragmentary specimens. Of the 28 specimens collected in the project, 11 are classified in Group A, four in Group B, five in Group C, three in Group D, and five in Group E. Of the three in Group D, one has a convex and a concave edge, one has two straight edges, and one has two concave edges. One of the Group C specimens shows wear, suggesting heavy use as a percussor.

The distribution of cobble unifaces by group and by site (not shown) indicates no deviation from a random pattern.

I C 1: BURNINS. This is a traditional category. While the burnins of the Upper Paleolithic of the Old World are based on a blade technology (Bordaz 1970:50-88), those from the vicinity of Stinkingwater Pass are made on unspecialized flakes, and true blades are not present. Specimens range in size as follows: length 1.5 to 8.2 cm, width 1.3 to 7.0 cm, and thickness 3 to 23 mm. Of the 31 specimens, 15 (48.4%) are obsidian, 13 (41.9%) CCS, and three (9.7%) basalt. There is a single burnin facet on 25 specimens (80.6%), and six specimens (19.4%) are dihedral burnins. A single-faceted specimen from HA69, made of CCS, has four corners, all burinated.

I C 2: PIECES EQUILIBRES. As defined by MacDonald (1968:88-90), these are flake tools showing bipolar percussion, with two opposite battered and crushed edges. Some specimens may show two or even more directions of bipolar percussion. The size of the collected specimens ranges as follows: length 2.8 to 5.9 cm, width 2.2 to 3.7 cm, and thickness 5 to 13 mm. Of the nine specimens, five (55.6%) are made of obsidian, three (33.3%) of basalt, and one (11.1%) of CCS. Four specimens show one direction of bipolar percussion, and five show two directions. One specimen from HA75, made of basalt, also has a Type 3 unifacially flaked edge.

I C 3: CORES. These are chunks of stone with a platform or platforms which were struck by percussion in such a way that usable flakes have been produced. The edges at the platform do not appear to have been produced for use directly as tools. The cores have often been rotated, with several different platforms used, and the platforms are often prepared by flaking, crushing or grinding. The collected specimens range in length from 2.9 to 19.4 cm, most falling between 6 and 10 cm. Of the 38 specimens, 21 (55.3%) are made of basalt, 13 (34.2%) of CCS, and four (10.5%) of obsidian. A single platform is evident on 15 specimens (39.5%), while 12 (31.5%) have two platforms, six (15.8%) have three, two (5.3%) have four, one (2.6%) has five, and two (5.3%) have six platforms.

II A: GRINDING TOOLS. Only one specimen of this class was found, number HA69-A2-1/6A-8. It is roughly rectangular, 10.6 cm long, 4.6 cm wide, and 2.3 cm thick, and made of scoriaceous basalt. It does not resemble what are usually called 'manos.' One face and one edge are unmodified, the others roughly ground. One end is unmodified, and the other end is rounded by grinding.

II B: PERCUSSION TOOLS. All of these specimens are made of hard igneous stone, and show percussive use on their ends and/or edges. Of the 31 collected, six are complete, weighing 170.2, 213.1, 272.0, 400, 540, and 1110 grams, respectively. Eight specimens have an elongate shape, one is discoidal, and two are unifacially flaked cobbles hammered on both ends. Specimen HA69-Loc11-surf-3 was ground and pecked into a regular, tapering shape with an oval cross-section. It appears to have been broken at the midsection and then heavily pounded at both ends.
On three specimens, the polish on the faces, edges, or both suggests wear from frequent manipulation. Two specimens consist of spalls struck off the ends of elongate percussors.

II C: ANVIL STONES. These are stones showing pitting on one or both faces, apparently from percussion. Specimen HA69-AI-1/5A-5 is a corner fragment of a rectangular slab of vesicular basalt, showing percussion on both faces and possible grinding on one face. Overall dimensions are 17.5 by 14.6 by 6.8 cm. Specimen HA69-Loc9-1 is an irregularly shaped, fragmentary basalt slab, showing percussion on both faces. Overall dimensions are 21.8 by 14.7 by 2.1 cm. Specimen HA70/L-AI-1/5-2 is a corner fragment of a rectangular basalt stone with rounded edges, with heavy polish (apparently from frequent percussion) all around the unfractured surfaces, but heaviest on one face. Dimensions are 18.3 by 15.5 by 7.4 cm. Specimen HA70/L-32-1/4-1 is a complete, subangular, basalt boulder with one flat face heavily polished from percussive use, with remnants of percussion flake scars at one edge. Overall dimensions are 31.8 by 15.0 by 6.9 cm.

II D: HOPPER MORTAR BASSES (Plate 13). These are boulders with one flat face showing a distinct circular concavity worn by percussion and grinding. Both collected specimens are complete and made of basalt. Specimen HA69-Loc5-surf-4 (Plate 13b) has overall dimensions of 26.0 by 22.5 by 12.0 cm, and a concavity 11.0 cm long, 9.3 cm wide, and 0.5 cm deep. Specimen HA69-A2-1/7-1 (Plate 13a) has overall dimensions of 37.5 by 36.5 by 19.0 cm, and a concavity 15.5 cm long, 13.5 cm wide, and 1.7 cm deep.

III: UNIQUE STONE TOOLS. There are six specimens that differ enough from the rest of the collection that they are described separately.

Specimen HA66-D3-surf-7 is a flake uniface, made of CCS, with an excurvate, serrated edge. Overall dimensions are 2.9 by 2.1 by 0.6 cm.

Specimen HA68-TP11/1-surf-1 is a large flake of hard, black, igneous stone, oval in plan view, unifacially flaked around its entire circumference. The entire edge is heavily rounded and polished from use, and the ridges between the flake scars on both faces are also heavily polished, presumably from frequent manipulation. Overall dimensions are 7.8 by 5.5 by 1.5 cm.

Specimen HA69-Loc7-14 is a combination percussor and anvil stone, made on a roughly tabular piece of basalt that is triangular in plan view. Two long edges and all three tips are rounded, and both faces are pitted from use as an anvil. Overall dimensions are 16.6 by 8.6 by 3.6 cm, and it weighs 625 grams.

Specimen HA69-AI-1/6-11 is an edge-ground cobble, made on an irregularly shaped, subangular, basaltic cobble broken at the mid-section. One edge is polished, at least in part by percussion, judging from the percussion spall scars on the adjacent portion of one face. Overall dimensions are 10.4 by 8.0 by 4.6 cm, and it weighs 540 grams.

Specimen HA69-A2-1/3-1 is a unifacially flaked cobble with ground and polished faces. It is made on a tabular piece of hard igneous stone with an irregular plan outline. One convex edge is flaked unifacially. Two adjoining edges come to a point opposite the flaked edge, and both of these edges are ground parallel to the faces, with clearly distinguishable striations. Both faces are heavily ground, with striations visible at random angles, and both faces also show pitting from use as an anvil. The flaked edge has also been used in percussion, as shown by percussion-spall scars radiating back on the unflaked face, and the flaked edge is also worn from use. Overall dimensions are 15.8 by 12.6 by 2.3 cm, and the weight is 595 grams.

Specimen HA76-Loc2-surf-4 is a tabular piece of hard igneous stone, trapezoidal in plan view, and unifacially flaked on two opposite edges of the same face. All four corners have been used in percussions. Overall dimensions are 6.6 by 6.6 by 1.4 cm, and the weight is 98.4 grams.
IV: FLAKED STONE DETRITUS. In this category is included all of the waste material from stone flaking. This material was collected both in controlled surface collections and in excavation. Three major types of material are present: basalt (most of which is a very dark, fine-grained variety found naturally within the project area), CCS and obsidian. Other materials constitute less than one per cent of the specimens collected.

Figures 4 through 13 show the frequency distributions of the three major material types and the total collections at the sites where controlled surface collections were made. The locations of the gridded areas are shown in the site maps (Map 2 through 11). It is observable in Figures 4 through 13 that the different raw materials used in stone flaking often cluster separately on the surfaces of the sites, suggesting that use of the sites was at different times, and/or by different peoples. This problem will be taken up in a following chapter.

Table 8 summarizes the detritus collected in the surficial grids, Table 9 that collected by excavation, and Table 10 the total sample, by site and raw material. It is apparent from these tables that the various sites differ widely in their relative proportions of the three major types of materials. The observable patterns and possible explanations for them are discussed in a following chapter.
Figure 4. Detritus Distribution in Surface-Collection Grid, Site 35 HA 66.
Figure 5. Detritus Distribution in Surface-Collection Grid, Site 35 HA 67.
Figure 6. Detritus Distribution in Surface-Collection Grid, Site 35 HA 68.
Figure 7. Detritus Distribution in Surface-Collection Grid, Site 35 HA 69.
Figure 8. Detritus Distribution in Surface-Collection Grid, Site 35 HA 70/2.
Figure 9. Detritus Distribution in Surface-Collection Grid, Site 35 HA 71.
Figure 10. Detritus Distribution in Surface-Collection Grid, Site 35 HA 72.
Figure 11. Detritus Distribution in Surface-Collection Grid, Site 35 HA 74.
Figure 12. Detritus Distribution in Surface-Collection Grid, Site 35 HA 75.
Figure 13. Detritus Distribution in Surface-Collection Grid, Site 35 HA 76.
Table 8: Detritus Collected on the Surface in Grids

<table>
<thead>
<tr>
<th>Site</th>
<th>Basalt (%)</th>
<th>Obsidian (%)</th>
<th>CCS (%)</th>
<th>Total*</th>
</tr>
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<tbody>
<tr>
<td>HA66</td>
<td>333 (72.4)</td>
<td>120 (26.1)</td>
<td>7 (1.5)</td>
<td>460</td>
</tr>
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<td>HA67</td>
<td>280 (55.9)</td>
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<td>8 (1.6)</td>
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<td>48 (26.7)</td>
<td>78 (43.3)</td>
<td>54 (30.0)</td>
<td>180</td>
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<tr>
<td>HA70/2</td>
<td>14 (14.6)</td>
<td>4 (4.2)</td>
<td>78 (81.3)</td>
<td>96</td>
</tr>
<tr>
<td>HA71</td>
<td>289 (42.3)</td>
<td>98 (14.3)</td>
<td>296 (43.3)</td>
<td>683</td>
</tr>
<tr>
<td>HA72</td>
<td>32 (33.0)</td>
<td>29 (29.9)</td>
<td>36 (37.1)</td>
<td>97</td>
</tr>
<tr>
<td>HA74</td>
<td>16 (2.6)</td>
<td>51 (8.4)</td>
<td>541 (88.8)</td>
<td>609</td>
</tr>
<tr>
<td>HA75</td>
<td>7 (1.1)</td>
<td>76 (12.4)</td>
<td>530 (86.5)</td>
<td>613</td>
</tr>
<tr>
<td>HA76</td>
<td>23 (5.4)</td>
<td>138 (32.5)</td>
<td>263 (62.0)</td>
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<td>Total</td>
<td>3273 (43.0)</td>
<td>2373 (31.2)</td>
<td>1881 (24.7)</td>
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*percentages by material are computed on the basis of the total sample, but frequencies of miscellaneous and unidentified materials are not given separately.

Table 9: Detritus Collected in Excavation

<table>
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<th>Basalt (%)</th>
<th>Obsidian (%)</th>
<th>CCS (%)</th>
<th>Total*</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA67</td>
<td>36 (43.9)</td>
<td>44 (53.7)</td>
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<tr>
<td>HA68</td>
<td>104 (59.4)</td>
<td>59 (33.7)</td>
<td>10 (5.7)</td>
<td>175</td>
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<td>HA69</td>
<td>1195 (18.7)</td>
<td>4883 (76.2)</td>
<td>306 (4.8)</td>
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<td>HA70/1</td>
<td>56 (3.9)</td>
<td>27 (1.9)</td>
<td>1349 (94.2)</td>
<td>1432</td>
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<tr>
<td>HA72</td>
<td>9 (23.7)</td>
<td>6 (15.8)</td>
<td>23 (60.5)</td>
<td>38</td>
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<tr>
<td>HA76</td>
<td>4 (5.4)</td>
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<td>50 (67.6)</td>
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<td>Total</td>
<td>1404 (17.1)</td>
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*percentages by material are computed on the basis of the total sample, but frequencies of miscellaneous and unidentified materials are not given separately.
Table 10: Total Sample of Detritus, Including Excavated and Surface Collections, Excluding Miscellaneous and Unidentified Materials

<table>
<thead>
<tr>
<th>Site</th>
<th>Basalt (%)</th>
<th>Obsidian (%)</th>
<th>CCS (%)</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>HA66</td>
<td>333 (72.4)</td>
<td>120 (26.1)</td>
<td>7 (1.5)</td>
<td>460</td>
</tr>
<tr>
<td>HA67</td>
<td>316 (55.0)</td>
<td>250 (43.5)</td>
<td>9 (1.6)</td>
<td>575</td>
</tr>
<tr>
<td>HA68</td>
<td>2335 (57.7)</td>
<td>1632 (40.3)</td>
<td>78 (1.9)</td>
<td>4045</td>
</tr>
<tr>
<td>HA69</td>
<td>1243 (18.9)</td>
<td>4961 (75.6)</td>
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<td>HA70/1</td>
<td>56 (3.9)</td>
<td>27 (1.9)</td>
<td>1349 (94.2)</td>
<td>1432</td>
</tr>
<tr>
<td>HA70/2</td>
<td>14 (14.6)</td>
<td>4 (4.2)</td>
<td>78 (81.3)</td>
<td>96</td>
</tr>
<tr>
<td>HA71</td>
<td>289 (42.3)</td>
<td>98 (14.3)</td>
<td>296 (43.3)</td>
<td>683</td>
</tr>
<tr>
<td>HA72</td>
<td>41 (30.4)</td>
<td>35 (25.9)</td>
<td>59 (43.7)</td>
<td>135</td>
</tr>
<tr>
<td>HA74</td>
<td>16 (2.6)</td>
<td>51 (8.4)</td>
<td>541 (89.0)</td>
<td>608</td>
</tr>
<tr>
<td>HA75</td>
<td>7 (1.1)</td>
<td>76 (12.4)</td>
<td>530 (86.5)</td>
<td>613</td>
</tr>
<tr>
<td>HA76</td>
<td>27 (5.4)</td>
<td>158 (31.7)</td>
<td>313 (62.9)</td>
<td>498</td>
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<tr>
<td>Total</td>
<td>4677 (29.8)</td>
<td>7412 (47.2)</td>
<td>3620 (23.0)</td>
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CHRONOLOGY

It is possible to estimate the ages of the sites at Stinkingwater Pass, in the absence of radiocarbon dates, only through stylistic analysis of projectile points. The stylistic variability of projectile points, coupled with knowledge of types of projectile points objectively dated in adjacent regions, enables us to cross-date the Stinkingwater sites.

The sites investigated are listed in Table 4 by percentages of projectile point types, in the order considered most closely to approximate a seriated chronological order, assuming that the broad-necked types are generally earlier than the narrow-necked types. Table 5 lists the same sites, ordered solely on the basis of their relative proportions of broad- and narrow-necked types. The resulting order is similar to that seen in Table 4. In both tables, sites HA 70/1 and HA 72 are placed at the top, and HA 70/2 is near the bottom of the seriation. The relative order of the sites with the four largest samples, HA 68, 69, 66, and 67 is the same in both tables, and HA 74 and 76 are together near the middle of the ordering in both. The two remaining sites that are seen in both tables, HA 71 and 73, have very few specimens, so that their varying placement in the ordering is probably due to sampling error.

In spite of the generally low sample-sizes of projectile points, it is reasonable to propose that the ordering of sites displayed in Tables 4 and 5 is very much a function of time. When the estimated time ranges of the point types found at the various sites is taken into account (see Appendix A), this view is further supported.

The only classifiable points at HA 72 are of Type E, estimated to date from A.D. 1 to historic times; and Types D and E, the only types represented at HA 70/1, both belong to the same late period. These facts place HA 72 and HA 70/1 at the top of the order. Site HA 68 has types ranging from the most recent (Type A) to the most ancient (Types J and L), suggesting it was used during much of the interval between 7000 B.C. and historic times. It is fitting that the greatest typological variability should occur at the site with the largest sample, but still the proportions of Types J and L seem unusually large when compared with their frequencies at other sites with relatively large sample, HA 69, 66 and 67. This suggests that HA 68 was in use earlier than the others, or that the intensity of occupation in the early period, from 7000 to 2000 B.C., was greater at HA 68 than at the others. The relatively high proportion of Type E, the primary late period type, and the low proportion of Type F, the primary middle period type, suggests also that the intensity of occupation at HA 68 was least during the middle period (2000 B.C. to A.D. 1), and greater before and after that time.

Sites HA 69, 66 and 67 are similar to one another in that middle and late period types predominate. Site HA 67 differs from the others, however, in its low proportion of Type E, high proportion of Type F, and presence of Type L, all suggesting a greater occupational intensity at HA 67 during the early and middle periods than at the other two sites. The very high proportion of broad-necked points at HA 67 supports this conclusion.

The samples from HA 74 and 76, though small, give the impression that the sites were used in all three periods. Both sites yielded narrow- as well as broad-necked points, and both have some early (Types J, K and L) as well as middle (Types F, G, H, and I) period types present. And at both sites, the early and middle periods are better represented than the late period.

At both HA 70/2 and 73, the only points present are broad-necked, including a middle period point (Type F) at HA 73, and an early period point (Type L) at HA 70/2.

The pattern at HA 71 is much less straightforward, since narrow- and broad-necked points are equivalent in number, yet the only two points classifiable by specific type belong to the early and middle periods. The evidence overall, then, indicates occupation in all three periods.

At HA 75, the only classifiable point belongs to Type J, an early type that has no neck.
In summary, the best chronological estimates for the occupation of the Stinkingwater sites appear to be as follows:

HA 66: middle (2000 B.C. to A.D. 1) and late (A.D. 1 to historic) periods, with greatest intensity in the middle period.

HA 67: early (7000 to 2000 B.C.), middle and late periods, with emphasis on middle period.

HA 68: early, middle and late periods, with emphasis on early and late periods.

HA 69: middle and late periods, with emphasis on middle period.

HA 70/1: late period only.

HA 71: early, middle and late periods, almost equally represented.

HA 72: late period only.

HA 73: middle period only.

HA 74: early, middle and late periods, almost equally represented.

HA 75: early period only.

HA 76: early, middle and late periods, almost equally represented.

Considering all sites taken together, the sample of projectile points is dominated by the middle period types (F, G, H, and I), which make up 43.7% of the total. These are followed by the late period types (A, B, C, D, and E), with 37.5%. The least proportion, 18.7% is made up by the early period types (J, K, and L).

Let us assume a constant rate of deposition of projectile points in the area of Stinkingwater Pass. Let us assume also that the middle period extended from 2000 B.C. to A.D. 1 and the late period from then until A.D. 1850 (see Appendix). We would then expect 1850/3850, or 48.1% of the points deposited since 2000 B.C. to be late period types, and 2000/3850, or 51.9%, to be middle period types. These percentages are very close to the actual figures from the sample. Excluding the early period types, there are 91 classifiable points, 42 (46.2%) of which are from the late period, and 49 (53.8%) from the middle period. The rate of deposition of projectile points under these assumptions is 2.4 points per hundred years. Early period types account for only 21 points; if these were spread throughout the 5000 years of the early period (7000-2000 B.C.), then the rate of deposition was only 0.4 points per hundred years. If the rate of deposition of points in the early period was the same as in the middle and late periods, then the early period occupation could have lasted only 875 years, e.g., from 2875 to 2000 B.C.

It becomes clear, then, that the sites at Stinkingwater Pass were used either very little or for only a short time in the early period, and that intensive occupation began around 2000 B.C. If this is true, then we are faced with the question of what factors brought about such a change in the intensity of use of the area. This problem will be brought up again in the concluding section.
ANALYSIS OF CULTURAL DEBRIS

There are several patterns observable in the data that can help us interpret the uses to which the Stinkingwater sites were put. One way to distinguish the sites from one another is to compare them in terms of the relative proportions of the various kinds of artifacts found there, a comparison which is useful in distinguishing the sites from one another on the basis of the functions performed at each. Different kinds of tools reflect different purposes, so that variation in the relative proportions of tool types from site to site implies that different activities were emphasized at each.

Table 2 shows the percentages of each artifact class found at each site investigated. While it is possible to pick out major differences among some of the sites by inspection of the table, such differences are more readily evident when these data are converted into a cumulative graph, shown here as Figure 14.

The cumulative graph appears to separate the sites into three major categories: HA 76, with its high proportion of projectile points and simple inventory; HA 70/1, the most clearly distinct line on the graph, with its very low percentages of bifacially flaked tools; and the remaining sites, very closely grouped.

The patterns seen in Figure 14 allow the inspection of Table 2 to be more meaningful. It is clear that HA 76 differs from the other sites primarily in terms of its very high proportion of projectile points, and in the presence there of only four classes. These factors distinguish it even from the other two sites (HA 72 and 75) with similarly small sample-sizes. The uniqueness of the inventory at HA 76 correlates well with its geographical and ecological uniqueness as the only site of the group in a flat, bottomland area outside of the upland zone.

Site HA 70/1 is different because of its very low proportion of bifacially flaked tools, especially projectile points, and relatively high proportions of burins, cores and percussion tools. Its pattern suggests a markedly low importance of hunting activities (presumably requiring projectile points and other cutting and puncturing tools), and a great emphasis on activities of lithic manufacture (though not the production of finished artifacts) and on the use of minimally altered flake tools (e.g., burins).

The remaining sites differ only slightly from one another, although HA 69 is the only site where every artifact class is present, the only site where grinding tools and hopper mortar bases are present, and one of only two sites (the other being HA 70/1) where anvil stones are present. The distinctiveness of HA 69 in these regards may be correlated with its unique setting: a forested, sheltered locality with deep soil.

Among the remaining sites, only a few patterns seem potentially significant. Drills at HA 66 seem unusually common, and their absence at HA 67 is also unusual. Also, the number of burins at HA 71 is much greater than one would expect. This fact which may be connected with the high proportion of burins at HA 70/1, which is at the bottom of the canyon directly below the ridge-top location, and within sight, of HA 71.

Other unusually high or low percentages seen in Table 2 are considered to be most likely the result of sampling error caused by small sample-size.

As discussed in a previous section, Table 7 shows the percentages of flaked edge types on flake unifaces by site. A cumulative percentage graph based on these data, Figure 15, allows a visual impression of the differences between the sites in this dimension. The graph shows a remarkable similarity from site to site, but, as with the data on projectile points, Site HA 76 again appears to be the most distinct, with a rather simple inventory and a very high proportion of Type 4 flaked edges. The line for HA 66 is also distinct from the others, because of its high percentage of Type 1 and low percentage of Type 4, quite the opposite of HA 76. Site HA 66 is the only one where Type 1 is proportionately more frequent than Type 4. The meaning of this distinction is difficult to interpret, but the Type 4 edge
Figure 14. Cumulative Percentages of Artifact Classes Within Sites.
Figure 15. Cumulative Percentages of Flake Uniface Edge Types Within Sites.
is usually thought of as an engraving tool and the Type 1 edge (concave) as a tool for shaving or scraping cylindrical objects such as long bones or wooden projectile shafts. The latter may relate to maintenance activities at big game hunting camps (HA 66?), and the former to more delicate bone- and wood-working activities (HA 76?).

Cobble unifaces, which are all made of dense basaltic stone, are absent at sites HA 70/2, 73, 74, 75, and 78, all in the northeastern half of the project area. The significance of this pattern is believed to relate to the availability of the raw material and other factors, a topic discussed below.

The presence of hopper mortar bases at only one site, HA 69, is significant not only in its uniqueness, but also because it is the only indication of aboriginal women's activities, and the only suggestion of the collection of vegetable foods in an area where hunting activities appear predominant. Just what vegetable foods were mashed in the hopper mortars is something of a mystery. The only possibilities seem to be the juniper berries available today at HA 69, or some as yet unrecognized roots or tubers present in the vicinity, such as bitterroot. It may also be that the vegetable food collected for processing in the mortars no longer grows in the area.

The fact that collections were made in the field in a systematic manner, both by surface collection and in excavation, permits analyses of detritus to be made without fear of collector bias. The patterns seen in the Stinkingwater detritus shed a great deal of light on the behavior of the people who used the sites.

Table 8 summarizes the detritus collected systematically on the surface, and Table 9 that collected in excavation, by site and the three major categories of material. Table 10 lumps together the surficial and excavated collections, and is considered the most useful summary of detritus among the three tables. Figure 16, a triangular graph, is based on the data in Table 10, and visually separates the sites on the basis of their proportions of the three major kinds of raw materials: basalt, cryptocrystalline silica (CCS) and obsidian.

Inspection of Table 10 and Figure 16 reveals that the proportion of basalt generally declines from southwest to northeast across Stinkingwater Pass, and that CCS is predominant in the northeastern sites and nearly absent in the southwestern sites. The proportion of obsidian is more balanced geographically, though the southwestern sites tend to have more than the rest. The presence of basalt as cobbles eroding out of the bedrock in the vicinity of HA 66 accounts for the presence of so many basaltic flakes there. It is probably that basaltic cobbles were reduced to cores at HA 66 and carried to adjacent sites for further flake removal, and that the proportion of basalt at the other sites is mostly a function of the distance from HA 66.

Site HA 70/1 appears to have been a primary decortication site for CCS, judging from the extremely high proportion of CCS there, the large size of the flakes, the lack of bifacially flaked tools, and the strong presence of percussors and anvil stones. The proportions of CCS at the other sites, however, cannot be explained as a function of distance from HA 70/1. They appear, rather, to be a function of the direction from HA 70/1, since CCS predominates in the northeastern sites and is nearly absent in the southwestern sites. Nor is this pattern dependant on temporal relationships, since southwestern and northeastern sites cannot be temporally separated. The only explanation which seems appropriate is that the two groups of sites were used by two distinct groups of people, one from the southwest and one from the northeast, who had distinct sources and preferences for raw lithic materials. This is good evidence that a territorial boundary persisted for several thousands of years at Stinkingwater Pass, between people from the south west, probably the Harney Basin, and people from the northeast, probably the Malheur River Valley.

The wide distribution of obsidian across Stinkingwater Pass appears to indicate that obsidian was a more highly valued material than either basalt or CCS, since people were willing to carry it great distances from the source (there is recorded no source of obsidian in the area of the Stinkingwater Mountains). The very great percentage of obsidian at HA 69
Figure 16. Triangular Plot of Sites by Percentages of Three Major Lithic Materials in Flaked Detritus.
suggests that the site was a major base camp for hunting groups, probably from the southwest, who brought obsidian to Stinkingwater Pass for the manufacture of projectile points and other bifacially flaked tools. The suggestion that HA 69 was a base camp is supported by its ideal, sheltered location, and the presence there of hopper mortars, generally considered women's tools.

Sites HA 71 and 72 have higher proportions of basalt and obsidian than one would predict if they were used only by groups from the northeast who principally used CCS. Outside of HA 70/1 and 70/2, these are the nearest of the northeastern group to HA 69 and the rest of the southwestern group of sites, a fact lending itself to the interpretation that these two sites were used at times by peoples from both directions.

Site HA 76 stands out among the northeastern sites in its relatively high proportion of obsidian. This probably does not mean that groups from the southwest used the site, but may relate to the propinquity of the nearest known source of obsidian, only seven miles to the east. It could also result from an emphasis on the manufacture of projectile points, which are unusually common at the site.

Inspection of Figures 4 through 13, as was mentioned in the section describing the cultural debris, reveals that the three major kinds of raw lithic materials often form distinct clusters on the surfaces of the sites in the gridded areas:

At HA 66 (Figure 4) basalt forms clusters in areas 80-90N, 50-60E and 50-60N, 20-40E; and CCS in area 40-50N, 50-60E.

At HA 67 (Figure 5) obsidian and basalt seem to follow the same pattern, and CCS is too sparsely represented to be of use.

At HA 68 (Figure 6) the only aberrant cluster is basalt in area 70-80N, 20-30E.

At HA 69 (Figure 7) CCS and basalt have almost entirely separate patterns, with a strong negative correlation, while obsidian and basalt appear to fall together.

At HA 70/2 (Figure 8) a strong CCS cluster in area 40-50N, 30-35E is entirely separate from the basalt, while obsidian is too infrequent to describe a pattern.

At HA 71 (Figure 9) one basalt cluster, in area 15-25N, 30-35E, separates itself from both CCS and obsidian.

At HA 72 (Figure 10) the three materials are in accord except for a basalt cluster in area 15-20N, 25-30E.

At HA 74 (Figure 11) CCS is much more frequent in the southern half of the area, especially in square 5-10N, 30-35E, than the other two materials.

At HA 75 (Figure 12) there is no striking difference in clustering.

At HA 76 (Figure 13) CCS is predominant in the area 0-105N, 15-30E, while obsidian is more frequent in the remaining area 105-150N, 15-30E.

It has been proposed that the Stinkingwater sites were used by two different groups of people coming from different directions into the area. A corollary to this hypothesis is that those from the southwest were the principal users of the basalt from HA 66, and those from the northeast the principal users of the CCS from HA 70/1. If this is true, then we would expect CCS and basalt detritus to cluster separately on the surfaces of the sites more often than would CCS and obsidian or basalt and obsidian, since the basalt-users and CCS-users would have occupied these sites at different times. This is, in fact, what we
find. Of the clusters summarized above, CCS and obsidian cluster separately in four cases, and obsidian and basalt in five cases; but CCS and basalt are separately clustered in eight cases.

Apparent functional relationships between raw material and tool types are also evident in the data. As shown in Table 10, of the three major raw lithic materials from all sites taken as a group, basalt constitutes 29.8%, obsidian 47.2%, and CCS 23.0% of the total. When these figures are compared with the proportions of the same materials used for making the various kinds of artifacts found at the sites, differences are seen which help us understand the preferred prehistoric uses of these materials.

Projectile points are overwhelmingly made of obsidian (93.0%). Of the formed bifaces, the great majority (72.4%) are obsidian, followed by CCS (24.1%) and basalt (3.4%). Drills are mostly CCS (60.0%), with the remainder obsidian. Unformed bifaces have percentages similar to formed bifaces: obsidian 67.7%, CCS 22.6%, and basalt 7.9%. Among the flake unifaces, there is a slight bias toward the use of obsidian (49.6%) and basalt (32.9%), against CCS (17.3%). All cobble unifaces are basalt. Burins show a strong bias toward CCS (41.9%), and against basalt (9.7%), with obsidian close to neutral (48.8%). Pieces esquillees show a tendency to be made of obsidian (55.6%) and basalt (33.3%), and not of CCS (11.1%), though error due to small sample size could have a strong influence on these figures. Cores are biased toward basalt (55.3%) and CCS (34.6%), and against obsidian (10.5%). Grinding tools, percussion tools, anvil stones, and hopper mortar bases are all made of basaltic stone, though not normally the dense, fine-grained variety used for the flaked stone tools.

An interesting fact is that, while projectile points, formed and unformed bifaces, flake unifaces, and pieces esquillees all tend to be made of obsidian, obsidian cores are rare. This pattern supports the idea that obsidian was carried into the area from some distance: the rarity of cores argues that artifacts were brought into the area finished, or were manufactured in the area from easily transported preforms or blanks. For most kinds of flaked stone tools CCS was used to some degree, but it was preferred only for drills and burins, both tools that require a tough, non-brittle material. Basalt shows the greatest extremes in its percentages: it was used very little for most flaked stone tool classes, but is present in proportions slightly larger than expected for flake unifaces and pieces esquillees; was used exclusively for cobble unifaces; and is the most common material for cores.

The large proportion of basalt cores in the collection demands some kind of explanation. One strong possibility is that a principal use for basalt was as fresh, unretouched flakes, used in their unmodified form for cutting and scraping purposes. This would explain why there seem to be too many basalt flakes in the collection for the rather low number of flaked basalt tools. By this reasoning, basalt cores were kept close at hand by the prehistoric hunters for quick removal of usable flakes. This may also have been done to some degree for CCS flakes, but least of all for obsidian, a precious material that would not often have been wasted in this manner. This is not to say that obsidian flakes were not used in their unmodified form, but only that obsidian flakes were not produced primarily for this purpose. Rather, they were a waste product from the manufacture of flaked stone tools.

**SUMMARY AND CONCLUSIONS**

The major conclusions reached in the preceding section regarding the principal activities performed at, and the primary prehistoric functions of the Stinkingwater sites, were as follows:

Sites HA 66, 67, 68, and 69 (the southwestern sites), with their near absence of cryptocrystalline silica (CCS) detritus, and high frequency of basalt and obsidian detritus, were used almost exclusively by people from the southwest (the Harney Basin).
Sites HA 70/1, 70/2, 71, 72, 74, 75, and 76 (the northeastern sites), with their high proportions of CCS and relatively low proportions of obsidian and basalt detritus, were within the domain of people from the northeast (the Malheur River Valley). The only qualification is that HA 71 and 72, with aberrantly high proportions of basalt and obsidian, were apparently used as well by people from the southwest.

Site HA 66 was a source and a major flaking station for basalt, judging from the basalt cobbles eroding out of the bedrock and the very large proportion of basalt flakes. The site also appears to have been a temporary upland hunting camp, based on the array of artifact classes present there.

Sites HA 67, 68, 70/2, 71, 72, 73, 74, and 75, on the basis of similarity in their artifact inventories, appear to be temporary upland hunting camps. There were performed activities such as the manufacture and repairing of hunting tools and the partial butchering of animal carcasses.

Site HA 69, with its very high proportion of obsidian detritus, extensive artifact inventory, presence of hopper mortar bases, and location in a sheltered, forested area with deep soil, was most likely a hunting base camp, to which family groups from the lowlands came to spend at least part of the warm season. From this location women collected berries, roots, or both, for preparation in hopper mortars for winter storage, and men traveled in search of game, bringing portions of the carcasses back as food for immediate consumption and for preservation. Sites HA 66, 67, 68, 71, and 72 are, then, related to HA 69 as satellites to a central base camp, in terms of their use by people based at HA 69.

Site HA 70/1 was used primarily for the decortication of locally available CCS chunks, for the production of both portable cores and usable flakes. Some hunting activities may also have been carried on there, such as butchering and the modification of bone and antler, the latter involving the use of burins.

Site HA 76 is the only non-upland site in the project area and, judging from its relatively low elevation, the site most likely to have been used outside of the warm season. The low density of cultural debris argues only for very temporary use as a hunting station. The high proportion of projectile points suggests the hunting of mammalian species, but the location adjacent to a marshy zone leads to the suspicion that birds may have been important as well.

The patterns of use of the Stinkingwater Pass area by two separate aboriginal groups fit into a model (see Figure 17) in which these two groups had different adaptive strategies. By this model, the people of the Malheur River Valley had a Plateau-like subsistence pattern, in which the primary subsistence activity was salmon-fishing, the harvesting of a large and reliable resource. The dependability of the salmon allowed the people of the Malheur River Valley to congregate in large winter villages and at large summer fishing stations outside the immediate Stinkingwater area. The gathering of roots such as camas was also an important activity, providing most of the remaining portion of the diet. Both salmon and camas are lowland resources, and the exploitation of upland resources, including the hunting of large mammals during the warm season, was not a highly important economic activity, though it was no doubt done to some degree at localities such as Stinkingwater Pass.

On the other side of Stinkingwater Pass is the Harney Basin, a portion of the much larger Great Basin, where neither salmon nor any similarly abundant and reliable resource is available. The model proposed here attributes to the people of the Harney Basin a Great Basin-like subsistence pattern, in which the gathering of food required frequent movement by small family groups throughout their territory, collecting foods as they became available in different ecological zones. Of roughly equivalent importance were roots and seeds, fresh-water fishes, waterfowl of the vast lakes and marshes in the center of the Harney Basin, rabbits, antelope, perhaps bison, and deer, sheep and elk. An important part of the annual round of economic activities would have been the movement to summertime hunting camps in the mountains, to take advantage of the movement of deer and elk herds into the upland zones, and to collect roots and seeds which ripened later than those of the lowlands.
Figure 17. Explanatory Model of Settlement Pattern of Stinkingwater Sites.
Since the distance between Stinkingwater Pass and the nearest well-watered localities along the Silvies River and Malheur Lake is between 20 and 25 miles, the most efficient way to exploit the Stinkingwater Mountains was to establish a central base camp there instead of making frequent trips back and forth between the lowlands and uplands. From the base camp, men could track and hunt game, and women could collect seeds and roots and process the animal products brought in by the men. Even if their major sites in the lowlands were closer than 20 miles, an upland base camp would still have been advantageous if they intended to spend at least several weeks in the area.

The distance from Stinkingwater Pass to the Malheur River is only ten miles, and the distance to Stinkingwater Creek, a permanent tributary of the Malheur River, is only five miles. For people from the northeast, the establishment of base camps in the Stinkingwater Mountains would have been much less necessary than for the people of the Harney Basin, both because daily trips could easily have been made on foot from lowland bases to temporary upland sites, and because long-term hunting trips, especially by whole family groups, would not have been as necessary or as common.

According to the model proposed here, then, groups of one or several families from the Harney Basin made annual or nearly annual trips to Site HA 69, an upland base camp, during the warm season, most likely between July and September. From that location, men dispersed to hunt game, using more temporary, satellite camp sites (HA 66, 67, 68, 71, 72) for specialized, short-term activities such as repairing hunting tools and preliminary butchering. Site HA 66 was unique among those studied in that it apparently was a source of raw basalt as well as a temporary hunting camp.

Groups of people from the Malheur River Valley, most likely individuals or small groups of men, occasionally traveled to short-term camp sites in the uplands (HA 70/1, HA 70/2, 71, 72, 73, 74, 75), probably to hunt game animals, without establishing a base camp for more intensive exploitation. This activity probably took place mostly in July, between the first and second runs of spring and summer Chinook salmon, and in October, after the last run of spring and summer Chinook and before the arrival of fall Chinook salmon (Smith 1975:92-96; Thompson and Fortune 1967:1). Of the upland sites used by the people of the Malheur River Valley, HA 70/1 is unique in that it was a primary decortication site for raw cryptocrystalline silica. Site HA 76, the only lowland site in the project area, was used by these people as well, but its seasonality may not have been as limited by weather as was that of the upland sites, and its resources probably included lowland game such as birds as well as mammalian species.

A necessary corollary to the hypothesized model is that the intensity of occupation of the Stinkingwater Pass area by the Harney Basin people was much greater than that of the Malheur River people, especially as expressed in terms of man-days of time spent in the area. It would follow, then, that the sheer amount of cultural debris deposited by the Harney Basin people would be much greater than that of their neighbors across the pass. This is just what we see in the data: outside of sites HA 71 and 72, which were apparently shared by the two peoples, 804 artifacts were found, of which 669, or 83.2%, came from the four southwestern sites, and the remaining 135, or 16.8%, came from six northeastern sites. Also, outside of HA 71 and 72, some 14,911 pieces of flaked detritus were collected, of which 11,664, or 78.2%, came from the four southwestern sites, and 3247, or 21.8%, came from the five northeastern sites. Even though these figures are not normed for the mount of surface area collected and volume excavated, it is clear that the density of debris in the southwestern sites is vastly greater than at the northeastern sites, supporting the model proposed here.

The basic differences between the subsistence strategies of the Malheur River people and those of the Harney Basin are essentially the same as those outlined by Rice (1970:85) in his comparison of Plateau and Great Basin socio-cultural patterns, and are in keeping with the Plateau pattern described by Ray (1939) and the Great Basin pattern discussed by Steward (1938, 1955). These authors, however, do not make a strong distinction between stylistic elements of culture and those more closely related to ecological-economic factors. This distinction is discussed by Aikens (1970), who uses the term 'diffusion sphere' to refer to a geographical area in which there is a high commonality of specific stylistic traits, and the term 'regional pattern of cultural ecology' to encompass a particular kind of economic strategy used by people of an area. Diffusion spheres and regional patterns of cultural ecology can overlap, since the latter is tied to the ecological situation while the former is not.
The cultural boundary proposed at Stinkingwater Pass between the peoples of the Malheur River Valley and the Harney Basin is considered to be a border in terms of regional patterns of cultural ecology, but not necessarily in terms of diffusion spheres. It remains to be established whether this is a boundary between diffusion spheres as well, but this can be done only by stylistic comparisons between the areas separated by Stinkingwater Pass, and only with the temporal factor held constant.

A problem discussed for some time among archaeologists of western North America has been the chronology of the separation of Great Basin and Plateau cultures from a presumed common cultural ancestor (Daugherty 1962, Swanson 1962, Cressman et al. 1960, Swanson, ed. 1970). The contribution of the present study to that discussion is simply this: intensive use of the Stinkingwater Pass area by both Harney Basin and Malheur River groups does not appear to have begun until some time just prior to 2000 B.C., and by that time the cultural-ecological differences between the two areas were already evident, though it is unclear whether they ever were separate diffusion spheres. Prior to the onset of intensive use of the area the data of course offer no evidence relating to the problem.

Another interesting problem is that of why intensive use of the Stinkingwater Pass area did not begin earlier. The evidence points to a real change in intensity of occupation between 3000 and 2000 B.C., a change which must relate to a basic change in the annual economic schedule of the Harney Basin people particularly, since the intensity of use of the area by Malheur River people remained low throughout prehistory. It is considered likely that this change in the annual economic schedule was brought about by the interplay of environmental and cultural change in the northern Great Basin.

The archaeological record in the northern Great Basin begins at about 9000 B.C., at a time when the region was much wetter than today. Forested land was probably much more widespread and at much lower elevations than today, grasses dominated the unforested land, and the area covered by lakes and marshes was much greater. As a result, ecological zones which are today widely separated in elevation were much more closely spaced. The currently most reasonable interpretation of the prehistoric record of that time is that human populations were able to focus almost entirely on resources available at the lowest elevations, including waterfowl, fish and large herbivores, all of which were more abundant, and more concentrated than they are today. Exploitation of upland zones such as Stinkingwater Pass might then have been an unnecessary or relatively insignificant part of the annual round. The cultures marked by this adaptation to the lacustrine-grassland environment have been grouped into the Western Pluvial Lakes Tradicional by Bedwell (1973:170-72) and the San Dieguito Complex by Warren (1967:183-84).

This type of culture characterized the northern Great Basin, including Harney Basin, until about 6000 B.C., when evidence points to a significant, overall decline in precipitation. The dating and the intensity of this period of aridity are controversial, but there seems little doubt that the dry interval, most often called the Altithermal (somewhat of a misnomer since precipitation, not temperature, would have been the most important factor), actually occurred (Antevs 1948, 1955; Aschmann 1958; Baumhoff and Heizer 1965; Bryan and Gruhn 1964; Fagan 1974; Mehringer 1977). One result of this dry interval was a reduction of the area covered by lakes and marshes and of the productivity of grasslands. The forests apparently retreated to higher elevations than they occupy at present (La Marche and Mooney 1976). As a result of these environmental changes, the old cultural pattern may have become untenable. Populations of waterfowl, fish and large ungulates probably declined and became less concentrated in the lowlands, and people responded by extending their annual economic round into upland as well as lowland zones, following resources which once were available close to their lakeside sites, but which had now retreated to higher elevations.

The Stinkingwater Pass area was not intensively used during the dry interval, most likely because it was too dry to attract the kinds of game animals (deer, elk, and perhaps sheep) sought in the uplands. Even today the area is marginal for elk, and water, the principal limiting factor for large upland game (Thompson, Hattan, Fortune, and Hutchison 1968:9) is scarce during the warm season. The only permanent water source in the project area is the spring at Site HA 72. There may be other springs in the Stinkingwater Mountains, but it is clear that any reduction in the availability of water from the present condition would render the area practically uninhabitable for larger game. Such a
reduction probably took place during the dry interval which began around 5000 B.C. Exploitation of upland zones during the dry interval likely was restricted to locations higher than Stinkingwater Pass (ca. 4850 feet), or otherwise more favorable.

Various kinds of evidence place the date for the onset of a wetter regime at about 2500 B.C. in the western United States (e.g., Antevs 1948, 1955; Hammatt 1976; Porter and Benton 1967). It might be expected that such a climatic change would result in an increase in the area habitable by certain kinds of plants and animals for which the availability of water is a major limiting factor. It is proposed here that this increase in annual precipitation caused the Stinkingwater Pass area to become suitable for big game animals such as deer, elk, and sheep, and possibly also for types of plants exploited by the human population. Consequently, the area became a regular part of the annual economic cycle of the Harney Basin people, and exploitable also for the people of the Malheur River Valley, though to the latter the zone was less important. From 2500 B.C. to historic times then, it is hypothesized, the Stinkingwater Pass area was wet enough to support significant populations of game animals, which were regularly hunted by the people who deposited the cultural debris described in the present report.

The chronology of occupation of the sites at Stinkingwater Pass tends to support the conclusion of Fagan (1974:102-106), that sites with deposits older than about 5000 years tend to be above 5000 feet in elevation, while those with more recent deposits are found both above and below 5000 feet.

Further research in the Stinkingwater Pass area would help to test the conclusions and hypotheses presented here, but the broad significance of the patterns seen in the present analysis allows these hypotheses to be approached also from other localities in the northern Great Basin, both at high and low elevations. Research in the Malheur River drainage area will be needed to test the proposition that the prehistoric culture there had a basically Plateau pattern of subsistence.

It is also evident from this study that purely surficial deposits of cultural debris can have great archaeological significance and usefulness, despite the undeniable problem of possible mixing of cultural components, provided that the data from them are collected in a systematic way designed to detect the patterns which may be present.

APPENDIX: PROJECTILE POINT TYPOLOGY

Because they are one of the most common kinds of artifacts found, and because they exhibit stylistic variability, projectile points are the most useful chronological indicators found in sites in the northern Great Basin and the Plateau. The points from the Stinkingwater sites have been grouped into 12 types on the basis of several distinguishing criteria, or dimensions.

One of the most important dimensions is neck width, used and measured as defined by Corliss (1972). All the points with measurable necks were measured and plotted on a frequency graph in terms of this dimension (Figure 18), with the result that a bimodal curve was produced similar to those illustrated by Corliss (1972: Figures 4 and 7). It is clear from inspection of the collection that points with narrow necks (less than 8 mm wide) strongly tend to be smaller and lighter, while those with broad necks (width greater than or equal to 8 mm) just as strongly tend to be larger and heavier. On the basis of these observations it was decided to use the neck width as a criterion for discriminating types of projectile points, a method used profitably (Pettigrew 1977) for point collections from the Lower Columbia.
Figure 18. Frequency of Projectile Points from Stinkingwater Sites by Neck Width.

Other dimensions used to discriminate types of projectile points are as follows. Generally, if a stem is distinguishable, the point is either barbed or shouldered. A barbed point is one whose blade corner projects downward, even if only slightly; and a shouldered point has no such downward projection at the corner of the blade. A diverging stem is narrowest at the neck, but a non-diverging stem is not. Diverging stems are often referred to as "expanding." The remaining dimensions used in the typology are self-explanatory.

The projectile point types found at Stinkingwater Pass are presented below, including for each type a discussion of the traditional Great Basin types which appear to be similar, and the estimated chronological range based on cross-dating (cf. Hester 1973, Fagan 1974, Pettigrew 1977).

**TYPE A:** narrow-necked, side-notched, straight or concave base (Plate 6a-6b, Figure 19). This type fits easily into the traditional Desert Side-notched type, believed to have been in use during the period A.D. 1200 to historic times.

**TYPE B:** unstemmed, straight base (Plate 6c-6k, Figure 19). Many of these may be preforms for other types. The established type that Type B most resembles is the Cottonwood Triangular, a class which includes also specimens with concave bases. The Cottonwood Triangular type is believed to range from A.D. 900 to historic times.

**TYPE C:** narrow-necked, barbed, non-diverging stem (Plate 61-6m, Figure 19). Both specimens are rather small, and would be traditionally classed as Rose Spring Contracting Stem, a type which is estimated to date from A.D. 1 to historic times. Not all Rose Spring Contracting Stem points are barbed, however.
**TYPE D:** narrow-necked, shouldered, non-diverging stem (Plate 6n, Figure 19). The only specimen found is rather small, and, just as the Type C specimens, would be traditionally classed as Rose Spring Contracting Stem, dating from A.D. 1 to historic times. However, many Rose Spring Contracting Stem points are barbed.

**TYPE E:** narrow-necked, diverging stem (Plate 7a-7q, Figure 19). Most of these points are small and barbed. Traditional types that would be included in this group are Rose Spring Corner-notched, Eastgate Split Stem, and Eastgate Expanding Stem. These types all range from A.D. 1 to historic times.

**TYPE F:** broad-necked, barbed, converging stem, concave base (Plate 7r-7aa, Figure 20). Most of these points are relatively large. Traditional types that would be included are Elko Eared, estimated to date from 2000 B.C. to A.D. 500, and Pinto Barbed, dated from 3000 to 700 B.C. Type F, then, ranges in age from 3000 B.C. to A.D. 500.

**TYPE G:** broad-necked, barbed, diverging stem, straight or convex base (Plate 8a-8h, Figure 20). All of the points in this group are relatively large. The traditional type Elko Corner-notched, dated 2000 B.C. to A.D. 500, would be included, as well as barbed examples of Martis Corner-notched, estimated to date from 1000 B.C. to A.D. 500.

**TYPE H:** broad-necked, shouldered, non-diverging stem (Plate 8i-8o, Figure 20). This group has been sub-divided into two categories. Type H1, represented by eight of the nine specimens collected, has a stem whose base is convex, resembling none of the traditional Great Basin types, though Gypsum points, dated 1800 to 450 B.C., would fit into the class. Type H2, the only example of which is from Site 35 HA 67, has a single-notched base, and would fall into the Pinto Square-shouldered type, with an estimated temporal range of 3000 to 700 B.C.

**TYPE I:** broad-necked, shouldered, diverging stem, concave base (Plate 9a, Figure 21). This type would include traditional types Pinto SLOping Shoulder and Pinto Square Shoulder, both ranging in age from 3000 to 700 B.C., and Elko Eared, dated from 2000 B.C. to A.O. 500. Type I, then, dates from 3000 B.C. to A.D. 500.

**TYPE J:** unstemmed, convex base (Plate 9b-9g, Figure 21). The specimens of this type could be termed 'leaf-shaped,' and are medium to large in size. No traditional Great Basin type is very similar to Type J, but leaf-shaped points are common throughout the Northwest. Here they fit into a very broad chronological range, approximately 7000 B.C. to A.D. 1000, though their relative proportion in sites is rather low after about 1000 B.C.

**TYPE K:** unstemmed, concave base (Plate 9h, Figure 21). The single specimen found most resembles the traditional Humboldt Concave Base type, estimated to date from 5000 to 1000 B.C.

**TYPE L:** broad-necked, side-notched (Plate 9i-9q, Figure 21). This is the well-known large, side-notched type, called variously Northern Side-notched, Bitterroot Side-notched and Cold Springs Side-notched. This group is estimated to range in age from 4500 to 1000 B.C.

Chronological estimates for the types of points presented here appear to fall into three categories of antiquity: Types A through E all belong to the range A.D. 1 to historic times: Types F through I fit into the range 3000 B.C. to A.D. 500; and Types J through K are covered by the range 7000 to 1000 B.C. To simplify matters, these three groups of points can be considered markers for three separate periods of prehistory: an early period (7000 to 2000 B.C.) (Types J through K), a middle period (2000 B.C. to A.D. 1) (Types F through I), and a late period (A.D. 1 through the historic period) (Types A through E).
Figure 19. Sketches of Projectile Points, Types A Through E. Actual Size.

Type A: 19a-19b
19a: Specimen No. HA68-Loc2-surf-82
19b: Specimen No. HA68-C4-surf-6.

Type B: 19c-19d
19c: Specimen No. HA66-B3-surf-8.

Type C: 19e-19f
19e: Specimen No. HA69-A3-1/6-1.
19f: Specimen No. HA68-C6-surf-10.

Type D: 19g
19g: Specimen No. HA70/1-B3-1/4-3.

Type E: 19h-19j
19h: Specimen No. HA69-Loc3-surf-56.
19i: Specimen No. HA69-A3-1/6-4.
19j: Specimen No. HA68-C3-surf-10.
Figure 20. Sketches of Projectile Points, Types F Through H. Actual Size.

Type F: 20a-20b
20a: Specimen No. HA68-Loc3-surf-5.
20b: Specimen No. HA69-A2-1/5A-5.

Type G: 20c-20d
20c: Specimen No. HA66-Loc1-surf-1.

Type H1: 20e

Type H2: 20f
Figure 21. Sketches of Projectile Points, Types I Through L. Actual Size.

Type I: 21a

21a: Specimen No. HA69-A1-1/2-2

Type J: 21b-21c

21b: Specimen No. HA68-C6-surf-2.

Type K: 21d

21d: Specimen No. HA76-A9-surf-1.

Type L: 21e-21g

21e: Specimen No. HA70-Loc3-surf-2.
21f: Specimen No. HA68-C14-surf-4.
21g: Specimen No. HA68-Loc2-surf-79.
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Plates 1 to 13 Follow
Plate 7. Top: Site 35 HA 66 in foreground, looking northeast.
Middle: Site 35 HA 67 in foreground, looking southwest, Highway 20 to the right.
Bottom: Site 35 HA 68, looking northeast, Highway 20 to the right.
Plate 2. Top: Site 35 HA 69; surface collection in open area, excavation in forested area in right background, Highway 20 in left half, looking south. Bottom: Site 35 HA 69, excavation in progress, looking north.
Plate 3. Top: Site 35 HA 70/1 in lower left, excavation in progress; Highway 20 in upper left; Site 35 HA 71 at ridge top at extreme right; looking northwest.
Bottom: Site 35 HA 70/2 in foreground, looking west northwest.
Plate 4. Top: Site 35 HA 71 at top of ridge above Highway 20 road cut, looking east.
Middle: Site 35 HA 72 in foreground, Highway 20 in upper left, looking north.
Bottom: Site 35 HA 74 at top of low ridge in left half, Highway 20 at extreme right, looking north.
Plate 5. Top: Site 35 HA 75 on slope in foreground above Highway 20 road cut.
Bottom: Site 35 HA 76 in foreground, Beede Reservoir in background, looking south.

Type A: 6a-6b

6a: Specimen No. HA68-Loc2-surf-82.
6b: Specimen No. HA68-C4-surf-6.

Type B: 6c-6k

6c: Specimen No. HA69-A3-1/6-2.
6d: Specimen No. HA66-B3-surf-8.
6e: Specimen No. HA69-Loc6-surf-5.
6f: Specimen No. HA67-Loc5-surf-23.
6g: Specimen No. HA68-Loc2-surf-29.
6h: Specimen No. HA68-Loc2-surf-42.
6i: Specimen No. HA69-A3-1/5-8.
6j: Specimen No. HA69-A3-1/(3-4)-5.

Type C: 6l-6m

6l: Specimen No. HA69-A3-1/6-1.
6m: Specimen No. HA68-C6-surf-10.

Type D: 6n

6n: Specimen No. HA70/1-B3-1/4-3.
Plate 7. Projectile Points, Types E Through F. Actual Size.

Type E: 7a-7q

7a: Specimen No. HA67-Loc5-surf-49.
7c: Specimen No. HA68-E4-surf-2.
7d: Specimen No. HA68-C3-surf-10.
7e: Specimen No. HA68-Loc2-surf-69.
7f: Specimen No. HA66-Loc3-surf-56.
7g: Specimen No. HA68-Loc2-surf-56.
7h: Specimen No. HA68-Loc2-surf-72.
7i: Specimen No. HA68-C1-surf-29.
7j: Specimen No. HA67-Loc5-surf-47.
7k: Specimen No. HA69-A2-1/49-4.
7l: Specimen No. HA69-TP1-1/2-2.
7m: Specimen No. HA72-D5-surf-1.
7n: Specimen No. HA66-Loc2-surf-1.
7o: Specimen No. HA68-Loc2-surf-71.
7q: Specimen No. HA69-A3-1/6-4.

Type F: 7r-7aa

7r: Specimen No. HA67-Loc5-surf-42.
7s: Specimen No. HA67-Loc3-surf-1.
7t: Specimen No. HA66-Loc3-surf-55.
7u: Specimen No. HA69-Loc8-1.
7v: Specimen No. HA67-B6-surf-2.
7w: Specimen No. HA68-Loc3-surf-5.
7x: Specimen No. HA68-Loc5-surf-2.
7y: Specimen No. HA68-Loc2-surf-55.
7z: Specimen No. HA69-A2-1/5A-5.
7aa: Specimen No. HA76-A10-surf-2.

Type G: 8a-8h

8a: Specimen No. HA68-Loc2-surf-44.
8b: Specimen No. HA67-Loc6-surf-1.
8c: Specimen No. HA66-Loc1-surf-1.
8d: Specimen No. HA69-Loc7-7.
8e: Specimen No. HA68-Loc2-surf-43.
8f: Specimen No. HA69-A3-1/(3-4)-6.
8g: Specimen No. HA68-Loc2-surf-53.
8h: Specimen No. HA67-Loc5-surf-40.

Type H: 8i-8o

8i: Specimen No. HA69-Loc1-surf-5.
8j: Specimen No. HA76-Loc1-surf-1.
8k: Specimen No. HA68-Loc2-surf-19.
8l: Specimen No. HA74-Loc6-surf-3.

Type I: 9a


Type J: 9b-9g

9c: Specimen No. HA68-C6-surf-2.
9d: Specimen No. HA68-Loc2-surf-60.
9e: Specimen No. HA74-Loc5-surf-13
9f: Specimen No. HA75-Loc1-surf-5.
9g: Specimen No. HA68-Loc3-surf-7.

Type K: 9h

9h: Specimen No. HA76-A9-surf-1.

Type L: 9i-9q

9i: Specimen No. HA68-Loc2-surf-70.
9j: Specimen No. HA68-Loc3-surf-1.
9k: Specimen No. HA67-Loc5-surf-29.
9l: Specimen No. HA70-Loc3-surf-2.
9m: Specimen No. HA68-Loc2-surf-50.
9n: Specimen No. HA76-Loc2-surf-5.
9o: Specimen No. HA68-C2-surf-6.
9p: Specimen No. HA68-C14-surf-4.
9q: Specimen No. HA68-Loc2-surf-79.

10a: Specimen No. HA73-Loc1-surf-2.
10d: Specimen No. HA69-TP1-1/1-4.
10f: Specimen No. HA67-Loc5-surf-16.
10g: Specimen No. HA69-Loc11-surf-6.
10h: Specimen No. HA70/1-Loc2-surf-2.
Plate 11. Formed Bifaces: Crescents and Miscellaneous; Drills.
Actual Size.

Crescents: 11a-11b


Miscellaneous Bifaces: 11c-11d

11c: Specimen No. HA74-Loc5-surf-2.
11d: Specimen No. HA70-Loc3-surf-3.

Drills: 11e-11k

11e: Specimen No. HA75-Loc2-surf-1.
11f: Specimen No. HA68-Loc2-surf-84.
11g: Specimen No. HA69-A2-1/6A-6.
11h: Specimen No. HA74-Loc8-surf-2.
11i: Specimen No. HA66-Loc3-surf-54.
11j: Specimen No. HA66-Loc3-surf-36.
11k: Specimen No. HA71-Loc3-surf-10.

12a: Specimen No. HA69-A3-1/7-3.
12b: Specimen No. HA71-Loc3-surf-16.
12c: Specimen No. HA69-A2-1/6A-4.
12d: Specimen No. HA68-D4-surf-1.
12e: Specimen No. HA70/1-Loc2-surf-3.
12f: Specimen No. HA67-Loc1-surf-46.
12g: Specimen No. HA68-TP1-1/2-2.
12h: Specimen No. HA68-Loc2-surf-10.

13a: Specimen No. HA69-A2-1/7-1.