Prehistoric Obsidian Quarry Use and Technological Change in the Western Great Basin: Examining Lithic Procurement at the Truman/ Queen Obsidian Source, California and Nevada

By

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Abstract

Prehistoric obsidian quarries in the western Great Basin show peak levels of use ca. 3150-1350 B.P. immediately followed by sharp declines in overall volume and a shift away from biface production. The models developed to explain this pattern either view quarry use as part of a trans-Sierra Nevada luxury exchange network with central and southern California populations as primary consumers, or as utilitarian toolstone procurement responding to western Great Basin settlement patterns and mobility. Obsidian hydration dates obtained on artifacts systematically collected from the Truman/Queen source demonstrates a history of use similar to other sources, suggesting that regional changes in western Great Basin obsidian quarry use was not the result of trans-Sierra Nevada exchange because Truman/Queen obsidian is virtually absent west of the Sierra Nevada. The results of this study also indicate that models that emphasize mobility as the primary conditioner of lithic technology are also inadequate. First order determinants of technology are most likely subsistence related and based on the ability of a specific tool form to contribute to subsistence return rates by reducing resource handling time. Differential mobility likely contributes to technology in a lesser way, affecting decisions regarding degrees of processing, such as biface stage, primary and secondary reduction loci, but not ultimately tool form.

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CHAPTER I

Introduction

Because of the large quantity of high quality obsidian in a geographically confined area, archaeological investigations regarding prehistoric lithic technology in the western Great Basin have often focused on major quarry sites (Fig. 1.1.). These obsidian quarry studies consist of two main components; firstly an empirical component, focusing on the identification of temporal patterns, and secondly a theoretical component, in which models are presented to explain the patterns. The patterns are identified through a series of obsidian hydration measurements taken on bifaces, cores and reduction debris found at the source, and collectively are a measure of the intensity of source use and technological change over time. The first of such studies (Singer and Ericson 1977) was at the Bodie Hills source, located in Mono County, California, and was followed by several publications focusing on the Casa Diablo obsidian source (e.g., Bouey and Basgall 1984; Ericson 1977,1982; Goldberg et al. 1990; Jack 1976; R. Jackson 1985; T. Jackson 1984; Singer and Ericson 1977). The third quarry to receive direct study, is the Coso source located in southern Owens Valley. Large projects were completed at the Sugar Loaf locale (Elston and Zeier 1984) and the Coso Volcanic Field (Gilreath and Hildebrandt 1995). Each quarry study is described in greater detail in Chapter 2.

For the most part archaeologists are in agreement about the patterns these studies identify, and the consensus is, that use of all three sources (Bodie Hills, Casa Diablo and Coso) changed over time in very similar ways. All demonstrate constant use beginning

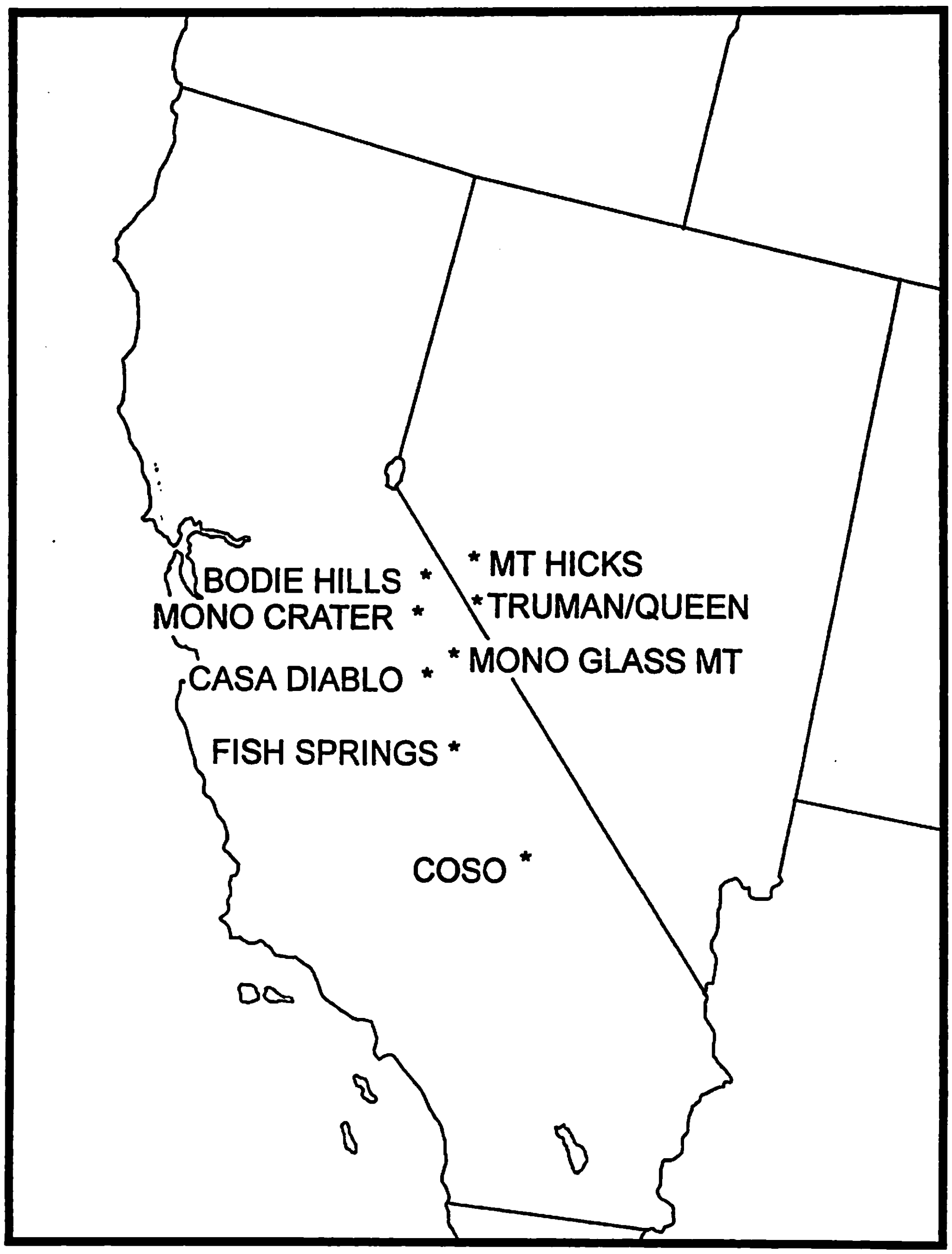

Figure 1.1. Major Obsidian Sources in the Inyo-Mono Region of the Western Great Basin

roughly 6000 B.P., with an emphasis on biface production. The production of bifaces appears to increase in intensity, reaching a peak during the Newberry period (ca. 3150-1350 B.P.). Each source then shows a more or less abrupt shift to a flake based technology, which is accompanied by sharply declining intensities of quarry use at the transition of the late Newberry-early Haiwee time period roughly 1350 years B.P.

The theoretical component to these studies has been the development of models to account for the way quarry use has changed over time, particularly focused on the decline in use and reduction in biface production ca. 1350 B.P. Several models came out of these studies. However the few which continue to dominate archaeologist's perception fall into two main categories. The first group are socio-technic arguments, where exchange and non-local populations (i.e. central and southern California) are seen as a critical component of lithic procurement, and thus are primary causal factors in the pattern of quarry use. The second type of argument examines the relationship of settlement patterns and mobility of local populations (i.e. western Great Basin inhabitants) to changes in lithic procurement and technological change evident at quarry sites.

The first of the exchange models comes from Ericson, based on study of the Bodie Hills (Singer and Ericson 1977, Ericson 1982) and Casa Diablo sources (Ericson 1982). Ericson asserts that an organized trans-Sierra Nevada luxury exchange system produced the pattern of high levels of biface production apparent in obsidian hydration profiles, dating to ca. 3150-1350 B.P. To support his argument, Ericson emphasized the regularized production (e.g. standardized bifaces) at the source, and the presence of Casa Diablo obsidian in high status burials in the San Joaquin Valley of central California, west of the Sierra Nevada. According to Ericson (1982) the technological transition from bifaces to a blade/flake industry approximately 1350 BP, was in part a shift from the production of luxury items to utilitarian items. Ericson (1982) identifies a series of changes which occurred in central and southern California, that he asserts, created a supply and demand problem. The two strongest factors which drove up demand were population growth and a technological change from the atlatl to the bow and arrow. When this increased demand could not be met with imported products, consumers from west of the Sierra Nevada resorted to direct procurement of unprocessed material and use of more local sources. Thus the exchange system collapsed, producing the decline in eastern Sierra Nevada source use evident in obsidian hydration profiles.

The next exchange based model, is essentially a limited access model, put forth by Bouey and Basgall (1984). From eastern Sierra Nevada sites, Bouey and Basgall identify the same pattern of use as Ericson described at Casa Diablo, where high levels of use begin roughly 3000 B.P., and abruptly decline after ca. 1350 B.P., with the accompanying shift from bifaces to a flake/core technology described by Ericson. On the west side of the Sierra Nevada, Bouey and Basgall (1984) identify a similar obsidian hydration profile as well as factors which they believe indicate greater levels of social complexity in populations on the western Sierra Nevada front and in central California. These factors, according to Bouey and Basgall (1984:144) created a special demand for status items. Populations from west of the Sierra Nevada were both the producers and suppliers of the Casa Diablo obsidian which reached central California during the Middle Horizon, since the egalitarian nature of populations in the western Great Basin could not support specialists manufacturing items for inter-group exchange. Therefore they conclude that the high levels of biface production from 3150-1350 B.P. "was (due to) western Sierra

Nevada populations obtaining obsidian through direct access " (Bouey and Basgall 1984:149). To explain the decline in the use of the source Bouey and Basgall assert that, as populations increased on the east side of the Sierra Nevada access to sources for western Sierra Nevada populations became limited. This was due to the increased territoriality which accompanied increased levels of social complexity in eastern Sierra Nevada populations. Because access to eastern California sources was effectively cut off for populations outside the area (i.e. central California), there was an increase in the use of obsidian from sources in the Napa Valley area and thus the sharp decline in use of eastern Sierra Nevada sources (Bouey and Basgall 1984). Like Ericson, Bouey and Basgall view bifaces as a luxury commodity and non-local populations as the primary consumers.

The third of these trade dependent models appears in the most recent treatise on eastern California quarry use. Gilreath and Hildebrandt's (1995) study of the Coso source, also attributes the increase in biface production to an expanding exchange network. The subsequent drop in biface production ca. 1350 B.P., however, is explained as a result of increased territoriality due to reduced mobility, and a subsistence change geared around the acquisition of plants which reduced the importance of obsidian (Gilreath and Hildebrandt 1995:194). In the Gilreath and Hildebrandt model, the peak biface production is the result of external factors (i.e. trans Sierra Nevada trade), while the decline in use is due to local factors, (i.e. settlement centralization, territoriality and subsistence change).

The fourth model discussed here belongs to the second group of explanations for changes in eastern California quarry use. It differs from the previous three models in that it emphasizes direct access and utilitarian use by local populations as part of an overall adaptive strategy as driving the patterns of quarry use, rather than socio-economic change linked to the source through trade. This theoretic perspective, and emphasis on ecological variables, is referred to here as an "organization of technology" model, because of its similarity to other such theoretical approaches (e.g. Kelly 1988, Bamforth 1986, Parry and Kelly 1987). In a 1989 article, Basgall questions the presumption in quarry studies, that the "displacement of material from its place of origin… is a relatively straightforward signature of trade, territoriality and other behaviors that operate within a strong sociological matrix (Basgall 1989:111)." Basgall (1989:114-116) identifies patterns from various sites in eastern California that are quite similar to quarry use data, and indicate the same biface emphasis from low levels increasing in importance during the Newberry Period (ca. 3150-1350 B.P.). Basgall also identified a greater diversity of sources type in earlier components which he concluded reflects a more mobile settlement system. Later components indicate reduced biface frequencies and an increased emphasis on a flake based technology (Basgall 1989:114). This was accompanied by an increased reliance on local material which is indicative of more intensive land use strategies and increased territorial control (Basgall 1989). Interestingly this adaptive pattern, in which a formal exchange system would more likely operate, does not emerge in the region until the time in which quarry use became greatly reduced.

The important difference to the organization of technology model is the emphasis on local populations as consumers and the utilitarian nature of technology and quarry use, contrast to the previous trade models which emphasize outside populations and luxury exchange. Both types of models, as well as the evidence for patterns of quarry use, are discussed in greater detail in Chapter 2.

Primary Research Objectives

The Truman/Queen Obsidian Quarry archaeological project was conducted to examine these competing hypotheses regarding obsidian quarry use in the region. The Truman/Queen obsidian source located on Inyo National Forest land roughly twelve kilometers north of Benton California, on the Nevada border, provides one of the best test cases for this problem. Most data pertaining to the Truman/Queen source relates to material from non-quarry sites, traced to the source by chemical analysis. These data suggest that Truman/Queen obsidian is primarily distributed to the east in west and west-central Nevada (Hughes 1983; Hughes and Bennyhoff 1986). The obsidian appears in sites in Long valley (Basgall 1983; Hall 1983), to the south in the Volcanic Tablelands (Basgall and Giambastiani 1992, 1995) and in southern Owens Valley (Basgall 1989). The material found to the west in both Long Valley and in southern Owens Valley is in highest frequencies in Newberry contexts (Basgall 1989). Given that the primary distribution of Truman/Queen obsidian is to the east, and that there is a clear absence west of the Sierra Nevada, the source was less likely subject to the effects of an extensive trans-Sierra Nevada trade network such as that proposed in most of the literature concerning use of other obsidian sources in the region (i.e. Bouey and Basgall 1984; Ericson 1977, 1982; Gilreath and Hildebrandt 1995; Goldberg et al. 1990; Jack 1976; R. Jackson 1985; T. Jackson 1984; Singer and Ericson 1977). Because of this, the

Truman/Queen source is one of the best suited for directly evaluating the degree to which trans-Sierra Nevada trade contributes to the pattern of use evident at area quarries. The implication of the trans-Sierra Nevada exchange model is that the Truman/Queen source should be independent and part of a different system and thus not have the same pattern. Given the clear lack of trans-Sierra Nevada exchange in the Truman/Queen case finding a similar pattern there would require re-examination of the trade hypothesis, since its "signature" would no longer be distinct from the signature of other patterns. The Truman/Queen source area, including its known distribution, as well as, the past and present environment, geology and ethnographic context is described in greater detail in Chapter 3.

Part of the field work for this project was conducted in conjunction with the University of California, Riverside archaeological field school during the summers of 1994 and 1995. The majority of the surface survey and all surface collection was completed during the summer of 1996 with the University of California, Davis archaeological field school. In total, over five hundred man days of field work were completed, resulting in intensive surface survey and density mapping of 61 quadrats (500 x 500 meter). The surface collection, conducted at 77 randomly selected points across the source, yielded 315 bifaces, 13 biface/points, 88 cores, 10 flakes tools, 45 projectile points, 12 unifaces and approximately 3900 pieces of debitage. The methods of data recovery and laboratory analysis as well as descriptive metrics of the collection are described greater detail in Chapter 4. The source map and locational summaries of the surface collection efforts are described in Chapter 5. The overall production history for the Truman/Queen source is described in Chapter 6. This is based on hydration readings obtained on 528 artifacts collected at the source. These data are used to evaluate the competing models of quarry use described above.

Secondary Research Objectives

The secondary research goals of this study relate to spatial variability at quarry sites, which occurs along two distinct but related dimensions. The first of these, is behavioral, and is measured by identifying the quantity and type of things made at different parts of the source. It is clear that behavioral variability at the source is related to variability that occurs naturally, due to the geology of the source area. Thus, mapping the source included recording surface characteristics such as densities of raw material and reduction loci, in contiguous twenty-five meter grid squares across the source. Collectively these comprise the density map in Chapter 5 and are individually presented in Appendix C. The examination of natural geological variability included neutron activation analysis to identify possible variance in geo-chemical composition across the source. This is important because such inter-source variability may help clarify questions about the distribution of material from different zones to outlying areas, identify access variables such as territories or directions of seasonal movements of different groups using the source. Another form of natural variability relates to the quality and size of raw material relative to its suitability for the manufacture of particular tool types. This was examined by obtaining measurements of raw material cobbles from different points across the source. Cobble size is likely a conditioning factor determining where certain tool types are found at the source. This part of the study is described in greater detail in Chapters 4 and 5, and the cobble size data is listed in Appendix E.

CHAPTER II

Background: Quarry Use in the western Great Basin

The importance of highly localized obsidian sources in eastern California has long been noted by archaeologists. There are eight major obsidian sources (Fig. 1.1) in the Inyo-Mono region of eastern California/western Nevada that were known to have been used prehistorically for the production of stone tools. These are Bodie Hills, Casa Diablo, Coso, Fish Springs, Mono Craters, Mono Glass Mountain, Mt. Hicks and Truman/Queen (Basgall 1989). Systematic study of three of these quarries (Bodie Hills, Casa Diablo and Coso) has been conducted, each resulting in the determination of a production curve. Essentially this consists a diachronic summary of the use of a quarry, and to a certain degree identification of temporal change in quarrying technology and tool production. Production curves are derived through a series of obsidian hydration dates obtained on artifacts from different technological trajectories, and have typically been used to evaluate hypotheses about changes in social and economic processes such as exchange or territoriality.

This chapter examines previous archaeological research of quarry use in the area, which has identified a common pattern of use over time at each of the three quarries studied. The second part of this chapter will examine the models and theories archaeologists have used to explain the pattern of quarry use in the region. This is followed by a discussion of problems with the current arguments regarding lithic procurement and quarry use in the region.

Bodie Hills Production System

During the 1970's and early 1980's, new analytical techniques for the study lithic technology, such as x-ray fluorescence (XRF) and obsidian hydration, shifted archaeological focus from artifact typology and chronology to an examination of lithic sources themselves. Such studies usually consist of a spatial dimension, where material is traced back to a source by XRF based on its chemical composition. The spatial distribution of material from a particular source is typically viewed as an indicator of trade. The other main aspect of these types of studies is an examination of temporal variability measured by a series of obsidian hydration readings. The frequency of each resulting hydration measurement is plotted on a histogram, depicting a production history, or gross measure of a source's use and changes in technology over time.

The first quarry to be studied in this manner was the Bodie Hills source (Singer and Ericson 1977), earlier described and characterized by Jack and Carmichael (1969). The source is located in Mono County, California, approximately 12 kilometers east of the modern town of Bridgeport, at elevations of roughly 2500 meters (Singer and Ericson 1977). Obsidian at Bodie Hills appears in both primary outcrops of angular material and secondary ridge deposits of cobbles, and covers an area of roughly eight square kilometers (Singer and Ericson 1977). In what was the beginning of a series of treatises on prehistoric exchange, Jonathan Ericson published (Singer and Ericson 1977) a study of the Bodie Hill source. This study, which used obsidian hydration dating, was offered as an example of a "inexpensive and comprehensive means to investigate prehistoric trade...and estimate the quantities of items produced for export as a function of time

(Singer and Ericson 1977:171)." This early study, as most that have followed, assumed that trade and exchange of obsidian material into central and southern California were the major factors contributing to temporal variability in quarry use and the distribution of material from a source (Ericson 1981, 1982, 1984). This assumption is also evident in Singer and Ericson's (1977:186-187) use of a central and southern California cultural sequences to describe temporal variability in use of eastern California sources. The bulk of all subsequent investigations regarding obsidian source use in eastern California have been built on these assumptions.

Fieldwork at the Bodie Hills site included a series of linear transects where information (Table 2.1) was recorded at 230 different points believed to represent approximately 4% of the total site (Singer and Ericson 1977: 175).

Table 2.1 Data Recorded in Bodie Hills Study (from Singer and Ericson 1977:175)
1. Artifact density recorded as flakes per square meter
2. Types of artifacts present with their relative frequencies.
3. Approximate sizes of artifacts.
4. Presence (or absence) of natural obsidian material including size and form
5. Description of any non-obsidian materials (both natural and artifactual)
6. General description of topography and proximity to natural outcrops.

The spatial dimension of the Bodie Hills study, although critical to exchange based models, was quite limited in Singer and Ericson's (1977) first paper, which was based on obsidian hydration dates from material recovered *at* the source. Nevertheless they conclude that trans-Sierra Nevada trade produced the pattern of use observed there. Singer and Ericson (1977) used a computer model to estimate the presence of 479 million pieces of debitage at the source. From this, they estimated that between 4.79 and 8.62 million bifaces were made over a five thousand year period, with 960 to 1,725 bifaces per year being made by specialists (Singer and Ericson 1977 183-185). Singer and Ericson (1977:176) collected a total of 816 artifacts, a sub-sample of which were dated through obsidian hydration and comprise the main part of their study of prehistoric trade. The temporal pattern they present (Singer and Ericson 1977) is depicted below in Figure 2.1.

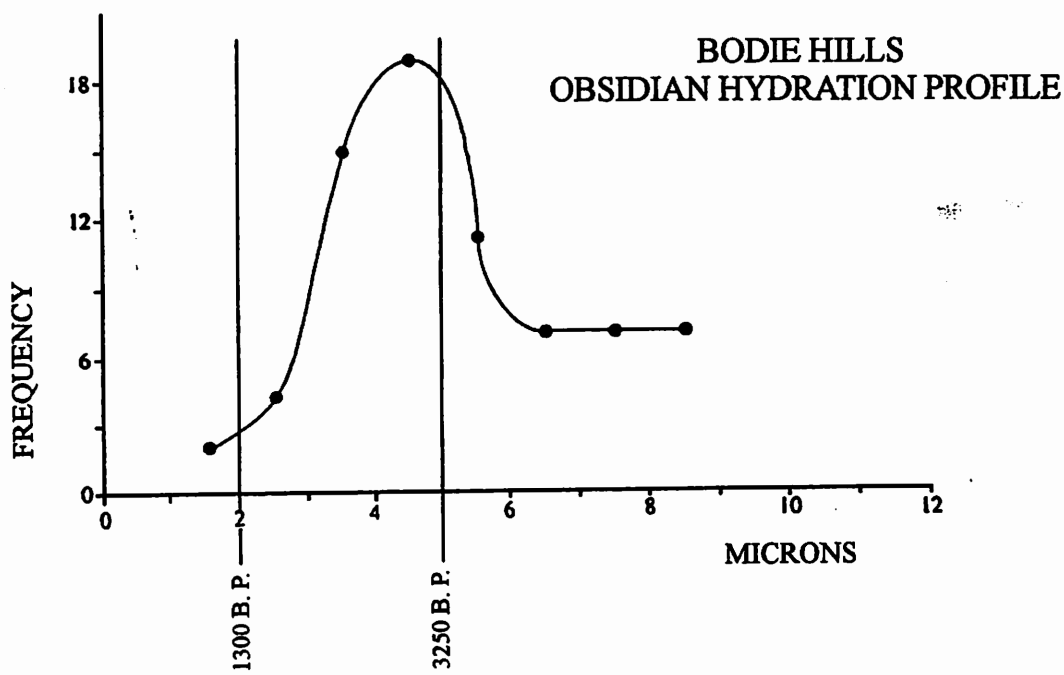

Figure 2.1 Bodie Hills Obsidian Hydration Profile (redrawn from Singer and Ericson 1977, Fig. 8. Temporal indicators added.)

According to Singer and Ericson (1977:177) Bodie Hills was initially used primarily for the export of partially finished bifaces and later for the export of prismatic blades. Figure 2.1 is the curve redrawn from the curve published in Singer and Ericson. To assign absolute dates to the hydration data, Singer and Ericson use a rate (Ericson 1975) of 650 years per micron. The peak levels of use evident in the production curve

(Singer and Ericson 1977:181 Fig. 8) were thus argued to correspond to dates between 300 and 2200 B.C. These correspond to the manufacture of partially finished bifaces represented by 57 of 98 obsidian hydration readings (Singer and Ericson 1977:186). Although Singer and Ericson lacked data with chronological control regarding blade/flake production, it was seen as subsequent to biface production, and believed to date between 2000 B.C. and 500 A.D. (Singer and Ericson 1977:187). However, it is possible that the prismatic blades they identify (Singer and Ericson 1977:177 Fig. 4) are early stage decortication or biface thinning flakes which often have a single dorsal aris formed by two previous flakes causing a blade like appearance. In any case the "blades" were not dated thus the replacement of a biface centered technology with a core/flake based technology was assumed rather than demonstrated in these early quarry studies.

Of the three quarries studied to date, the temporal data from the Bodie Hills source is the least clear. This is in part due to its relatively limited study, as well as confusion in the published data. In Singer and Ericson (1977:Fig. 8) there are apparently 71 data points represented in the Bodie Hills hydration profile, however according to the text there are 98 data points (Singer and Ericson 1977:186-187). The data from which the curve was presumably derived was later published with apparent modification (Meighan and Vanderhoven 1978:33-36).

Interestingly most subsequent quarry studies that mention Bodie Hills production history (Ericson 1981 plates 7-4, 7-7; Ericson 1982:181 [Fig. 6.4]; Ericson 1982:144 [Fig. 6.8]; Ericson 1984; Gilreath and Hildebrandt 1995:19), cite the Singer and Ericson (1977) summary paper rather than the published data. Any possible difference between the well cited curve (Singer and Ericson 1977) and the actual hydration data (Meighan and

Vanderhoven 1978) is important, because all current models regarding quarry use in the region make note of the pattern visible in the Bodie Hills data. Because of this additional hydration data from the Bodie Hills source is needed to reestablish confidence in the pattern of use noted by Singer and Ericson.

Figure 2.2 is a comparison of the curves derived from the data points in Singer and Ericson (1977) and the 85 hydration readings published in Meighan and Vanderhoven 1978). This later total is from 98 samples which were submitted however thirteen specimens had no visible band ("NHV"), 2 had double readings both of which were counted, and an extreme value of 17.1 microns and one specimen label "less than one" were excluded, giving the total of 85.

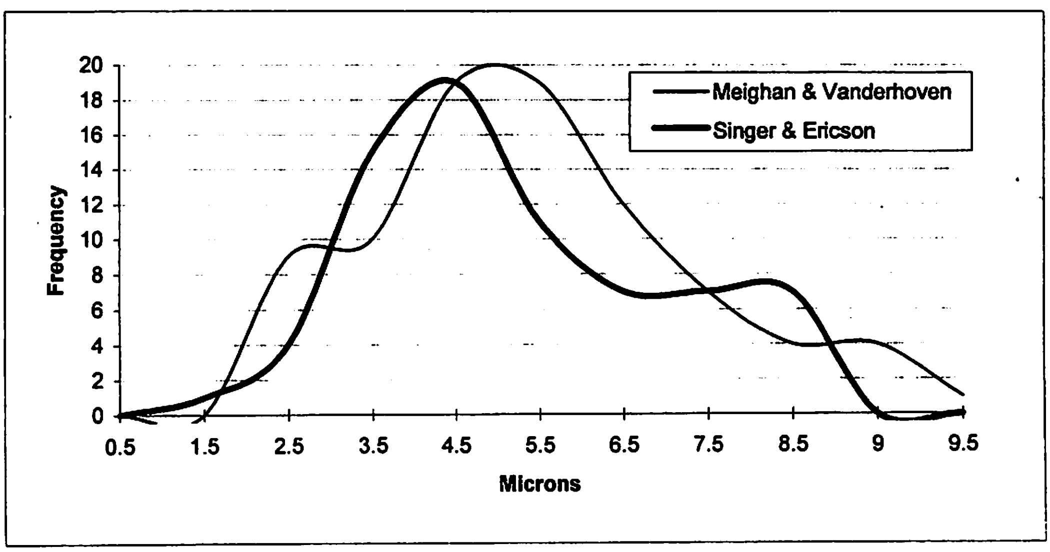

Figure 2.2 Hydration curve with 85 data points from Meighan and Vanderhoeven (1978), and 71 data points from Singer and Ericson (1977, Figure 8).

Although the basic forms of the two curves in Figure 2.2 are similar, it is important that they be accurately depicted. According to the data in Meighan and Vanderhoeven, the decline in quarry use at Bodie Hills is later in time and less abrupt than previous studies have emphasized. The curve depicted in Figure 2.3, based on the 85 hydration readings listed in Meighan and Vanderhoven, will be used through out this study for comparison. However the curve depicted in Figure 2.3 in .25 micron intervals demonstrates the need for additional hydration data from Bodie Hills to identify smaller changes in source use.

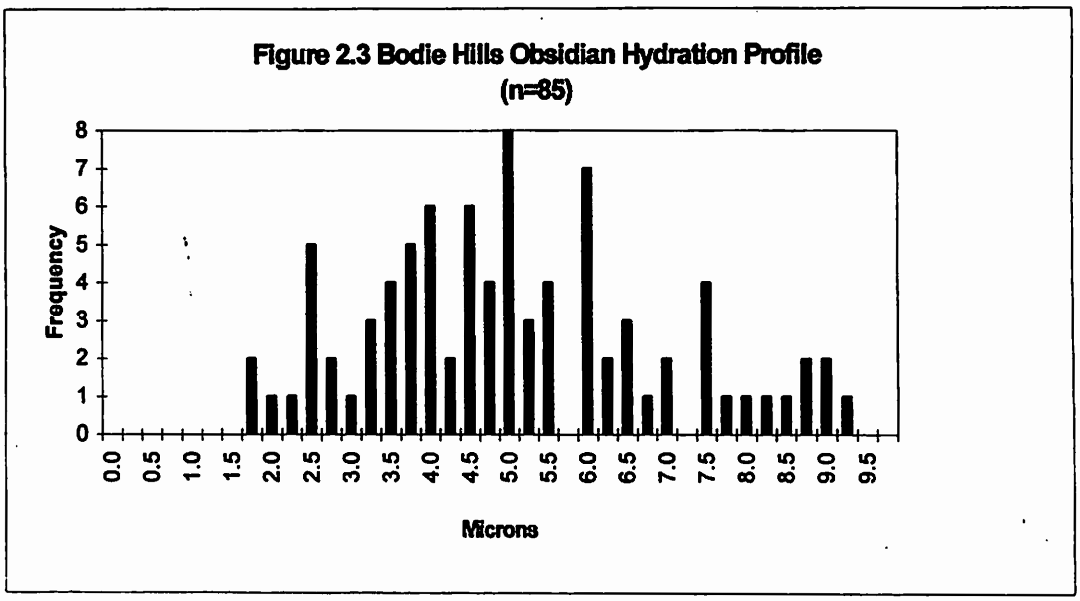

Figure 2.3 Bodie Hills Obsidian Hydration Profile

The obsidian hydration data for Bodie Hills shows a range of readings from 1.6-9.2 microns. It shows low levels of use at 9.2 microns which increase around 7.5 microns, reaching a peak at roughly 4.8 microns. The majority of values (58 of 85 hydration readings) fall between 3.1-6.8 μ, one standard deviation from the mean of 4.95 microns. The summary statistics in Table 2.2 are based on actual hydration values from Meighan and Vanderhoeven (1978).

Table 2.2 Descriptive statistics for the Bodie Hills source (based on Meighan and Vanderhoeven 1978).

Mean	4.95	Minimum	1.6
Median	4.8	Maximum	9.2
Standard Deviation	1.85	Range	7.6
Count	85		

The are several interesting aspects of the pattern depicted in Figure 2.3 including 1) apparent stability in low levels from first use at 9.2 microns; 2) a large increase at 6 microns; 3) a rapid decline at roughly 3.5 microns; and 4) disuse at 1.5 microns. This pattern, discussed in more detail in Chapter 6, is what archaeologists studying quarries have sought to explain. Interestingly, according to the data from Meighan and Vanderhoven, the decline after 3.5 microns is not as rapid as other studies emphasize. This less rapid drop-off is more evident when the hydration data are matched to more recent hydration rate estimates for Bodie Hills. Based on a collection of material from Bodie Hills recovered on the west slope of the Sierra Nevada, R. Jackson (personal communication) has proposed the following rate. [Years B.P. = 102.04 X $(\text{microns})^2$]. According to this rate the majority of production at Bodie Hills occurred between 4950 B.P. and 980 B.P.. The frequency of hydration values by temporal period for Bodie Hills based on R. Jackson's rate are listed in Table 2.3.

The Mohave Period (ca. 4950; > 6.96 microns) is represented by 17.6% (n=15) of the total hydration samples. Little Lake period (ca. 4950-3150 B.P.) is represented by hydration values between 6.96 -5.57 microns represents 15.3% (n=13) of the total. The Newberry period (ca. 3150-1350 B.P.) represented by a hydration range of 5.56-3.65 microns had the highest frequencies of 43.5% (n=37). The Haiwee period (ca. 1350-650

B.P.; 3.64-2.53 microns) has significantly lower frequencies of use at only 13% (n=11) of the total hydration values. The Marana period, represented by hydration values of 2.52 microns or less, had the lowest levels of use, representing only 10.5% (n=9) of the total. These frequencies are discussed in more detail below.

Table 2.3 Frequency of hydration reading by Temporal Period for Bodie Hills

Chronological Periods		Hydration Range *	# of readings	% of total
Marana	650 B.P. - Contact	2.52-0.0	9	0.11
Haiwee	1350-650 B.P.	3.64 - 2.53	11	0.13
Newberry	3150-1350 B.P.	5.56 - 3.65	37	0.44
Little Lake	4950- 3150 B.P	6.96 - 5.57	13	0.15
Mohave	pre-4950 B.P	> 6.96	15	0.18

* Based on R. Jackson's (Personal Communication) Rate:
Years B.P. = $(\text{microns})^2$ X (102.04)

Casa Diablo Production System

The Casa Diablo source was brought to prominence by Ericson (1982) through a series of articles that, like the Bodie Hills study, were offered as a means to examine prehistoric trade. Ericson (1982) demonstrated that the Casa Diablo and Bodie Hills sources have similar patterns of use evident in obsidian hydration profiles (Fig. 2.4). Ericson also demonstrated that the St. Helena source near the Napa Valley of California peaks much later in time, contemporaneous with the decline in use of the eastern California obsidian sources. This observation was an important part of Ericson's model, and is discussed in more detail below.

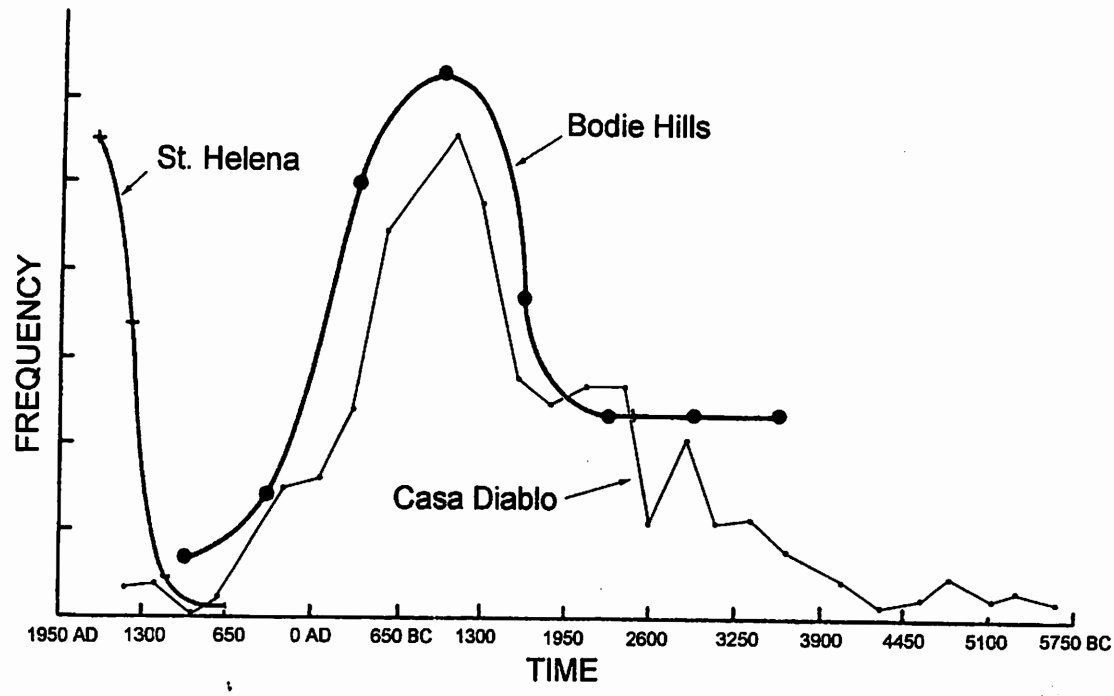

Figure 2.4 Comparison of Bodie Hills, Casa Diablo and St. Helena Sources (redrawn from Ericson 1982).

The obsidian hydration data for Casa Diablo used in Ericson's (1982) study was originally from J. Michels (1965) dissertation, which was an early examination of obsidian hydration dating techniques, and used material collected at the Mammoth Junction site near the Casa Diablo source. Following Michels (1965), Ericson used the hydration rate of 1000 years per micron for Casa Diablo obsidian. According to Ericson (1982) use of the source began with low levels of biface production approximately 7000 B.P. The production of bifaces increased in frequency between 5500-3700 B.P., peaks between 3600 and 2180 B.P., and is followed by a reduction in frequency of use and diversity of products (Ericson 1982). Between 170 BC and AD 300 the site was abandoned (Ericson 1982).

Some subsequent studies of Casa Diablo have focused on questioning the obsidian hydration rate, as a way to take issue with the models which have explained the patterns. According to T. Jackson (1984) the decline in quarry use occurred much later in time and was the result of western contact disrupting the way of life which included use of the source. In another study, Hall (1983) examined the relationship of late Holocene volcanism to quarry use. More recent studies have added resolution to the production history for Casa Diablo, due to the larger number of hydration readings and refinements to the Casa Diablo hydration rate. Hall and Basgall (1994) have constructed a similar production history based on approximately 2500 hydration readings (Fig. 2.5) on material collected from a number of sites in the eastern Sierra Nevada, near the Casa Diablo source.

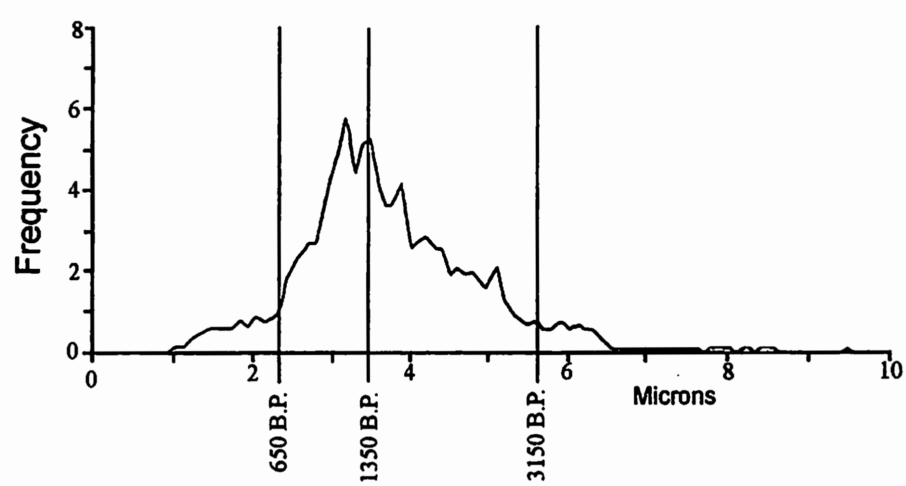

Figure 2.5 Casa Diablo Cumulative Hydration Profile from Eastern Sierra Sites (redrawn from Hall and Basgall 1994, temporal indicators added)

Collectively there are more hydration data for Casa Diablo, than any of the other sources. A number of cultural resource management projects (Table 2.3) at or near the Casa Diablo source have produced a large number of these.

Table 2.4 Sources of data used in Casa Diablo Curve II (Figure 2.6).

Site	Cores	Bifaces	Flakes	Total	Reference
Ca-Mno-529	0	30	126	156	Basgall 1983: 184-193
Ca-Mno-561	0	0	66	66	Hall, 1989: Appendix B
Ca-Mno-574	0	36	46	82	Goldberg et al.,1990: Tables H6, H11
Ca-Mno-577	40	24	46	110	Goldberg et al.,1990: Tables H7, H11
Ca-Mno-578	22	101	48	171	Goldberg et al.,1990: Tables H8, H11
Ca-Mno-833	0	10	45	55	Goldberg et al.,1990: Tables H9, H11
WARFAR	0	248	473	721	R. Jackson, 1985: 314-331
Total	62	449	850	1361	

Figure 2.6 is the hydration profile derived from 1361 hydration readings from the four different studies. This production curve for the Casa Diablo source is not offered as a better curve than the Hall and Basgall (1994) curve, but is included, because the hydration values are used in the descriptive statistics (Table 2.5) and comparison to other sources that follows. These data show the same pattern of use over time as the previous curve from Ericson. The data from which Figure 2.6 is derived has a mean of 3.98 microns and ranges in value from a minimum of 1.0 microns to a maximum 10.7 microns. This is based on 1361 hydration values from the studies identified in Table 2.4. Temporal placement of the data is based on the best accepted rate (Hall and Jackson 1989) for the Casa Diablo source, the history of use becomes evident. Hall and Jackson's rate is as follows; [years B.P. = $129.656(\text{microns})^{1.826}$]

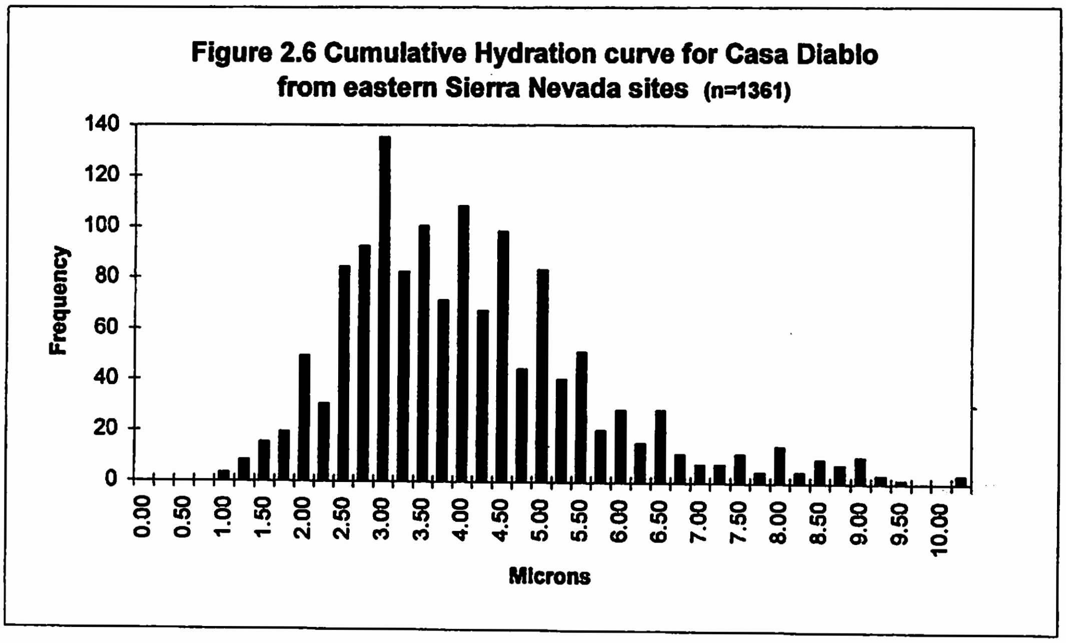

Figure 2.6 Casa Diablo Hydration Curve II. Derived from several studies in eastern sierra.

Thus, the mean hydration value of 3.98 for the 1361 readings corresponds to 1615 B.P.. Based on a standard deviation of 1.57, the majority of values fall between 5.55 microns and 2.41 microns. This suggests that most production at Casa Diablo occurred between 2964 B.P. and 646 B.P. These dates correspond quite well with the beginning of the Newberry period (ca. 3150 B.P.), and the end of the Haiwee period (ca. 650 B.P.). Interestingly the decline at the Casa Diablo source appears to be later in time than what archaeologist consider to be the major decline in use of eastern Sierra Nevada sources.

Table 2.5 Descriptive Statistics for Casa Diablo Obsidian Source

Mean	3.98	Minimum	1.00
Median	3.70	Maximum	10.70
Standard Deviation	1.57	Range	9.70
Count	1361		

The hydration profile for the Casa Diablo source can be related to the cultural sequence for the area (c.f. Bettinger and Taylor 1974) to establish the history of use (Table 2.6).

Table 2.6 Frequency of hydration reading by Temporal Period for Casa Diablo

Chronological Periods		Hydration Range *	# of readings	% of total
Marana	650 B.P. - Contact	< 2.4 microns	171	0.13
Haiwee	1350-650 B.P.	3.6 - 2.4 microns	477	0.35
Newberry	3150-1350 B.P.	5.7 - 3.6 microns	551	0.40
Little Lake	4950- 3150 B.P	7.3 - 5.8 microns	98	0.07
Mohave	pre-4950 B.P	> 7.3 microns	64	0.05

* based on Hall and Jackson's (1989) rate of $y=129.656x^{1.826}$

Based on the above mentioned hydration rate, the Mojave Period (pre 4950 B.P.) likely corresponds to hydration values greater than 7.3 microns and represents only 5% of all values (n=64), although three of these are greater than 10 microns and may be excluded as outlyers. Collectively these indicate that use of the source began with early use of other resources in the area roughly 7000-8000 B.P., although it was minimal at that time. The Little Lake Period (ca. 4950-3150 B.P; 7.3 - 5.8 microns) accounts for only 7% of all hydration readings (n=98). The Newberry Period (ca. 3150-1350 B.P; 5.7 - 3.7 microns) is marked by a substantial increase in use, and represents 40% of all hydration values (n=551). The Haiwee Period (ca. 1350-650 B.P.; 3.6 - 2.5 microns) is characterized by only slight reduction in use and represents 35% of all hydration values (n=477). This is somewhat unexpected, given that prior studies have emphasized a substantial reduction in source use at the Newberry/Haiwee transition. This pattern is discussed in greater detail in Chapter 6. By the Marana Period (ca. 650 B.P.; <2.5

microns) use of the Casa Diablo source has greatly diminished and only represents 13% of all hydration values (n=171) are within this range.

Coso Production System

Two substantial projects have been carried out at the Coso source in southern Owens Valley. Production histories for the Coso source have been derived from material collected at both the Sugar Loaf locale (Elston and Zeier 1984) which is depicted in Figure 2.7, and the Coso Volcanic Field (Gilreath and Hildebrandt 1995) which is depicted in Figure 2.8. Both locations indicate a similar temporal pattern of quarry use, but because the Gilreath and Hildebrandt study is the more extensive and more recent it is used here as the standard for inter-quarry comparison.

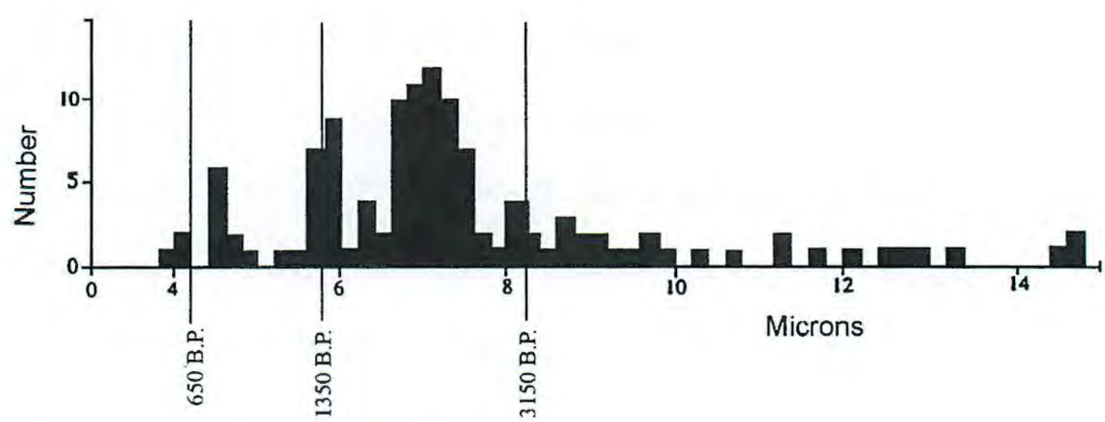

Figure 2.7. Obsidian Hydration profile for the Sugar Loaf Local of the Coso Source, (redrawn from Gilreath and Hildebrandt 1995 to show temporal periods, data from Elston and Zeier 1984).

Although the sample size is much smaller in the Sugar Loaf study (Elston and Zeier 1984), it is clear that the majority of use occurred during the Newberry Period from 1275 - 3500 B.P. Like other sources, pre-Newberry period use occurs for long periods of time but is limited in volume. Post Newberry hydration values are greatly reduced, again similar to the Bodie Hills and Casa Diablo hydration profiles.

The larger study by Gilreath and Hildebrandt included excavations and/or surface collection at 19 quarry loci/sites and at 30 off-quarry loci/sites (Gilreath and Hildebrandt 1995:5). This resulted in the collection of roughly 7,500 artifacts and 185,000 pieces of debitage. The study also included over 4000 obsidian hydration readings on artifacts of various categories. The descriptive statistics (Table 2.7) for the Coso source are also interpolated and thus does not include mean, standard deviation, and other descriptive statistics which are included for other sources.

Table 2.7 Descriptive Statistics for Coso Obsidian Source

Median	8.0	Minimum	0.0 - 0.4
Mode	6.0 - 6.4	Maximum	26.5 - 26.9
Count	4211	Range	26.5

The hydration values from the Coso Volcanic Field range from a high between 26.5 and 26.9 microns to a low between 0 and 0.4 microns. The data most relevant to the problem discussed here is the cumulative obsidian hydration curve for the Coso source, depicted in Figure 2.8.

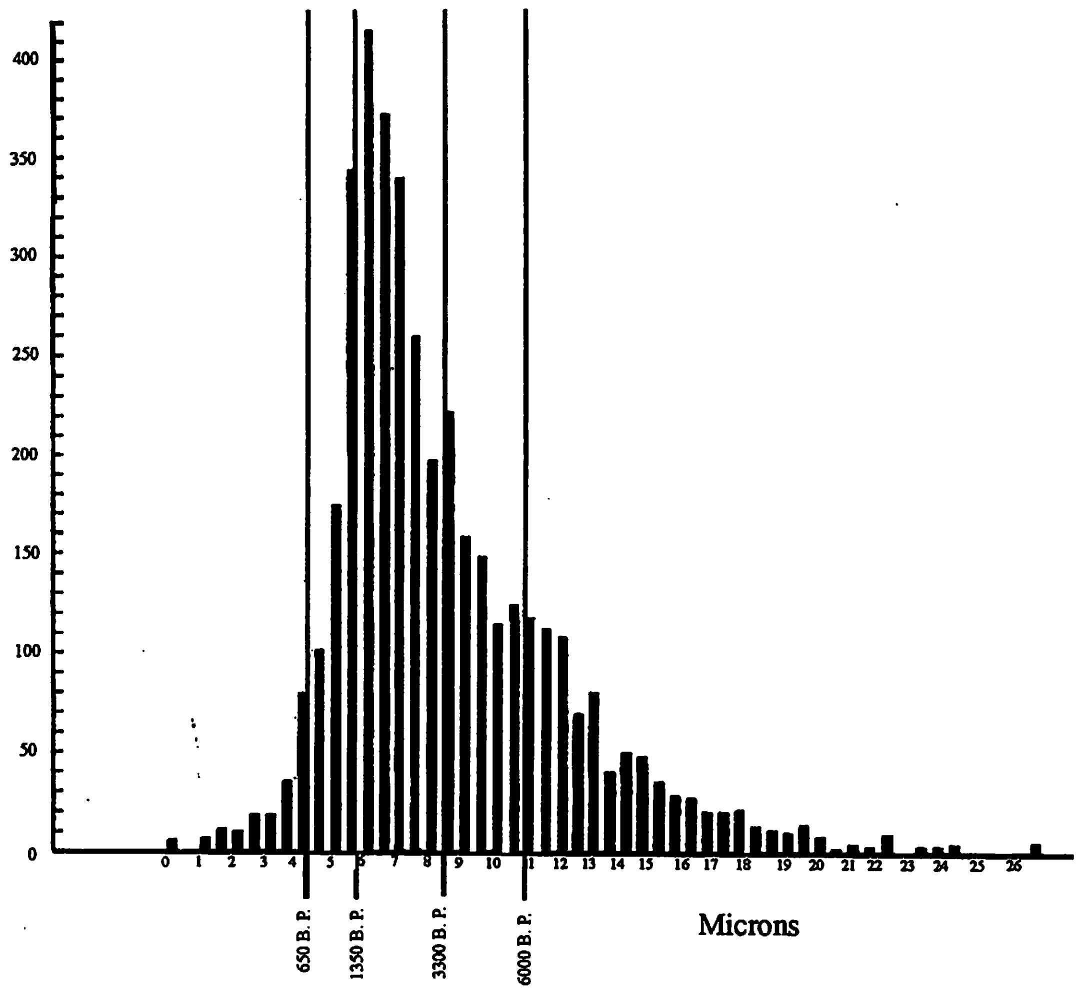

Figure 2.8 Obsidian Hydration Profile for the Coso Volcanic Field (Redrawn from Gilreath and Hildebrandt 1991:176, Fig. 24-d.)

Gilreath and Hildebrandt (1995) recognized the similarity of the obsidian hydration profile (Figure 2.8) for the Coso Volcanic Field to those from Bodie Hills and Casa Diablo. Based on Basgall's (1990) rate for Coso, Gilreath and Hildebrandt data (1995:166-167 Table 82) indicates the following chronology of use for the Coso source. The most complete summary by temporal period in Gilreath and Hildebrandt (1995:144 Table 64) lists only selected artifacts. This is limited to cores, bifaces and milling equipment, thus the breakdown by temporal period below (Table 2.8) does not include debitage. The percentages of cores and bifaces by time period are based on only the biface and core total, and exclude milling equipment.

Table 2.8 Frequency of hydration readings by temporal Period for Coso

Gilreath and Hildebrandt Chronological Periods		Hydration Range	Artifacts	% of total
Marana	650-200 B.P.	4.2-2.5 microns	31	0.01
Haiwee	1275-650 B.P.	5.65-4.2 microns	190	0.06
Newberry	3500-~~2800~~ 1275 B.P	8.7-5.65 microns	1294	0.38
Little Lake	5500-3500 B.P.	10.6-8.7 microns	481	0.15
Mohave	pre-5500 B.P.	> 10.6 microns	1361	0.40

% based on biface and core total (n=3359) only from Gilreath and Hildebrandt (1994:144 Table 64)

Although initial levels of use are low, it is clear from the range of hydration readings, that the source has been important and used with early occupation of the Coso area. 1363 of 3359 artifacts (Gilreath and Hildebrandt 1995: 144 Table 64) are over 10.9μ, and likely predate the Little Lake period beginning ca. 5500 B.P. These account for 40% of the selected artifacts reported by Gilreath and Hildebrandt for the Coso Volcanic Field. The Little Lake period represented by hydration values between 10.6 - 8.7μ, accounts for only 15% (n=481) of the values but because of the potentially greater time span of the early period (i.e. all readings >10.6μ), Little Lake frequencies may actually indicate an increase in use over what immediately preceded it. Gilreath and Hildebrandt break the Newberry period three parts; Early 3500-2800 B.P. (8.7-7.9μ) Middle Newberry ca. 2800-2300 B.P. (7.9-7.3μ) and Late Newberry is between 2300-1275 B.P. (7.3-5.65μ). Collectively the Newberry period (ca. 3500-1275 B.P.) shows a marked increase in biface and cores, accounting for 38% (n=1294) of all bifaces and cores recovered. The Haiwee period (ca 1275-650 B.P.) which corresponds to a range of

5.65-4.2μ. is marked by significantly reduced levels of use with 6% (n=190) of the total bifaces and cores. According to Gilreath and Hildebrandt (1991:66) the Marana Period (ca 650-200 B.P.) is represented by obsidian hydration range between 4.2-2.5 μ. This period is characterized by the lowest levels of use and accounts for less that 1% (n=31) of the total bifaces and cores listed in Gilreath and Hildebrandt's (1995 Table 64) data.

Discussion: Temporal Pattern of Quarry Use

The production histories for Casa Diablo and Coso are better understood than the one for Bodie Hills. This is largely due to the fact that these studies were more recent and have benefited from larger hydration samples and more refined hydration rates. The study of the Bodie Hills source should still be focused on the development of an adequately tested rate, and collection a larger sample for obsidian hydration before its history can confidently be summarized. Nevertheless, the Bodie Hills source seems to have the same general pattern as the Coso and Casa Diablo sources. Figure 2.9 below, which is a comparison of all three sources, demonstrates their similarity. It is important to note that the curve depicted in Figure 2.9 for the Bodie Hills source is in 1.0 micron intervals rather than .5 micron intervals used for the others. This is to illustrate the general similarity to the other sources. Figure 2.3 in this chapter shows the same curve in .5 micron levels, which disclosed fluctuations that make the general pattern less clear.

Each apparently had low levels of use coinciding with early occupation of the region. During the early periods of western Great Basin prehistory, quarry use appears quite limited, likely due to low population levels. Although the Mojave period for

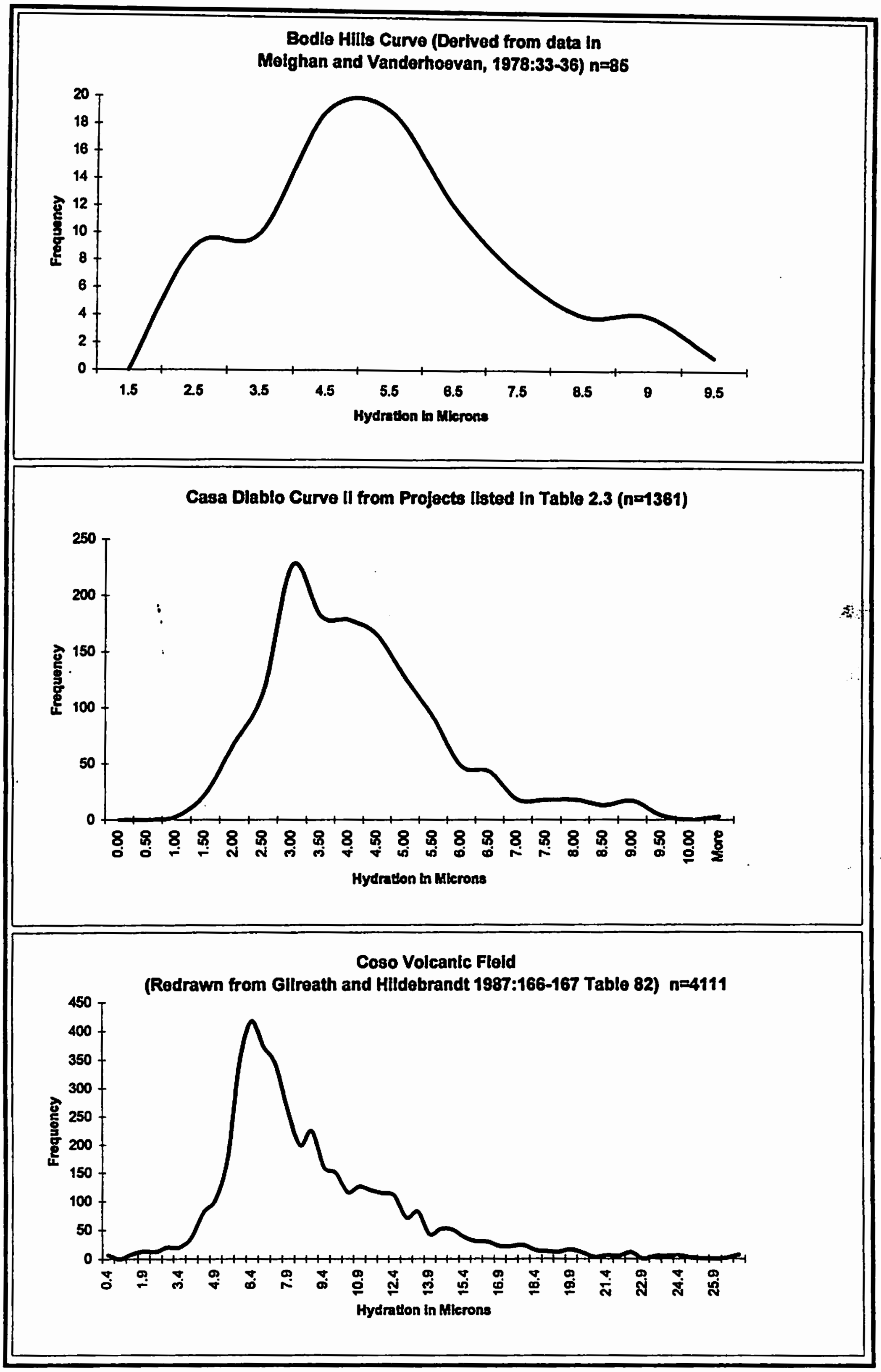

Figure 2.9. Comparison of Production Curves for 3 eastern California Obsidian Sources.
Data series are in .5 micron increments, Bodie Hills is in 1 microns intervals

the Coso source represents 40 % of the biface and core totals, it is due to the breadth of hydration values over 10.9 microns. This is due to the relatively rapid hydration rate for Coso obsidian. All three sources show low levels of use during the early periods.

The most notable similarity between sources is the sharp increase during the Newberry period. The Newberry period represents 44% of the of the hydration values at Bodie Hills, 40% of the values from the Casa Diablo source, and 38% of the Coso source. The sharp decline at the end of the Newberry period (ca. 1350 B.P.) is use is most evident at the Bodie Hills and Coso sources. Haiwee period hydration values represent only 13% of the hydration values Bodie Hills obsidian. Even lower frequencies represent the Haiwee period for Coso (6%). By contrast the Haiwee period levels of use are greater at Casa Diablo and represent 35% of the total hydration sample.

Marana period (ca. 650 B.P.) hydration values are similar for all sources. The use of the Coso source appears to be almost non-existent and represents less than 1% of the chipped stone sample. At the Casa Diablo source only thirteen percent of the hydration samples are from the Marana Period, similar to the 11% at the Bodie Hills source. The greatest similarity between the curves corresponds to the Newberry period pattern of apparently high volume. The most notable differences in the curves are the relatively higher than expected frequency of Haiwee period hydration values for the Casa Diablo source. This is likely due to the nature of the site from which the samples were collected. With the exception of Ca-Mno-577 which is located at the source (Goldberg et. al 1990), all other sites comprising the sample are non-quarry sites associated with the use of the area for subsistence. Thus it is partially an indicator of increased use of the area over time rather than a straight indicator of the history of quarry.

Archaeologists generally agree on the history of use eastern California obsidian sources but they differ in interpretations. The remainder of this chapter examines models that archaeologists have developed to account for changes in eastern California obsidian source use. The following discussion also examines theoretical approaches to lithic procurement that are not specific to the area, but relate to technological organization in mobile hunter-gatherer societies

Models of Quarry Use

The second element to quarry studies has been the development of models to account for the way quarry use has changed over time. There are four models which come out of these studies that have shaped archaeologist's thinking about the problem of quarry use in the region. Many of these studies have focused on explaining the apparently rapid decline in use at the end of the Newberry Period (ca. 1350 B.P.). The first of these models identified trade and a technological transition as the primary factors contributing to the decline in use observed at the Bodie Hills (Singer and Ericson 1977) and Casa Diablo sources (Ericson 1982). Ericson (1982:139) asserts that the early biface production served a luxury item trans-Sierra Nevada exchange network, as demonstrated by the presence of Casa Diablo obsidian in high status burials in San Joaquin Valley, in central California, west of the Sierra Nevada. According to Ericson (1984:6), the uniformity in production at eastern California obsidian sources could only occur if specialists were manufacturing exchange items to suit some highly specialized set of consumer requirements, in this case connected with prestige.

This *a priori* assumption has led Ericson (1982) to conclude that the technological transition from bifaces to a blade/flake industry approximately 1350 BP, represented a shift to utilitarian production, and a relocation of field processing from the quarry sites to the more dispersed settlements of individuals who started using the material for utilitarian purposes. Ericson (1982:144-146) concluded that this was supply and demand problem brought about by two primary factors; population growth west of the Sierra Nevada, and an increase in material demand caused by the shift from atlatl to bow and arrow technology. The material demand hypothesis is based on the assumption that the use lives of arrow points, is significantly shorter than that of bifaces and dart points. Collectively these factors resulted in an increase in the amount of raw material needed per consumer. When this increased demand could not be meet with imported products, consumers from west of the Sierra Nevada resorted to direct procurement of more local material and the exchange system collapsed. This produced the observed decline in use of eastern California obsidian source use, and the associated increase in use of sources in the Napa Valley area.

The next model, which focuses on exchange and territoriality as central processes, was put forth by Bouey and Basgall (1984). Bouey and Basgall's model was based on new data from sites in the Mammoth Lakes/Long Valley area, lithic material from three sites on the west slope of the Sierra Nevada, and a recently refined (Hall 1983) obsidian hydration rate for Casa Diablo (Bouey and Basgall 1984:137). According to Bouey and Basgall (1984) sites on both sides of the Sierra Nevada have patterns of use very similar to what Ericson described for the Casa Diablo and Bodie Hills sources. There is an increase in lithic activity ca. 3000 B.P., and a continual decline after ca. 1350 B.P., this being accompanied by a shift from bifaces to a flake/core technology. Bouey and Basgall contend that greater levels of social complexity in populations on the western Sierran front and in central California, created special demand for "socio-technic commodities relative to the office and type of status they supported (1984:144)" Because this level of social complexity is not believed to have occurred in the egalitarian Great Basin "the major consumer area, and apparently the hub of a major portion of economic activity, was central California (1984:144)." The egalitarian nature of populations is the western Great Basin could not support specialists manufacturing items for inter-group exchange. Therefore they conclude the reason for the high volume of bifaces produced from 3150-1350 B.P. "was western Sierran populations, obtaining obsidian through direct access, that were both the producers and suppliers of Casa Diablo obsidian which reached central California during the Middle Horizon" (Bouey and Basgall 1984:149).

Bouey and Basgall conclude that the decline in use of eastern California sources is due to population increase on the east side of the Sierra Nevada, as access to area sources for western Sierra Nevada populations, became limited. This was due to the increased territoriality which accompanied increased levels of social complexity in eastern California populations. Because access to eastern California sources was effectively cut off for populations outside the area (i.e. central California) one sees an increase in the use of obsidian from sources in the Napa Valley area.

The most recent exchange based model to emerge is from Gilreath and Hildebrandt's (1995) study of the Coso source. They also attribute the increase in biface production to an expanding exchange network. However, the subsequent drop in biface production is attributed to increased territoriality due to reduced mobility, and a subsistence change geared around the acquisition of plants which reduced the importance of obsidian (Gilreath and Hildebrandt 1995:194). This models is similar in many ways to the Bouey and Basgall model, however it provides less detail as to how changes in such systems could bring about the observed changes in quarry use. It also relies on two different processes to explain the pattern of use over time. The peak in biface production is argued to be due to social mechanisms in the form of an expanding exchange network. The decline in use (ca 1350 B.P.) is argued to be due to a more ecological process, being the result of settlement centralization and a subsistence change, which reduced the importance of obsidian tools.

More recent archaeological studies at non-quarry sites in eastern California describe similar temporal patterns in technology and obsidian source use, supporting the ecological component of the Gilreath and Hildebrandt (1995) hypothesis. The literature clearly shows that the majority of obsidian from eastern California sources occurs in sites east of the Sierra Nevada. This suggests that factors contributing to quarry use are local, rather than inter-regional. The most likely of these local factors is related to the now well documented subsistence change and settlement centralization which occurred in populations *east* of the Sierra Nevada. The most notable of these studies is Bettinger's (1975, 1976, 1977, 1982, 1989), work in the Owens Valley of eastern California. There Bettinger identified a major adaptive change around 1350 B.P., in his extensive study of the prehistoric settlement-subsistence systems in the area. This change was marked by a transition from a relatively high mobility settlement system with specialized hunting camps relying on selective plants and large mammals, to an intensive use of pinyon pine nuts and permanent or semi-permanent lowland villages a reduced distance from upland pinyon camps (Bettinger 1989:340-341).

Several authors have examined the technological changes that correspond to these adaptive shifts. It is these kinds of patterns that have provided the impetus for the fourth model. In what is referred to here as an *organization of technology* model, Basgall (1989), emphasizes mobility as a potential primary casual factor on technology and source use. Basgall (1989) commented that there has been an presumption in quarry studies that the "displacement of material from its place of origin… is a relatively straightforward signature of trade, territoriality and other behaviors that operate within a strong sociological matrix." Based the similarity of quarry production histories to source profiles and technological change at various local sites in the area, Basgall takes an alternative position and suggests that local populations are both the producers and consumers of material. The Basgall model focuses on the archaeological record in eastern California, and is thus a stronger argument than trade based models.

At Inyo-30 located near Owens Lake, Basgall (1989:114-116) reported that Newberry components (ca. 3150-1350 B.P.) contained a wide variety of finished and unfinished biface forms from a highly diverse range of sources. Although Haiwee (ca. 1350-650 B.P.) components contain debitage from pressure flaked bifaces, the reduced frequencies indicate an increased emphasis on a flake based technology (Basgall 1989:114). The Haiwee (ca. 1350-650 B.P.) and Marana (ca. 650-100 B.P.) components demonstrate the highest degree of regularity in source types with greatest reliance on Coso, the nearest source (Basgall 1989:119). From these findings, along with obsidian hydration and sourcing data from the Long Valley Caldera, Basgall (1989:123) concluded the greater diversity of sources in earlier components reflects a more mobile settlement system. This is because groups are assumed to use an "embedded" procurement, where toolstone acquisition is integrated in scheduled subsistence activities to avoid direct travel cost to a toolstone source. Thus high toolstone variability equals more movement across the landscape. In the same manner, the subsequent (post 1350 B.P.) reliance on local material is indicative of more intensive land use strategies and increased territorial control. Interestingly this adaptive pattern, in which a formal exchange system would more likely operate, does not emerge until the time in which quarry use has greatly reduced.

It is possible that prehistoric adaptive changes, which occurred throughout the region were in part conditioning toolstone needs, quarry accessibility, and therefore, use of different obsidian sources. Furthermore, it is evident that flaked stone assemblages in the region are very similar in technology and age to those identified in previous quarry studies in the area. Because these data closely match the variability in use of eastern California obsidian quarries, they may potentially be the cause of that variability. The study of relationship of technology and toolstone acquisition to settlement and subsistence has increased in current literature and is usually identified as the study of the "organization of technology." These types of works use a middle range approach to understanding technology within an overall system of adaptation. Thus these model focus on the effects of such factors as mobility and raw material availability as first order determinants of technology. The logic of this approach is based on the assumption that technology is fully integrated into an economic matrix, with a number of variables contributing to technological decisions.

As with most human behavior, the prehistoric acquisition, manufacture and use of stone tools was likely affected by many different processes. At the center of contention regarding technological organization in mobile forager societies, is the relationship of raw material procurement to scheduled subsistence behavior. The debate began when Binford (1979) concluded that Nunamiut hunter-gatherers could procure raw material for tools with little cost, as an secondary activity in conjunction with scheduled subsistence activity. Toolstone, in this case, has minimal costs, since acquisition is "embedded" in food procurement activities. This account is largely derived from ideas put forth by Karl Polanyi (1957), where the exchange of material goods is viewed as a fully integrated, fundamental aspect of a society's organization. A contrasting view has been provided by Gould and Saggers (1985) to explain patterns observed at the Puntutjarpa rockshelter in Australia. They identify the presence of exotic, non-local material they argue was superior to local raw material, and was logistically procured at a greater cost. Gould and Saggers (1985:134) conclude that the techno-mechanical properties of the raw material must be understood before economic embeddedness can be determined. Although these studies identify different factors expected to drive a system of acquisition and use of stone tools, each assumes that efforts to manufacture and transport lithic material were conducted in an economizing manner. More importantly, these studies question whether technological organization in hunter-gatherer societies is subject to universal processes.

Anthropologist have moved away from the "embedded" vs. "dis-embedded" dichotomy (see Binford and Stone 1985), and now use a middle range approach that emphasizes mobility (Bamforth 1986; Bleed 1986; Shott 1989; Kelly 1988), or the abundance of raw material (Bamforth 1991, 1992; Elston 1990; Andrefsky 1994) as the primary factors affecting the acquisition, production, maintenance, use and discard of stone tools. These economic models contend that in a system of high residential mobility, direct procurement costs are low since acquisition of toolstone can be embedded in subsistence activities. However, high mobility means that much of these subsistence activities will be conducted at considerable distances from a source. This requires procurement strategies which reduce the risks created by the increased distance between the toolstone source and place of tool use. Many authors have argued that bifaces are an efficient response to these risks (Kelly 1988; Shott 1989; Elston 1990). This tool type is argued to manage risk as multipurpose tools with extended use lives (Bamforth 1986; Bleed 1986; Shott 1989; Kelly 1988), which are both maintainable and reliable (Bleed 1986). Because highly mobile groups incur transport costs with each move, weight is important. Bifacial tools are potentially an efficient response due to the high usable blade to weight ratio (Kelly 1988; Andrefsky 1994). Bifaces can also serve as a standardized core technology (Kelly 1988) which requires less material weight to produce sufficient flake tools for anticipated needs (Parry and Kelly 1987:298). Efforts to maintain technological efficiency and minimize transported weight in this type of system require most costs of acquisition to be incurred by extensive processing at the source. However many of these assertions remain poorly tested and rest on the assumption that bifaces are a generalized not specialized technology.

In contrast, less mobile populations have less opportunity for embedded procurement of high quality stone unless there is a high quality source within the range of their seasonal round. This might be impossible for groups further from high quality sources, and require direct logistical procurement of toolstone. A less costly option is the use of locally available lower quality material (Elston 1990:160), providing the available material can yield edges of adequate sharpness and durability (c.f. Parry and Kelly 1987:300). Use of lower quality local toolstone is expected to increase when its cost of use (including acquisition) is less than that for more distant high quality toolstone (Elston 1990:160). In this type of system a high quality source is likely to be used only by immediately local populations. Within this restricted area, more sedentary groups do not have the same transported weight restrictions faced by more mobile populations (Parry and Kelly 1987; Andrefsky 1994). In addition, for groups using only this limited area, there are fewer temporal and spatial incongruities in the location of raw material and tool use (Parry and Kelly 1987:300). Both of these factors make the large time investment required to produce portable tool forms unnecessary. In this system, efforts are expected to be directed toward the production of cores and the use of informal flake tools, which result in a decrease in the frequency of formalized tools and tool pre-forms(Parry and Kelly 1987; Elston 1990). In areas where the availability of acceptable quality toolstone is low, increased instances of scavenging, reworking and higher frequencies of spent tools are expected (Elston 1990). The high costs of lithic procurement in such a residential tethered system, may greatly reduce the reliance on stone tools since it may be cost effective only to populations with little or no travel costs.

Discussion

The primary research objective of this project is to determine the degree to which variation in the use of eastern California obsidian quarries is driven by the processes archaeologists have previously identified. These include changes in socio-political systems of complex hunter-gatherers in central and southern California or changes in egalitarian hunter-gatherer populations in the western Great Basin. The archaeological record at eastern California quarries should mirror flaked stone assemblages in either the western Great Basin or central and southern California but not both.

It is clear here why the Truman/Queen source is particularly important to this problem. Most data regarding the Truman/Queen source relates to material from non-quarry sites, traced to the source by chemical analysis. These data suggest that Truman/Queen obsidian is primarily distributed to the east in west and west-central Nevada (Hughes 1983; Hughes and Bennyhoff 1986). The obsidian appears in sites in Long valley (Basgall 1983; Hall 1983), to the south in the Volcanic Tablelands (Basgall and Giambastiani 1992, 1995) and in southern Owens Valley (Basgall 1989). The material found to the west in both Long Valley and in southern Owens Valley is in highest frequencies in Newberry contexts (Basgall 1989). That the primary distribution of Truman/Queen obsidian is to the east, suggests that quarry use here was less likely subject to the effects of an extensive trans-sierran trade network proposed in most of the literature concerning use of other quarries in the region (i.e. Bouey and Basgall 1984; Ericson 1977,1982; Gilreath and Hildebrandt 1995; Goldberg et al. 1990; Jack 1976; R. Jackson 1985; T. Jackson 1984; Singer and Ericson 1977). Because of this, the Truman/Queen quarry provides one of the best cases for directly evaluating the degree to which trans-Sierra Nevada trade contributes to the pattern of use at area quarries. The implication of the exchange model is that the Truman/Queen source should be independent and part of a different system and thus not have the same pattern. Given the clear lack of trans-Sierra Nevada exchange of Truman/Queen obsidian the presence of similar patterns would suggest a non-trade process that might account for the other quarries as well.

CHAPTER III

Natural and Cultural Context

As the previous chapters suggest, the prehistoric procurement of obsidian for the manufacture of stone tools operated within a system of adaptation consisting of many variables. These variables likely acted as constraints and thus potentially contributed to decisions regarding technology and quarry use. In other words there are system specific variables that contribute to technology and lithic procurement which must be examined before generalities can be made. Lithic procurement and the organization of technology occur within both a natural and cultural contexts comprised of many elements that may be conditioning technology in some way. This chapter outlines several of these elements, the first of which relate to the natural environmental productivity of the area including flora and fauna, and present and past climate. These are important because lithic sources in eastern California are located in areas that vary in terms of abundance and quality of resources. Thus the description of the Truman/Queen obsidian quarry area, includes both a description of spatial variability of naturally occurring obsidian in Chapter 5, as well as a description of biotic communities represented in the study area.

The many variables that comprised the overall lifeways of the prehistoric inhabitants of the area which in some way contributed to both technological requirements, also produced constraints in meeting those requirements. Unfortunately very little can be elucidated from ethnographic sources regarding the cultural context specifically related to the Truman Meadows area or the Truman/Queen obsidian source. Nevertheless a brief summary of relevant ethnographic data is provided here to serve as a more general model of the social context. The archaeological record, fortunately provides greater insight regarding the cultural context in which lithic procurement operated. The discussion of the relevant archaeological record for the area includes a summary of the prehistoric cultural sequence and archaeological evidence for culture change in the area. This chapter concludes with a discussion of the known distribution of Truman/Queen obsidian across the landscape.

The Study Area/Natural Context

The Truman/Queen obsidian source (Fig. 3.1) is located roughly 5 kilometers north of the modern town of Benton California. The source area is north of Highway 6, which travels through Queen Canyon and eventually over Montgomery Pass in Nevada. Other than a brief description of the Truman Meadows area (Davis 1963) and identification of extensive quarry debris at the mouth of Truman Canyon (Ericson, Hagan and Chesterman 1976), there has been little archaeological work published on the Truman/Queen quarry. One study (T. Jackson 1974:51) provides a short description of the source as being spatially limited to Township 1 N., Range 32 E., Sections 7,8,9,17 and 19, but the survey conducted during this project indicates that raw material and quarrying debris covers a more extensive area, comprising large upland expanses of debris and a series of drainages supplying lowland areas of the source. In addition the survey located a previously undescribed primary outcrop deposit near Queen Canyon in the south east portion of the quarry. This consisted of contiguous but highly fractured flows of obsidian within a rhyolite matrix. Other than this outcrop the Truman/Queen source is better characterized as a "float" source where material is in the form cobbles.

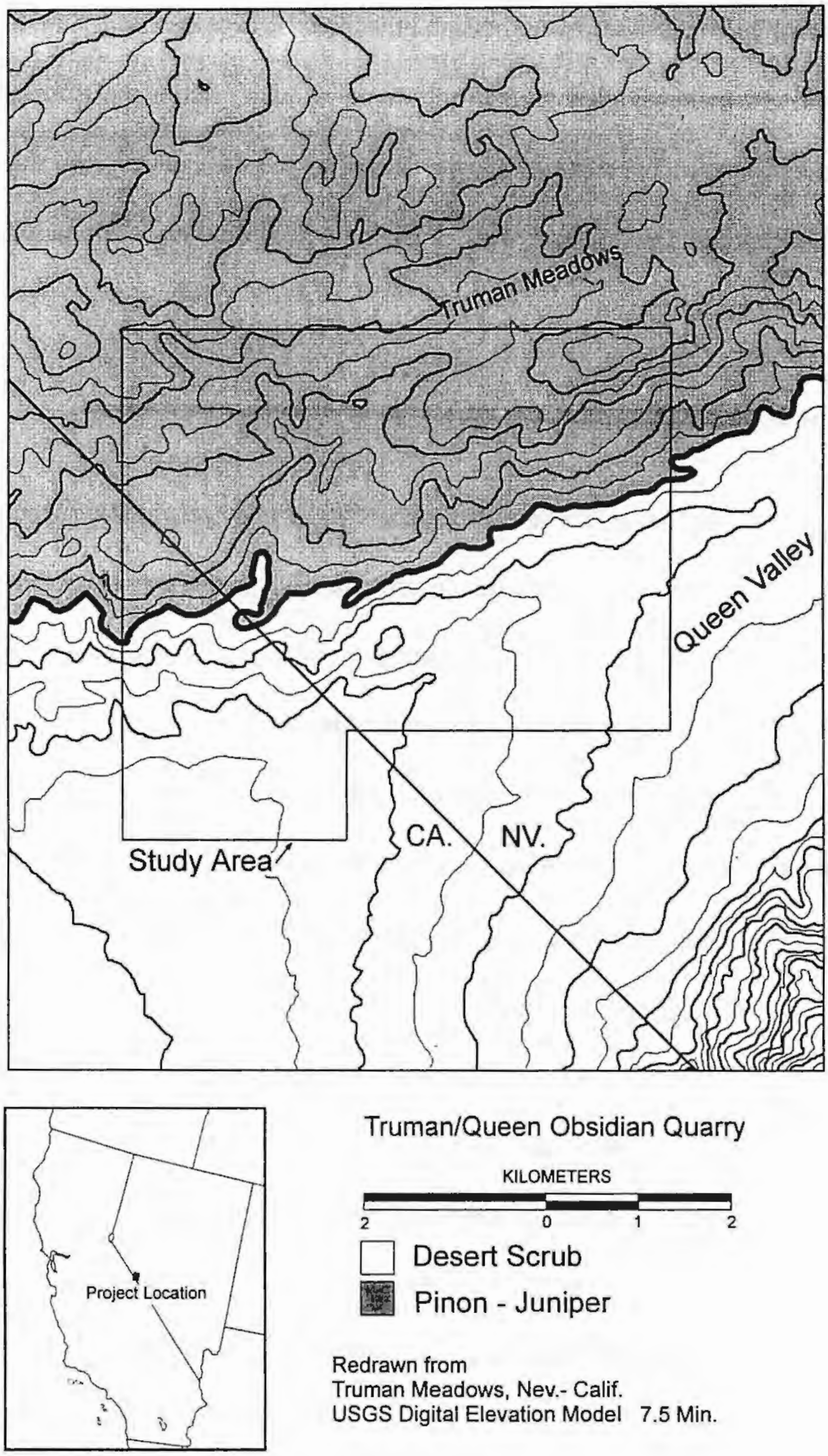

Figure 3.1 Map of the Truman/Queen Source Area

These are most common in the upland portions of the source, where raw material typically consists of cobbles eroding out of the hillsides or ephemeral stream channels. It is now clear from the survey conducted as part of this project that both raw material and reduction debris was present in much higher densities in the upland areas. Many upland survey quadrats have ground surfaces completely covered by quarrying debris. This is in sharp contrast to lowland areas where material is water transported and occurs almost exclusively in two main drainages. The distribution of material across the lowland zone is in highest concentrations near these drainages and densities decrease as distance from the drainage increases.

The obsidian from the Truman/Queen source is visually distinguishable by its translucency almost to the degree of transparency, with few if any inclusions and nearly parallel dark flow banding (Bettinger, Delacorte and Jackson 1984). The obsidian occurs in the form of small nodules averaging 10-15 centimeters in diameter, but pieces up to 30 centimeters in diameter have been observed. Most nodules are located in the eroded stream channels within the deep canyons typical of the study area. More specific descriptions of the spatial distribution of raw material and quarrying debris are provided in Chapter 5.

The study area is part of a larger hydrographic and physiographic region, the Great Basin, which is characterized by its north and south running basin and range topography. The larger region is bounded on the west side by the Sierra Nevada which has peaks above 4400 meters (14,000 ft.) and is bounded on the east by the Rocky Mountains. The project area is located in the western Great Basin at the north end of the White Mountains which also peaks above 4400 meters. The topographical relief characteristic of the area is a major influence on the climate and distribution of resources in the area resulting in the formation of somewhat discreet biotic zones. The western Great Basin is in the rain shadow of the Sierra Nevada and also local rain shadows and elevational gradients create substantial variability in precipitation across the region. For the most part temperature declines and precipitation increases with increasing elevation. North and north west areas get a dominance of cool-season precipitation (Sept. to May) from low pressure systems from the northern Pacific Ocean (Thompson 1992). Eastern and southeastern areas get a substantial portion of their precipitation in rainfall during the summer months in the form of sub-tropical storms (Thompson 1992). This has resulted in substantial spatial variability in resource distributions.

The Truman/Queen source is located in one of the more productive areas in the region. The northern boundary of the source includes Truman Meadows, a spring fed meadow with a substantial water supply. Additionally the majority of the source, particularly the areas of highest quality lithic material, is located within a massive Pinyon-Juniper Woodland zone. The mountain ranges at this portion of the Benton Range peak in elevation within the range of growth (2000-2600 meters) for the Pinyon Pine (*Pinus monophylla*) and the Utah Juniper (*Juniperus osteosperma*). Thus, rather than the relatively narrow band or zonation common in the area (c.f. Billings 1951), the Truman Meadows area has massive stands of Pinyon-Juniper Woodland forests. This area, unlike the location of some of the other obsidian sources (i.e. Coso Volcanic Field) is rich in both lithic and subsistence resources.

Vegetation Zones

A complete description of the modern environment of the area is beyond the scope and relevance of this project, and the literature contains many summaries (i.e. Billings 1951, Cronquist et. al. 1972, Harper 1986, Spira 1991). The description of environment below follows a summary by Bettinger (1982), who divides biotic communities into two major groupings of upland and lowland plant zones. Within the lowland plant zone, Bettinger (1982) recognizes two major biotic communities, a Riparian community consisting of the narrow band of vegetation surrounding marshes, springs and other sources of slow moving water and the Desert Scrub zone which is located on basin floors, typically below 2000 meters.

The upland biotic zones are sub-grouped into the Sierran Montane Series and the Basin Montane Series (Bettinger 1982). The Basin Montane Series, which is more typical for the study area, consists of, from lowest to highest , the Pinyon-Juniper Woodland (Billings 1951), typically located at elevations between 2000-2600 meters, followed by the Upper Sagebrush (2600-2900 meters elevation), the Bristlecone/Limber Pine Forest (2900-3500 meters elevation) and finally the Alpine Tundra above 3500 meters (Bettinger 1982). The source is located at elevations ranging between 1900 and 2305 meters above sea level, thus the Pinyon-Juniper Woodland, and Desert Scrub zones are the primarily ones represented in the Truman/Queen study area.

The southern boundaries of the Truman/Queen source are located at lower elevations (1900m) in the Desert Scrub community, which has Shadscale (*Atriplex confertifolia*) and Great Basin Sagebrush (*Artemisia tridentata*) as dominant plant species. Other important species in this zone include Spiny Hopsage (*Grayia spinosa*), Bitterbrush (*Purshia tridentata*), Greasewood (*Sarcobatus vermiculatus*), Nevada Ephedra (*Ephedra nevadensis*) and Rabbitbrush (*Chrysothamnus nauseosus*). A number of grasses with edible seeds are found in the area, including Ricegrass (*Oryzopsis hymenoides*), Great Basin Wild Rye (*Elymus cinereus*), Giant Wild Rye (*Elymus tricoides*), Needlegrass (*Stipa speciosa*), Squirreltail (*Sitanion hystrix*), and Wheatgrass (*Agropyron trachycaulum*). A variety of edible forbs are also located in the area including, Chia (*Salvia columbariae*), Sunflower (*Helianthus nuttaii*) and Blazing Star (*Mentzelia albicaulis*).

Large mammals included Pronghorn Antelope (*Antilocapra americana*) during prehistoric times, and Mule Deer (*Odocoileus hemionus inyoensis*), Sierra Bighorn Sheep (*Ovis canadensis californiana*) and Desert Bighorn (*Ovis canadensis nelsoni*) in winter months. Small mammals include the Black-tailed Jackrabbit (*Lepus californicus*), Pocket Gopher (*Thomomys* sp.), California Ground Squirrel (*Spermophilus beecheyi*), Antelope Ground Squirrel (*Ammospermophilus leucureus*), Pocket Mouse (*Perognathus* spp.) Kangaroo Rat (*Dipodomys* spp.), and the Desert Woodrat (*Neotoma lepida*). Birds include California Quail (*Lophortyx californicus*), and Sagehen (*Centrocercus urophasianus*).

The upper portions of the source contain species characteristic of the Pinyon-Juniper Woodland including the Pinyon Pine in the upper portions and Utah Juniper in the lower (Billings 1951). The understory of the Pinyon-Juniper Woodland is similar to that of the Desert Scrub (Billings 1951). It is characterized by Great Basin Sagebrush (*Artemisia tridentata*), Bitterbrush (*Purshia tridentata*), Tobacco Brush (*Ceanothus *velutinus*), Mountain Mahogany (*Cercocarpus ledifolius*), Green Ephedra (*Ephedra viridis*), Gooseberry (*Ribes cereum, R. velutinum*) and Elderberry (*Sambucus racemosa*). Rabbitbrush (*Chrysothamnus viscidiflorus*) is found in particularly high concentrations around Truman Meadows, because of a substantial water supply in the form of several springs. A number of grasses are present in this zone, such as Ricegrass (*Oryzopsis hymenoides*), Wheatgrass (*Agropyron trachycaulum*), Bluegrass (*Poa fendleriana*), Squirreltail (*Sitanion hystrix*) and Needlegrass (*Stipa speciosa*). Edible forbs in the Pinyon-Juniper Woodland include Yarrow Milfoil (*Achillea millefolium*), Locoweed (*Astragalus* spp.) and Buckwheat (*Eriogonum* spp.).

Fauna include the Golden Mantled Ground Squirrel (*Spermophilus lateralis*), the Inyo Chipmunk (*Eutamias umbrinus inyoensis*), Bushy Tailed Woodrat (*Neotoma cinerea*), Coyote (*Canis latrans*), Bobcat (*Lynx rufus*), Gray fox (*Urocyon cinereargenteus*) and Mountain Lion (*Felis concolor*). Inyo Mule Deer (*Odocoileus hemionus inyoensis)* and Desert Bighorn(*Ovis canadensis nelsoni*) used the area below the snow line as their winter rangeland.

The Truman/Queen source is located in the same location as high quantities of food resources, thus use of the area was likely constrained in lesser or at least different ways than a place like the Coso source in southern Owens Valley. According to Gilreath and Hildebrandt (1995:163) there were various times in prehistory when the Coso area supported only limited subsistence activities. The potential effects of these environmental differences on lithic procurement and technology are discussed below in Chapter 7.

Prehistoric Environment

The reconstruction of past environments is conducted in a relatively straight forward manner from a number of indicators such as pollen cores, Packrat middens (*Neotoma sp.*), and lake levels. These techniques are usually the only direct way to identify the presence or absence of particular flora or fauna at a given point in space and time. Because these data cover a relatively limited area a number of inferences must be made in order for any patterns to be cast across a larger area. These inferences allow specific environmental data to be used as proxy indicators of past climate and environments. The logic behind this is based on knowledge of the natural history of plants related usually to tolerances to precipitation and temperature. For example changes in precipitation should have the greatest effect at lower elevations where moisture is the primary limiting factor, thus drought tolerant species such as Shadscale (*Atriplex confertifolia*) and Hopsage (*Grayia)* expand at the expense of the more moisture sensitive plants of the Desert Scrub zone during dry periods. The lower boundaries of the Montane series are also limited by precipitation, they expand downwards during increased precipitation and retreat upwards during dryer periods. This is also true with temperature where changes have greater effects in the upper boundaries of the montane series. Very low temperatures result in downward movement of the tree lines and warm periods produce an expansion of the upper limits.

This is roughly true across space as well, where warmer temperatures can result in a northern advance of certain species (i.e. *Pinus monophylla*). Thus past plant distributions can serve as proxy indicators of past climatic conditions. This approach assumes that the physical tolerances of plants are the same today as they were in the past. For a general characterization, such as that presented here this is not problematic. However this assumption should be reconciled in specific attempts to reconstruction past environments. For example, Thompson (1990) has noted that there are time lags between climatic changes and migrations of plants related to the specific degree of tolerance to climatic stimuli of various plants. In addition, much of the paleo-environmental record is from the Mojave region or sites in the eastern Great Basin, and focus largely on the Late Pleistocene early Holocene transition. Therefore using the data to infer specific environmental conditions at a given location is problematic unless it is the location from which the data were obtained. This is compounded when attempts are made to directly correlate past changes in human behavior to environmental change. Given this, the following is a only a generalization of paleo-environmental data available for the western portion of North America.

A complete review of the paleo-environmental data for the Great Basin is beyond the scope and relevance of this project. The literature contains several summaries of the data available from across the region (Bettinger 1982, Hall 1983, Thompson 1990, Grayson 1993). The following draws primarily on the previous summary by Thompson (1990) who examined the available Neotoma middens and pollen data.

There are several sources of proxy data available for the early Holocene (ca. 10,000-7,000 B.P.). Although the evidence from one source sometimes conflicts with that of another, enough of a pattern exists to at least characterize the early Holocene of western North America in general terms. According to Thompson (1990) vegetational change from the late Pleistocene through the Holocene, mimicked modern elevational gradients. Late Pleistocene sub-alpine forest gave way to a mixture of montane and upper-woodland species, which was in turn replaced by pinion juniper woodland. From the Snake range of the eastern Great Basin three *Neotoma* middens indicate that limber and Bristlecone pines were located at elevations below their modern limits. (Thompson 1990). This suggests cooler than modern conditions, given that the lower boundaries of this zone expand during cooler times. In the Confusion Range of western Utah Limber and Bristlecone Pine, which was present at 11.9 kya, moved up slope and was replaced by Rocky Mountain Juniper at 8.6 kya (Thompson 1990). The same transition is found at Carlins Cave, where Limber and Bristlecone Pine present until 12.8 kya were replaced by Rocky Mountain Juniper and Utah Juniper (Thompson 1990). Similar transitions were identified at Gatecliff Shelter in central Nevada where roughly nine thousand years ago, an area that is now Pinyon-Juniper Woodland was dominated by upper Sagebrush plants (Thompson and Hatori 1983). Pollen data (Wigand and Mehringer 1985) from Hidden Cave in western Nevada indicates Sagebrush dominated steppe was at lower than modern levels until about 8 kya, and were then replaced by Shadscale steppe (Thompson 1990). Packrat middens from the Volcanic Tablelands and Falls Canyon in Hammil Valley just south of the project area indicate a change in the composition of the Pinyon-Juniper Woodland from Juniper (*J. osteosperma*) dominated to Pinyon dominated during the early to mid-Holocene. In the White Mountains just to the east early Holocene Woodlands in were 600 meters lower than present day tree lines (Jennings 1998:144).

The climatic implications for the Early Holocene from the above points to conditions which were cooler and with greater moisture than today. The replacement of montane plants by the Pinyon-Juniper Woodland suggest that conditions during the early

Holocene were cooler than today, but warmer than the Pleistocene. Pollen data from lower valley locations show that Sagebrush was well below its modern limits also indicating cooler and moister conditions (Thompson 1990). Collectively these suggest that climatic conditions during the early Holocene were cooler and moister than today

In comparison to the early Holocene, the Middle Holocene (ca. 7000-4000 B.P.) is characterized by warmer and dryer conditions, and is marked by the arrival of the Single Needle Pinyon Pine to the area (Thompson 1990). Middens from Gatecliff Shelter (Thompson and Hatori 1983) dating between 5300 - 2400 B.P. indicate Pinyon Pine and Utah Juniper are the dominant plant species. Pollen data from valley locations indicate a regional expansion up-slope of Shadscale and Greasewood steppe at the expense of Sagebrush after 7,000 B.P. (Wigand and Mehringer 1985), effectively raising the lower elevational limits of Sagebrush (Thompson 1990). This is supported by tree ring data (LaMarche 1973) which shows movement of the upper limits of sub-alpine forest to over 100 meters above modern levels. This indicates warmer temperatures than today, given that the upper limits of the alpine forest are temperature controlled.

According to Thomas (1985) the Mid-Holocene is marked by the arrival of Single Needle Pinyon Pine in central Nevada at 6500 B.P. The northern migration of Pinyon suggests conditions warmer than those that preceded it (Thompson 1990). Collectively these factors indicate a rise in summer temperatures and a possible shift in the seasonality of precipitation. Modern distribution of Pinyon Pine, Ponderosa Pine and White Fir correlate with the limits of significant amounts of summer precipitation from subtropical sources (Thompson 1984). The abundance of Utah Juniper in woodland areas also increases with increased summer precipitation (Jennings 1988, Thompson 1990). In a summary of the then available paleo-environmental data, Grayson (1993:214) concludes that all data similarly suggest that an interval which began between 8,000 to 7000 years ago and ended between 5,000 and 4,000 years ago was warmer and/or dryer than all other times before or since.

The *Neotoma* midden record for the Late Holocene (4000 B.P. to present) is more limited, and indicates very few changes in species (Thompson 1990). The late Holocene is characterized by a general trend toward cooler and moister conditions. According to Grayson (1993) Great Basin environments became "modern" roughly 4500 years ago, marked largely by the late expansion of single needle Pinyon Pine. Pollen data from valley locations indicate an increase in the aerial expansion of Sagebrush (moisture sensitive) at the expense of Shadscale (more drought tolerant) (Mehringer 1986). Dendro-climatic data from between roughly 3500-3000 B.P., indicate cooler summer temperatures, marked by the downward movement of the upper boundaries of Bristlecone Pines in the White Mountains (LaMarche 1973). Increased precipitation is evident by shallow lakes developing in dry playas and at Little Lake (Mehringer 1986). Bristlecone Pine data (LaMarche 1973) indicate that between 2700-2200 B.P. is a period of Neoglaciation marked by cool and moist conditions. By 2200 B.P. there is evidence for a move away from Neoglacial conditions, which appears to be initially warm and moist conditions followed by warm and dry conditions (LaMarche 1973, 1978). The pattern of warmer and dryer conditions which appears as an upward advance and retarded growth rings of the Bristlecone pine (LaMarche 1978) is also supported by evidence of the desiccation of local lakes (i.e. Little Lake, Mehringer 1977). By 1700 B.P. the dendroclimatic data indicate cooler summer temperatures followed by a change to cold temperatures and high winter precipitation between 1100-950 B.P. (LaMarche 1973). This is followed by what LaMarche (1973) describes as drought like conditions between 950 and 750 B.P. This is immediately followed by very cool conditions marked by the rapid retreat of the Bristlecone tree line (750 meters down slope) (LaMarche 1973, 1974). The late period drought like conditions identified by LaMarche are supported by radiocarbon dates on relict tree stumps located in low elevation shore lines of Mono Lake (Stine 1994). Based on the presence of relict tree stumps rooted in present day lakes and marshes, Stine (1994:549) concluded that the Sierra Nevada experienced two episodes of extreme and persistent drought The first of these lasted for more than two centuries before A.D. 1112, and the second last roughly 140 years before A.D. 1350 (Stine 1994:549). Although the time of these drought episodes are not precisely correlated to that identified by LaMarche, collectively they are strong indicators of anomalous conditions during the late Holocene. There is evidence, finally, of a cool/moist period between 500 and 150 B.P., which has been referred to as the Little Ice Age (Grove 1988).

The above discussion of prehistoric environment is included to provide context for past activities, although it has been difficult for archaeologists to relate specific environmental change to past behavioral or cultural change. Most of these efforts seek to identify specific changes in subsistence that are in some way related to differential availability in resources due to some climatic or environmental change. This approach becomes more problematic when examining technology or quarry use changes. This is because any change in technology can only loosely be attributed to changes in environment. While a change in environment may contribute to changes in subsistence, any change in technology, raw material acquisition strategies etc., can only linked back as far as the change in subsistence or settlement, not ultimately to environmental change. While environmental change may require subsistence change, which in turn requires technological change, the effect of environment on lithic technology should not be viewed as direct. Furthermore archaeologists working in the area have had difficulties in correlating changes in the archaeological record with evidence of environmental change.

Cultural Context: Ethnographic Record

Information that provides the cultural context for this study comes from both the ethnographic literature which is quite rare and the archaeological record. There are no ethnographic data and very little archaeological data that relate specifically to the Truman/Queen source or the Truman Meadows area in general. The lack of specific ethnographic information from the Truman Meadows area requires inferences from ethnographic information from other areas in proximity be used to make more general inferences. This is less problematic at a place such as the Truman/Queen quarry since the distribution of obsidian both to the south in the Volcanic Tablelands and to the east into central Nevada, clearly shows that many different groups had access to the source area. Ethnographic information from the immediate area is for the most part non-existent, with only limited mention of sites in the general vicinity. For example, Steward (1938:Fig.1) provides a map with a native village site that appears to be located near Benton, California, although Steward (1933, 1938) does not identify the Truman Meadows area as one of the places used by the Owens Valley Paiute for gathering pine nuts. This is the only general reference to the Benton area by Steward (1938) who indicates that pine nut were principally gathered in the Inyo and White Mountains. The omission by Steward by no means indicates lack of use of the areas only that there is not specific documentation of such use. Inferring from other areas however, it is likely that these pinyon gathering locations were sometimes owned with boundaries based on natural land marks (Steward 1938:52). According to Steward (1938) trespassing could lead to fighting, although it rarely resulted in blood shed. Sanctions were in the form of fear of evil magic as a deterrent to trespassing, however many times people were invited to gather on each others plots, and limitations to access were not major (Steward 1938). This territorial system although weak, likely emerged in conjunction with a pattern of settlement centralization described below. In spite of this, it does not appear that land ownership, which was likely most developed in Owens Valley, served as a very strong factor to limit access to a particular area. Because there is no specific description of ownership of a lithic source, any system of territoriality that included a source area must have had equally weak mechanisms for defense or enforcement.

According to Steward (1938:66) people from several areas including Paiute from Montgomery Pass would join others from throughout Fish Lake Valley for communal rabbit drives in the Fall. These usually began in Oasis in Fish Lake Valley to the southeast (Steward 1938). Steward also provides a brief account of marriage between individuals from Fish Lake Valley and Benton (Steward 1938:67). Given the fact that the elevations at Montgomery Pass (7150 feet) are substantially lower that the White Mountains immediately to the south, the pass was likely used often as a route for travel to communal activities such as rabbit drives as well as trade and inter-group marriages. The fact that the obsidian source is in such close proximity to the relatively low mountain pass suggests that at very few times would use of the source require a specific lithic procurement foray. It is likely that use of the Truman/Queen source could be scheduled between travel times and done in conjunction with use of the area for food resource or travel over the pass.

Given the lack of ethnographic information a general treatment of the past lifeways of the area is more useful than the specific but limited information above. This approach is likely more useful for this study, given that no single group enjoyed sole access to the source, and different groups with somewhat different adaptive strategies likely utilized the source area.

The range of variability in adaptive systems in the Inyo-Mono region of the western Great Basin have been previously characterized by Bettinger (1978, 1982) in a manner, which on the surface is similar to Binford's (1980) forager/collector model. In both models, groups are distinguished by differing subsistence strategies and settlement patterns. Bettinger (1978, 1982) contrasts the Owens Valley Paiute, marked by permanent or semi-permanent villages, relatively specialized subsistence patterns and stable social groupings, with the Coso Shoshone and Mono Lake Paiute both marked by shifting settlements, unspecialized subsistence patterns, and fluid social groupings.

According to Bettinger (1978,1982) the Owens Valley Paiute are marked by year round occupation of large permanent villages (group size 25-250) from the spring through the fall, which served as centers for procurement of dryland resources. Smaller groups or individuals would utilizes temporary camps for more distant plant resources (riparian and desert scrub). This was also true with temporary camps in uplands during summer and early fall, and also use of riverine temporary camps for fishing and communal hunting (Bettinger 1982). The settlement system is also marked by seasonal Pinyon camps used by small groups and/or individual families typically during the late fall, and through the winter in particularly good years (Bettinger 1982).

The social organization in Owens Valley was anomalous for the region, owing largely to a greater abundance resources, which promoted relatively larger populations with restricted seasonal movements, occupation of permanent villages, resulting in more stable group composition, and resource ownership (Bettinger 1982:32). Only Owens Valley saw levels of social organization approaching formally recognized sociopolitical groups such as chieftainships, as well as localized territories.

Bettinger (1982) describes contrasting social systems in the Coso Shoshone and Mono Lake Paiute. These groups are characterized by highly mobile family groups that more closely match Steward's (1955) family band model (Bettinger 1982). The primary socio-economic unit was the nuclear family, and any associations between groups was informal and usually limited to hunting and gathering pinyon (Bettinger 1982, cf. Steward 1938, 1955). For the Coso Shoshone the largest settlements were groups of 50 to 100 people in lowland winter villages in places such as Little Lake or Coso Hot Springs, but these were fluid in composition (Bettinger 1982:29). These were often located near nut caches in Pinyon-Juniper Woodland or pinenuts were moved to lowland winter village locations. The larger groups became dispersed in the spring for short term occupations at temporary camps in the lowland areas to procure plants in the Desert Scrub zones. During the late summer Sunflower and various grasses were collected in areas with more water on daily excursions short distances from permanent villages or base camps on valley floors (Bettinger 1982). During the fall Pinyon harvest was conducted in the

Coso Range; in bad years groups might have to travel further to Panamint Range (Bettinger 1982).

In a similar manner fall pinyon harvest for Mono Lake Paiute (*kuzabidikadi*) groups would occur in the mountains at places such as Bodie Hills and the Glass Mountain Range (Bettinger 1982). These groups would occupy winter villages at lower elevations near seed and insect caches and summer was dominated by insect procurement (Bettinger 1982). Like the Coso Shoshone, pinenut procurement for the Mono Lake Paiute could begin as early as October or November when families would establish temporary camps in pinyon groves (Bettinger 1982). Often groups cooperated in collection and processing of pinenuts. But because the quality of the Pinyon harvest varied greatly from year to year, groups may not rejoin each other in subsequent years. This contributed to the fragmentary natural of the social system. During particularly good years families would winter in mountains near caches, however a less substantial pinyon harvest might have been transported to lowland winter villages (Bettinger 1982). Small game such as rabbits and rodents were often taken with traps or snares. Deer and mountain sheep were also hunted by small hunting parties or individuals in hunting blinds. Larger scale communal hunting was limited to Antelope, in which groups participated in drives of Antelope into wing traps, usually during the spring and fall (Bettinger 1982). Jackrabbits were also driven by large groups into nets where they were killed. Both of these required larger groups so they typically occurred in the fall near the time of the pinyon harvest and resulted in the largest population aggregation of the year. During this time there may be individuals in a more formal leadership role, however that status was limited to the task and the status dissolved after the activity was over (Bettinger 1982).

The ethnographic picture above indicates that the Coso obsidian source may have been used more frequently by groups that are more similar to the family band model by Steward (1955), in part due to the relatively lower resource base there. The Truman/Queen obsidian source on the other hand was likely used by groups with varying subsistence/settlement systems, such as those from the Owens Valley *and* those from the Mono Basin.

Cultural Context: Archaeological Record

The archaeological record for the Inyo-Mono portion of the western Great Basin provides a greater body of information for inferring the cultural context in which eastern California obsidian source use operated in. The archaeological record most relevant to this project are the well document changes in settlement and subsistence practices during the prehistory of the Inyo-Mono region. In addition there is limited information related specifically to the Truman/Queen area as well as the archaeological evidence that relates to the known distribution of material from the Truman/Queen source.

This section summarizes changes in the archaeological record identified by others that correspond to particular time periods for the area. A number of cultural sequences have been put forth for the western Great Basin (e.g. Lanning 1963, Bettinger and Taylor 1974, Warren 1980) that provide a relevant framework for discussing changes in eastern California obsidian source use. Lanning's (1963) chronology is based on the work of

Riddell (1963) and the nearly continuous projectile point sequence at the Rose Spring site in Owens Valley. The chronology was later revised by Bettinger and Taylor (1974) and later by Bettinger (1975) and typifies what has been referred to as the "short chronology". In this scheme the prehistory for the region in divided into five periods. The earliest of these termed the Mohave Period , is marked by Lake Mohave and Silver Lake projectile points which in many parts of the western Great Basin predates 4950 B.P. The Bettinger and Taylor (1974) sequence actually places the terminal temporal breakpoint for this period at 4000 B.C., which was later changed to 3500 B.C. (Bettinger 1975). More recently there has been common usage of 3000 B.C. (or 4950 B.P. (e.g.. Hall 1983, Basgall and Giambastiani 1995)) as the date of the Mohave-Little Lake transition. This date is used in this study to mark the end of the Mohave period for this study. This is followed by the Little Lake Period (ca. 4950-3150 B.P.), marked by Pinto or Little Lake projectile points (Gatecliff split stem projectile points in central Nevada (Thomas 1981)). This period is followed by the Newberry Period (ca. 3150-1350 B.P.) marked by Elko Series projectile points. The Haiwee period (ca. 1350-650 B.P.) is marked by Rose Spring and Eastgate projection points (Rosegate in the central Nevada sequence (Thomas 1981)). The final period of the prehistoric sequence is the Marana period (650 B.P. to contact) marked by Desert Series projectile points consisting of Desert Side Notched and Cottonwood forms. The chronological periods used in this study are largely those of Bettinger and Taylor and are listed in Table 3.1.

Table 3.1 Chronological Periods for the Inyo-Mono Region

Period	Interval	Diagnostic Projectile Points
Mojave	pre 4950 B.P.	Lake Mohave / Silver Lake
Little Lake	4950-3150 B.P.	Pinto/Little Lake (Gatecliff Split stem)
Newberry	3150-1350 B.P.	Elko Series
Haiwee	1350 - 650 B.P.	Rose Spring / Eastgate
Marana	650 - 100 B.P.	Desert Series (DSN/ Cottonwood)

There are a number of cultural changes evident in the archaeological record that are of particular relevance to the Truman/Queen project and the problem of quarry use in the eastern California. The following summarizes several studies which have identified patterns at non-quarry sites in the Inyo-Mono region of eastern California that are similar to the archaeological record at obsidian sources there. The most notable of these studies comes from the extensive research completed by Bettinger (e.g. 1975, 1976, 1977, 1978, 1982, 1989) in Owens Valley located south of the Truman/Queen source. Bettinger's early work (1975, 1978) in Owens Valley set out to question the assumption of stasis over time and uniformity across space in the lifeways of past Great Basin inhabitants. The perception of archaeologists up to the time work was that the archaeological record was the material representation of the basic ethnographic pattern described by Steward (1938, 1955), and thus Steward's family band model could be extended into the past. This view was based largely on Jennings' Desert Culture Model (Jennings and Norbeck 1955; Jennings 1957, 1964, 1968), which held that from roughly 10,000 B.P. to the historic period, regional subsistence patterns were broadly similar and unchanged through time. This way of life is characterized as an intensive but unspecialized pattern of exploitation of all available food resources with a transhumant settlement patterns and a family band level social organization as described by Steward (1938, 1955). Bettinger's 1972-1973 probabilistic survey of large transect near Big Pine, California was one of several regional studies during the early 1970's which tested the Desert Culture model. Bettinger's work in Owens Valley, conclusively demonstrated that the prehistory of the area is marked by significant changes in material culture and adaptive strategies both in time (i.e. inception of pinyon, Bettinger 1975, 1977) and space (i.e. alternative adaptive strategies, Bettinger 1978, 1982). This was later synthesized in subsequent work by Bettinger (1989) with work primarily from three sites which represent distinct segments of a single subsistence settlement system (Bettinger 1989).

The changes identified by Bettinger (1989) included the establishment of centralized settlements around Desert Scrub villages (i.e. Crater Middens) dependent on Desert Scrub resources between 2000 B.P. and 1350 B.P. Probably the most distinct development was the inception of intensive pinyon procurement roughly 1350 B.P., marked by the appearance of upland pinyon camps (i.e. Pinyon House). Intensification at this time is also supported by the use of long term seed camps (i.e. Two Eagles). Bettinger (1989) also identifies a decrease in large game hunting AD 1000, evident by the disuse of upland Desert Scrub temporary camps. In simplest terms the later prehistory of central Owens Valley (5000 B.P. to the Historic period) is characterized by increasingly intensive patterns of resource use and greater settlement centralization. The most marked of these changes occurred roughly 1350 B.P. and indicate a signification reduction in seasonal mobility and far greater settlement centralization (Bettinger 1989).

Delacorte (1990) has identified a similar change in Deep Springs Valley. His reconstruction of settlement and subsistence for the area identified Newberry period (3150-1350 B.P.) seasonal base camps, short term milling locations and hunting camps.

Based on the indications of these subsistence activities and the high diversity of raw material, Delacorte (1990:359) concluded the settlement system to be reliant on a high degree of logistical mobility which extended beyond Deep Springs Valley. A different system was identified (Delacorte 1990) during the Haiwee period (1350-650 B.P.) with the introduction of pinyon camps, pinyon caches and alpine occupational sites. Delacorte (1990) reasoned that this subsistence shift, with increased use of lower ranked resources resulted in a reduction in the range size covered by seasonal movements. Although the sedentism was not to the degree of that in Owens Valley, this adaptive change suggests year round occupation within Deep Springs Valley (Delacorte 1990:359)

A region wide change is supported by similar changes which are seen in the archaeological record in the White Mountains to the east. In a long term study of alpine sites, Bettinger (1991) has identified a pre-1350 B.P. emphasis on large game hunting, with little plant processing suggesting a system of short term occupation. Bettinger (1991) concluded that sometime after 1350 B.P. there was a considerable change in alpine adaptation. Intensification of plant procurement resulted in seasonal occupation in well built houses and an extensive inventory of processing equipment and storage of raw material (Bettinger 1991:675).

This overall pattern of resource intensification and settlement centralization in the western Great Basin has been connected by Bettinger and Baumhoff (1982, and Bettinger 1991) to a major ethnic spread (cf. Lamb 1958), in which hunter-gatherers with a low cost, high ranked resource procurement strategy (travelers) were replaced by Numic speakers with a high cost, low ranked resource procurement strategy that originally developed in Owens Valley or nearby. The Numic (processor) strategy with its reliance on high cost plant foods resulted in an increase in the handling time of food resources and subsequently less time was invested in travel (Bettinger and Baumhoff 1982). This fact, coupled with increasing population resulted in the pattern of settlement centralization. However, the relatively broader diet of Numic peoples created a competitive advantage and Numic folk rapidly expanded their range across the Great Basin at the expense of pre-Numic peoples (Bettinger and Baumhoff 1982). Regardless of the causes of this pattern of settlement centralization and resource intensification (i.e. increased diet breadth) they are well documented and better mirror quarry production data than does the record of socio-political change in central and southern California.

Distribution of Truman/Queen Obsidian

Most information pertaining to the Truman/Queen source relates to material from non-quarry sites, traced to the source by chemical analysis. These data suggest that Truman/Queen obsidian is primarily distributed to the east in west and west-central Nevada (Hughes 1983; Hughes and Bennyhoff 1986). Thomas (1985) reports a small sample of projectile points made from Truman/Queen obsidian at Hidden Cave Located approximately 150 km to the north/north east. Material from the Truman/Queen source is also found in small quantities to the west, but only as far as the Long Valley/Mono Basin area. A small number of projectile points and bifaces made from Truman/Queen obsidian, were located at the Mammoth Junction Site (CA-MNO-382) in Long Valley (R. Jackson 1983), and in southwestern Long Valley at CA-MNO-561 (Hall 1983). The southern distribution is also quite limited with most found in the Volcanic Tablelands

(Basgall and Giambastiani 1992, 1995) and in very small quantities in southern Owens Valley (Basgall 1989). The material found to the west in both Long Valley as well as that in southern Owens Valley is in highest frequencies in Newberry contexts (Basgall 1989).

Given that the primary distribution of Truman/Queen obsidian is limited to the east side of the Sierra Nevada, it is likely that quarry use here was less likely subject to the effects of an extensive trans-Sierra Nevada trade network proposed in most of the literature concerning use of other quarries in the region. Because of this, the Truman/Queen quarry provides one of the best cases for evaluating whether changing quarry use patterns in eastern California are due mainly to trans-Sierra Nevada trade or technological shifts affecting use of toolstone by local groups.

CHAPTER IV

Archaeological Investigations

The preliminary phases of this project focused on the development of field methods in consideration of a number of important sampling issues. A large quarry site such as the Truman/Queen source requires a sampling program that will result in the collection of an adequate sample of artifacts, such that any temporal or spatial variability is not obscured or missed. The Truman/Queen source has naturally occurring obsidian cobbles that are suitable for the manufacture of stone tools in both the Pinyon-Juniper Woodland and the lower Desert Scrub communities. Because the use of resources in each of these zones has changed over time in the region (c.f. Bettinger 1989), lithic procurement activities that were carried out, in connection with the use of these zones may be subject to temporal fluctuations as a result.

The Truman/Queen project thus required a sampling program that would result in an overall production history, but that also could distinguish overall temporal changes in quarry use, from zonal site use changes. Furthermore, identifying changes in the use of different zones at the source could have important implications for understanding the relationship of lithic procurement to settlement patterns and subsistence practices throughout prehistory in the region. In simplest terms, because different zones of the source may have been used at different times in prehistory, sampling must provide adequate spatial coverage in each of these zones so they may be compared.

Additionally, field work must also avoid becoming bogged down in the redundancy inherent in quarry sites due to the large volume of debris on the surface.

Solving these problems and the development of a practical sampling program were the primary goals of the first two seasons of field work conducted in conjunction with the University of California, Riverside, Archaeological Field School during the summers of 1994 and 1995. The majority of the surface survey and the all surface collection were conducted during the summer of 1996 with the University of California, Davis, Archaeological Field School. In total, over five hundred man days of field work were completed.

Field investigations were conducted with two main objectives governed by the research objectives of this study. The first of these was to identify spatial variability at the source. Spatial variability was measured along several dimensions; first the relationship between raw material quality (as measured by cobble size) to lithic technology, and second, the relationship of quarry zone use to subsistence resources. Data collection relevant to the examination of spatial variability included mapping the locations of raw material, the intensity of use of primary quarrying areas, and secondary lithic reduction loci. The second main objective of the field work was to identify and accurately measure temporal variability which required the collection material in a manner that is believed to be representative of the full range of spatial, temporal and technological variability, from randomly selected locations at the source.

Collectively this resulted in the surface survey and density mapping of 61 quadrats (500 x 500 meter). The surface collection, conducted at 77 randomly selected points across the source, yielded 315 bifaces, 13 biface/points, 88 cores, 10 flakes tools, 45 projectile points, 12 unifaces and approximately 3900 pieces of debitage. The processing and analysis of these artifact is described below. Five hundred and twenty five samples from various artifact categories were selected and submitted for obsidian hydration dating, by Glen Wilson of San Jose State University, Obsidian Hydration Laboratory. Two samples were returned with no visible hydration values and sixteen were returned with double readings, both of which were counted giving a total of 539 obsidian hydration readings. Subsequent geo-chemical analysis of the 35 typable projectile points by XRF, revealed that eleven points were not manufactured from Truman/Queen obsidian. Thus, the overall production history for the Truman/Queen source is based on a total of 528 readings. The cumulative hydration profile consists of the following hydration reading totals; 248 bifaces, 95 cores, 140 pieces of debitage, 23 projectile points, 12 unifaces and 10 flake tools.

Field investigations also included two supplementary studies. The first of these was an examination of natural spatial variability in the suitability of raw material for tool manufacture, as measured by variation in obsidian cobble size. This was completed by measuring a total of 2400 unmodified cobbles from 48 of the 77 collection loci (≈50 at each loci). The second supplementary study was an examination of geo-chemical variability of Truman/Queen obsidian. This was accomplished by the collection of naturally occurring obsidian cobbles from four points at the source, and subsequent testing by Neutron Activation Analysis. Adding resolution to measurements of intra-source geo-chemical variability is important for tracking the movements of obsidian across the landscape, and for potentially identifying the distributional aspects of differential zone use at the source. These data are to be published later.

Reconnaissance Survey and Source Boundary Determination

The first objective of mapping the source was accomplished by a multiple phase surface survey. On a USGS Truman Meadows 7.5 Minute quadrangle map, a grid was established, which divided the study area into 500x500 meter quadrats. The first phase of mapping consisted of a non-probabilistic reconnaissance survey of approximately twenty four square kilometers to identify which of these quadrats contained raw material or lithic debris so the boundaries of the study area could be determined. This was completed by a two person crew, that surveyed the surface of each quadrat, spaced at intervals of roughly 100 meters recording only the presence or absence of raw material and quarrying debris in the entire quadrat. The quadrats lacking material were excluded from further study and all subsequent survey and collection was conducted from within the 61 quadrats determined to contain material.

Figure 4.1 also shows the areas covered by the reconnaissance, which included a complete survey of Truman Canyon, and delineated the spatial extent of the source. At the western boundary of the source, the reconnaissance survey covered an area of approximately 14 km^2. This area is bounded by a line on the west from N419700/E370000 to N4201500/E370000, and on the east by N419700/E373000 to N201500/E373000. The same technique was used at the eastern edge of the quarry, where the reconnaissance survey covered an area bounded on the west by N4202500/E375000 to N419800/E375000 and on the east by N4202500/ E378000 to N4198000/E378000.

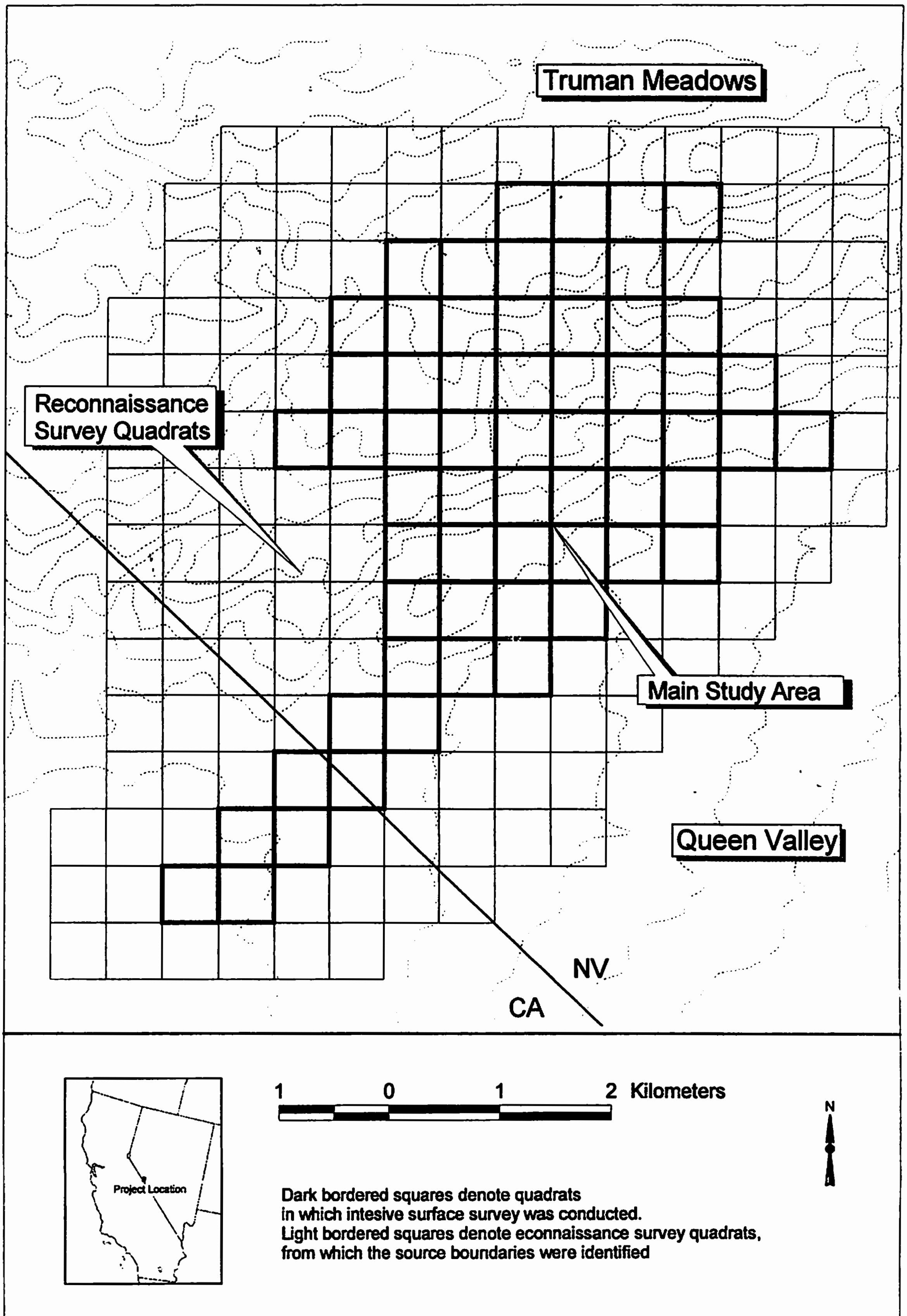

Figure 4.1 Map of Main Study Area with Reconnaissance Quadrats

The result of this part of the field investigation was the determination of the source boundaries and identification of the quadrats to be more intensively surveyed during the second phase of the surface survey. The source area was determined to contain 61 quadrats (500x500 meter) for the second phase of the survey. Figure 4.2 depicts the source boundaries and the sixty one quadrats which were surveyed during phase two of the mapping project and that are discussed below.

Two areas that contain raw material were excluded from the second phase of the project due to time constraints and the probability of collecting redundant information. The first of these is a section to the northwest of Truman Canyon which has small amounts of raw material in several ephemeral drainages and minor amounts of reduction debris. This is an area of approximately two square kilometers centered around N4200500/ E371000. This is located approximately 2 kilometers west of quadrat U-03 (Figure 4.2). This small concentration of raw material and flaking debris was located during the later stages of the project and time prohibited surveying of those areas. The second area excluded from further survey and collection is the continuation of the drainage at the southern portion of the source that passes through quadrats L-19, L-20, L-21, L-22, L-23 and L-24 (Figure 4.2). This drainage, which contains raw material and has adjacent areas of reduction debris, continues into Benton Valley (K. Halford, Personal Communication). Although the densities of both raw material and reduction debris reduce in frequency toward the south, any additional study of the area was likely to yield redundant information.

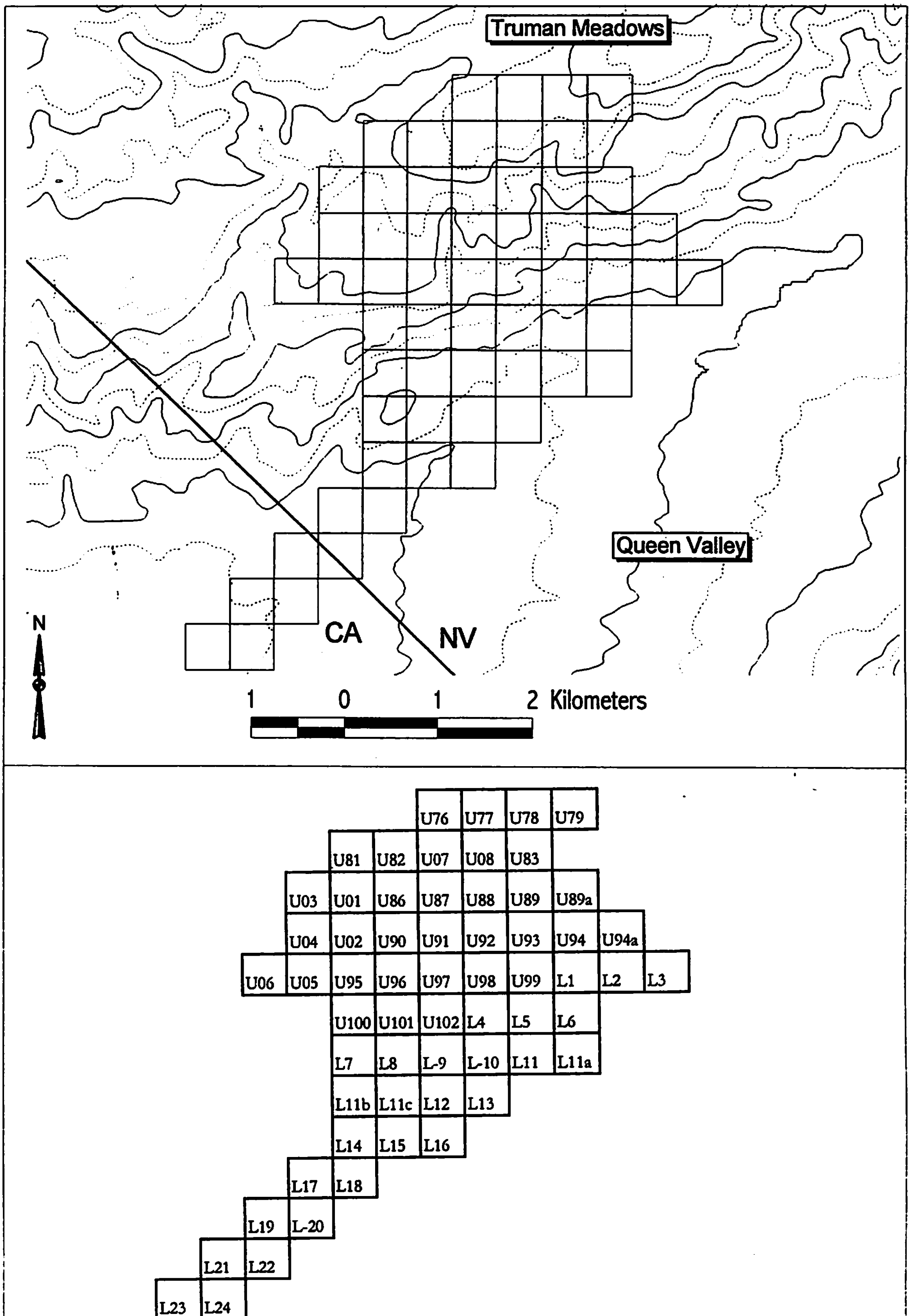

Figure 4.2 Map of Study Area with Survey Quadrat Key

The impression during the initial survey, was that both raw material and quarrying debris were more densely distributed on the surface of the upland zone than in the lowland zone. In addition, upland areas of the source area appeared to have higher frequencies of bifaces and bifacial thinning flakes, while cores, flake tools and blade like implements were found in higher frequencies in lowland areas. Given this initial observation and the possibility of differential zone use of the source, the study area was stratified into an upland zone and lowland zone prior to surveying. An informal exercise during the 1995 field season in which cobbles and flake debris were measured in a series of upland and lowland loci also suggested lowland cobbles were smaller. A more detailed examination of raw material variability was conducted with the surface collection and is discussed later in this chapter.

Surface Survey and Mapping of the Site

As mentioned above spatial variability at the source is likely to occur along two distinct but related trajectories. These are the natural density of raw material based on geologic processes, and the intensity of lithic reduction that occurred at a particular locus at the quarry. Raw material varies across space both in overall quantity as well as the size of obsidian cobbles. Because of these differences, areas appear to have been used in varying frequencies in the past. The surface survey was conducted in an attempt to measure these dimensions. Thus, for any given area, the surveyor would determine the overall quantity of material present and the degree to which that material has been utilized. With this in mind the second phase of the mapping project consisted of the intensive surface survey of the sixty one quadrats determined to contain raw material or quarrying debris during the initial reconnaissance survey (Table 4.1 and Figure 4.2).

Table 4.1 List of Quadrats Surveyed

Lowland Quadrats			Upland Quadrats		
Quad	Northing	Easting	Quad	Northing	Easting
L-1	4199500	375500	U-01	4200500	373000
L-2	4199500	376000	U-02	4200000	373000
L-3	4199500	376500	U-03	4200500	372500
L-4	4199000	374500	U-04	4200000	372500
L-5	4199000	375000	U-05	4199500	372500
L-6	4199000	375500	U-06	4199500	372000
L-7	4198500	373000	U-07	4201000	374000
L-8	4198500	373500	U-08	4201000	374500
L-9	4198500	374000	U-76	4201500	374000
L-10	4198500	374500	U-77	4201500	374500
L-11	4198500	375000	U-78	4201500	375000
L-11a	4198500	375500	U-79	4201500	375500
L-11b	4198000	373000	U-81	4201000	373000
L-11c	4198000	373500	U-82	4201000	373500
L-12	4198000	374000	U-83	4201000	375000
L-13	4198000	374500	U-86	4200500	373500
L-14	4197500	373000	U-87	4200500	374000
L-15	4197500	373500	U-88	4200500	374500
L-16	4197500	374000	U-89	4200500	375000
L-17	4197000	372500	U-89a	4200500	375500
L-18	4197000	373000	U-90	4200000	373500
L-19	4196500	372000	U-91	4200000	374000
L-20	4196500	372500	U-92	4200000	374500
L-21	4196000	371500	U-93	4200000	375000
L-22	4196000	372000	U-94	4200000	375500
L-23	4195500	371000	U-94a	4200000	376000
L-24	4195500	371500	U-95	4199500	373000
			U-96	4199500	373500
			U-97	4199500	374000
			U-98	4199500	374500
			U-99	4199500	375000
			U-100	4199000	373000
			U-101	4199000	373500
			U-102	4199000	374000

As mentioned above, the upland quadrats (n=34) exclude those in the north west area of the source; and the lowland quadrats (n=27) exclude those in the continuation of the drainage toward the southern portion of the source. Within each of the sixty one survey quadrats crew members spaced at 25 meter intervals, noted surface characteristics every 25 meters in an effort to identify both varying densities of raw material and associated reduction debris, as well as areas of high or low intensity of use. The purpose of this exercise was to produce a rough density map and identify areas for subsequent surface collection.

The site can be characterized in simplest terms by either being areas of raw material with no evident use, moderate levels of use or extensive use. Or an area may have no raw material and contain no flaking debris, moderate flaking debris or extensive flaking debris. Put another way a given area could varying both in terms of the overall quantity of raw material and/or lithic debris, but also in the ratio of flakes to raw material. This designation allows for a qualitative distinction between area based on the intensity of use of the material present.

To simplify data collection of these rough density measurements, field personnel recorded surface characteristics according to the following codes (Table 4.2.). Areas which were sterile were left blank. The overall volume was designated by the use of upper case letters (high volume) or lower case letter (low volume). For example, primary quarry areas that were limited to raw material and contained no apparent flaking debris were designated as "R" for raw material only. The upper case letter "R" noted areas of high density (>20 cobbles per sq meter) which for the most part was limited to the major drainages which supply the lowland and the geologic outcrop located at the north end of West Queen Canyon. A lower case "r" was used to note those areas of unmodified naturally occurring obsidian as well, however, these areas contain only light (< 20 cobbles per sq. meter) densities of raw material. These were primarily ephemeral stream beds and hillsides were erosion exposed cobbles to the surface.

Table 4.2. Surface Characterization Codes

Category	Characteristics
F area of intensive use	waste flakes represent over 70% of the obsidian on the surface, the remainder unmodified raw material in the form of cobbles
M area of moderate use	waste flakes represent less than 70% of the obsidian on the surface, lower ratio of reduction debris to unmodified raw material
A assaying/prospecting	area limited to broken, but minimally worked cobbles
R raw material	area contains only raw material with few if any flakes
S non-quarry site or secondary reduction loci	includes rock rings and small lithic scatters away from any raw material.

It was noted during the early phases of this project that some areas could be characterized as being used for assaying or prospecting. This was evident by minimal modification of the material limited to the break up of cobbles, and small amounts of flaking on the expose surface of the broken cobble, believed to represent testing of the material. If such an area had high concentrations of material relative to other parts of the source it was marked with an "A". If it contained low concentrations of material is was marked with an "a". Assaying areas were the rarest category across the site. The occurrence of non-quarry sites were also recorded, including light lithic scatters (marked with an "s"), and more dense secondary lithic reduction locations (marked with an "S"). Quarry areas could vary both in terms of the overall quantity of material as well as the degree to which that material has been worked. Areas were the flake to cobble ration is greater than %70 were designated as "F" for extensive flaking debris. Areas which contained moderate flaking debris (<%70) relative to cobbles were considered moderate and designated “M”. Upper and lower case letters were used to designate high and low volumes of material respectively. The designation between extensive and moderate flaking debris is arbitrary and intended only a rough measure to identify the primary areas of use.

Figure 4.3 Density of Material and Intensity of Use Matrix

		Raw Material Quantity		
		High	Low	Absent
Processing Debris	High	“F”	“f’	“S”
	Low	“M”	“m”	“s”
	Absent	“R”	“r”	--

Figure 4.3 shows the relationship of raw material volume and toolstone reduction intensity to the categories assigned. In Figure 4.3, extensively used areas contain a ratio of flaking debris to cobbles of greater than 70% and are thus marked “F” or“f’. If these extensively used areas contained a high volume of material (greater than ≈200 flakes per square meter) they were marked “F”. If an extensively used area had a low volume of material it was marked as “f’. Moderately used areas (flake to cobble ratio < 70%) that had high volumes of material were marked “M” and those with low volume marked “m”.

The criteria, which was recorded on the personnel field forms were combined to produced a grid map of raw material and reduction debris densities for each quadrat.

Figure 4.4 is an example (Quad L-19) from the surface survey, in which an ephemeral drainage which supplies a portion of the raw material to the lowland areas is evident. The survey crew noted both the small amount of raw material noted by the letter "r" and the adjoining debris scatters, noted by the "m". All units were surveyed in this manner and have a corresponding grid such as the example in Figure 4.4. The data from each survey quadrat has been combined and imported into a Geographic Information System (GIS) to provide a density map of the entire source (Figure 4.5). Spatial variability at the Truman/Queen source is described in greater detail in Chapter 5. The quadrat surface survey data are presented in their entirety in Appendix C.

The surface survey also located 211 rock rings on the surface, which are either Pinyon pinenut caches or habitation structure foundations. The survey only recorded the location of the rock rings and did not attempt to interpret their function. Nevertheless the features are clearly associated with use of resources and habitation in the Pinyon-Juniper Woodland given the fact that all but 2 features were in the upland zone (Figure 4.6). The implications of this are discussed in Chapter 7.

Figure 4.4 Surface Characterization Grid Example

Quadrat Number L-19   Provenience 4196500/372000

500x500 Meters (Each square = 25m)

																s			
								m	m										
																			s
				s														s	s
														s	s	m	m	m	m
													s	m	m	r	m	m	m
												m	m	m			m		
									m	m	m					r	r		
										s	m	s			r			s	
			s	s	s	s	s	r	m	m	m	m							
				s	s	s	s	m	m	m									
					m	m	m	m											
r	r			m	m	m	m	r											
			s		m	m	R												
r	m	m	m	m	m	m													
s	s	m	m	m	m	r	m						s	s					
			m	m	r						s		s						
			m	m	M	r						s	s					s	
	s	s			s								m	m	s				s
s					s	m											s	s	s

M = Moderate Flaking Debris Relative to Cobbles < 70%
F = Flake Debris Dominant Relative to Cobbles > 70 %
A = Assaying (Cobble Breakup Dominant)
R = Raw Material Only
S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

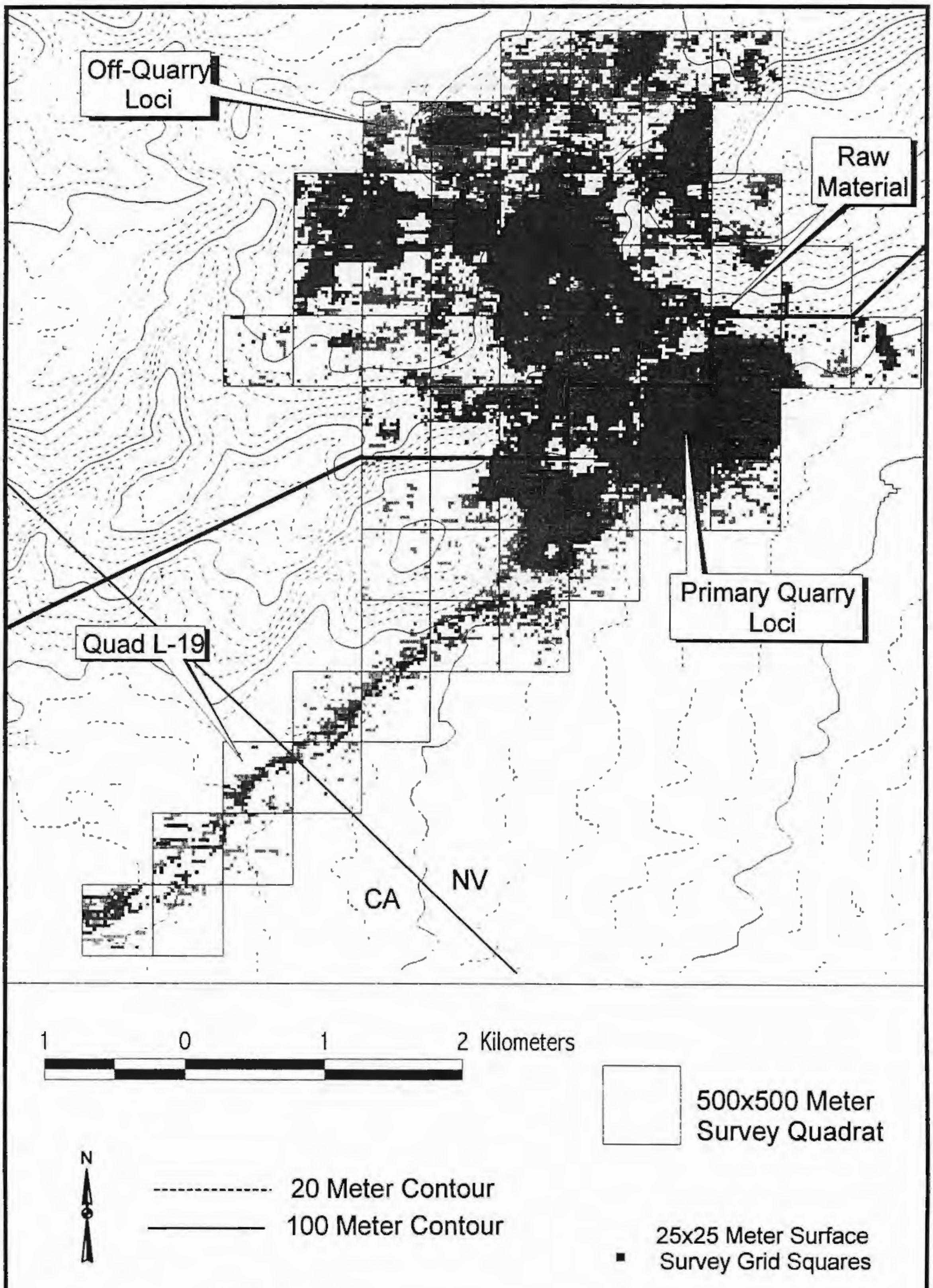

Figure 4.5
GIS Suface Map
of Truman/Queen Obsidian Source

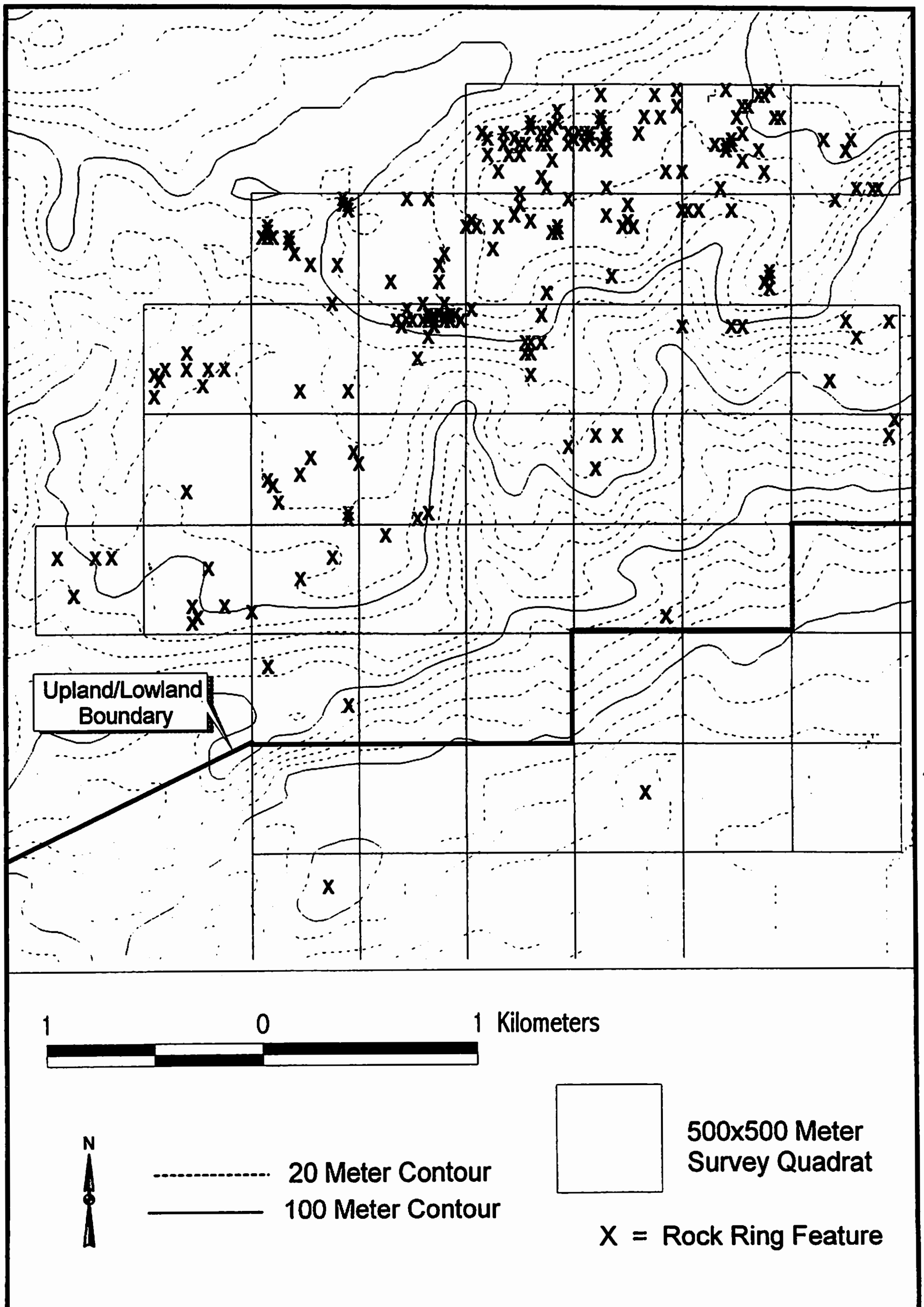

Figure 4.6 Map of Study Area with Rock Rings

Surface Collection

The second set of major objectives of the field work, was the surface collection of artifacts and more precise identification of spatial variability in raw material quality. These objectives were accomplished by randomly selecting ten upland and ten lowland quadrats from those previously surveyed. Table 4.3 is a list of the twenty quadrats selected for surface collection.

Table 4.3 List of Collected Quadrats and Provenience

Zone	Quadrat	Northing	Easting	Zone	Quadrat	Northing	Easting
Upland	U-02	4200000	373000	Lowland	L-2	4199500	376000
	U-07	4201000	374000		L-4	4199000	374500
	U-86	4200500	373500		L-5	4199000	375000
	U-87	4200500	374000		L-6	4199000	375500
	U-88	4200500	374500		L-8	4198500	373500
	U-89	4200500	375000		L-9	4198500	374000
	U-95	4199500	373000		L-10	4198500	374500
	U-97	4199500	374000		L-11	4198500	375000
	U-100	4199000	373000		L-12	4198000	374000
	U-101	4199000	373500		L-14	4197500	373000

The following discussion uses survey quadrat U-101 as an example to demonstrate the methods used to select the specific location within each survey quadrat for surface collection. Each randomly selected quadrat was divided into four quadrants, labeled NW ¼ , NE ¼, SW ¼ and SE ¼ respectively. The example in Figure 4.7 shows two grids; the left is the actual surface survey grid for quadrat U-101, the right is the pattern in which collection loci are selected. For example, the collection unit for the NW ¼ of U-101 was selected by the predetermined pattern in the grid on the right side of Figure 4.7.

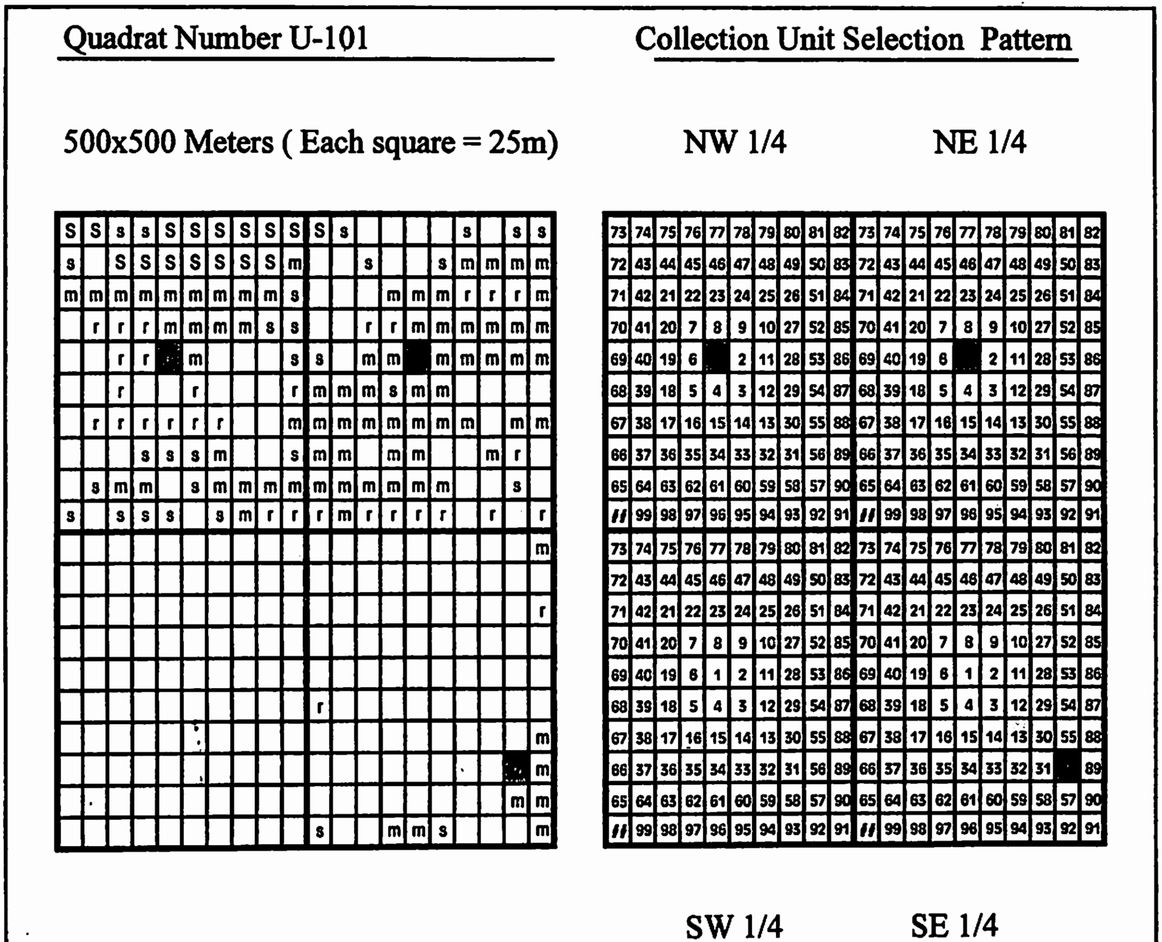

Figure 4.7 Method of Determining Surface Collection Location
Square on left is Quadrat U-101, square on right is pattern
from which collection loci are selected

In both the NW ¼ and the NE ¼ of U-101, square #1 contained surface material and was thus collected. If the collection square did not contain material it was replaced by another according to the predetermined sequence in the grid on the right in Figure 4.7. This was the case for the SE ¼ of U-101, where due to the lack of material in all preceding grid squares, #56 was actually collected. In the SW ¼, there were no grid squares with material, and thus none were collected. Provenience for each of these is based on the UTM coordinate for the southwest corner of the quadrat. Again using quad U-101 as an example, material was collected from the following locations and labeled based on the southwest corner of the 25x25 meter collection square. In the NW¼, square #1 was collected and given the unit provenience designation of "U-101 NW ¼ N325/E100". This method assured an unbiased selection of collection loci. Surface collections were obtained from 39 out of 40 quadrants of the 10 upland quadrats, and 38 out of 40 quadrants in the lowland quadrats (Figure 4.8). The remaining quadrants were sterile.

Two separate collection units were obtained from each of the selected 25x25 meter collection squares. The first of these was a random collection of material from the square, which was accomplished by running a line from the southwest corner diagonally across the selected 25x25 meter collection square. The first 50 artifacts touching the line were collected and bagged. This included any modified obsidian material regardless of technological category. These items were bagged together and comprise those collection units referred to in this document as "50 Counts". Because this method was likely to produce an assemblage dominated by debitage, an additional collection of tools was conducted across the 25x25 meter square. These units are referred to in this document as "Ancillary" collection units. Each location from which material was collected were designated as lots for all subsequent analysis.

Table 4.4 shows the units collected in each quadrat. At a given loci, 2 units; 50 Count and Ancillary, may have been collected. These were assigned "lots", as a designation of location for the spatial analysis that follows in the next chapter. For example in the NW quadrant of quadrat U-101 both a "50 count" and an "Ancillary" collection was conducted, both are part of lot # 71. Lot numbers 1-77 were assigned to

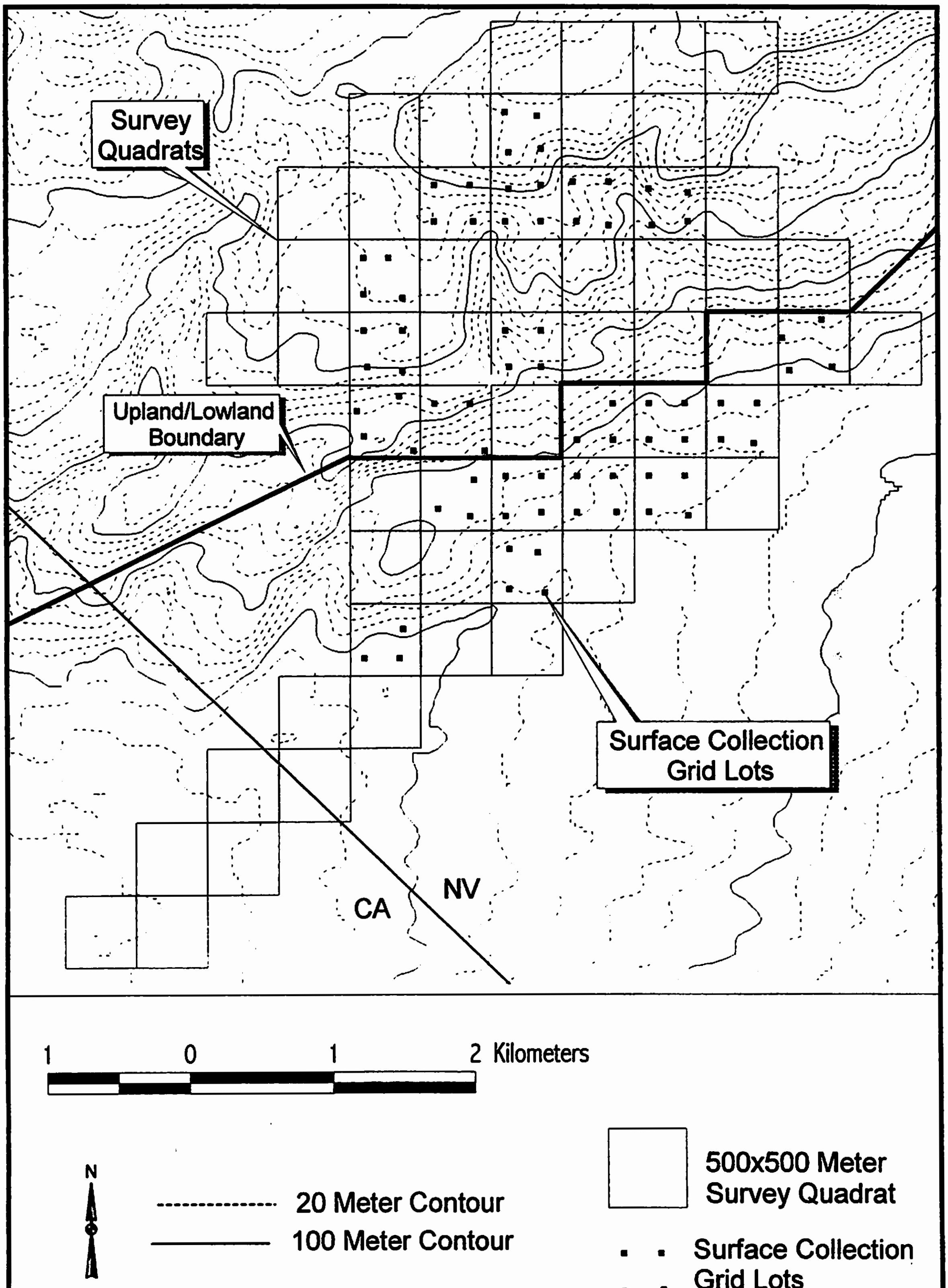

Figure 4.8
Map of Study Area
with Surface Collection Lots

Table 4.4 Lowland Collection Units

Quad	Quad UTM	Collect Quadrant	Unit Prov.	Lot #	Collection Unit	Desig.	Cobble Count
L-2	4199500/376000	NW 1/4	N325/E25	1	50 Count Ancillary	s	no
		NE 1/4	N450/E300	2	50 Count	s	no
		SW 1/4	N100/E75	3	50 Count	s	no
		SE 1/4	N125/E375	4	50 Count	s	no
L-4	4199000/374500	NW 1/4	N375/E100	5	50 Count Ancillary	m	yes
		NE 1/4	N375/350	6	50 Count Ancillary	m	yes
		SW 1/4	N125/E100	7	50 Count Ancillary	m	yes
		SE 1/4	N125/E350	8	50 Count Ancillary	m	yes
L-5	4199000/375000	NW 1/4	N375/E100	9	50 Count Ancillary	M	yes
		NE 1/4	N375/E350	10	50 Count Ancillary	M	yes
		SW 1/4	N125/E100	11	50 Count Ancillary	m	yes
		SE 1/4	N125/E350	12	50 Count Ancillary	m	yes
L-6	4199000/375500	NW 1/4	N375/E100	13	50 Count	m	yes
		NE 1/4	N375/E350	14	50 Count Ancillary	m	yes
		SW 1/4	N125/E100	15	50 Count Ancillary	m	yes
		SE 1/4	N100/E325	16	50 Count Ancillary	m	yes
L-8	4198500/373500	NE 1/4	N350/E375	17	50 Count Ancillary	m	yes
		SW 1/4	N150/E125	18	50 Count	s	no
		SE 1/4	N100/E350	19	50 Count	s	no
L-9	4198500/374000	NW 1/4	N375/E100	20	50 Count Ancillary	m	yes
		NE 1/4	N375/E350	21	50 Count Ancillary	m	yes
		SW 1/4	N100/E100	22	50 Count	s	no
		SE 1/4	N125/E350	23	50 Count Ancillary	m	yes
L-10	4198500/374500	NW 1/4	N375/E100	24	50 Count Ancillary	M	yes
		NE 1/4	N375/E350	25	50 Count Ancillary	m	yes
		SW 1/4	N125/E100	26	50 Count Ancillary	M	yes
		SE 1/4	N125/E375	27	50 Count Ancillary	S	no
L-11	4198500/375000	NW 1/4	N375/E100	28	50 Count	m	yes
		NE 1/4	N375/E350	29	50 Count	m	yes
		SW 1/4	N125/E100	30	50 Count	s	no
		SE 1/4	N100/E375	31	50 Count	s	no
L-12	4198000/374000	NW 1/4	N375/E125	32	50 Count Ancillary	m	yes
		NE 1/4	N350/E325	33	50 Count Ancillary	m	yes
		SW 1/4	N100/E125	34	50 Count Ancillary	s	no
		SE 1/4	N75/E375	35	50 Count Ancillary	s	no
L-14	4197500/373000	NE 1/4	N325/E375	36	50 Count	s	no
		SW 1/4	N125/E100	37	50 Count	s	no
		SE 1/4	N125/E350	38	50 Count Ancillary	s	no

Table 4.4 (Cont.) Upland Surface Collection Units

Quad	Quad UTM	Collect Quadrant	Unit Prov.	Lot #	Collection Unit	Desig.	Cobble Count
U-02	4200000/373000	NW 1/4	N375/E100	39	50 Count Ancillary	M	yes
		NE 1/4	N375/E275	40	50 Count Ancillary	m	yes
		SW 1/4	N125/E100	41	50 Count Ancillary	S	no
		SE 1/4	N100/E375	42	50 Count Ancillary Rock Ring Ancil.	S	no
U-07	4201000/374000	NW 1/4	N375/E100	43	50 Count Ancillary	m	yes
		NE 1/4	N350/E325	44	50 Count Ancillary	M	yes
		SW 1/4	N100/E125	45	50 Count Ancillary	S	no
		SE 1/4	N125/E350	46	50 Count Ancillary Red Flakes Ancillary	m	yes
U-86	4200500/373500	NW 1/4	N375/E100	47	50 Count Ancillary	s	no
		NE 1/4	N375/E350	48	50 Count	s	no
		SW 1/4	N125/E100	49	50 Count Ancillary	f	yes
		SE 1/4	N125/E375	50	50 Count Ancillary	m	yes
U-87	4200500/374000	NW 1/4	N350/E125	51	50 Count	m	yes
		NE 1/4	N375/E350	52	50 Count Ancillary	M	yes
		SW 1/4	N125/E100	53	50 Count Ancillary	M	yes
		SE 1/4	N125/E350	54	50 Count Ancillary	F	yes
U-88	4200500/374500	NW 1/4	N400/E75	55	50 Count	m	yes
		NE 1/4	N400/E325	56	50 Count	m	yes
		SW 1/4	N125/E100	57	50 Count Ancillary	m	yes
		SE 1/4	N100/E325	58	50 Count Ancillary	s	no
U-89	4200500/375000	NW 1/4	N350/E100	59	50 Count Ancillary	m	yes
		NE 1/4	N325/E375	60	50 Count Ancillary	M	yes
		SW 1/4	N100/E125	61	50 Count	m	yes
		SE 1/4	N125/E375	62	50 Count Ancillary	m	yes
U-95	4199500/373000	NW 1/4	N375/E100	63	50 Count	s	no
		NE 1/4	N375/E375	64	50 Count Ancillary	s	no
		SW 1/4	N125/E125	65	50 Count Ancillary	s	no
		SE 1/4	N100/E375	66	50 Count	s	no
U-97	4199500/374000	NW 1/4	N375/E100	67	50 Count Ancillary	m	yes
		NE 1/4	N375/E350	68	50 Count Ancillary	f	yes
		SW 1/4	N125/E125	69	50 Count Ancillary	m	yes
		SE 1/4	N125/E350	70	50 Count Ancillary	m	yes
U-100	4199000/373000	NW 1/4	N325/E50	71	50 Count Ancillary	s	no
		NE 1/4	N425/E350	72	50 Count	s	no
		SW 1/4	N150/E100	73	50 Count Ancillary	s	no
		SE 1/4	N50/E450	74	50 Count	s	no
U-101	4199000/373500	NW 1/4	N375/E100	75	50 Count Ancillary	m	yes
		NE 1/4	N375/E350	76	50 Count	m	yes
		SE 1/4	N50/E450	77	50 Count	m	yes

those loci which were part of the systematic surface collection, and lots numbered 200-244 were isolates collected while either in route to a survey zone or during the non-probabilistic initial survey. These included forty projectile points, two bifaces, three biface/points and one historic button and were labeled as part of "reconn" collection units, and assigned provenience designations based on the existing grid, in the same manner as the collection lots. In combination all surface collection efforts yielded an assemblage of 315 bifaces, 13 biface/points, 88 cores, 10 flake tools, 45 projectile points, 12 unifaces, and approximately 3900 pieces of debitage from 72 different collection squares or "Lots", and isolate finds. A summary of artifact types by collection location is provided in Chapter 5.

Raw Material Variability: Cobble Measurement

A more detailed identification of raw material variability was conducted during the surface collection. This was an effort to identify differences in cobble size across the source. This is important since bifaces require a larger parent piece than flake tools, and thus lower frequencies in the lowlands, may be due in part to a material constraint. To test this, 50 cobbles on the collection line in each 25x25 meter collection square were measured during the surface collection. A total of 1250 cobbles were measured from 25 squares in the lowlands and 1150 cobbles were measured from 23 squares in the uplands. This demonstrated that lowland cobbles are smaller, likely due to their deposition by water transport. The greater distance a cobble is transported the greater reduction in size. Thus it was expected based on initial observations that technology may vary across space as a result of the differences in cobble size. The relationship of raw material variability and spatial variability of artifacts found at the source is also described in greater detail in Chapter 5.

The breakdown of ranges in cobble size for each zone is listed in Table 4.5. The most marked difference between upland and lowland cobbles relates to the frequency in which the smallest forms occur. 33% (n=381) of lowland cobbles measure between 1-4 centimeters in diameter compared to 18% (n=229) of upland cobbles. In both zones the majority of cobbles are between 5 and 8 cm. in diameter, however cobbles larger than 12 cm. in diameter are more frequent in the upland zone (n=26) than in the lowland zone (n=9).

The chi square statistic comparing observed and expected frequencies of different cobble sizes by zones indicates that lowland cobbles are smaller on average (p value of $<$ .001), and in fact cobbles larger than 12 cm. are virtually absent.

Table 4.5 Obsidian Cobble Measurements by Zone

Size	Upland %	Lowland %	Total
1-4cms	0.18	0.33	610
5-8cms	0.59	0.55	1370
9-12cms	0.21	0.11	385
13-16cms	0.02	0.01	31
17-20cms	0.00	0.00	4
Total	1.00	1.00	2400

Laboratory Analysis

All artifacts collected in the field were brought to the University of California at Davis and assigned accession number #468. The artifacts were washed with a soft brush and fresh water and placed in 3mil archival quality plastic bags. Each was cataloged to the level of the following basic artifact classes; projectile points, biface/points, bifaces, cores, uniface-bs (defined below), unifaces, debitage, flake tools, modified flakes, flakes, and historic artifacts. Each of these artifact types are described in detail below.

It was an important objective of this study to categorize the assemblage in such a way that direct comparisons between the Truman/Queen and Coso sources could be made. With this in mind, all artifact categories and analytical categories used here are the same as those used by Gilreath and Hildebrandt (1995). There were some minor changes to these categories which are discussed below. Like Gilreath and Hildebrandt, functional analysis was not conducted, given the dominance of cores and preforms. However a series of attributes such as size shape and condition, were recorded for descriptive purposes. Adding difficulty to the determination of function is the fact that most material collected from the surface exhibits a high degree of edge damage, no doubt from turbation by water transport. Given this a conservative approach to classifying tools was taken.

Bifaces

Bifaces (n=289) are flaked stone tools that exhibit flake scars on the two planar surfaces of the implement. Metric attributes for all bifaces are listed in Table 4.6 below. It should be noted here that the category of core (bifacial) which was used by Gilreath and Hildebrandt (1995) was not used here. The Gilreath and Hildebrandt typology assumes that "bifacial cores" can be distinguished from bifaces by a perceived end product. However, early stage bifaces are quite thick with sinuous margins and large and deep flake removal scares. It is problematic to conclude that these items, identified here as simply early stage bifaces rather than cores, were to be reduced into more formal knife like implements or be used as a core for flakes. Thus for this study all bifacially modified artifacts which are not projectile points were categorized as bifaces.

Uniface-b (n=26) is a category described by Gilreath and Hildebrandt (1995:36) as an artifact related to biface production, however it differs in that flaking is primarily limited to a single surface of the specimen. These items are made exclusively on large flakes and many have a small amount of flakes removed from the smooth ventral surface. Because uniface-bs vary with respect to degree of flakes remove the same stage scheme and attributes used for the biface analysis were used for uniface-bs. For the purpose of this study the artifact category of uniface-b (Fig. 4.9) is assumed to simply represent an alternative form of biface production techniques. Reduction strategies during the early stages of biface production are centered around manufacturing a blank that is of suitable dimensions. These dimensions should include the relative proportions of length width and thickness. Because of this suitable pieces for biface production should come from relatively larger parent cores, and subsequently be modified into large early stage bifaces. An alternate strategy may be the manufacture of bifaces from large and relatively flat flakes that already approximate the dimensions of middle stage bifaces. This is a possible alternative lithic procurement strategy that has received very little attention from archaeologist work on lithic technology, who tend to limit typologies to either bifacing strategy or core procurement strategy. However the validity of this sub-type needs to be examined further. Thus for analytical purposes in this study, bifaces and uniface -bs are combined and all totals reflect the combined numbers of both artifact categories. However in the temporal variability section of Chapter 5, production curves for both bifaces and uniface-bs are described. Most discussion that follows however uses the combined curve because of the above mentioned assumption that they are the same thing, and are both part of the same reduction and technological trajectory at the scale that is used here (i.e. biface vs. core).

Table 4.6 Descriptive Statistics of Biface Metric Attributes

	Weight	Length	Width	Thickness
Mean	90.53	88.61	59.43	19.84
Median	69.60	88.00	59.00	19.00
Mode	26.70	78.00	56.00	28.00
Standard Deviation	93.45	20.34	15.91	10.42
Minimum	1.60	46.00	22.00	1.00
Maximum	738.40	161.00	165.00	62.00
Count	315	162	179	302

Numerous authors (Muto 1971, Thomas 1983) have noted that biface manufacturing is a reductive process which passes through a continuum that can be divided into a series of stages. It is clear that such distinction is arbitrary and any comparisons between sources relying on specific stages would be problematic, particularly if the two studies were conducted by different lithic analysts. Nevertheless if one assumes that economic decisions regarding toolstone procurement relate in some way to the amount of time invested in tool manufacture and the increase in the utility of the tool through the shaping process, then some measure of both of these is necessary. This is one area for continuing research, but it is clear that there has been less time invested in an early stage biface (a specimen that was just started when discarded) than a late stage biface (a specimen that was almost finished when discarded). To facilitate comparison between the Truman/Queen and Coso sources, Gilreath and Hildebrandt's (1995:36-37) biface stage typology was used adhered to during biface analysis for this project.

According to the Gilreath and Hildebrandt (1995) typology, stage 1 bifaces are large and often very think pieces, with modification limited to percussion flaking. This form often has deep flake scars, which produces irregular sinuous margins and irregular planar form (Gilreath and Hildebrandt 1995:37). In the Gilreath and Hildebrandt (1995) typology, stage 1 bifaces are contrasted with bifacial cores by the proportion of worked margin, with stage 1 bifaces having over 60% of the margin bifacially modified more indicative of biface reduction rather than core/flake trajectory (Gilreath and Hildebrandt 1995:37). However, it is believed here that such a distinction is relatively arbitrary, and lacking other evidence for a widely used, but newly recognized artifact type for the region, all specimens that exhibited bifacial flaking were categorized simply as bifaces.

Weight measurements were recorded for all bifaces, however other dimensional metrics (length width thickness) were recorded only when a complete measurement could be taken. The same is true for the other artifact types described below. The sample of

315 bifaces included two biface margin fragments that were categorized as "indeterminate." These were excluded from the obsidian hydration sample and the descriptive statistics by stage below, however they are listed with the other bifaces in Appendix A. The mean metric attributes (weight, length, width, thickness) of Stage 1 bifaces (n=125) are listed in Table 4.7. Weight measurements were obtained on all stage 1 bifaces and averaged 141 grams. Only 98 of the 125 Stage 1 bifaces were complete enough to obtain length measurements (mean =90.56 mm.). The mean width of bifaces (n=101) was 63.2 mm, and the mean thickness (n=123) was 26.25 mm. Stage 1 bifaces are represented in Figure 4.10.

Table 4.7 Metric Attributes of Stage 1 Bifaces

	Weight	Length	Width	Thickness
Mean	140.98	90.56	63.22	26.25
Median	116.10	89.00	61.00	25.00
Mode	82.20	88.00	56.00	28.00
Standard Deviation	114.70	20.93	16.11	10.22
Minimum	5.70	46.00	35.00	8.00
Maximum	738.40	161.00	165.00	62.00
Count	125	98	101	123

The distinction between stage 1 and stage 2 bifaces although somewhat arbitrary, is based on a few primary characteristics. Stage 2 bifaces (Figure 4.11) tend to be thinner with more regular margins, and also exhibit over 80% bifacial flaking along the margins , and a general thinning of the piece due to the percussion flaking (Gilreath and Hildebrandt 1995). The average weight of the stage 2 bifaces (n=109) is 84.9 grams. This is roughly 60% of the total weight of stage 1 bifaces which averaged 140.98 grams. Stage 2 bifaces have an average length (n=57) of 87.61 mm, and are only slightly shorter than stage 1 bifaces (90.56 mm). Stage 2 bifaces (n=63) have an average width of 57.32 mm, which is roughly 17 % less than stage 1 Bifaces (69.36mm.) The mean thickness (19.9 mm.) of stage 2 bifaces (n=105) is also reduced in comparison to stage 1 bifaces. This general reduction in size is true throughout all subsequent stages, although the subsequent summaries will not reiterate the discussion of the pattern. The descriptive statistics of stage 2 biface metric attributes are listed in Table 4.8.

Table 4.8 Metric Attributes of Stage 2 Bifaces

	Weight	Length	Width	Thickness
Mean	84.93	87.61	57.32	19.91
Median	70.70	89.00	56.00	20.00
Mode	23.60	101.00	52.00	12.00
Standard Deviation	57.68	19.30	12.67	7.06
Minimum	9.60	56.00	25.00	8.00
Maximum	290.40	135.00	92.00	38.00
Count	109	57	63	105

Stage 3 Bifaces (Figure 4.12) are thinner have more regular margins than stage 2 bifaces (Gilreath and Hildebrandt 1995). They may at this stage exhibit evenly spaced flake removal scars, be symmetrical in planar shape, and bi-convex in cross section (Gilreath and Hildebrandt 1995:37). The metric attributes of Stage 3 bifaces are listed in Table 4.9., which show lower values for each of the attributes. Interestingly it is at the transition from stage 2 to stage 3 where there is the greatest reduction of weight. Stage 2 bifaces weigh 60% of the Stage 1 biface weight, while by stage 3 there is only 19% of the weight of a stage 1 biface remaining.

Table 4.9 Metric Attributes of Stage 3 Bifaces				
	Weight	Length	Width	Thickness
Mean	26.84	71.80	44.64	10.19
Median	24.00	73.00	42.00	10.00
Mode	26.70	66.00	34.00	10.00
Standard Deviation	20.99	5.59	15.44	4.12
Minimum	1.90	66.00	22.00	1.00
Maximum	105.40	78.00	69.00	23.00
Count	47	5	11	43

Stage 4 bifaces (Figure 4.13, Table 4.10) exhibit some degree of pressure flaking and are generally thinner than stage 3 bifaces. As expected they are generally smaller in all dimensions than the stage 3 bifaces. Stage 4 bifaces weight less than 10% of the weight of stage 1 bifaces. The same is true for the relationship of size and stage when comparing stage 4 to stage 5.

Table 4.10 Metric Attributes of Stage 4 Bifaces				
	Weight	Length	Width	Thickness
Mean	13.25	63.50	40.67	8.09
Median	7.60	63.50	32.00	7.00
Mode	#N/A	#N/A	#N/A	6.00
Range	41.00	7.00	30.00	10.00
Minimum	1.60	60.00	30.00	4.00
Maximum	42.60	67.00	60.00	14.00
Count	25	2	3	23

Stage 5 bifaces (Figure 4.13, Table 4.11) are for the most part finished items, such as projectile points or bifacial knifes. According to the Gilreath and Hildebrandt (1995:37) typology these items demonstrate extensive pressure flaking, with either side covered with the scars of closely spaced shallow pressure flakes. These pieces were either discarded at the end of their use-life or were broken during the final stages of tool manufacture. Analysis of the late stage bifaces in this study identified no conclusive evidence that these items were spent tools.

Table 4.11 Metric Attributes of Stage 5 Bifaces

	Weight	Length	Width	Thickness
Mean	4.6	-	28	5
Median	4.2	-	28	5
Mode	4.2	-	-	6
Range	5.6	-	-	2
Minimum	2.4	-	28	4
Maximum	8	-	28	6
Count	7	0	1	6

A comparison of each of the attributes for biface by stage (Table 4.12), indicates some not surprising trends. At each stage of the manufacturing process, the values of weight, length, width and thickness become less. This is of course because biface production is a reductive process, and there is no way for these values to become larger.

Table 4.12 Comparison of Bifaces Stage Metric Attributes by Stage

	Weight	Length	Width	Thickness
Stage 1	140.98	90.56	69.36	26.25
Stage 2	84.93	87.61	57.32	19.91
Stage 3	26.84	71.80	44.64	10.19
Stage 4	13.25	63.50	40.67	8.09
Stage 5	4.60	n/a	28.00	5.00

Some authors have sought to identify optimal solutions to the problem of resource transport, more recently with models applicable to lithic procurement (i.e. Metcalfe and Barlow 1992). Such models predict that field processing time, is a contingency with an optimal solution. This optimal solution is determined by the transport costs and solved by an optimal degree of field processing prior to transport. However for these models to be tested, archaeologist need to determine some measurement of utility of stone tools as they go through the progression of stages.

The problem lies in the fact that the reduction of stone tools is actually a process of infinite stages, with as many stages as there are flakes struck off of the parent piece. In reality at no point is a biface at stage 3, and then when another flake is removed it is stage 4. Stages therefore, are simply not a measurement of any thing real. If the actual time investment between a stages is minuscule the decisions to process material at the site probably were never made at that level. As transport models identify, the actual contingency is centered around the utility of a transported load (cf. Metcalfe and Barlow 1992). This concept of utility relates ultimately to the amount of the load that is transported waste. In other words, transporting a load of only finished tools would be a high utility, and transporting unprocessed material would be a low utility load. The optimal solution to a transport problem likely would be a load somewhere in between these two extremes. In some ways then, it is more appealing to limit analytical categories for bifacial reduction to three stages; the tool maker either just started and it is early stage or it is nearly finished and it late stage, or it falls somewhere in-between the two and is middle stage. Given this line a thinking the analytical categories relating to biface reduction stages for debitage described below are limited to early, middle, late stage reduction categories.

Looking at the metrics for the bifaces described above in the three stage scheme (Table 4.13) does draw attention to some aspects of variability that would be less obvious if viewed as five stages. For all metric attribute the greatest degree of reduction occurs between early and middle stage. For example, the reduction of mean weight of bifaces between early stage (114 grams) and late stages (11 grams) is over 100 grams, however 85% of this reduction occurs between early and middle stages. Only roughly 15% of the weight is reduced during the late stages of biface manufacture. The same is true for the other attributes, such as length, width and thickness. During biface manufacturing 68% of the length, 74% of the width and 64% of the thickness are reduced during the early to middle stage. Of the total amount of length reduced, only 32% occurs in late stages. An similarly, only 26% of the width, and only 36% of the thickness reduction occurs during late stages. These data should be viewed as provisional, however, given the sample size of some types such as stage 5 bifaces. Nevertheless when all attributes are taken together there are some generalities that can be made.

Assuming that the time investment in each stage is the same, collectively these data indicate that the greatest, gain in utility occurs during early stages, and utility gain sharply decreases as reduction stage increases. Therefore, it appears that there is less incentive for processing bifaces much past the middle stage. It is likely that the relatively lower numbers of late stage bifaces at the source is due to the fact that they were rarely made there, given the lack of incentive for late stage process, based on the lower utility gain per unit of time.

Table 4.13 Comparison of Mean Measurements for Bifaces by Stage

	Weight	Length	Width	Thickness
Early Stage	114.87	89.48	60.95	23.33
Middle Stage	26.84	71.80	44.64	10.19
Late Stage	11.36	63.50	37.50	7.45

This may be further compounded by the apparently higher manufacturing failure rate of later stage bifaces. Of the stage 1 and stage 2 bifaces, an average of 29% were discarded because of a manufacturing break, while a higher proportion were discarded because of an inability to control either planar or cross-sectional shape. This is in marked contrast to stage 3 biface where 60% were discarded due to a manufacturing break. This result in a higher degree of fragmentation where pieces where fractured in half resulting in a greatly reduced weight from stage 2 to stage 3. Of the late stage bifaces (Stage 4 &5) where reject cause could be estimated, they were either all rejected for manufacturing breaks (77%) or because of a structural flaw (23%) in the raw material.

Table 4:14 Causes of Rejection of Bifaces by Stage

Type	no reason noted	human error, break	structural flaw	could not control planar shape	could not control cross-section	error otrepasse	indeterminate
Stage 1	7	27	0	14	14	0	63
Stage 2	12	40	4	11	12	1	29
Stage 3	6	28	0	2	1	1	9
Stage 4	0	18	7	0	0	0	0
Stage 5	0	5	0	0	0	0	2

The fragmentation conditions (Table 4.15) of the bifaces also support this. Pieces are discarded in whole conditions as rejects early in the process, but it is usually reduction failure that stops the process in later stages of reduction. There were no whole stage 5 bifaces, and only a single stage 4 biface recovered from the source. Given the lack of complete late stage bifaces and the apparent increase in human error during late stages it is tempting to conclude that the lack of late stage bifaces at the source is in part due to a high failure rate. This means there may be little incentive to proceed late stage tools on site. Manufacturing failure during late stages of manufacturing is more costly given the greater time invested in production without a return of any toolstone benefit. The exact difference is difficult to determine given the fact that the transport of early stage bifaces, is a strategy that still contains the risk of manufacturing failure during subsequent processing away from the source. Nevertheless, this points to the likelihood that the failure rate of late stage bifaces may be conditioner of transport decisions, not just the utility and cost of a transported load.

Table 4.15 Fragment Type Comparison of Bifaces

	whole	base	distal (tip)	indeterminate end	medial (midsection)	margin	interior fragment
Stage 1	77	5	3	30	0	8	2
Stage 2	42	15	6	36	3	7	0
Stage 3	6	10	11	13	1	6	0
Stage 4	1	5	9	4	2	4	0
Stage 5	0	1	4	1	1	0	0

Cores

Cores (n=88) are chipped stone artifacts with a minimum of three flake removal scars. This slight change from the Gilreath and Hildebrandt (1995) typology, was necessary to reduce limit the amount of non-diagnostic material collected. The majority of material at the source has been damaged by water transport down the hillsides in the area. Thus almost all naturally occurring cobbles exhibit multiple flake scars as a result. To minimize the collection of geo-facts, only those pieces which were clearly modified by humans were collected. Standard measurements for cores included weight, length, thickness, and width. Cores were then assigned to various sub-types based on morphology in keeping with the Gilreath and Hildebrandt (1995) typology. These include, bi-directional cores, non-patterned cores, unidirectional cores, cobble test cores, and chunk test cores. Two categories used by Gilreath and Hildebrandt (micro-blade core, and prismatic core) were not represented in the collection from Truman/Queen. A series of additional attributes were recording such as degree and type of cortex present, number and type of striking platforms, evidence of wear, and several shape attributes. These data are presented in Appendix A.

"Bi-directional cores" (Figure 4.14) are characterized by flake scars which indicate that flakes were removed in more than one direction and from multiple platforms. These cores were more cubic in shape owing to the multiple direction of the flake removal scares. These forms exhibit tremendous variability and range in weight from 22.8 to 602.5 grams. Descriptive statistics for bi-directional cores are listed in table 4.16. Because of the often irregular morphology it is more difficult to determine the completeness of cores than bifaces, thus all cores were considered complete and weight, length, width and thickness measurements were obtained on all specimens.

Table 4.16 Bi-directional Cores (Type 2) Descriptive Statistics

	Weight	Length	Width	Thickness
Mean	225.53	96.30	70.60	40.60
Median	190.25	93.50	70.00	40.00
Standard Deviation	166.04	14.28	16.00	13.52
Minimum	22.80	76.00	47.00	22.00
Maximum	602.50	122.00	99.00	69.00
Count	10	10	10	10

Non-patterned cores (Figure 4.15) tended to be slightly larger than bi-directional cores. Non-patterned cores averaged 301.28 grams in weight however the overall dimension were not that different from bi-directional cores except that they are slightly thicker than bi-directional cores The length width and thickness determinations on these types of cores was somewhat arbitrarily determined, and these dimensions have less meaning for informal artifacts than for bifaces or projectile points in which the distinction is clear.

Table 4.17 Non-patterned Cores (Type 3) Descriptive Statistics

	Weight	Length	Width	Thickness
Mean	301.28	96.53	69.18	48.33
Median	282.45	93.00	68.00	51.00
Standard Deviation	179.22	24.51	17.17	14.01
Minimum	37.10	62.00	33.00	20.00
Maximum	924.60	166.00	121.00	74.00
Count	40	40	40	40

"Unidirectional cores" (Figure 4.16) have flake scars which indicate that the flakes were removed from a single platform and in a single direction. These were quite varied in shape from forms exhibiting a somewhat tabular appearance with flake removal limited to a singe direction to more blocky forms with flakes removed from a single platform.

Table 4.18 Unidirectional Cores (Type 4) Descriptive Statistics

	Weight	Length	Width	Thickness
Mean	227.09	90.32	64.27	42.14
Median	190.05	88.50	64.00	38.00
Standard Deviation	123.84	20.46	11.72	12.11
Minimum	75.40	47.00	42.00	24.00
Maximum	572.60	132.00	87.00	78.00
Count	22	22	22	22

Split cobble cores (Figure 4.17) are pieces which exhibit very little modification other than the initial splitting of the cobble. These items although relatively rare in the surface collection, were seen often on surveys. These type were often found in areas identified during the survey as assaying or prospecting. It is possible that these split cobbles are efforts to assess the quality of raw material at particular concentrations of cobbles. In some cases during the surface survey, some these forms were observed to have additional percussion flakes removed from the freshly exposed flat surface of the split cobble. These might appear quite biface-like in form, on a single face, however the backside is unmodified and usually covered by natural cortex.

Table 4.19 Split Cobble Cores (Type 5) Descriptive Statistics

	Weight	Length	Width	Thickness
Mean	209.56	90.56	67.56	34.00
Median	227.90	93.00	68.00	29.00
Standard Deviation	104.05	10.99	10.09	13.80
Minimum	73.70	72.00	52.00	18.00
Maximum	352.40	105.00	83.00	64.00
Count	9	9	9	9

Chunk test cores (Figure 4.18) differ from split cobble cores having little if any cortex, and are more cubic in shape, because of the larger number of flakes which have been removed. Split cobble core usually have modification limited to the single surface as a the result of the cobble being split. The chunk test cores tended to be lighter and smaller in overall dimension. Like all the core forms described above, these specimens were quite varied in form, and exhibited greater ranges in size than more formal tools such as bifaces or projectile points. Furthermore these forms may not reflect an actual technological trajectory but rather are the cubic “shatter” associated with various processing activities.

Table 4.20 Chunk Test Cores (Type 6) Descriptive Statistics

	Weight	Length	Width	Thickness
Mean	90.06	67.14	51.43	26.57
Median	66.10	70.00	41.00	24.00
Standard Deviation	58.22	14.38	14.52	8.40
Minimum	26.80	44.00	38.00	18.00
Maximum	177.50	82.00	74.00	42.00
Count	7	7	7	7

Projectile Points

Projectile points are extensively flaked stone tools that have a hafting element evident usually in the form of notching or a stem. During the surface collection efforts at the Truman/Queen source 45 projectile points were recovered. Of this total, 34 could be confidently assigned to current Great Basin typologies (e.g. Bettinger and Taylor 1974, Thomas 1981). Desert Series projectile points include two well recognized types. The first, Desert Side-notched points (Fig. 4.19) were originally identified by Baumhoff (1957, Baumhoff and Byrne 1959) and later more precisely defined (Thomas 1981). These forms are small triangular points usually weighing less than 1.5 grams. Although there are variants to this type, all contain the diagnostic side notching. Desert Side-notched points are one of the temporal indicators of the Marana Period ca. 650 B.P-contact (Bettinger and Taylor 1974, Thomas 1981). There were only three Desert side-notched points recovered during the surface collection efforts at the Truman/Queen source. One specimen was recovered from the upland zone and two from the lowland zone. All three specimens are obsidian, however only one sample was sourced to Truman/Queen by XRF. That specimen had a mean hydration value of 2.5 microns.

The second point type of the desert series are Cottonwood projectile points (Fig. 4.19) named after the Cottonwood Creek Site in Owens Valley California (Riddell 1951). These forms were first described by Heizer and Baumhoff (1961) and later more formally by Thomas (1981). Like the Desert Side-notched points, Cottonwood projectile points are usually less than 1.5 grams in weight and are also triangular in form, but lack notching. These points also are time markers for the Marana period. There were three Cottonwood points collected during this project, all from the upland zone. Two of the samples are made of obsidian and one is of chert. The two obsidian specimens were both sourced to Truman/Queen by XRF and have hydration values of 1.5 microns and 1.4 microns.

Two major projectile point types that are time markers for the Haiwee period ca. 1350-650 B.P. (Bettinger and Taylor 1974, Thomas 1981). Eastgate points were first identified by Heizer and Baumhoff (1961), from specimens recovered at Wagon Jack Shelter. These are small triangular forms, with two small basal notches that produce a straight or expanding stem. The other type of point from this series are Rose Spring projectile points. These were originally defined by Lanning (1963) and are more varied in form than Eastgate points. These can be similar in form to some variants of the Elko Series, and are usually distinguished by a weight under 3.0 grams and a basal width under 10 mm. (Thomas 1981). Because both Rose Spring and Eastgate projectile points are temporally limited to ca 1350-650 B.P., Thomas (1981) combines them into a single Rosegate type. Of the five points recovered that were assigned to the Rosegate series, all were of the Rose Spring type, all five specimens were recovered from the upland zone of the source. One specimen is made from chert and four are made of obsidian. Only two of the obsidian samples could be traced to the Truman/Queen source by visual inspection and XRF. The hydration values for these two points were 2.8 microns and 3.7 microns.

Elko Series (Fig 4.19) projectile points which also varied in form, are time markers for the Newberry period ca. 3150-1350 B.P. (Bettinger and Taylor 1974). These were first defined by Heizer and Baumhoff (1961). In central Nevada the Contracting-stem variant bas been referred to as Gatecliff Contracting Stem projectile points (Thomas 1981). The Corner-notched variants are distinguished from Rose Spring projectile points by having a weight above 3.0 grams and a basal width over 10 mm. There were a total of 13 Elko Series projectile points recovered during the project. Of these, one specimen is Corner-notched, three are Contracting-stem variants, six are Elko Eared and, one specimen is an Elko Side-notched. The collection also includes two projectile points that were within the size range of Elko points, but are too fragmentary to be assigned to a subtype. Seven of the points were recovered in the upland zone and six from the lowland. Ten of the points were sourced to the Truman/Queen by visual inspection and XRF, thus there are a total of 10 hydration readings on Elko points from the Truman/Queen source collected as part of this project.

Humbolt Basal Notched points (Fig.4.20) are bifacially worked lanceolate shaped implements. Only one Humbolt Basal-notched specimen was recovered. Unlike other point forms in the region, the Humbolt series seem to be less temporally discreet. In central Nevada they have been dated across several time periods (Thomas 1981). Some consider the form to be a dart point predating 1350 B.P. (Heizer and Clewlow 1968). According to Bettinger (1978a), Humbolt Basal-notched tools may not be dart points, but rather hafted knives, similar in age to Rosegate Series projectile points. Other data (Iny-

30) suggest a late Elko early Rose Spring age. Because of the difficulty in placing this form within a chronological frame work, the single specimen collected in this study was not included in the hydration rate calculation described below. However it yielded a reading of 3.3 microns, which is within the range of hydration readings on Haiwee Period projectile points.

Little Lake Series projectile points (Fig. 4.20) are also referred to as Pinto points (Harrington 1957) and Gatecliff Split-stem points (Thomas 1981). They are similar in size to Elko points but have large open corner notches and small basal notching giving them an eared appearance. There is some question as to the actual temporal limits of Little Lake points, with two predominant views. Flenniken and Wilke (1988) contend that they are merely reworked Elko series points and thus do not represent a discreet temporal period, but their view is less widely accepted. Most authors (Bettinger and Taylor 1974, Thomas 1981) contend that they predate Elko Points, dating between 4950-3150 B.P. However Warren (1980) places these forms still earlier between ca. 7000-4000 B.P.. There were 6 Little Lake points recovered during this project, 5 of which could be attributed to the Truman/Queen source by XRF. Hydration values on the 5 Little Lake specimens ranged from 2.9 - 5.3 microns. Some of the problems in dating Little Lake points from the Truman/Queen source is discussed in greater detail below.

Great Basin Stemmed points (Fig. 4.20) have less certain age ascription. Bettinger and Taylor (1974) designated these forms as time markers for the Mohave period (ca. pre 5500 cf. Bettinger 1975), although the precise temporal placement is not known. Three points of this type were recovered during this project, all three were sourced to Truman/Queen by XRF. The three points have readings of 3.7, 4.2 and 5.6

microns. Because the dating of these forms is less certain they were excluded from the sample below in which a rate for Truman/Queen was attempted.

Biface/Points

There were 13 projectile point size bifaces collected and categorized as Biface/Points, in keeping with the Gilreath and Hildebrandt typology. These are likely to be projectile points due to their size, thickness and the high degree of pressure flaking, however these specimens contain no diagnostic hafting element and are thus different from the untyped projectile points described above. For this class of artifact, measurements and analysis was the same as for bifaces discussed above. One exception to this is that of each artifact, the size category (arrow point size or dart point size) was noted. No further analysis of these artifacts was conducted. The metric measurements and collection location information are listed in Appendix A.

Unifaces

Unifaces (n=12) are chipped stone tools that exhibit flake removal scars, limited to one side of the tool. This often results in a steep margin which originates from an unmodified ventral surface. Some specimens exhibit a small degree of micro-chipping on the ventral surface, possibly from use or platform preparation. In accordance with the Gilreath and Hildebrandt (1995:37) typology, unifaces are distinguished from unidirectional cores due to the uniformed planar shaped and keeled cross sections. They are also significantly smaller that unidirectional cores.

Table 4.21 Metric Attributes of Unifaces

	Weight	Length	Width	Thickness
Mean	57.15	69.10	41.67	17.50
Median	49.35	69.00	42.50	17.50
Standard Deviation	32.01	11.66	12.04	4.06
Minimum	16.70	54.00	20.00	9.00
Maximum	140.90	89.00	60.00	23.00
Count	12	10	12	12

Flake Tools

Flake Tools (n=10) are flakes that have unequivocal post detachment modification. Assignment to this category was done cautiously given the high degree of edge damage on most material present at the source. Thus the flake tool category was limited to those pieces with patterned micro-chipping or pressure flaking on the margins.

Table 4.22 Metric Attributes of Flake Tools (n=10)

	Weight	Length	Width	Thickness
Mean	48.55	64.57	39.00	14.80
Median	38.00	59.00	31.00	16.00
Standard Deviation	43.98	23.87	15.15	6.84
Minimum	8.30	34.00	25.00	6.00
Maximum	140.50	98.00	71.00	28.00
Count	10	7	9	10

The manufacturing of flake tools at a quarry site is problematic given the high volume of material present. There would seem to be no reason to manufacture such implements given the availability of material. The presence of flake tools is thus likely an indication of one of two things. First, these forms may not be quarry debris in the strict sense and may be a manufacturing trajectory. They more likely, however were being used in conjunction with the use of the area, and discarded. The second possibility is that these forms were originally large waste flakes which were subsequently modified through use. It is likely, given that large biface thinning flakes usable as tools are present in infinite numbers, at no time would one be require to manufacture flake tools.

Debitage

The surface collection included 77 "50 count" units of debitage. The category debitage refers to chipped stone artifacts that were presumably struck from a core or biface but lack any conclusive evidence of subsequent modification. They are thus distinguished from flake tools by the lack of these attributes. All debitage was collected as part of the 50 count units described in the field methods section above. In keeping with the analytical categories utilized by Gilreath and Hildebrandt (1995:40) initial analysis of the debitage separated the material based on an association with biface reduction or core/flake percussion debris. Biface reduction debris can be viewed on a continuum from early to late stages of biface production. Those categories of debitage associated with early stage biface production include, biface primary decortication flakes, biface secondary decortication flakes and early stage biface thinning flakes. Primary decortication and secondary decortication flakes are distinguished by the proportion of cortex on the dorsal surface of the flake. Primary decortication flakes exhibit cortex on more than 30% of the surface, while secondary decortication flakes have less than 30% cortex (Gilreath and Hildebrandt 1995). However distinguishing between a biface or core trajectory at this stage of reduction is problematic. Biface thinning flakes are more recognizable and tend to be broad, curved specimens with easily identified striking platforms and bulbs of percussion. Biface thinning flakes were assigned stages based on their size, number of dorsal arises and size of previous flake scares on the dorsal surface. While this distinct is admittedly arbitrary, there are clear distinctions between early and late stage biface thinning flakes, and the judgment of the author was used for those that fall in between and were thus assigned to middle stage biface thinning flakes. The final category likely associated with biface production is pressure flakes, however given the recovery methods used during this project this category was rare and not subjected to any subsequent analysis.

Core reduction debris may also viewed on a manufacturing continuum from early to late stage as follows; core primary decortication flakes, core secondary decortication flakes, core simple interior flakes, core complex interior flakes. However, core primary and secondary reduction flake categories include any flake that contains cortex and diagnostic flake attributes such as a striking platform and bulb of percussion. Because core typologies are poorly defined, the core decortication flake categories tended to be catch-all types and are not believed to actually represent debitage associated with core manufacture.

Table 4.23 Debitage Counts From Surface Collection

Biface Reduction	n=935	Count
Early Stage Biface Thinning Flake		357
Middle Stage Biface Thinning Flake		477
Late Stage Biface Thinning Flake		101
Core Reduction	n=613	
Core Simple Interior		397
Core Complex Interior		216
Decortication Flakes (provisional categories)	n=1413	
Biface Primary Decortication		12
Biface Secondary Decortication		62
Core Primary Decortication		797
Core Secondary Decortication		542
Other Unknown Trajectory	n=846	
Rectangular Blades (provisional)		17
Indeterminate Percussion Flakes		690
Edge Preparation		67
Gravel		63
Pressure Flake		9
Total		3807

A number of additional debitage categories were also identified, but given the research questions of this project and the difficulty in assigning these to a technological trajectory, analysis was limited to distinguishing these forms only to the catalog level. These included indeterminate percussion flakes, edge preparation flakes and small obsidian gravel. In addition a number of artifacts (n=17) were assigned to a provisional category of rectangular blade. These pieces are long and relatively flat flakes with usually a single longitudinal dorsal aris, and appear quite blade like.

Of the 3807 pieces of debitage collected at the source during the surface collection, 37% are decortication flakes, 25% are biface reduction flakes, 22% are of an unknown trajectory, and 16% are core reduction flakes. Because of the difficulty in classifying cortex removal flakes as part of a particular trajectory, the discussion of biface and core debitage in subsequent chapters excludes cortical debitage. Analysis indicates that biface thinning flakes are the most common diagnostic debitage from the source. This suggests that the failure rate on biface manufacture is quite high and coupled with the higher debitage levels indicates that biface production was a high waste endeavor. Waste is in the form of both the large amounts of material removed during sequential reduction stages but also due to the fact that many bifaces were likely discarded prior their successful completion.

Two additional units of debitage were collected and given the analytical category of "Flakes." The first of these comprises approximately 200 pieces of debitage and has not been analyzed beyond the catalog level. This sample was collected from one of the several small (40-70 cm) rock-rings that were located during the surface survey. The second sample is from the surface collection of a small area located in a 25x25 meter collection square that almost exclusively contained mahogany obsidian. This is marked as Red Flakes Ancillary on Table 4.4.. Both the RR ancillary and Red flakes Ancillary, were excluded from analysis with other debitage samples.

Modified flakes are those artifacts which were collected as flake tools during the surface collection but upon more detailed analysis were determine to be inconclusive and excluded from further analysis. This is due to the fact that the majority of surface material contains some degree of edge damage.

Additional laboratory analysis included the geo-chemical analysis of 40 unmodified cobbles, collected from four different locations at the source. These specimens were submitted to The University of Missouri, Research Reactor Archaeometry Laboratory for Neutron Activation Analysis, by Michael Glasscock. The results of these tests are to published at a future date. Obsidian hydration analysis was conducted by Glen Wilson of the obsidian hydration laboratory at San Jose State University. The data from both the obsidian hydration and the XRF data are listed in data appendices.

Figure 4.9 Uniface-B's, Top specimen #468-0061, Bottom specimen #468-0187

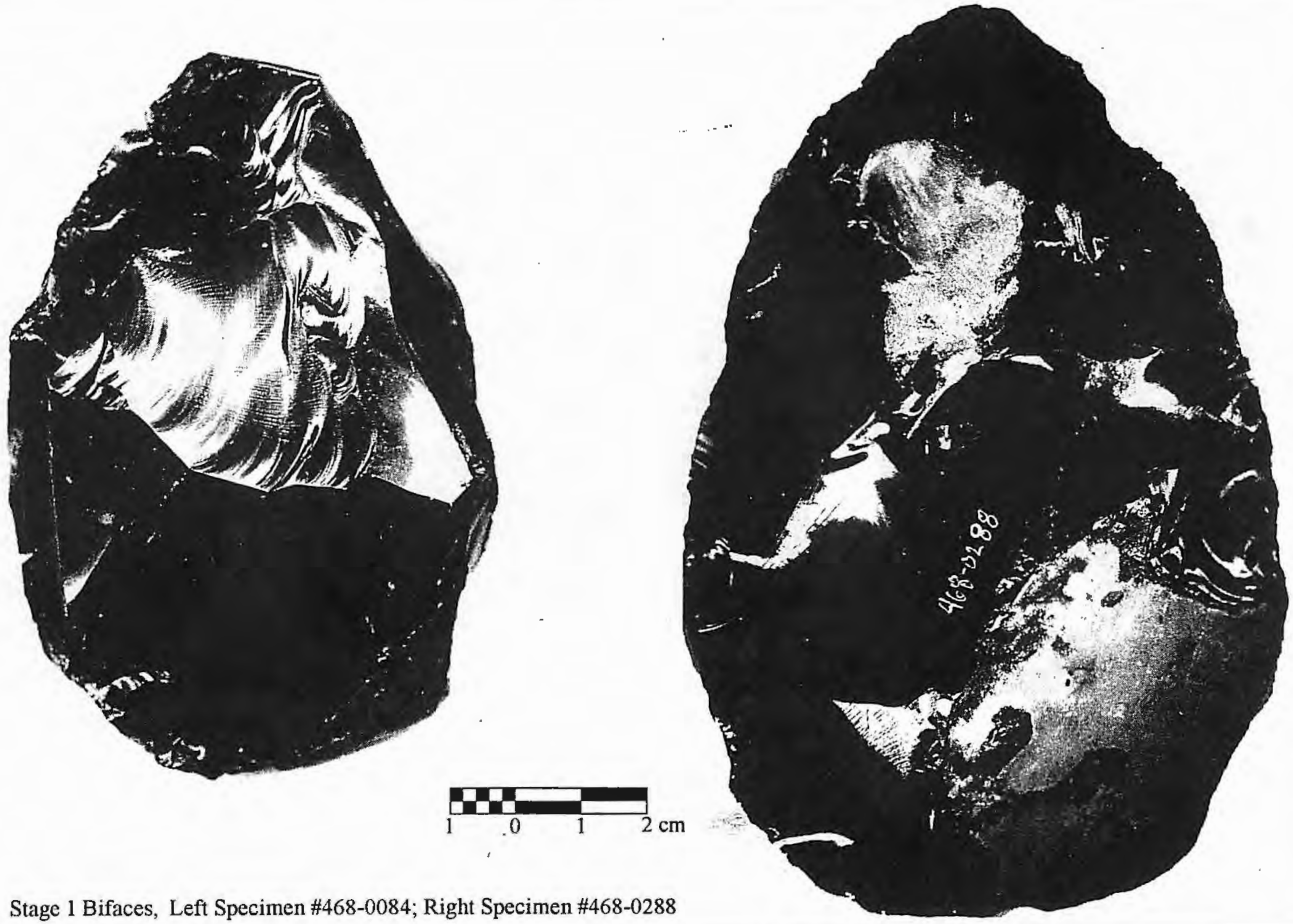

Figure 4.10 Stage 1 Bifaces, Left Specimen #468-0084; Right Specimen #468-0288

Figure 4.11 Stage 2 Bifaces; Left Specimen #468-0434, Center Specimen #468-0412, Right Specimen # 468-0067

Figure 4.12 Stage 3 Bifaces; Top Left Specimen # 468-0151, Top Right Specimen # 468-0406
Bottom Left Specimen # 468-0199, Bottom Right Specimen # 468-0172

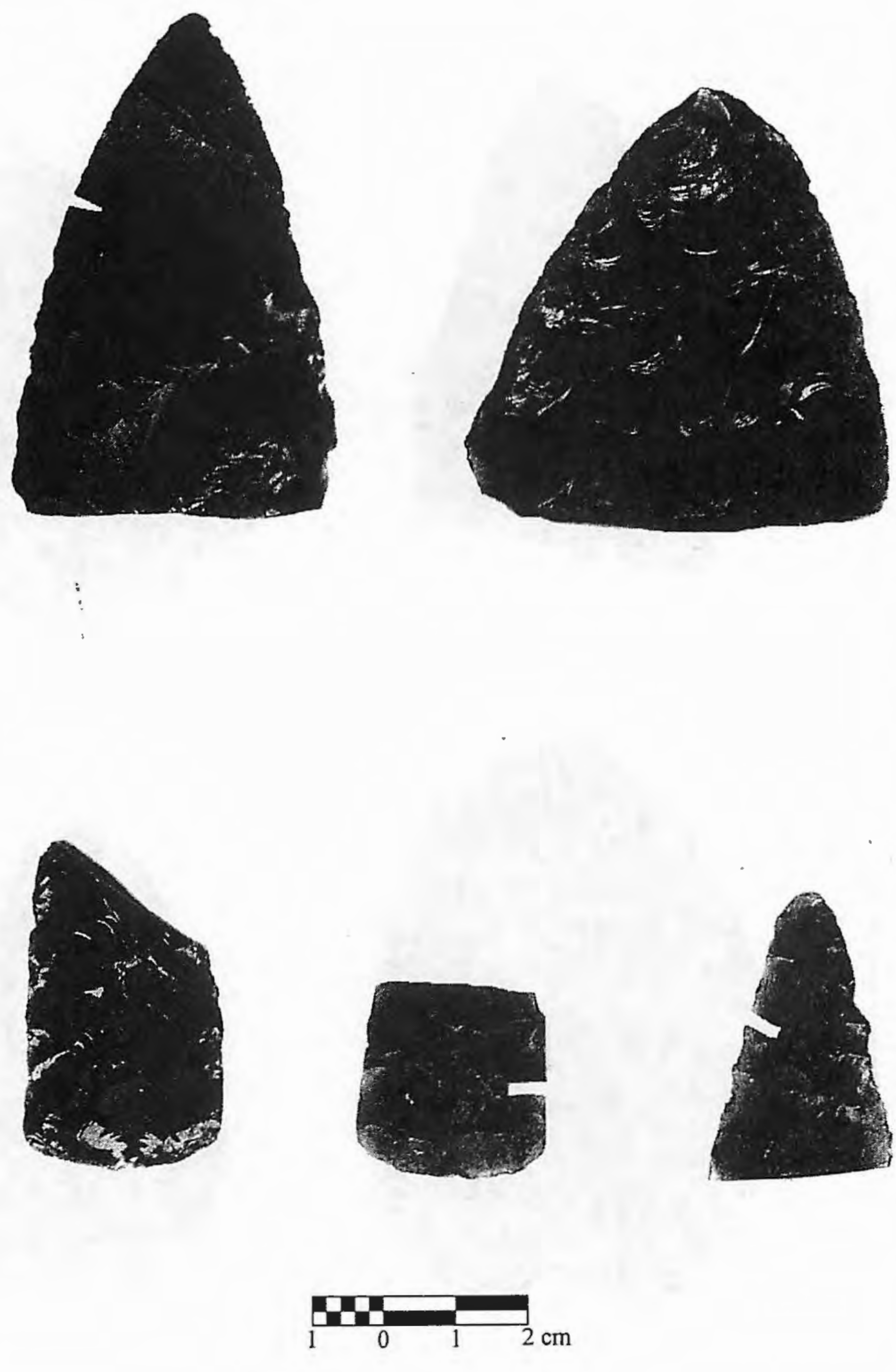

Figure 4.13 Stage 4 Bifaces, Top Left Specimen # 468-0377, Top Right Specimen #468-0056
Stage 5 Bifaces, Botton Left Specimen #468-0422 , Bottom Middle Specimen #468-0220, Bottom Right Specimen #468-0123

Figure 4.14 Bi-directional Core (type 2) Two views of Specimen #468-0126

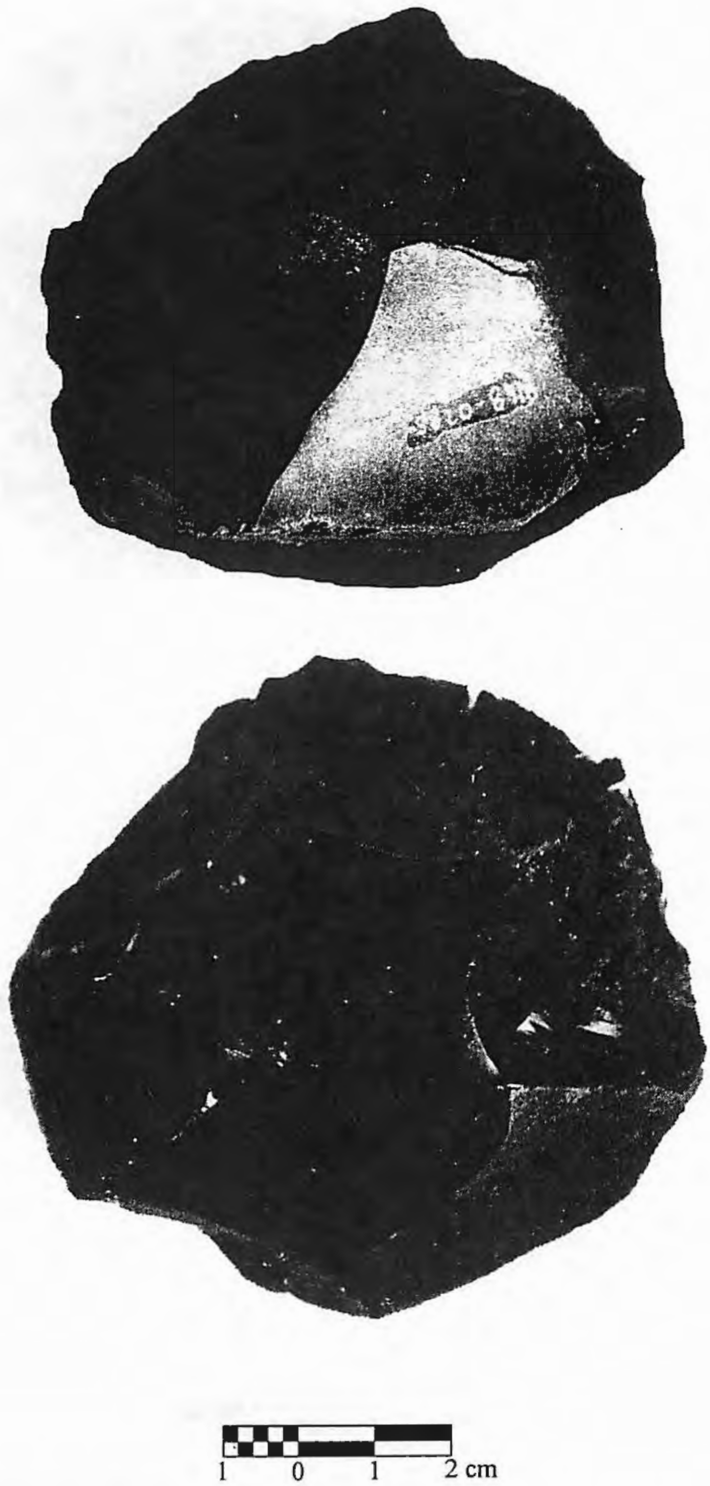

Figure 4.15 Non-patterned core (type 3), opposing views.

Figure 4.16 Uni-directional core (type 4) specimen #468-0073, top veiw shows flake removal scars, bottom view shows striking platform

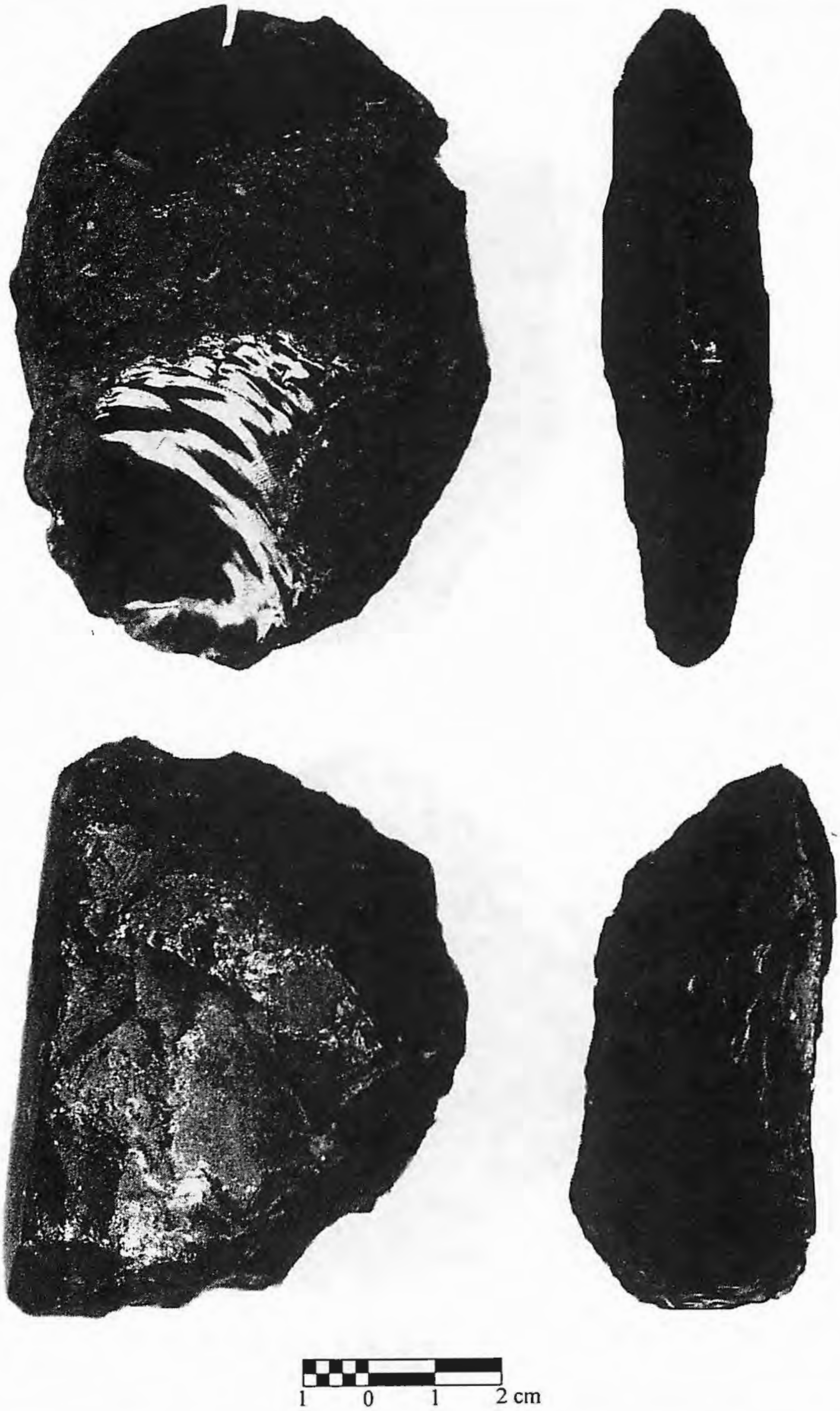

Figure 4.17 Split cobble test core (type 5), top specimen #468-0133, bottom specimen #468-0074

Figure 4.18 Chunk test cores (type 6) oppsoing view, top specimen #468-0290, bottom specimen #468-0289

Figure 4.19
Top Row: DSN's #468-0019,#468-0005;Cottonwoods #468-0006,#468-0026
Middle Row: Rosespring Series #468-0009,#468-0012,#468-0013,#468-0037
Bottom Row: Elko Eared #468-0001,#468-0014; Elko Contracting Stem #468-0004,#468-0018

Figure 4.20
Top Row: Little Lake Points #468-0015, #468-0025; Humbolt Basal Notched #468-0021
Middle Row: Great Basin Stemmed #468-0011, #468-0030, #468-0033
Bottom Row: Untyped Points #468-0020, #468-0022, #468-0024, #468-0035

CHAPTER V

Spatial Variability at the Truman/Queen Source

This chapter examines the patterns of lithic production at the Truman/Queen source along spatial dimensions related to both natural and behavioral variability. There are several factors that contribute to spatial variability at large quarry sites, some of which are visible in the archaeological record at the Truman/Queen source. Up to now this document has examined more general processes such as exchange or mobility as contributors to variability in quarry use. However some smaller scale local factors, such as the natural distribution of material itself, contribute to spatial variability at the source. Because the overall quantity and quality of raw material at quarry sites vary across space and contributes to spatial variability in behavior, quarry study should include attempts to measure this relationship. For this study natural variability was measured through surface density mapping and raw material cobble measurements.

Another factor which may contribute to spatial variability at quarry sites is the relationship of the distribution of raw material to other resources in the area. As mentioned before, raw material at the Truman/Queen source is distributed in high densities in both the Pinyon-Juniper Woodland and the Lower Desert Scrub communities. These zones were utilized in fundamentally different ways, and their use has changed over time, potentially contributing to spatial and spatio-temporal variability in lithic procurement activities identified at the source. To examine the potential effects of variation in zone use, lithic procurement data from the upland zone (Pinyon-Juniper Woodland) and lowland zone (Desert Scrub) are compared. This comparison is made with respect to natural variability of raw material densities across space, based on the surface density mapping data described in Chapter 4, and shows that the zones vary with respect to the overall volume and quality of raw material, size and abundance of quarrying areas, and number and types of off-quarry sites.

The differences in quality and overall volume of raw material can be viewed as natural variability, and the intensity of use of different areas at the source as behavioral. Thus the natural variability at quarry sites conditions behavioral variability directly since processing locations are determined by raw material location, and less directly by such things as return rates on lithic procurement. Thus behavioral variability was measured relative to natural variability by examining differences in artifact numbers and types recovered from quarry and off-quarry sites from both the upland and lowland zones. This chapter summarizes the data relevant to natural and behavioral variability at the source along a strictly spatio-technic dimension.

Lowland Artifact Totals

The total archaeological investigation of the lowland zone consisted of the surface survey and density mapping of 27 quadrats (500x500 meter). Intensive surface collection of ten quadrats (described in Chapter 4) resulted in the collection of 104 bifaces, 44 cores, 1 flake tool, 12 modified flakes, 10 projectile points, and 1 uniface (Table 5.1). These were described in Chapter 4 and are discussed in comparison to upland zone artifacts below. The artifact totals and collection location information are listed in Appendix D.

Table 5.1 Surface Collection Lowland Quadrats

Collection Quadrat	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uniface	Total
L-2	-	1	4	-	-	1	-	6
L-4	19	13	4	-	4	-	-	40
L-5	20	6	4	-	-	-	-	30
L-6	6	1	4	-	1	-	1	13
L-8	6	3	3	-	-	-	-	12
L-9	13	8	4	-	6	1	-	32
L-10	29	9	4	-	1	1	-	44
L-11	2	2	4	1	-	-	-	9
L-12	9	1	4	-	-	3	-	17
L-14	-	-	3	-	-	1	-	4
Reconn. Isolates								
L-3	-	-	-	-	-	1	-	1
L-16	-	-	-	-	-	1	-	1
L-17	-	-	-	-	-	1	-	1
Total	104	44	38	1	12	10	1	210

As described in Chapter 4, because quadrats L-8 and L-14 each had sterile quadrat quarters, only 38 of a possible 40 debitage lots were collected in the lowland zone. This resulted in the collection of 1894 pieces of debitage, listed by type in Table 5.2. Of these roughly 17 % (n=323) could be attributed to biface reduction. This total excludes 7 primary decortication flakes (biface) and 22 secondary decortication flakes (biface) which were difficult to separate from early core reduction flakes. In the lowland zone, 20% (n=384) of the debitage could be attributed to core reduction. Again 422 primary decortication flakes (core), and 260 secondary decortication flakes (core) were excluded from the comparison that follows. Because it is problematic to distinguish between biface and core decortication flakes, these are assigned to the "other" category which also includes 10 rectangular flakes, 432 pieces of indeterminate percussion flakes, 13 edge preparation flakes, 5 pressure flakes, and 16 pieces of gravel that were not attributed to any particular reduction trajectory. Thus the lowland totals are as follows: biface production debitage represent 17% (n=323) of the total, core debitage represents 20% (n=384), and the remaining 63% (n=1187) were assigned to the "other/decortication" category. The nature of quarry sites is such that a large percentage of the material is in the form of shatter and difficult to assign to a particular technology. Thus the comparison between zones that follows is limited to those specimens associated with either biface or core manufacture.

Table 5.2 Summary of Lowland Debitage by Type

		Biface			Core		Decortication				Other					
Survey Quadrat	# of 50 Count Units	EBT	MBT	LBT	Core SI	Core CI	BIF PD	BIF SD	Core PD	Core SD	Rect	Indet Perc	Edge Prep	Press	Grav	Total
L-2	4	15	36	3	21	11	0	3	27	18	1	60	0	1	7	203
L-4	4	10	10	0	39	13	0	6	43	45	0	25	0	0	0	191
L-5	4	24	10	0	31	23	0	2	51	29	0	38	0	0	0	208
L-6	4	13	19	0	21	26	0	2	46	32	1	37	0	0	3	200
L-8	3	11	16	5	12	11	0	3	17	15	0	48	5	1	0	144
L-9	4	15	10	0	26	8	3	1	62	41	1	29	0	0	0	196
L-10	4	14	16	4	20	17	2	5	55	24	1	36	0	0	0	194
L-11	4	13	14	0	19	14	2	0	50	25	5	65	0	0	0	207
L-12	4	18	12	0	28	19	0	0	47	22	0	53	0	0	0	199
L-14	3	12	16	7	18	7	0	0	24	9	1	41	8	3	6	152
Total		145	159	19	235	149	7	22	422	260	10	432	13	5	16	1894
	%	0.08	0.08	0.01	0.12	0.08	0.00	0.01	0.22	0.14	0.01	0.23	0.01	0.00	0.01	1.00

Table 5.2. BIF PD= Biface Primary Decortication Flake, BIF SD = Secondary Decortication Flake, EBT = Early Stage Biface Thinning Flake, MBT = Middle Stage Biface Thinning Flake. LBT = late Stage Biface Thinning Flake, Press = Pressure flake, Core PD = Core Primary Decortication Flake, Core SD = Core Secondary Decortication Flake, Core SI = Core Simple Interior, Core CI = Core Complex Interior, Rect. = Rectangular "blade" Flake, Indet. Perc. = Indeterminate Percussion Flake, Edge Prep = Edge Preparation Flake, Grav. = Gravel.

Lowland Surface Densities

Overall densities of material on the surface were recorded in accordance with the methods described in Chapter 4. Surface characteristics for the lowland zone are summarized in Table 5.3. The result of this is the surface density map below (Fig. 5.1, see also Fig. 4.5).

Table 5.3 Lowland Quadrat Surface Density Totals

Quadrat	m #	f #	a #	r #	s #	empty #	Total
L-1	218	31	0	39	29	83	400
L-2	38	0	0	12	40	310	400
L-3	41	1	0	33	17	308	400
L-4	300	9	0	21	17	53	400
L-5	363	27	0	6	2	2	400
L-6	293	35	0	59	6	7	400
L-7	0	0	0	0	32	368	400
L-8	61	0	0	3	54	282	400
L-9	281	3	0	42	17	57	400
L-10	211	30	0	5	72	82	400
L-11	164	17	0	1	74	144	400
L-11a	165	17	0	0	73	145	400
L-11b	0	0	0	0	16	384	400
L-11c	0	0	0	0	40	360	400
L-12	142	19	0	13	86	140	400
L-13	36	1	0	14	56	293	400
L-14	8	0	0	17	41	334	400
L-15	32	0	0	16	57	295	400
L-16	19	0	0	6	80	295	400
L-17	34	0	0	9	66	291	400
L-18	6	1	0	13	49	331	400
L-19	55	0	0	13	40	292	400
L-20	12	0	0	6	28	354	400
L-21	49	0	0	25	43	283	400
L-22	4	0	0	5	35	356	400
L-23	77	0	0	18	49	256	400
L-24	4	0	0	4	28	364	400
Total	2613	191	0	380	1147	6469	10800
	0.24	0.02	0.00	0.04	0.11	0.60	1.00

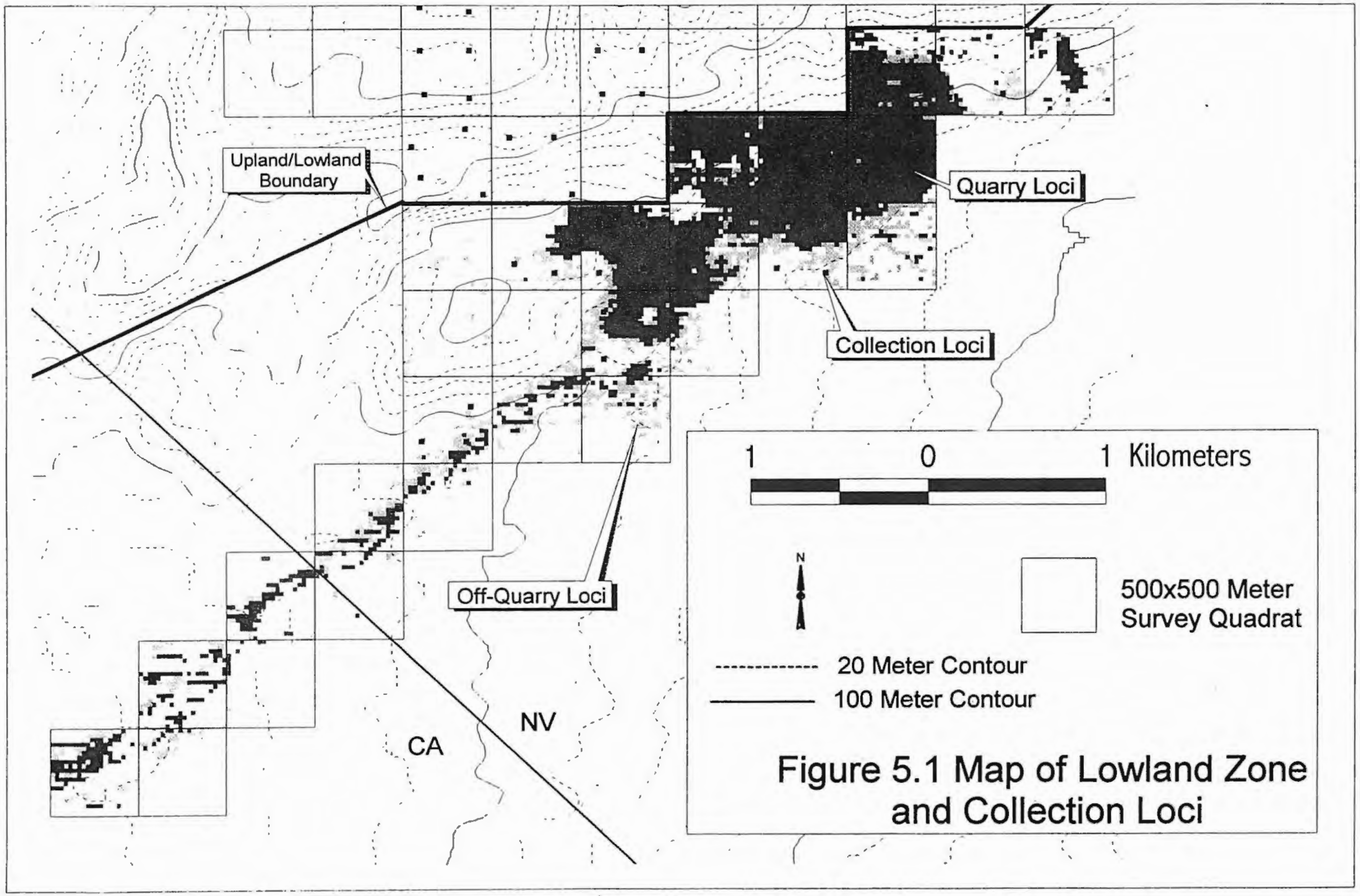

Figure 5.1 Map of Lowland Zone and Collection Loci

In the lowland zone 60% of the survey grid squares were sterile. Other lowland zone grid squares contained raw material but lacked flaking debris. These were labeled "r", and represent 4% (n=380) of the total grid squares in the lowland zone. There were no areas in the lowland labeled "a" for assay, characterized by high degrees of broken cobbles but few if any flakes. These areas were considered to be prospecting areas, where the quality of material was established. This is a provisional category, because such a behavioral determination is problematic, however given the overall rarity of these areas it has no large effect on the final mapping of the source. The comparison of the zones at the conclusion of this chapter focuses on differences between quarry sites ("m" and "f") which comprise 26% of the lowlands and off-quarry sites ("s") which comprise 11% of the lowland zone total. The comparison indicates that for multiple reasons the lowland source area can be characterized as being more marginal in terms of lithic resources.

Upland Artifact Totals

The total archaeological investigation of the upland zone consisted of the surface survey and density mapping of 34 quadrats (500x500 meter), and surface collection of artifacts from 10 quadrats as described in Chapter 4. Table 5.4. summarizes the results of the surface collection of the ten upland quadrats which produced 211 bifaces, 44 cores, 9 flake tools, 11 modified flakes, 35 projectile points, 12 biface/points, 39 lots of debitage, 2 additional unanalyzed lots of flakes, and 11 unifaces.

Table 5.4 Surface Collection Upland Quadrats

Surface Collection Quad	BIF/ PPT	Biface	Core	Debitage Lots	Flake Tool	Flakes	Modified Flake	PPT	Uniface	Total
U-02	-	28	5	4	-	1	1	2	-	41
U-07	-	19	5	4	2	1	2	-	4	37
U-86	1	23	12	4	2	-	2	1	1	46
U-87	-	43	4	4	1	-	-	-	5	57
U-88	-	14	-	4	2	-	2	2	1	25
U-89	1	30	7	4	-	-	2	-	-	44
U-95	-	8	1	4	-	-	1	1	-	15
U-97	6	34	6	4	-	-	-	-	-	50
U-100	-	2	2	4	1	-	1	3	-	13
U-101	2	9	2	3	1	-	-	-	-	17
Isolates										
U-08	-	-	-	-	-	-	-	1	-	1
U-76	-	-	-	-	-	-	-	3	-	3
U-77	1	-	-	-	-	-	-	3	-	4
U-79a	-	-	-	-	-	-	-	2	-	2
U-79b	-	-	-	-	-	-	-	2	-	2
U-79c	-	-	-	-	-	-	-	2	-	2
U-80	-	-	-	-	-	-	-	1	-	1
U-80b	1	1	-	-	-	-	-	-	-	2
U-81	-	-	-	-	-	-	-	2	-	2
U-83	-	-	-	-	-	-	-	2	-	2
U-84	-	-	-	-	-	-	-	1	-	1
U-85	-	-	-	-	-	-	-	1	-	1
U-89a	-	-	-	-	-	-	-	3	-	3
U-89b	-	-	-	-	-	-	-	1	-	1
U-90	-	-	-	-	-	-	-	1	-	1
U-94a	-	-	-	-	-	-	-	1	-	1
Total	12	211	44	39	9	2	11	35	11	374

A total of 39 debitage lots were collected from upland quadrats (Table 5.5). Those pieces of debitage attributed to biface reduction account for 32% (n=612) of the upland zone debitage total. Again due to difficulty distinguishing early stage biface from early stage core reduction, the upland biface debitage totals exclude the decortication flakes. Debitage attributed to core reduction (excluding decortication flakes) accounts for approximately 12 % (n=229) of the debitage total for the upland. The upland collection also includes pressure flakes, rectangular flakes, pieces of indeterminate percussion type flakes, edge preparation flake and pieces of gravel that were not attributed to any particular reduction trajectory. These were combined with the decortication flakes from both bifaces and cores represent 19% (n=370) of the material and comprise the "other/decortication" category in the discussion that follows.

Table 5.5 Summary of Upland Debitage by Type

		Biface			Core		Decortication				Other					
Survey Quadrat	# of 50 Count Units	EBT	MBT	LBT	Core SI	Core CI	BIF PD	BIF SD	Core PD	Core SD	Rect	Indet Perc	Edge Prep	Press	Grav	Total
U-02	4	23	47	6	14	3	0	8	25	28	3	34	8	0	0	199
U-07	4	16	33	36	15	6	0	0	42	28	0	22	6	1	0	205
U-86	4	58	37	0	14	6	3	3	30	16	1	16	3	0	1	188
U-87	4	23	23	0	31	9	0	0	45	37	0	19	4	0	0	191
U-88	4	24	22	0	24	2	0	6	60	31	0	22	3	0	2	196
U-89	4	9	24	2	6	13	0	3	50	21	0	39	8	0	22	197
U-95	4	18	35	24	13	7	0	8	24	19	0	43	7	0	0	198
U-97	4	33	37	4	17	9	2	7	22	42	1	20	3	0	0	197
U-100	4	0	34	8	10	4	0	1	45	31	1	34	8	2	22	200
U-101	3	8	26	2	18	8	0	4	32	29	1	9	4	1	0	142
Total		212	318	82	162	67	5	40	375	282	7	258	54	4	47	1913
	%	0.11	0.17	0.04	0.08	0.04	0.00	0.02	0.20	0.15	0.00	0.13	0.03	0.00	0.02	1.00

Table 5.5. BIF PD= Biface Primary Decortication Flake, BIF SD = Secondary Decortication Flake, EBT = Early Stage Biface Thinning Flake, MBT = Middle Stage Biface Thinning Flake. LBT = late Stage Biface Thinning Flake, Press = Pressure flake, Core PD = Core Primary Decortication Flake, Core SD = Core Secondary Decortication Flake, Core SI = Core Simple Interior, Core CI = Core Complex Interior, Rect. = Rectangular "blade" Flake, Indet. Perc. = Indeterminate Percussion Flake, Edge Prep = Edge Preparation Flake, Grav. = Gravel.

Upland Surface Densities

The surface densities for the upland zone are graphically represented in Figure 5.2. In the upland zone a total of 13600 grid squares were recorded during the surface survey, and a listed by quadrat in Table 5.6. Of the upland surface grid squares, 41% (n=5616) were sterile containing no raw material or flaking debris of any quantity.

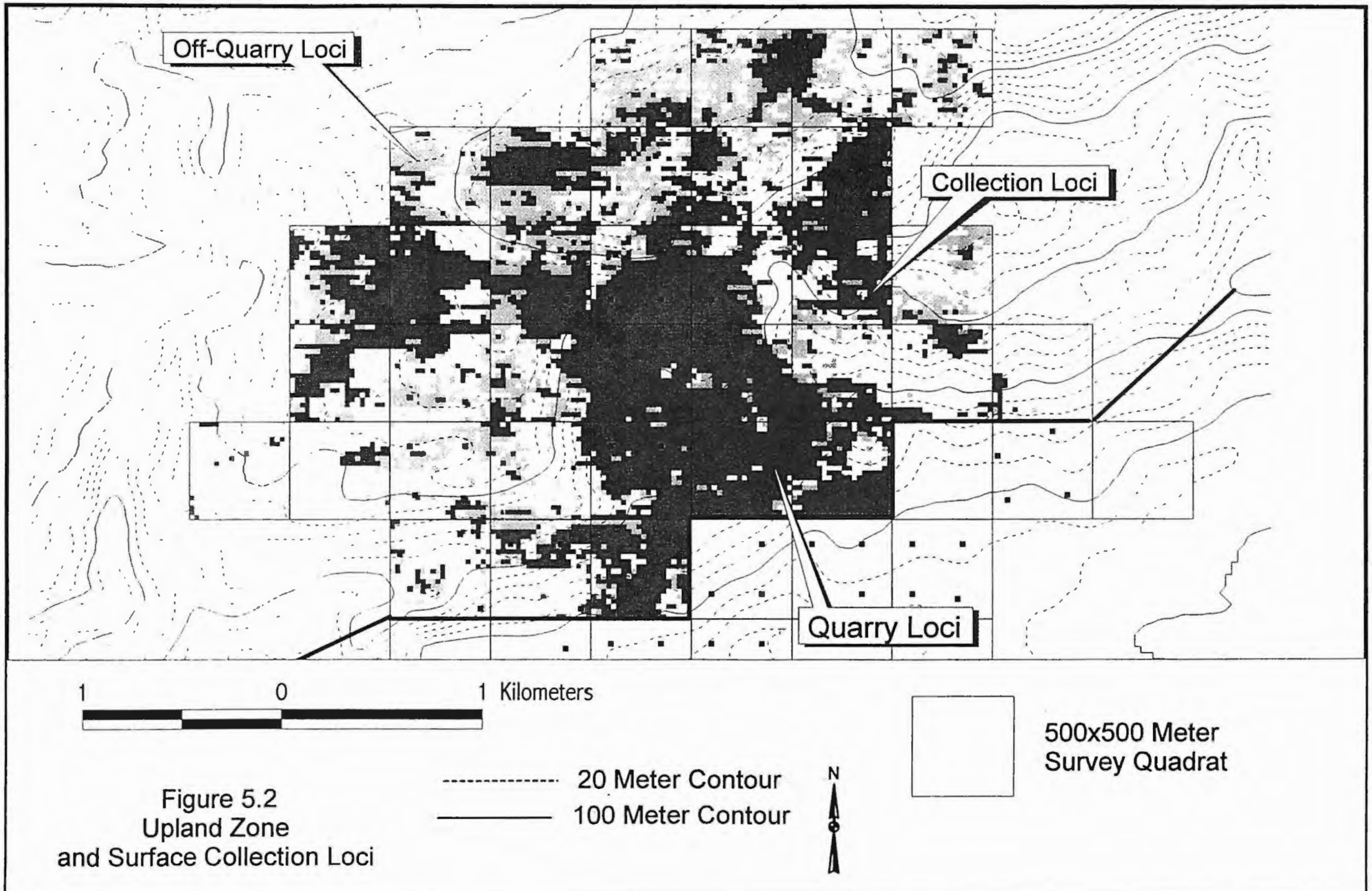

Figure 5.2
Upland Zone
and Surface Collection Loci

Table 5.6 Upland Quadrat Surface Density Totals							
Quadrat	m #	f #	a #	r #	s #	empty #	Total
U-01	188	74	18	2	4	114	400
U-02	78	8	4	7	97	206	400
U-03	176	44	12	10	75	83	400
U-04	129	15	12	19	48	177	400
U-05	19	2	1	8	23	347	400
U-06	5	1	2	7	25	360	400
U-07	93	11	27	17	129	123	400
U-08	106	3	32	20	57	182	400
U-76	72	3	0	0	141	184	400
U-77	116	13	0	0	186	85	400
U-78	92	11	2	6	102	187	400
U-79	51	5	0	13	78	253	400
U-81	62	13	0	2	162	161	400
U-82	158	54	3	4	135	46	400
U-83	249	9	0	24	30	88	400
U-86	156	81	0	9	115	39	400
U-87	241	62	0	4	40	53	400
U-88	152	60	0	11	27	150	400
U-89	209	13	0	48	33	97	400
U-89a	13	0	0	5	109	273	400
U-90	115	21	0	19	105	140	400
U-91	304	78	0	10	0	8	400
U-92	223	128	0	2	12	35	400
U-93	130	6	0	13	52	199	400
U-94	42	0	0	42	8	308	400
U-94a	2	0	0	15	4	379	400
U-95	16	4	0	3	106	271	400
U-96	38	8	0	5	66	283	400
U-97	299	19	0	16	14	52	400
U-98	268	69	0	35	9	19	400
U-99	250	32	0	26	19	73	400
U-100	21	0	0	12	32	335	400
U-101	79	0	0	31	45	245	400
U-102	261	2	1	44	31	61	400
Total	4413	849	114	489	2119	5616	13600
%	0.32	0.06	0.01	0.04	0.16	0.41	1.00

Table 5.6 Frequency of Surface Density Characteristic Types for Upland Zone Quarry loci are indicated in columns marked 'f', 'm" or 'a", as previously described. Off-quarry sites are indicated in the 's' column.

Collectively 38% (n=5262) of the upland zone was characterized as primary quarry sites consisting of moderately worked ("m") areas (n=4413), and extensively worked ("f') areas (n=849). These are contrasted with off-quarry sites ("s") or areas which represented 16% (n=2119) of the upland surface areas. Only 4 % (n=489) of the total grid squares in the upland zone contained raw material (labeled "r") but lacked flaking debris. In addition, 1% (n=114) of the grid squares in the upland were characterized by high degrees of broken cobbles with few if any flakes (labeled "a").

Comparison of Upland and Lowland Zones

The following section examines spatial variability at the source, largely through a simple statistical comparison of upland and lowland zones. A comparison at this level is important for examining some of the potential factors which effect lithic procurement and the organization of technology. Once again this is because the two zones at the Truman/Queen source were used in different ways and to varying intensities over time. Upland zone quarry use was more likely affected by post 1350 B.P. intensive pinyon procurement and occupied for longer episodes in the fall and often through winter. The lowland Desert Scrub zone was more likely used for shorter episodes pre 1350 B.P. for hunting and seed procurement as part of a more mobile settlement system. This 1350 B.P. settlement and subsistence change has been identified as a causal factor for the technological transition from bifaces to cores in the Inyo-Mono region (Basgall 1989) and similar settlement pattern changes have been used to explain similar technological change elsewhere (Parry and Kelly, 1987, Kelly 1988). Thus the comparison between zones that follows focuses on surface density variability at the source as well as comparisons bifaces, cores, and debitage attributed to the production of each between zones.

The surface survey results indicate that the primary difference between zones is the overall greater abundance of raw material and artifacts in the uplands (Table 5.7). 60% (n=6469) of the lowland grid squares are sterile compared to only 41% (n = 5616) of upland zone. In fact this volume difference accounts for most differences between zones. For example the ratio of off-quarry sites to quarry sites in both zones is 40%. This indicates that the overall greater abundance of artifacts and debris in the uplands described below is due to the simple fact that there is more raw material there. Greater use of the upland zone may also be influenced by the fact that cobbles in the uplands are larger on average, as described in Chapter 4.

Table 5.7 Comparison of Upland and Lowland Surface Characterization

	Lowland		Upland	
	#	%	#	%
m	2613	0.24	4413	0.32
s	1147	0.11	2119	0.16
f	191	0.02	849	0.06
a	0	0	114	0.01
r	380	0.04	489	0.04
Empty	6469	0.6	5616	0.41
Total	10800	1	13600	1

The surface collection, as expected then, indicates that the biggest difference between zones is the greater abundance of artifacts in the upland zone (Table 5.8). Of the 472 total formal artifacts collected, only 34% (n=159) were from the lowland zone. The same sampling techniques yielded roughly twice the total number of artifacts in the upland zone. However Table 5.8 also shows that cores are an exception to this pattern and occur in equal proportions in each zone. This means the biface to core ratio is quite different between zones. In the lowlands the biface (n=104) to core (n=44) ratio is 2.36 to 1, and in the uplands the biface (n=211) to core (n=44) ratio is 4.79 to 1.

Table 5.8 Comparison of Formal Tools by Zone

	Lowland %	Upland %	Total Count
Bifaces	0.33	0.67	315
Cores	0.50	0.50	88
Unifaces	0.08	0.92	12
Projectile points	0.22	0.78	45
Biface/Points	0.00	1.00	12
Zone Total	0.34	0.66	472

The statistical significance of this difference is demonstrated through the analysis of adjusted residuals, a procedure previously described by Bettinger (1989:312-313). This procedure measures the difference between observed and expected frequencies for a combination of variables adjusted according to their estimated variance (Bettinger 1989), in this case artifact types by zone. It also measures the strength of association, in that the larger the residual the stronger the association between the variables (Bettinger 1989:312). A positive value indicates a positive association, and a negative value a negative association, and adjusted residuals greater than 1.96 have a probability of 0.05 and thus correspond to that alpha level (Bettinger 1989:312). In Table 5.9 the adjusted residuals for each artifact type by zone indicate that only two artifact types, cores and biface/points occur in frequencies other than expected. Cores occur more frequently in the lowland zone than expected marked by an adjusted residual of 3.59, and biface/points occur more frequently in the upland zone marked by an adjusted residual of 2.50. Both are significant at the 0.05 alpha level. Bifaces, although the most common artifact category, do not differ significantly by zone.

Table 5.9 Observed Frequencies and Adjusted Residuals of Major Artifact Categories by Zone

	Observed Frequencies			Adjusted Residuals	
	Lowland #	Upland #	Row Total	Lowland	Upland
Bifaces	104	211	315	-0.44	0.44
Cores	**44**	44	88	**3.59**	-3.59
Unifaces	1	11	12	-1.88	1.88
Projectile points	10	35	45	-1.71	1.71
Biface/Points	0	**12**	12	-2.50	**2.50**
Column Total	159	313	472		

bold values indicate observed frequencies greater than expected

chi sq.=22.7 *df* = 4

A comparison of upland and lowland debitage indicates the upland zone has a greater proportion of biface production debris than the lowland zone, and the lowland zone has a higher frequencies of core debitage than the upland zone. Table 5.10 is a summary of debitage type by zone, with adjusted residuals that indicate that biface debitage is more frequent than expected in the upland zone and core debitage is more frequent than expected in the lowland zone. The “other” category also occurs more frequently in the lowland zone than expected however given the provisional nature of the category nothing is inferred from that pattern.

Table 5.10 Comparison of Debitage Types by Zone

	Observed Frequencies			Adjusted Residuals	
	Lowland #	Upland #	Row Total	Lowland	Upland
Bifaces	323	**612**	935	-10.71	**10.71**
Cores	**384**	229	613	**6.97**	-6.97
Other	**1187**	1072	2259	**4.17**	-4.17
Column Total	1894	1913	3807		

bold values indicate observed frequencies greater than expected   chi sq.=134.28   df = 2

Table 5.11 lists the observed frequencies and adjusted residuals for each sub-type of biface and core debitage. In the upland zone late stage biface thinning flakes, biface secondary decordation flakes, and core simple interior flakes occur more than expected. Early stage biface thinning flakes, complex interior core flakes, and core primary decortication flakes occur more than expected in the lowland zone. In simplest terms, biface debitage occurs more frequently than expected in the upland zone and core debitage is relatively more common in the lowland zone. Upland zone biface debitage indicates later stages of reduction than the lowland zone which indicates early stage reduction.

Table 5.11 Debitage Counts by type for each zone and adjusted residuals

Observed Frequencies					Adjusted Residuals	
Biface Reduction	n=935	Upland	Lowland	Total	Upland	Lowland
Early Stage Biface Thinning Flake		212	**145**	357	-3.07	**3.07**
Middle Stage Biface Thinning Flake		318	159	477	0.80	-0.80
Late Stage Biface Thinning Flake		**82**	19	101	**3.52**	-3.52
					Chi-sq. =17.19, *df* = 2	
Core Reduction	n=613					
Core Simple Interior		**162**	235	397	**2.39**	-2.39
Core Complex Interior		67	**149**	216	-2.39	**2.39**
					Chi-sq. =5.73, *df* = 1	
Decortication Flakes	n=1413					
Biface Primary Decortication		5	7	12	-0.56	0.56
Biface Secondary Decortication		**40**	22	62	**2.39**	-2.39
Core Primary Decortication		375	**422**	797	-2.25	**2.25**
Core Secondary Decortication		282	260	542	1.39	-1.39
					Chi-sq. =9.17, *df* = 3	
Other Unknown Trajectory	n=846					
Rectangular Blades (provisional)		7	10	17	-0.21	0.21
Indeterminate Percussion Flakes		258	**432**	690	-7.82	**7.82**
Edge Preparation		**54**	13	67	**6.34**	-6.34
Gravel		**47**	16	63	**5.13**	-5.13
Pressure Flake		4	5	9	0.04	-0.04
					Chi-sq. =72.72, *df* = 4	
Total		1913	1894	3807		

bold values indicate observed frequencies greater than expected

However comparisons of the reduction stages evident in upland and lowland bifaces themselves demonstrates no variance (Table 5.12). Adjusted residuals are not reported here given that both upland and lowland show similar relative frequencies regardless of stage. The fact that late stage biface thinning flakes occur more often than expected in the uplands but bifaces do not is discussed below.

Table 5.12 Comparison of Biface Stages by Zone

	Lowland %	Upland %	Row Total
Stage 1	0.39	0.40	125
Stage 2	0.42	0.31	109
Stage 3	0.13	0.16	47
Stage 4	0.06	0.09	25
Stage 5	0.01	0.03	7
Total	1.00	1.00	313 *

* total excludes 2 untyped fragments

A comparison of complete bifaces by zone indicates that lowland bifaces are slightly lighter (mean wt. =141.4 grams) than upland bifaces (mean wt.=149.8g.), as expected given the smaller cobbles in the lowlands. Other dimensions on complete specimens were also as predicted, and upland bifaces are longer (mean = 82.44mm), wider (mean = 59.25 mm) and thicker (mean = 29.28 mm), than lowland bifaces (mean length = 81.7 mm, mean width = 52.8 mm, mean thickness = 25.94 mm).

The expected effects of cobble size on artifact mass also holds true for cores. The average weight of lowland cores (245 grams) is less than that of upland cores (251 grams). However, the other attributes (cortex, reason for rejection, reworking, length, width, and thickness etc.) recorded for cores demonstrated no significant variability between zones. Because core production occurred in very similar ways in both the upland zones, it appears to be a technological form governed by few constraints.

More interesting is the fact that there is a higher frequency of fragmented or broken bifaces in the uplands. Only 35.4% of the bifaces collected from the uplands were whole pieces, while in the lowlands 49% were whole. This is unexpected because the quality of material in the upland is better, at least in terms of size (see Chapter 4).

This suggests that the difference in fragmentation rates between zones is not the result of raw material differences, but rather behavioral differences. These differences may be related to the varying intensities in which the two zones were used.

Not surprisingly the larger cobbles and the greater surface area covered by raw material is ultimately what is producing spatial variability as it relates to overall abundance of debris and artifacts totals between zones. Additionally, raw material is fairly uniformly distributed in the uplands, however in the lowlands, material is more linear (i.e. stream channels). This may have lowered the average travel time for quality material when foraging for toolstone in the uplands. The fact that bifaces occur in greater numbers in the uplands is likely due to the larger cobble size as well as the reduced time required to search for cobbles. During intensive biface procurement lithic foragers could use the upland areas of the source which likely yielded the highest return rates. In doing so they also produced the highest number of broken bifaces. These factors also indicate that the upland was use not just more, but more intensive. Evidence for this also comes from the greater number of upland grid squares having a higher ratio of flakes to raw material and are perceived to be the most exhausted areas (labeled "f"). Furthermore, use of the quarry in conjunction with seasonal use of the Pinyon-Juniper Woodland, increased the opportunity to spend spare time in lithic procurement, and may have permitted a more wasteful lithic procurement strategy.

Comparison of Quarry and Off-Quarry Contexts

Another important dimension in which spatial variability should to occur at large obsidian sources relates to differences in use of quarry sites were primary reduction occurred, and off-quarry sites where secondary reduction occurred in conduction with other activities. The following will focus only on the comparison of bifaces and cores and associated debitage in these two contexts for both zones.

The number of bifaces and cores in quarry and off-quarry sites from both the upland and lowland zones are listed in Table 5.13. Interestingly when examined without respect to zone, both quarry sites and off-quarry sites have a biface to core ratio of 3.6:1. In fact the major spatial difference between bifaces and cores relates to zones not quarry versus off-quarry contexts. An analysis of residuals for bifaces and cores indicates that cores are more common than expected in lowland quarry and off-quarry sites and bifaces are more common than expected in upland quarry sites but not upland off-quarry sites. As Table 5.13 shows bifaces and cores are found most often in quarry sites, and core are found more often in the lowland zone. This means bifaces and cores do not differ in quarry versus non-quarry comparisons but do when compared by zone.

Comparing biface and core debitage indicates a pattern consistent with the pattern from the artifacts themselves. Core debitage is more abundant in the lowland, however it is roughly twice as frequent in quarry sties than off-quarry sites in both zones (Table 5.14). Core debitage is rarest in upland off-quarry sites, suggesting that core processing rarely occurred there.

Table 5.13 Biface to Core Ratios for Quarry and Off-Quarry Loci

	Bifaces #	Cores #	Ratio
Lowland Quarry	98	**39**	2.50
Lowland Off-Quarry	6	**5**	1.20
Upland Quarry	**174**	37	4.70
Upland Off-Quarry	37	7	5.30
Total Quarry	272	76	3.60
Total Off-quarry	43	12	3.60
Total	315	88	3.60

bold values indicate observed frequencies greater than expected

Table 5.14 Biface to Core Debitage Ratios for Quarry and Off-Quarry Loci

	Biface debitage	Core debitage	Ratio
Lowland Quarry	162	**251**	0.6
Lowland Off-Quarry	161	**133**	1.2
Upland Quarry	**337**	169	2.0
Upland Off-Quarry	**275**	60	4.6
Total	935	613	1.5

Biface debitage occurs in highest densities in upland quarry sites but also in higher than expected frequencies in upland off-quarry site. Interestingly biface debitage occurs in greater than expected proportions in upland off-quarry sites but bifaces do not. This indicates that significant numbers of bifaces were processed in upland off-quarry sites but were not discarded there, since most bifaces were likely discarded during the early stages of reduction at the quarry proper. By the time later stage bifaces were being processed at upland off-quarry sites the failure rate was relatively low.

This two stage biface production scheme is supported by biface stage comparisons between quarry and off-quarry sites. The observed frequencies of bifaces by stage are listed in Table 5.15. The analysis of residuals indicates that early stage bifaces are more common than expected in lowland quarry sites and middle stage bifaces are more common than expected in upland off-quarry sites. This supports the previous assertion that secondary biface reduction occurred in off-quarry contexts only in the upland zone.

Table 5.15 Comparison of Biface Stages for Quarry and Off-Quarry Loci

	Observed Frequencies				Adjusted Residuals		
	Early Stage #	Middle Stage #	Late Stage #	Total	Early Stage	Middle Stage	Late Stage
Lowland Quarry	**81**	11	6	98	**2.17**	-1.27	-1.62
Lowland Off-Quarry	2	2	1	5	-1.80	1.58	0.73
Upland Quarry	134	20	19	173	1.22	-1.90	0.49
Upland Off-Quarry	17	**14**	6	37	-4.30	**4.14**	1.28
Total	234	47	32	313			

bold values indicate observed frequencies greater than expected chi sq.=26.6, df = 6

Summary of Spatial Variability

The greatest amount of spatial variability at the Truman/Queen source is the relatively greater abundance of raw material in the uplands. Because of this, there a higher volume of flaking debris and higher densities of formal artifacts in the upland zone. The only exception to this is the fact that cores are relatively more common in the lowlands. Debitage comparisons between zones also indicate that core production occurred more in the lowlands and biface production occurred more in the uplands.

Upland zone bifaces and cores are larger on average, likely because of the larger cobbles there. Interestingly however upland zone bifaces are broken more than lowland bifaces, suggesting that biface production in the uplands was not only more common, but it was also more intensive. The relatively higher number of cores in the lowland zone, indicates that the smaller cobbles there were not a significant constraint on core manufacture.

The comparison between quarry sites and off-quarry sites demonstrates no significant difference with respect to bifaces and cores. Cores are more common than expected in lowland quarry sites and bifaces are more common than expected in upland quarry sites. The debitage frequencies across space support the fact that most spatial variability at the source is between zones rather than between quarry versus off-quarry sites. Biface debitage is more common than expected in both quarry and off-quarry sites in the uplands, and core debitage is more common in both quarry and off-quarry sites in the lowlands. Biface stages do vary by context however and indicate that early stage bifaces are more common in lowland quarry sites and middle stage bifaces are more common in upland off-quarry sites. This leads to the conclusion that most processing which occurred in the lowlands was initial processing of cores at quarry sites, with low levels of biface production there as well. Upland quarry contexts were used primarily for early stage biface production. Material was then transported short distances to off-quarry locations within the Pinyon-Juniper Woodland for secondary biface reduction. The conclusion that these artifact totals represent a sequence of events from initial early stage reduction at the quarry proper, followed by transport to off-quarry sites for secondary reduction, is of course assuming that the events are contemporaneous. The timing of these activities is discussed in Chapter 6.

CHAPTER VI

Temporal Variability at the Truman/Queen Source

The primary research objective of this project was to test competing hypotheses regarding prehistoric obsidian quarry use in eastern California. Previous models have emphasized trade with populations west of the Sierra Nevada as the primary factors which produced temporal variability evident in obsidian hydration profiles. Because the distribution of Truman/Queen obsidian appears to be limited to the east side of the Sierra Nevada, it clearly was not affected by such exchange processes. Thus the simplest test of trans-Sierra Nevada exchange models is to compare the hydration profile of the Truman/Queen source to other eastern Sierra sources. A similar pattern at the Truman/Queen source would indicate internal or local factors, rather than exchange are the primary conditioners of quarry use. This chapter examines temporal data from Truman/Queen, first by examining the hydration rate for Truman/Queen obsidian, followed by a description of temporal variability in use of the source, in terms of technology and spatial change in the use of the source over time.

Truman/Queen Hydration Rate

Obsidian hydration readings from the Truman/Queen source are the primary data used to test the quarry use models described in Chapter 2. Although a similar hydration profile at the Truman/Queen source would require reconsideration of trans-Sierra Nevada exchange models, that support would not be assured with out determining the rate at which Truman/Queen obsidian hydrates thus allowing comparison of chronologies rather than merely profile shape. There have been two attempts to produce a hydration rate for Truman/Queen obsidian (Weaver 1992, Basgall and Giambastiani 1995). Both attempts used conventional methods, where the mean hydration values for projectile point types were paired with the midpoint of the accepted time period for that projectile point type. Various regression formulas are derived from these pairs and usually indicate a logarithmic or exponential relationship. An absolute date can be obtained by a hydration reading by applying the derived regression formula. The final part of determining a rate is to test how well the rate places the various projectile points in their proper temporal period.

The Truman/Queen obsidian, however, has been problematic and previous efforts (Weaver 1992, Basgall and Giambastiani 1995) have yet to produce a working rate. In a thesis focused on determining a hydration rate for Truman/Queen obsidian, Weaver (1992 Table 3:pgs. 44-46) examined and ranked sixteen different rate formulas using 98 hydration readings obtained on a sample of projectile points collected by vocational archaeologists (Enfield and Weller) around the Truman Meadows area. The Weaver study had only limited success for late period points (Desert Side-Notched and Cottonwood ca. 100-650 B.P.); only 68% yielded dates within their accepted spans (Weaver 1992:74). Rose Spring/Eastgate points were correctly placed only 60% of the time and the rate failed almost altogether with Elko points, only correctly placing 19.3% of the specimens. Weaver's rate only correctly placed 23% of the Little Lake points and the rate correlates with absolute dates of up to 40,688 years, further demonstrating that the rate is problematic (Weaver 1992:75).

Basgall and Giambastiani (1995:44) had more success with their rate developed from a small sample of projectile points recovered on the volcanic tablelands to the south of the quarry. They use a log regression on 29 points to estimate the following rate: [years B.P. =82.74 microns $^{2.06}$]. With this rate they could accurately place 23 of 29 points (79.3%). Given the small sample from which this rate was derived, it requires further validation. Even assuming it is correct, the Truman/Queen location will require correction for the effective hydration temperature.

To examine the hydration rate for Truman/Queen obsidian a total of 35 points collecting during this project was submitted for obsidian hydration and one sample was returned with no visible hydration band. Of these specimens, 7 were later omitted from analysis, 3 projectile points which could not confidently be assigned to any type based on Thomas' (1981) criteria, 3 large stemmed points and a single Humbolt Basal Notched point. Of the remaining 27 projectile points, only 20 were determined through visual inspection and XRF, to be from the Truman/Queen source.

These 20 readings were combined with the 94 hydration values (3 double readings and 1 outlier of 9.4 microns were omitted from his sample total) reported by Weaver (1992). Combining points from these two collections is warranted since all of the specimens in the Weaver study were collected in the Truman/Queen area. Descriptive statistics for the 114 hydration measurements on the different projectile point types are presented in Table 6.1.

Table 6.1 Projectile Point Obsidian Hydration Descriptive Statistics

	Desert Series	Rosegate Series	Elko Series	Little Lake
	0100-650 BP	0650-1350 BP	1350-3150 BP	3150-4950 BP
Mean	2.11	2.54	4.22	4.53
Median	2.10	2.55	3.80	4.20
Standard Deviation	0.49	0.68	1.44	1.68
Range	1.70	3.10	4.80	6.30
Minimum	1.40	1.80	2.60	2.70
Maximum	3.10	4.90	7.40	9.00
Count	18	28	41	27

Applying the Basgall and Giambastiani (1995) rate to the 114 projectile point readings from the Truman/Queen area shows that the rate does not work for dating material collected at Truman/Queen. Using their rate, only 36 points fell within their accepted time spans the other 78 did not. This is most likely due to the different effective hydration temperature on the Volcanic Tablelands which produces a faster hydration rate than at the Truman/Queen source proper. The following rate derived here is based on the same 114 samples from the Truman/Queen area just described.

In keeping with other efforts (e.g. Hall 1983, Hall and R. Jackson 1989) mean hydration values were compared as bivariate pairs with the temporal midpoint for the above projectile point sequence (Table 6.2).

Table 6.2 Bivariate pairs of Projectile Point Sequence Midpoints and Obsidian Hydration Mean values

Temporal Period	Dates	Temporal Midpoint	Mean Microns
Marana	650-100 B.P.	375	2.11
Haiwee	1350-650 B.P.	1000	2.54
Newberry	1350-3150 B.P.	2250	4.22
Little Lake	4950-3150 B.P.	4050	4.53

Table 6.3 lists the different regression formulas derived from the 4 bivariate pairings of projectile point mean hydration readings and the midpoints of each temporal period. Using log, power and linear regression analysis on the 4 pairs failed to produce a satisfactory rate. This is clearly the result of the large degree of hydration value overlap between different projectile point types. For example, Little Lake points have a range of 6.3 microns and 6 specimens have hydration readings around 2.9 microns, which is below most Elko points and within the range of Rosegate points. Nevertheless several regression techniques were used to determine temporal breakpoints for the regional sequence and permit provisional temporal placement of the relative hydration profiles that follows. Based on the 4 pairings the best result was a log regression, which correctly classified 46 of the 114 points. This is an unsatisfactory result and this rate formula produced future dates on values less than 1.5 microns.

Table 6.3 Number of Correct Point Classifications Using Various Regression Formulas

Regression Technique	Rate Formula	Point Type							
		R^2	DS	RG	Elko	LL	Total	*n*	% Correct
Log w/4 pairs	y = 3979.9 Ln (x) - 2687.3	0.852	1	15	19	11	46	114	0.40
Power w/ 4 pairs	$y = 62.88\ x^{2.6558}$	0.935	12	16	8	6	42	114	0.37
Linear w/ 4 pairs	y = 1257.5 x - 2294	0.872	2	16	19	8	45	114	0.39
Basgall and Giambastiani	$y = 82.74\ x^{2.06}$		17	3	13	3	36	114	0.32
Log w/ 3 pairs	y. = 2653.6 Ln (x) - 1550.3	0.995	4	16	25		45	87	0.52
Power w/ 3 pairs	y = 79.939 x 2.3759	0.903	12	16	12		40	87	0.46
Linear w/ 3 pairs	y = 847.92 x - 1298.7	0.981	7	16	16		39	87	0.45

Number indicates correct temporal placement based on rate
DS = Desert Series Points, RG = Rosegate Series Points, LL = Little Lake Points

The power function regression only classified 41 points, but was more successful in placing later period points. However overall it was also less successful than a linear regression which correctly classified 44 points. The Basgall and Giambastiani rate performed worst of all and only correctly classified 36 of the projectile points. Given that fact that the largest number of misclassifications were Little Lake Points, the same three regression techniques were tested using only three pairs (Table 6.3), corresponding to the Marana, Haiwee and Newberry period midpoints. The log regression ($R^2 = .9948$) based on three variate pairs, produced the best results of all the attempts. The provisional rate formula from this is as follows [years B.P. = 2653.6 Ln (microns) - 1550.3]. When this rate was applied to the sample excluding the Little Lake Points (n=27), the best result was 52% (45 of 87) correct classifications.

Lacking an acceptable rate for Truman/Queen obsidian, requires use of obsidian hydration readings as relative rather than absolute dates. However, an approximation of the temporal break points can be estimated by using the hydration values that result in the highest number of projectile points being place in their correct time span. It is important to note that these are considered provisional and only for the purpose of estimating the temporal placement of the relative hydration profiles described below. In the discussion that follows the relative hydration profiles will be divided into Pre-Newberry, Newberry and Post Newberry periods. The overlap in hydration values of Little Lake projectile points, makes it problematic to ascribe a hydration value to the break points between early periods (i.e. Mohave, Little Lake). For Elko series projectile points, however, a division at 6.2 microns results in the highest number of correctly placed Elko projectile points and will thus be used to mark the start of the Newberry Period (ca. 3150 B.P.). To estimate the hydration value corresponding to the Newberry/Haiwee transition the same technique was used. For the discussion that follows a value of 2.9 microns marks the end of the Newberry period and 2.8 microns marks the start of the Haiwee period. This of course resulted in the greatest number of Rosegate series projectile points and Elko series points being correctly placed. Thus, in the follow discussion all hydration values ≥ 6.3 microns are attribute to Pre-Newberry times, values which range from 6.2-2.9 microns are attributed to the Newberry period, and values ≤2.8 microns are attributed to post-Newberry times.

Production Patterns At The Truman/Queen Source

In keeping with previous quarry investigations, this study relies on a series of histograms to illustrate patterns of use of the source over time. This approach consists of two levels of inquiry. The first of which is the identification of gross changes in the overall use of the source in manner similar to the previous quarry studies described in Chapter 2. Thus, the overall history of use based on 528 hydration readings is particularly important for testing the trans-Sierra Nevada exchange models discussed in Chapter 2. Questions regarding technological organization and lithic procurement strategies relative to differential mobility and raw material availability are examined through a series of histograms for the different artifact types, technological trajectories and reduction stages. This project examines technology in a manner similar to other studies, focusing on the biface/core dichotomy. Data which are relevant to this include, obsidian hydration readings on bifaces and biface thinning flakes of various stages, and cores of various forms. Additionally, but less directly related to the primary research objectives of this project were a series of hydration measurements on other classes of artifacts, including rectangular blade like pieces of debitage, flake tools, unifaces and the projectile points already discussed. Obsidian hydration frequencies for all classes of artifacts are listed in Table 6.4. Each class of artifact is described individually in the sections that follow the discussion of the overall pattern of use. This section also looks at spatial variability over time at the source, by comparing upland and lowland zones hydration profiles for various artifact types. Temporal variability in use of quarry and off-quarry sites within each zone is also examined.

The overall hydration profile (Fig. 6.1) clearly demonstrates that the pattern of use the Truman/Queen source is similar to other sources in the area. All obsidian sources in the area, including the Truman/Queen source have an early pattern characterized by low frequencies of hydration values. Use of each source appears to increase gradually in intensity, until sharp increases to maximum levels near the middle part of their respective sequences. Toward the later part of each sequence there are abrupt declines in the frequency of hydration readings, presumably indicating reductions in the level of use, or relocation of field processing loci to sites away from the source. Clearly this same basic hydration profile exists at all four sources.

Table 6.4 Frequency of Obsidian Hydration Readings for All Artifacts

Mean Hydration	Bifaces	Cores	Debitage	Flake Tools	Projectile Points	Unifaces	Total
1.3	0	1	0	0	0	0	1
1.4	1	0	2	0	1	0	4
1.5	0	1	2	0	1	0	4
1.6	1	0	1	0	0	0	2
1.7	1	0	2	0	0	0	3
1.8	1	1	0	0	0	0	2
1.9	0	1	1	0	0	0	2
2.0	2	0	1	0	0	0	3
2.1	0	1	1	0	0	0	2
2.2	0	2	0	0	0	0	2
2.3	3	1	6	1	0	0	11
2.4	0	0	7	0	0	0	7
2.5	0	1	3	0	1	0	5
2.6	0	1	1	0	1	0	3
2.7	3	1	3	0	0	0	7
2.8	3	1	3	0	1	0	8
2.9	2	2	2	0	1	0	7
3.0	7	1	5	0	3	0	16
3.1	8	3	7	0	1	0	19
3.2	8	3	2	0	0	0	13
3.3	6	2	1	0	0	1	10
3.4	6	0	0	0	1	0	7
3.5	14	1	1	0	0	0	16
3.6	14	0	1	0	0	0	15
3.7	10	4	6	0	3	1	24
3.8	16	7	14	0	0	0	37
3.9	15	1	17	0	1	2	36
4.0	11	4	8	0	0	0	23
4.1	15	4	1	0	1	0	21
4.2	12	6	4	0	1	1	24
4.3	9	9	1	0	0	0	19
4.4	10	2	1	2	0	1	16
4.5	12	4	2	1	2	2	23
4.6	10	4	3	0	0	0	17
4.7	4	2	3	1	0	1	11
4.8	4	0	3	0	0	0	7
4.9	0	1	0	0	0	0	1
5.0	1	0	1	0	0	0	2
5.1	4	0	2	0	0	1	7
5.2	3	2	3	0	0	0	8
5.3	2	1	0	0	0	1	4
5.4	1	1	3	0	0	0	5
5.5	5	1	4	1	1	0	12
5.6	7	1	1	1	1	0	11
5.7	1	0	0	1	0	0	2
5.8	3	1	2	0	1	0	7
5.9	1	0	0	1	0	0	2
6.0	0	1	1	0	0	0	2
6.1	3	0	0	0	0	0	3
6.2	0	1	0	0	1	0	2
6.3	0	0	1	0	0	0	1
6.4	0	1	1	0	0	0	2
6.6	1	2	1	0	0	0	4
6.7	0	1	0	0	0	0	1
6.8	0	2	0	0	0	0	2
6.9	1	0	1	0	0	0	2
7.0	0	2	0	0	0	0	2
7.1	1	0	0	0	0	1	2
7.2	1	1	0	0	0	0	2
7.3	1	0	1	0	0	0	2
7.4	1	0	0	0	0	0	1
7.5	0	0	1	0	0	0	1
7.9	0	1	0	0	0	0	1
8.1	0	1	0	1	0	0	2
8.4	0	0	1	0	0	0	1
8.5	1	0	1	0	0	0	2
8.8	1	0	0	0	0	0	1
9.0	0	1	0	0	0	0	1
9.7	0	1	0	0	0	0	1
9.8	0	1	0	0	0	0	1
12.4	1	0	0	0	0	0	1
Total	248	95	140	10	23	12	528

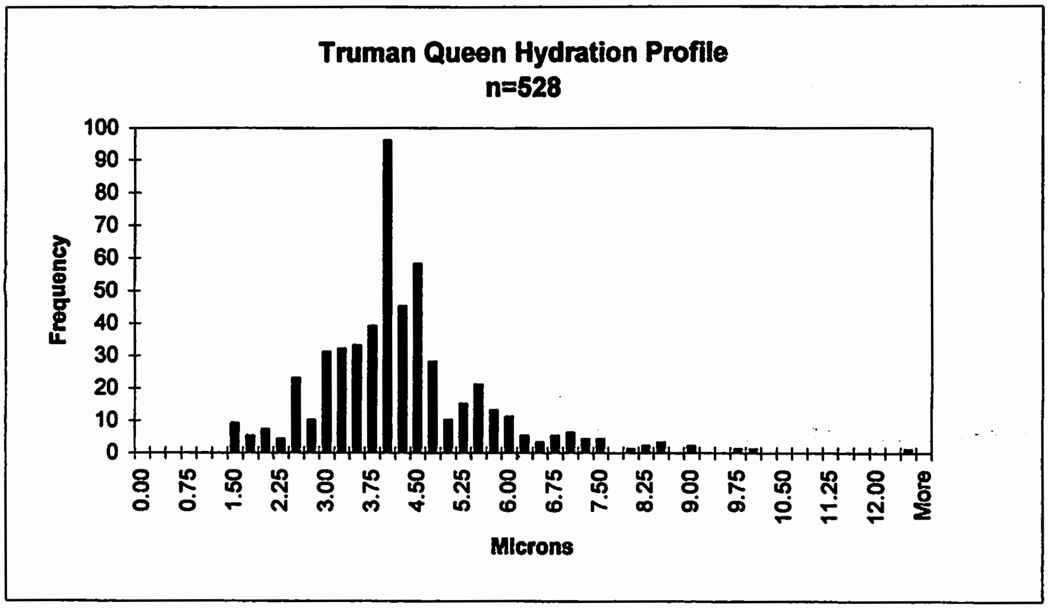

Figure 6.1 Truman/Queen Obsidian Hydration Profile

Figure 6.1 is depicted in .25 microns intervals. The hydration values shown, range from a high of 12.4 microns to a low of 1.3 microns with a mean of 4.12 microns. The curve clearly shows limited early use of the source, reaching a peak between 5.5 microns and 2.75 microns, with very few values less than 2.75 microns. In short, peak levels of production at the Truman/Queen source occurred during the Newberry period similar to the pattern from the other eastern California obsidian sources.

If the provisional temporal placement of the production curve, is correct then the use of the Truman/Queen source has changed overtime in a manner similar to the Casa Diablo, Bodie Hills and Coso sources. Of the total hydration values only 6.3 % (n=33) are greater than 6.2 microns and likely predate the Newberry Period. The Newberry Period ca 3150-1350 B.P. is marked by a substantial increase in use represented by values from 6.2 to 2.9 microns. A total of 81.3% (n=429) of all hydration readings are likely from this period. The same rapid falloff in use that has been described for other sources during the Haiwee period ca 1350-650 B.P. is evident in the Truman/Queen hydration profile. Only 12.4 % (n=66) of the hydration readings are attributed to the post-Newberry period, represented by values < 2.9 microns. The frequency of hydration readings by time period are summarized in Table 6.5.

Table 6.5 Frequency of hydration readings by provisional temporal break points

Temporal Period	Hydration Range	# of readings	% of total
Post-Newberry	< 2.9 microns	66	12.4
Newberry	6.2 - 2.9 microns	429	81.3
Pre-Newberry	> 6.2 microns	33	6.3
		528	100

Although the actual temporal breaks are only estimates until a better hydration rate is derived, the overall similarity of the Truman/Queen obsidian hydration profile to other sources indicates that the proposed time period breaks are probably not far from accurate. This is discussed in greater detail below in Chapter 7. The subsequent sections of this chapter examine hydration profiles for each artifact class. However the focus will be on biface and core trajectories.

Temporal Variability in Zone Use

The overall production curve based on 528 hydration readings indicates that use of the Truman/Queen source was at its peak during the Newberry Period (ca. 3150-1350

B.P.). A comparison of hydration readings for the upland and lowland zones indicates that although the two zones are similar overall they do differ in some ways over time. Figure 6.2 shows the hydration profiles for the upland and lowland zones. The strongest similarity is the high frequency of hydration values in both zones representing the Newberry period. The mean hydration value for samples collected in the upland zone (4.01 microns) is slightly less than the lowland mean (4.28 microns). As previously stated the proposed temporal range for the Newberry Period is 6.2 - 2.9 microns. The descriptive statistics for each zone are listed in Table 6.6.

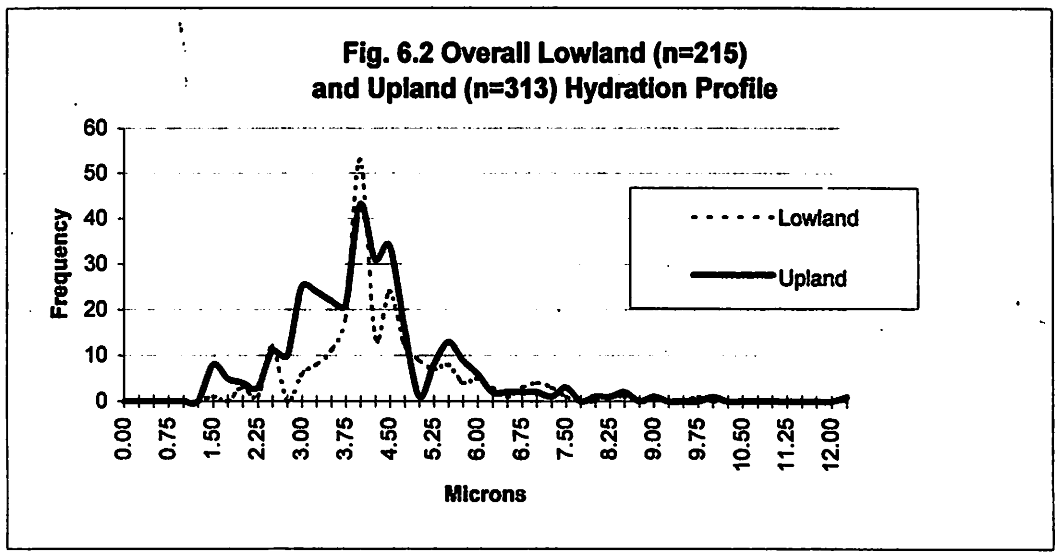

Figure 6.2 Comparison of Upland and Lowland Obsidian Hydration Profiles

Table 6.6 Hydration Values by Zone Descriptive Statistics

	Lowland	Upland	Total
Mean	4.28	4.01	4.12
Median	4.00	3.90	3.90
Standard Deviation	1.25	1.39	1.34
Range	8.40	11.00	11.10
Minimum	1.30	1.40	1.30
Maximum	9.70	12.40	12.40
Count	215	313	528

Pre-Newberry quarry use in the upland zone is very sparse, comprising only 5% (N=17) of the upland sample. Similarly, only 7% (n=33) of the lowland hydration values sample are pre-Newberry. The Newberry Period has the highest levels of use in both zones comprising 80% (n=249) of the upland sample and 84% (n=180) of the lowland sample. It appears that there are higher levels of upland zone use towards the later part of the Newberry period (Figure 6.2). The upland zone in the Haiwee Period show markedly lower levels of use and accounts for only 15% (n=47) of the upland samples. The decline is still greater in the lowlands, where only 9% (n=19) of the hydration values on the lowland are attributed to post-Newberry. Interestingly the upland profile, better mirrors the Casa Diablo source profile and the lowland profile better mirrors the source hydration profile. Obsidian hydration profiles indicate that use of the upland zone persisted later in time, which is likely the result of more intensive use of the upland zone for acquisition of food resources (pinyon) during the Haiwee period. This is discussed in more detail in Chapter 7.

Table 6.7 Frequency of hydration readings by zone.

Temporal Period	Hydration Range	Upland #	Upland %	Lowland #	Lowland %	total #	total %
Post-Newberry	< 2.9 microns	47	0.15	19	0.09	66	0.13
Newberry	6.2 - 2.9 microns	249	0.80	180	0.84	429	0.81
Pre-Newberry	> 6.2 microns	17	0.05	16	0.07	33	0.06
		313	1.00	215	1.00	528	1.00

Temporal Variability in Biface Production

In keeping with the typology used by Gilreath and Hildebrandt (1995), bifaces and uniface-bs were distinguished at the catalog level for this study. Gilreath and Hildebrandt segregated these forms on the premise that there is distinct technological difference between the two. It is assumed here that uniface-bs represent biface production despite the morphological difference. Uniface-bs show limited flaking on one surface of the implement. This is due to the fact that uniface-bs are typically made on large flakes not reduced from a large core. Thus a thin piece is obtainable without considerable bifacial flaking, because one surface of the piece is already at the desired flatness. Following this assumption bifaces and uniface-bs are treated as a single technological trajectory: biface production.

Temporal variability of the biface trajectory duplicates the same Newberry peak, seen in the overall hydration profile. This is not surprising since bifaces (n=248) constitute nearly half of the overall hydration sample. Bifaces have a mean hydration value of 4.14 microns and a standard deviation of 1.16 microns. The pattern depicted in Figure 6.3 indicates the same gradual increase in use over time as the overall curve, peaking around 4.0 microns, followed by a rapid decline. The hydration values which form the peak of the curve cover a range of readings corresponding to the Newberry period (6.2-2.9 microns).

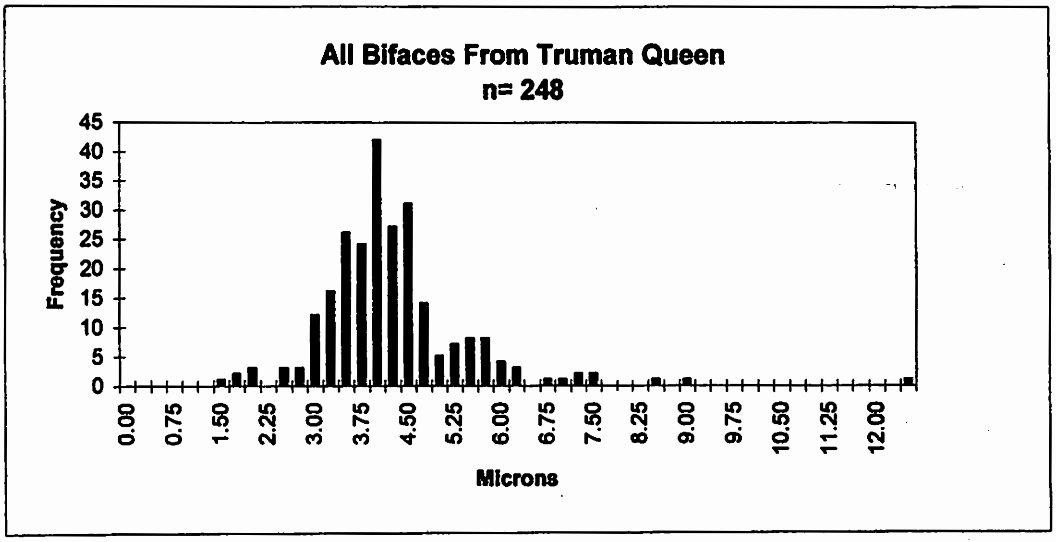

Figure 6.3 Biface Obsidian Hydration Profile

The breakdown of biface frequencies by temporal period and zone is described in Table 6.8. The table shows that 84% (n=208) of the total specimens were likely manufactured during the Newberry Period ca. 3150 - 1350 B.P. Pre-Newberry hydration values only represented 3% (n=16) of the total. Similarly low levels of biface production are represented by hydration values from post Newberry time periods. Only 10% (n=24) of the total hydration values fall below 3.1 microns, and likely post date the Newberry Period. Table 6.8 also indicates that the frequency of biface hydration values from upland and lowland zones for each temporal period are virtually identical. The similar histories of biface production in both the upland and lowland zones are evident in Figure 6.4.

Table 6.8 Biface Hydration Values by Temporal Period

Temporal Period	Hydration Range	Upland #	Upland %	Lowland #	Lowland %	total #	total %
Post-Newberry	< 2.9 microns	11	0.07	4	0.05	15	0.05
Newberry	6.2 - 2.9 microns	145	0.91	79	0.90	224	0.91
Pre-Newberry	> 6.2 microns	4	0.02	5	0.05	9	0.04
		160	1.00	88	1.00	248	1.00

Chapter 6 identified major differences between upland and lowland zones primarily with respect to the overall quantity of material. This difference relates primarily to the greater number of bifaces recovered from upland loci. What is interesting is that this difference does not have a significant temporal component. Relative to bifaces the largest differences between upland and lowland zones is in volume, given the similar profiles from each zone.

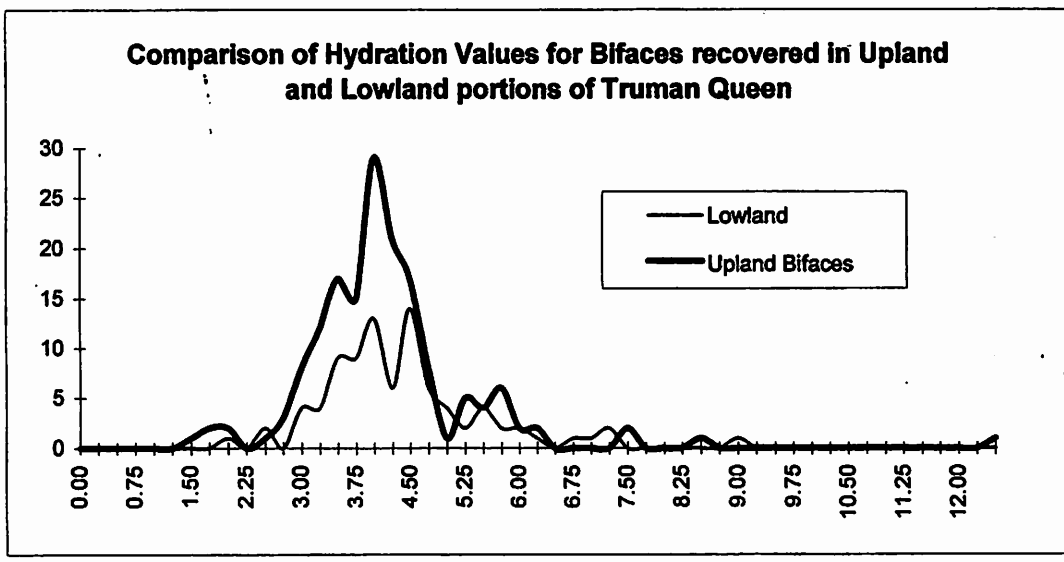

Figure 6.4 Comparison of Upland and Lowland Biface Hydration Profiles

Comparison between upland and lowland quarry and off-quarry loci, showed interesting patterns. For example the comparisons described in Chapter 6 indicate two distinct reduction episodes in the upland zone. Upland quarry loci were dominated by early stage debitage and larger numbers of discarded bifaces. In upland zone off-quarry sites biface debitage was more common than expected but bifaces were not. Bifaces were rarer in lowland quarry loci than upland quarry loci and biface discard in lowland off-quarry loci was almost nonexistent. Interestingly these contexts display slightly different mean hydration profiles, suggesting different temporal patterns of use. The descriptive statistics for bifaces from the upland and lowland zones are listed by context in Table 6.9.

Table 6.9 Descriptive Statistics of Biface Hydration Values by Zone and Context

	Lowland Off-Quarry	Lowland Quarry	Lowland Combined	Upland Off-Quarry	Upland Quarry	Upland Combined
Mean	4.25	4.28	4.28	3.58	4.16	4.06
Median	4.15	4.10	4.10	3.60	4.00	3.90
Standard Deviation	1.01	1.13	1.12	0.89	1.22	1.19
Range	2.30	6.80	6.80	4.70	10.80	11.00
Minimum	3.20	2.00	2.00	1.40	1.60	1.40
Maximum	5.50	8.80	8.80	6.10	12.40	12.40
Count	4	84	88	27	133	160

As described in Chapter 5, upland off-quarry assemblages, likely associated with the large settlements in the area, indicate an emphasis on secondary reduction of bifaces and very little if any core preparation. It is interesting that this context produced the most recent hydration value for any bifaces in the study. Lowland quarry sites yielded the highest mean hydration value of all contexts. This difference in means may be the effects of the increased use of the Pinyon Juniper Woodland ca. 1350 B.P. Table 6.10 gives the breakdown of the 248 bifaces by context by time period. This indicates that regardless of context bifaces occur most frequently during the Newberry Period. When viewed as frequencies by temporal period no particular post-Newberry loci pattern can be discerned. For the most part the frequency of bifaces for each cell of Table 6.10 is directly proportional to the number of bifaces from each time period and context respectively.

Table 6.10 Biface Hydration Values by Context						
		Upland (n=160)		Lowland (n=88)		(n=248)
Temporal Period	Hydration Range	Quarry	Off-Quarry	Quarry	Off-Quarry	total #
Post-Newberry	< 2.9 microns	7	4	4	0	15
Newberry	6.2 - 2.9 microns	122	23	75	4	224
Pre-Newberry	> 6.2 microns	4	0	5	0	9
	Total	133	27	84	4	248

However the obsidian hydration profiles depicted in Figure 6.5 indicate some more subtle temporal differences, between upland quarry and off-quarry site bifaces. Biface production in upland quarry sites peaks at 4.0 microns, while in upland off-quarry sites it peaks at 3.5 microns. Unfortunately the same comparison cannot be made between quarry and off-quarry contexts in the lowlands because of the small number of bifaces recovered in off-quarry contexts.

Comparisons of bifaces by stage also indicate highest frequencies during the Newberry Period. The descriptive statistics for bifaces by stage are listed in Table 6.11. There is some variation in terms of the mean hydration values by stage, although the sample size for stage 5 bifaces is not sufficient to support statistical inferences.

Table 6.11 Descriptive Statistics for Biface Hydration Values by Stage					
	Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
Mean	4.23	4.25	3.77	3.81	3.68
Median	4.10	4.10	3.75	3.50	3.80
Standard Deviation	1.30	1.16	0.80	0.70	0.45
Range	11.00	6.80	4.30	2.40	1.20
Minimum	1.40	2.00	1.80	3.20	3.00
Maximum	12.40	8.80	6.10	5.60	4.20
Count	113	84	30	15	6

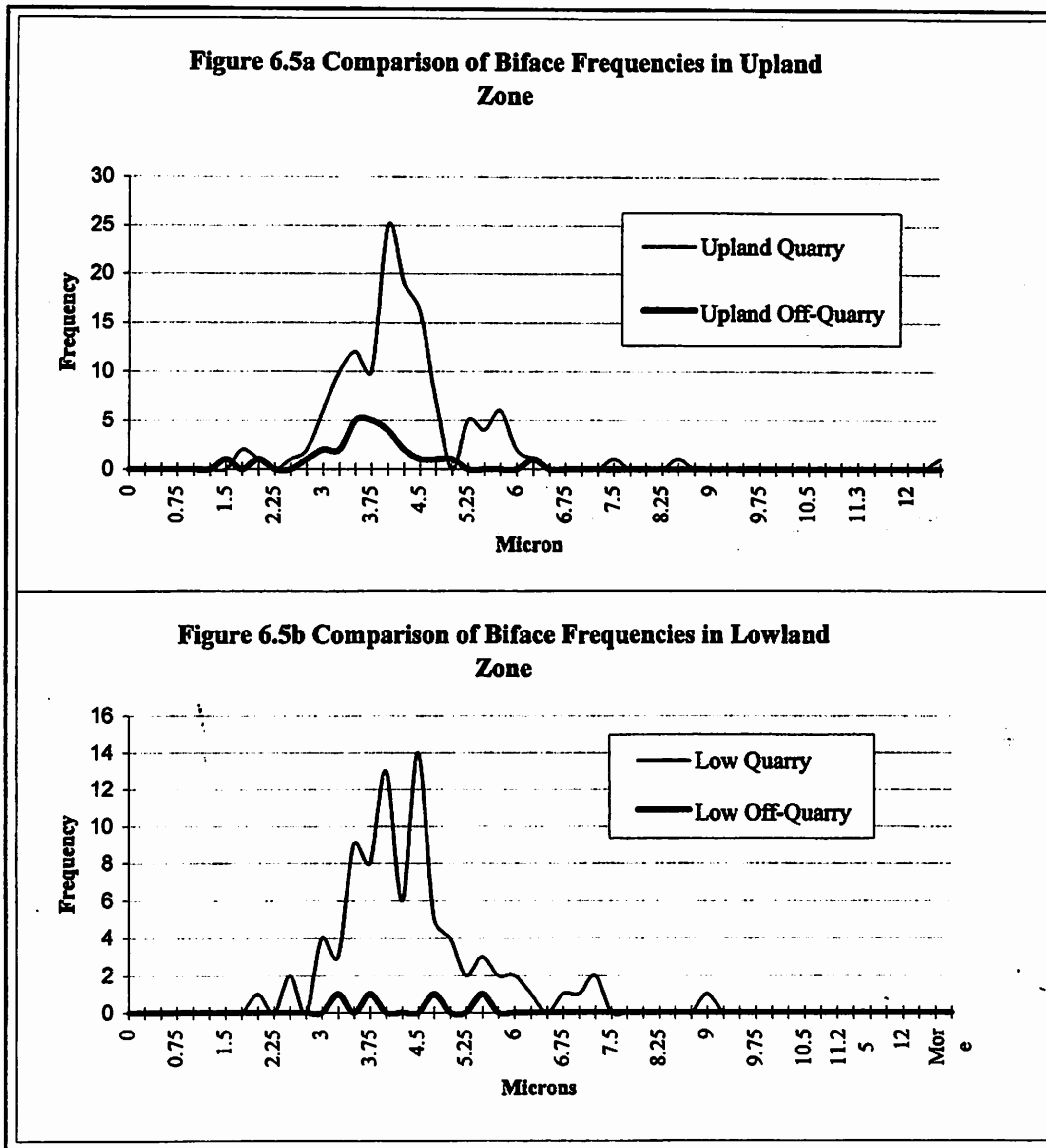

Figure 6.5 Upland (6.5a) and Lowland (6.5b) Hydration Frequencies comparing Bifaces in Quarry and Off-Quarry Contexts

The obsidian hydration profiles for each biface stage are depicted in Figure 6.6, which shows all stages appear in highest frequency between 3.0-5.0 microns. The slightly younger mean hydration values evident in stage 4 and stage 5 bifaces is potentially due to sampling error.

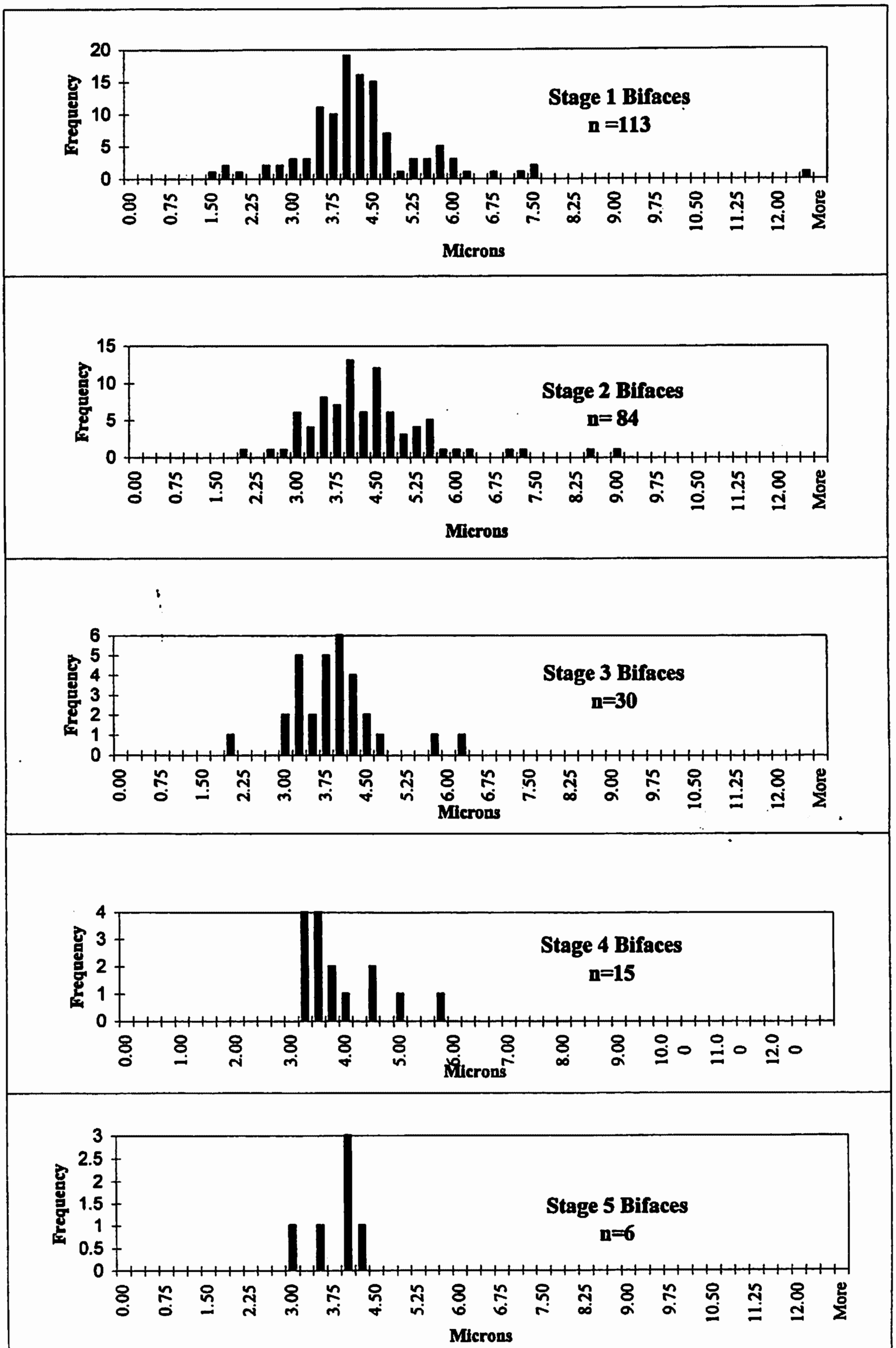

Figure 6.6 Hydration Profiles for All Biface Stages

The relatively smaller mean hydration value for late stage bifaces does not likely reflect changes in reduction strategies. As Table 6.12 indicates there are no late stage specimens (stage 4 and 5) with post Newberry period hydration value. Likewise there were no late stage specimens with hydration values corresponding to Pre-Newberry time periods.

Table 6.12 Biface Hydration Values By Stage By Temporal Period

Hydration Range	Stg1 #	Stg1 %	Stg2 #	Stg2 %	Stg3 #	Stg3 %	Stg4 #	Stg4 %	Stg5 #	Stg5 %
< 2.9 microns	9	0.08	5	0.06	1	0.03	0	0.00	0	0.00
6.2 - 2.9 microns	99	0.88	75	0.89	29	0.97	15	1.00	6	1.00
> 6.2 microns	5	0.04	4	0.05	0	0.00	0	0.00	0	0.00
Total	113	1.00	84	1.00	30	1.00	15	1.00	6	1.00

Similar difficulties related to sample size arise when comparing various shape bifaces. Only 108 bifaces were complete enough to determine planar shape. The frequency of hydration values are broken down by micron range in Table 6.13. What is clear from this is that the highest frequencies of all forms occur the Newberry Period. It is interesting however, that there are a relatively high number of irregular forms later in time. With only two exceptions, all hydration values attributed to post-Newberry Period were on irregular forms. By contrast only 22% of Newberry period bifaces were irregular. This may indicate that bifaces were serving some special set of needs during the Newberry period. This is discussed in more detail in Chapter 7.

Table 6.13 Biface Hydration Values by Shape

Hydration Range	Triangular	Lancelet	Rounded Elongate	Rectangular	Circular	Wide Shouldered	Irregular
< 2.9 microns	-	-	1	-	-	1	7
6.2 - 2.9 microns	3	8	23	5	7	30	21
> 6.2 microns	-	-	1	-	-	-	1
	3	8	25	5	7	31	29

In the study of the Coso source Gilreath and Hildebrandt (1995) differentiate between bifaces and uniface-bs. For the purpose of this study, the uniface-b is simply assumed to represent an alternative form of biface production. However, this assumption remains to be tested. In order to evaluate their histories, these forms are differentiated in Figure 6.7. This demonstrates that both bifaces and uniface-bs peak in frequency near 4.1 microns.

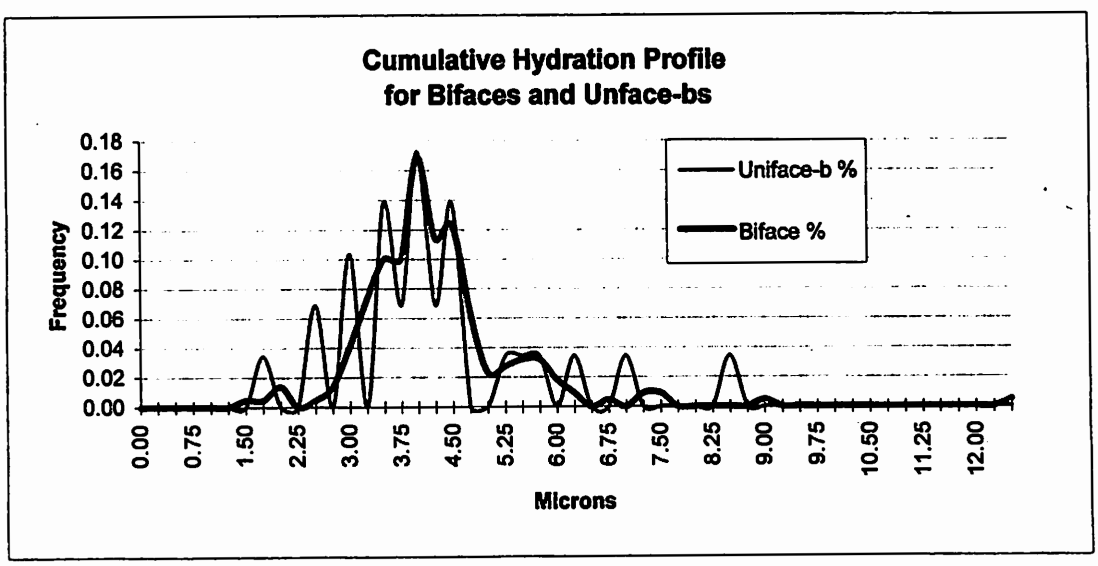

Figure 6.7 Cumulative Hydration Profile for Bifaces and Uniface-bs

Although the sample of hydration readings for uniface-bs is smaller than bifaces, it is clear that the production of both forms occurred at highest frequencies during the Newberry Period. The sample of uniface-bs is insufficient to characterize the history of production other than to say that most values fall within the peak levels for biface production. The hydration values for bifaces and uniface-bs cannot statistically be considered different. Given the similar mean hydration values the assumption that the two are simply variant forms of bifaces seems warranted.

Temporal Variability in Core Production

Temporal variability in core hydration value is similar to the biface hydration profile, with Newberry frequency peak. The production history for cores (Fig. 6.8) is based on a total of 95 obsidian hydration readings, which have a mean hydration value of 4.43 microns, and range from 9.8 to 1.3 microns.

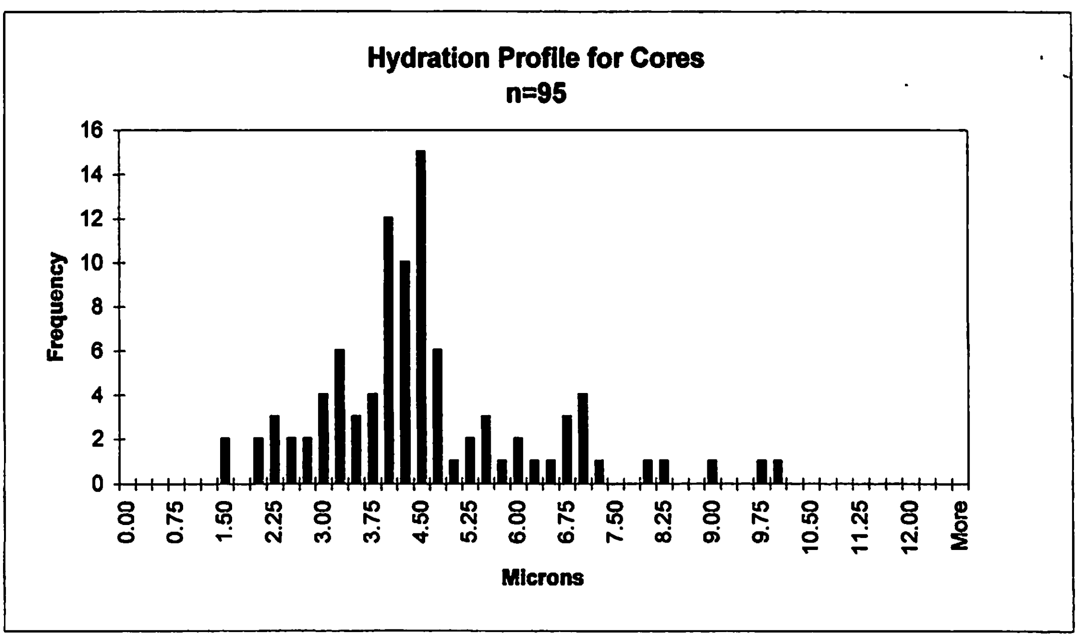

Figure 6.8 Obsidian Hydration Profile for Cores

The breakdown of core hydration frequencies by temporal period and zone (Table 6.14) indicates that 73% (n=69) of the total specimens were likely manufactured during the Newberry Period. Pre-Newberry hydration values represented 19% (n=14) of the total. Similarly low levels of core production are represented by hydration values from post Newberry time periods, with only roughly 12% (n=12) of the total hydration values falling below 2.9 microns. These data suggests that, like bifaces, cores were primarily a Newberry Period phenomenon, and that technological change at the Truman/Queen source was not simply a transition from biface to cores ca. 1350 B.P.

Table 6.14 Core Hydration Values

Temporal Period	Hydration Range	Upland #	Upland %	Lowland #	Lowland %	total #	total %
Post-Newberry	< 2.9 microns	6	0.12	6	0.12	12	0.12
Newberry	6.2 - 2.9 microns	36	0.77	33	0.69	69	0.73
Pre-Newberry	> 6.2 microns	5	0.11	9	0.19	14	0.15
		47	1	48	1	95	1

Table 6.14 also indicates that there was very little change overtime in zone use for core production. Pre-Newberry cores are rare in both zones, and Newberry period cores represent 77% (n = 36) the upland sample, and 69% (n = 33) of the lowland sample. Naturally, then, post-Newberry hydration values for the upland and lowland are also similar. Cores with hydration values attributed to Post-Newberry periods (< 2.9 microns), represent 12% of the core total in each zone. Lowland cores also have slightly smaller mean hydration values than upland cores (Table 6.15). The mean hydration value for lowland cores is 4.64 microns, slightly less than the mean hydration reading (4.21 microns) on upland cores.

Figure 6.15 Descriptive Statistics for Core by Zone	Lowland Off-Quarry	Lowland Quarry	Lowland Combined	Upland Off-Quarry	Upland Quarry	Upland Combined
Mean	3.06	4.83	4.64	3.37	4.36	4.21
Median	2.50	4.30	4.30	3.10	4.20	4.10
Standard Deviation	1.68	1.59	1.67	0.79	1.70	1.63
Range	4.30	7.90	8.40	2.00	8.30	8.30
Minimum	1.30	1.80	1.30	2.30	1.50	1.50
Maximum	5.60	9.70	9.70	4.30	9.80	9.80
Count	5	43	48	7	40	47

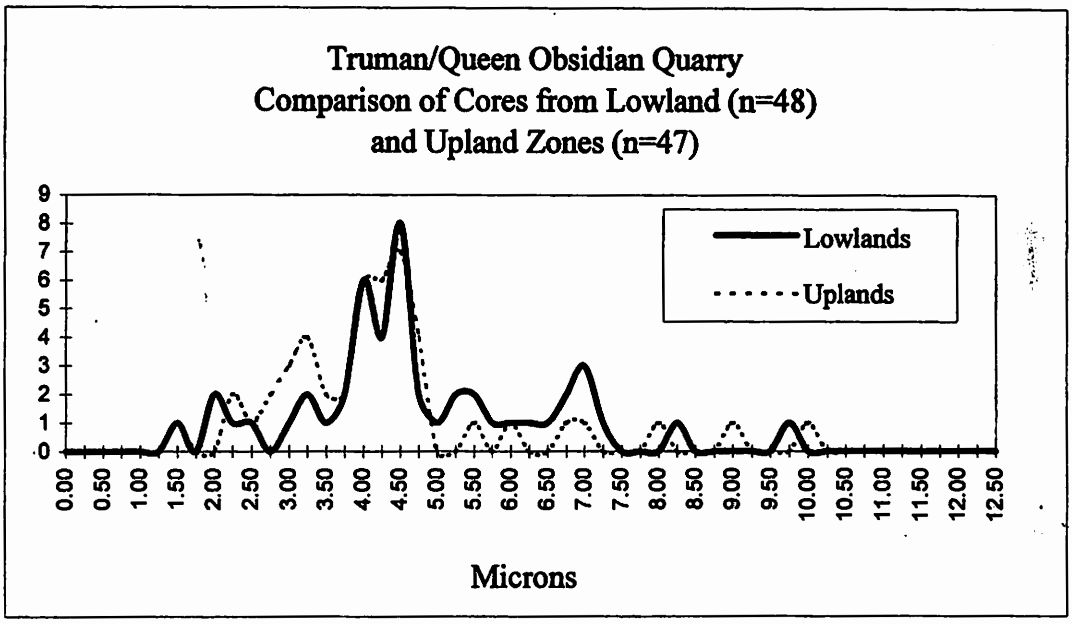

Figure 6.9 Upland and Lowland Core Obsidian Hydration Profiles

The inferences that can be made about the cores are more limited owing to sample size. The curves depicted in Figure 6.9 show the same basic pattern with a peak around 4.5 microns. However lowlands values decline more sharply after the peak than upland values. As with bifaces, one cannot compare the distribution of cores by context. Even so, as with bifaces cores from lowland quarries tend to be older than those from the uplands, quarry and off-quarry alike. Cores and bifaces from upland off-quarry sites tend to be the youngest. The hydration profile for cores by context are depicted in Figure 6.10. When viewed by time period (Table 6.16) the small sample effect is also evident. It is thus problematic to classify pre-Newberry core production in any other way than it occurred at very low levels.

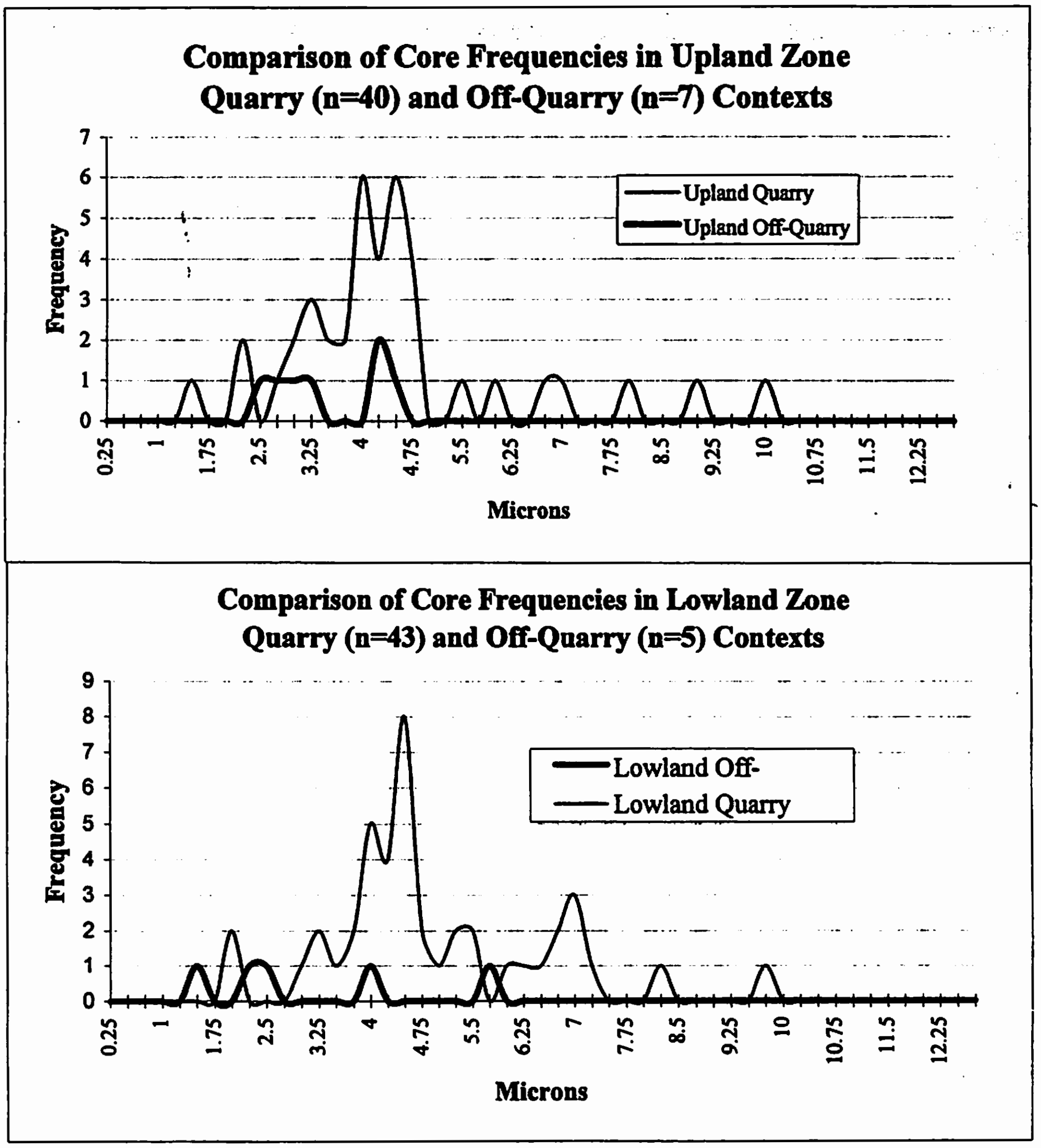

Figure 6.10 Upland (6.10a) and Lowland (6.10b) Hydration Frequencies comparing Cores in Quarry and Off-Quarry Contexts

Table 6.16 Core Hydration Values by Context by Temporal Period

		Upland (n=47)		Lowland (n=48)		(n=95)
Temporal Period	Hydration Range	Quarry	Off-Quarry	Quarry	Off-Quarry	total #
Post-Newberry	< 2.9 microns	4	2	3	3	12
Newberry	6.2 - 2.9 microns	31	5	31	2	69
Pre-Newberry	> 6.2 microns	5	0	9	0	14
	Total	40	7	43	5	95

The five core types described in Chapter 4 have similar mean hydration values (Table 6.17) although the sample for three types, bi-directional cores, cobble test cores and chunk test cores do not permit reliable statistical comparison.

Table 6.17 Obsidian Hydration Descriptive Statistics for Different Core Types

	Bi-directional Cores	Non-Patterned Cores	Unidirectional Cores	Cobble Test Cores	Chunk Test Cores
Mean	4.90	4.58	4.10	3.90	4.36
Median	4.30	4.30	3.80	4.00	4.30
Standard Deviation	1.30	2.03	1.41	0.90	0.22
Range	3.70	8.30	5.50	3.40	0.60
Minimum	3.30	1.50	1.30	1.80	4.10
Maximum	7.00	9.80	6.80	5.20	4.70
Count	12	45	22	9	7

The uni-directional cores sample, too, is only marginally satisfactory. Only non-patterned cores are present in adequate numbers for statistical inference (n=45). These forms, have a mean hydration value of 4.58, which is slightly more than the mean value (4.29 microns) for all the other core forms combined (n=50). Because of this, cores can be viewed as a single undifferentiated technological trajectory. This is not to conclude that core forms did not vary overtime, only that the sample collected here shows no such pattern. The frequency of the different core types by time period are summarized in Table 6.18.

Table 6.18 Cores Types by Temporal Period

Hydration Range	Bi-directional Cores	Non-Patterned Cores	Unidirectional cores	Cobble Test Cores	Chunk Test Cores	Total
< 2.9 microns	0	7	4	1	0	12
6.2 - 2.9 microns	9	29	16	8	7	69
> 6.2 microns	3	9	2	0	0	14
Total	12	45	22	9	7	95

Again it is clear that regardless of form, the highest frequencies are during the Newberry Period. Further, there is no evidence of significant post-Newberry core production at the Truman/Queen source. The production histories for each core type (Fig. 6.11) illustrate the impossibility of identifying spatial variation in these temporal patterns given the samples at hand.

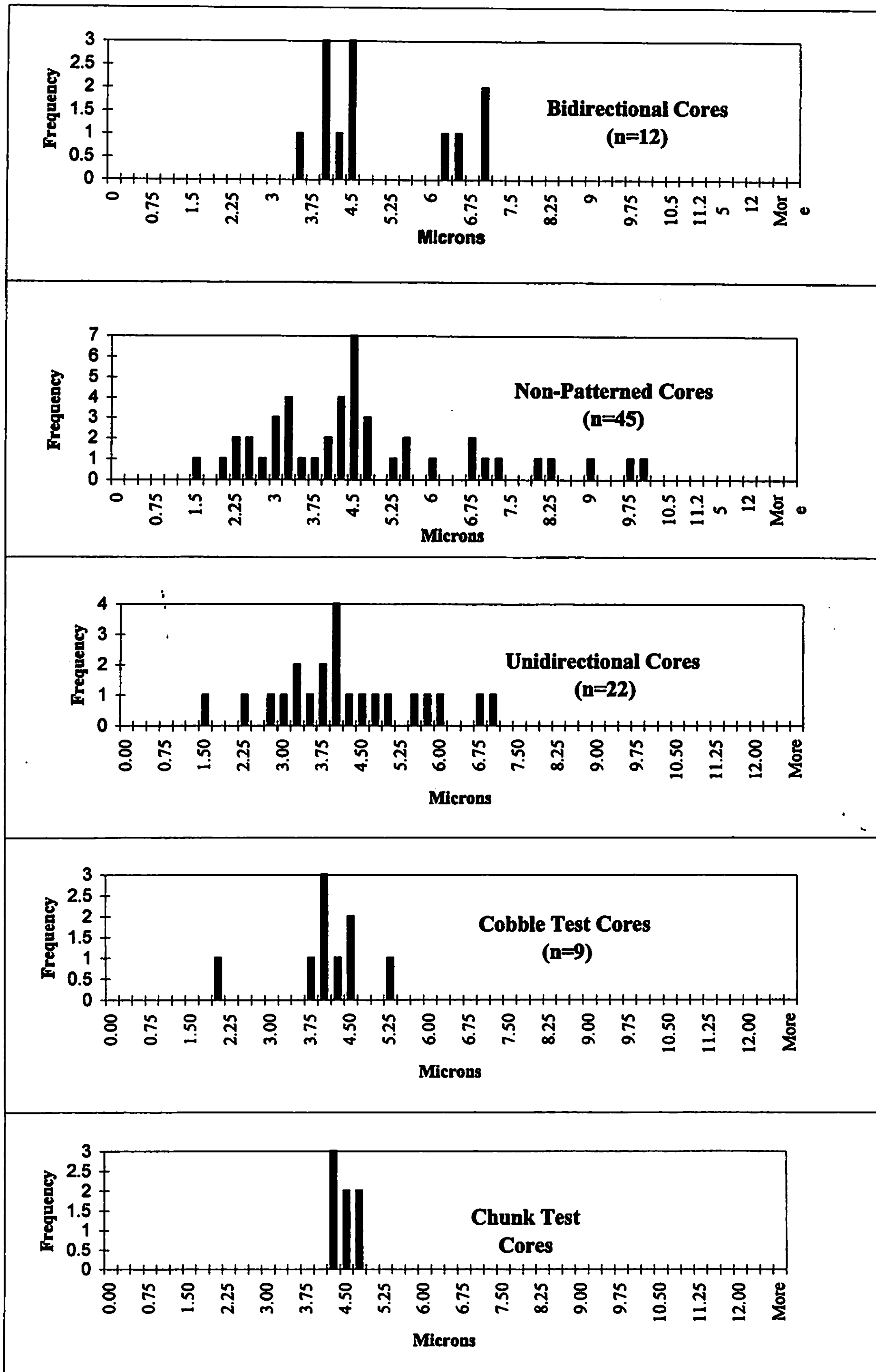

Figure 6.11 Obsidian Hydration Profile for Cores by Type

Debitage Obsidian Hydration Profile

The debitage hydration profile (Figure 6.12) is derived from 122 readings on biface thinning flakes and 18 readings on specimens classified in a provisional category as rectangular blades. The range of hydration values for debitage is similar to other artifact types. The hydration values for debitage form a sharp peak at 4.0 microns. The mean of 3.84 microns is slightly lower than that of bifaces (4.14 microns). The descriptive statistics for biface debitage by zone are listed in Table 6.19. Lowland quarry debitage has the largest mean hydration readings and upland off-quarry biface debitage has the smallest mean hydration values.

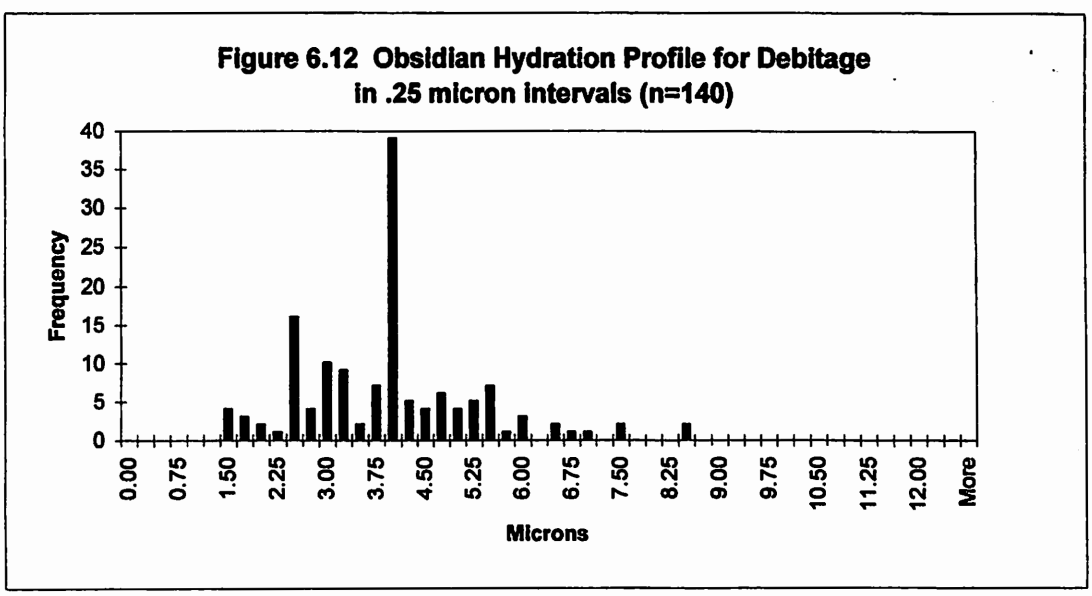

Figure 6.12 Obsidian Hydration Profile for Truman/Queen Debitage

Table 6.19 Debitage Hydration Descriptive Statistics by Context

	Lowland Off-Quarry	Lowland Quarry	Upland Off-Quarry	Upland Quarry	Total Debitage
Mean	3.82	4.45	3.66	3.70	3.84
Median	3.90	4.00	3.05	3.80	3.80
Standard Deviation	0.87	1.30	1.74	1.17	1.34
Range	3.70	6.10	6.90	4.10	7.10
Minimum	2.30	2.40	1.50	1.40	1.40
Maximum	6.00	8.50	8.40	5.50	8.50
Count	50	21	48	21	140

The breakdown for debitage by time period and zone are listed in Table 6. 20. There are several interesting aspects of the distribution of debitage by time. The first of these is the relatively higher amount of lowland hydration values that correspond to the Newberry Period. Of the uplands sample, 35% post dates the Newberry period, in contrast to only 13% of the lowlands debitage. Pre-Newberry hydration frequencies are about the same in both zones, but slightly higher in the uplands. In terms of debitage the largest difference between zones, is the higher frequency of Newberry debitage in the lowlands and the higher frequency of post-Newberry debitage in the uplands. The greater abundance of post-Newberry debitage in the uplands may reflect the use of that zone for pinyon, and continue biface production. This is discussed in greater detail in the next chapter, but it can be pointed out here that biface production persisted well into the post-Newberry period long after the major settlement centralization (ca. 1350 B.P.). This suggests that biface production was not undertaken to minimize toolstone procurement and transport costs in the presence of high mobility as the organization of technology models argue.

Table 6.20 Debitage Hydration Values (n=140)						
Hydration Range	Upland #	Upland %	Lowland #	Lowland %	total #	total %
< 2.9 microns	24	0.35	9	0.13	33	0.23
6.2 - 2.9 microns	41	0.59	60	0.84	101	0.72
> 6.2 microns	4	0.06	2	0.03	6	0.05
	69	1.00	71	1.00	140	1.00

A comparison of biface thinning flakes by stage indicated that early, middle and late stage biface thinning flakes all peak at 4.0 microns. This is of no surprise given the Newberry period hydration values evident in every other hydration profile described up to now. Of the 41 hydration values on early stage biface thinning flakes, 58% (n=24) corresponded to the Newberry Period (Table 6.21). This is similar to the frequency of Newberry period hydration values on late stage flakes 60% (n=24). However in marked contrast, 90% of middle stage bifaces thinning flakes have readings corresponding to the Newberry period. These data and summary statistics by flake stage reported in Table 6.22 suggest production weighted toward late stages in post-Newberry times, toward the middle stages in Newberry times, and somewhere in between these two in pre-Newberry times.

Table 6.21 Biface Thinning Flake by Stage						
Hydration Range	Early Stage #	Early Stage %	Middle Stage #	Middle Stage %	Late Stage #	Late Stage %
< 2.9 microns	14	0.34	3	0.07	14	0.35
6.2 - 2.9 microns	24	0.58	37	0.90	24	0.60
> 6.2 microns	3	0.08	1	0.03	2	0.05
	41	1.00	41	1.00	40	1.00

Table 6.22 Descriptive Statistics of Mean Hydration Values for Debitage by Type

	Rectangular Blades	Early Stage Thinning Flakes	Middle Stage Thinning Flakes	Late Stage Thinning Flakes	Overall
Mean	4.16	3.94	3.89	3.56	3.84
Median	3.90	3.90	3.90	3.70	3.80
Standard Deviation	1.44	1.58	1.00	1.35	1.34
Range	7.00	7.10	5.90	5.80	7.10
Minimum	1.40	1.40	1.60	1.50	1.40
Maximum	8.40	8.50	7.50	7.30	8.50
Count	18	41	41	40	140

Uniface Obsidian Hydration Profile

All twelve unifaces recovered during the project and were submitted for obsidian hydration analysis. The descriptive statistics for uniface obsidian hydration values are listed in Table 6.23. The sample size for unifaces is insufficient to infer an overall pattern of uniface production, but the observed values suggest a Newberry period phenomenon like all other technological categories examined up to this point. The hydration profile for the twelve unifaces depicted in Figure 6.13, demonstrates that most values are within the Newberry peak.

Table 6.23 Descriptive Statistics of Obsidian Hydration Values for Unifaces

Mean	4.55
Median	4.45
Standard Deviation	0.98
Range	3.80
Minimum	3.30
Maximum	7.10
Count	12

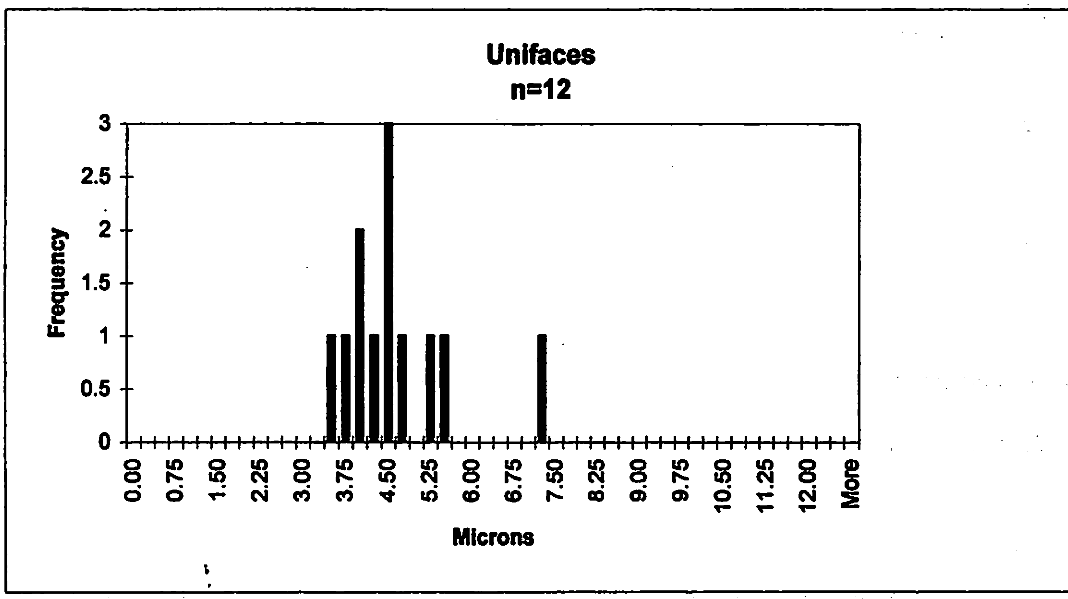

Figure 6.13 Obsidian Hydration Profile for Unifaces

Discussion: Comparison of Biface and Core Production Histories

A major focus of technological studies in the Great Basin, in recent years has sought to explain a seemingly sudden technological change from bifaces to cores at the Newberry / Haiwee transition ca 1350 B.P. As discussed above, most authors (i.e. Bouey and Basgall 1984; Ericson 1977,1982; Gilreath and Hildebrandt 1995; Goldberg et al. 1990; Jack 1976; R. Jackson 1985; T. Jackson 1984; Singer and Ericson 1977) have concluded that this transition is related to trans-Sierra Nevada exchange. Data from the Truman/Queen source suggests viewing the supposed technological change as a simple replacement of one tool type by another is an over simplification. It is clear from the Truman/Queen record that both bifaces and cores changed in frequencies together.

What is true however, is that Newberry period assemblages are dominated by bifaces and biface production debris. Post-Newberry assemblages, appear to have a reduced quantities of obsidian tools in general. Thus the technological change in the region should be viewed more as changes in intensity rather than changes in kind. Figure 6.16 depicts the production histories for bifaces and cores. These data indicate that there is strong similarity between bifaces and cores over time from the Truman/Queen source. Given the similarity of the Truman/Queen profile to those of other sources it is possible that a technological change from bifaces to cores did not occur in those places. For example, the Casa Diablo hydration profile presented in Chapter 2 based on 1311 hydration dates, is strikingly similar to the Truman/Queen profile.

The remarkable similarity of the overall curves from the two sources suggests that the technological change where cores replace bifaces, did not occur at Truman/Queen, Casa Diablo, or anywhere else and archaeologists have overemphasized the transition from bifaces to cores due to a bias in collecting samples. Such a bias would be compounded by the propensity for biface production to be wasteful and resulting in large volumes of material. A large part of this waste is evident at sources where production failure induced biface discard. Bifaces are rejected in greater numbers than cores which have a very low production failure rate. This means that the difference in the history of cores and bifaces evident in the obsidian hydration profile is really a reflection of the difference in the amount of waste of the two technologies, not a change from one form to another. Because ~~the~~ bifaces and cores have virtually the same frequency distribution over time, cores clearly did not replace bifaces as the dominant technology. Looking at both forms by time periods (Table 6.24) demonstrates the similar production histories for the two forms. Table 6.24 also indicates that technological change is not a simple replacement of bifaces with cores. Both forms are at highest frequencies during the Newberry period and drop off at the beginning of the Haiwee period roughly 1350 B.P. This is also illustrated by the similar cumulative hydration profiles for bifaces and cores (Figure 6.14).

Table 6.24 Comparison of Bifaces and Cores By Time Period

Hydration Range	Bifaces #	Bifaces %	Cores #	Cores %	total #	total %
< 2.9 microns	15	0.05	12	0.12	27	0.08
6.2 - 2.9 microns	224	0.91	69	0.73	293	0.85
> 6.2 microns	9	0.04	14	0.15	23	0.07
	248	1.00	95	1	343	1.00

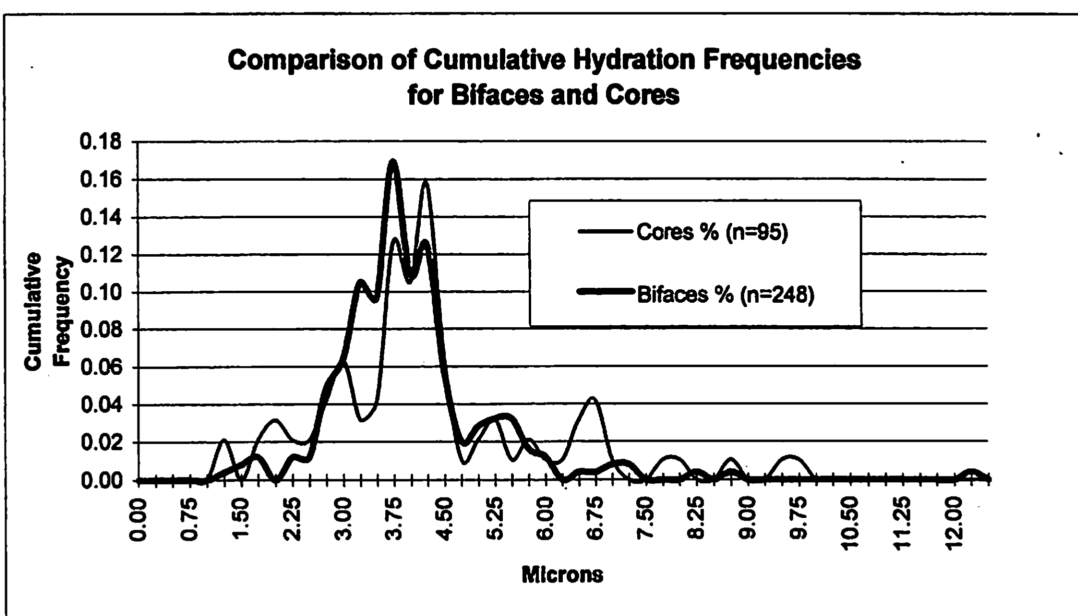

Figure 6.14 Comparison of Cumulative Hydration Frequencies for Bifaces and Cores

Based on the data from the Truman/Queen source, archaeologist should reexamine the reality of the proposed transition from biface to cores in the area. In reality the transition appears to be from cores to bifaces to neither. The well documented (i.e. Bettinger 1989) settlement and subsistence changes in the area are not tied to a replacement of bifaces with cores as the organization of technology models argue. Thus mobility is less likely a conditioner of technology to the degree that organization of technology models (e.g. Parry and Kelly 1987, Kelly 1988) suggest.

CHAPTER VII

Summary and Conclusions

The primary research objective of this study was to test competing hypotheses regarding diachronic variability in eastern California obsidian quarries. As previously stated, archaeologists who study quarry sites have identified, through obsidian hydration profiles, peak levels of use corresponding to the Newberry period (ca. 3150-1350 B.P.), immediately followed by a sharp decline in use and reduction in biface production. The models developed to explain this pattern fall into two main groups. The first group emphasizes exchange with non-local populations (i.e. central and southern California) as the primary causal factors in the pattern of quarry use. The second group emphasizes the relationship of settlement patterns and mobility of local populations (i.e. western Great Basin inhabitants) to changes in lithic procurement and technological evident in obsidian source profiles. The evidence most relevant to this problem is the production history for the Truman/Queen source which is based on a series of obsidian hydration dates obtained on artifacts systematically collected from the source.

The following is a description of the production history at the Truman/Queen source, based on the spatial data summarized in Chapter 5 integrated with the temporal data from Chapter 6. This is followed by an examination of the history of use of the Truman/Queen source relative to previous models of lithic procurement and technological change. The data from the Truman/Queen source indicate that previous models do not adequately explain patterns in obsidian quarry use and technological change in the western Great Basin.

Diachronic Variability in Lithic Procurement at the Truman/Queen Source

It is clear from the obsidian hydration data described in Chapter 6, that the pattern of use of the Truman/Queen source is very similar to other sources. The following section describes the history of use of the Truman/Queen source using the pre-Newberry, Newberry, and post-Newberry divisions described in Chapter 6. The actual frequencies for each time period are likely to be slightly different once a satisfactory rate for the Truman/Queen source has been established, however the overall nature of the production profile will not change, and the basic sequence inferred from the hydration data is not likely to change in dramatic ways with a new hydration rate formula.

Pre-Newberry Period Use of the Truman/Queen Source

The pre-Newberry period is represented by hydration values greater than 6.2 microns. Use of the source during pre-Newberry times is the lowest of all time periods, and represents only 6.3% (n=33) of the total obsidian hydration readings. The hydration sample includes the following number of readings on artifacts: 9 bifaces, 14 cores, 8 debitage, 1 flake tool, and 1 uniface. Very little can be concluded regarding biface reduction stages during this period, other than it is apparently dominated by early stages. Of the 9 bifaces attributed to this period, 5 are stage 1 and 4 are stage 2. The debitage sample is also too small to make inferences regarding reduction stage. There were 8 pieces of debitage attributed to this time period, of which 6 were biface thinning flakes and two were assigned to the provisional category of rectangular blade.

Of the total bifaces attributed to pre-Newberry times, roughly equal proportions were recovered from the upland zone (n=4) and the lowland zone (n=3). At this time there was likely less limitation in terms of the abundance of lowland cobbles large enough for biface production, and thus there was little zone preference. During the surface survey it was common to observe pieces of debitage in the lowland that were larger than any observed lowland cobble. This indicates that at one time the quality of lowland material was better and that supply in the lowlands became exhausted, in the sense that the return rates of lithic procurement in the lowland zone dropped overtime. Further evidence for this is the increased use of the upland zone during the Newberry period. Interestingly, all 9 pre-Newberry bifaces were recovered from primary quarry sites, and none were recovered from off-quarry sites. Cores have a pattern similar to bifaces, with equal proportions from both zones, although in very low numbers; and like bifaces all pre-Newberry cores were recovered from quarry sites.

The same number of bifaces and cores were collected using the same collection technique, thus no particular technology dominated pre-Newberry production. Furthermore, the comparison of the overall use of the upland and lowland zones indicate similar proportions of biface and cores during this time period. This indicates that during pre-Newberry times, lithic procurement was not constrained by factors with a salient spatial dimension. In other words, it was not strongly tied to intensive use of the area for subsistence resources but was dictated by the location of material. The fact that all bifaces and cores were recovered from quarry sites, suggests that lithic procurement was likely conducted independent of the use of the area for other purposes. If lithic procurement had been conducted in conjunction with subsistence activities, one would expect material to be transported short distances and processed in secondary reduction loci (i.e. off-quarry sites). Thus the source was likely used for shorter periods of time with less selective use of the most accessible and least costly material.

Newberry Period Use of the Truman/Queen Source

The Newberry period is provisionally represented by hydration values between 6.2 and 2.9 microns. Use of the source is at its zenith during the Newberry period, representing roughly 81% (n=429) of the total obsidian hydration readings, including 224 bifaces, 66 cores, 99 pieces of debitage, 8 flake tools, 11 unifaces and 18 projectile points. Unlike pre-Newberry times where bifaces and cores occurred in roughly equal proportions, Newberry period bifaces are the dominant tool form and outnumber cores by more than 3 to 1. The Newberry period is clearly the time of bifaces, and represents 91% of all biface hydration values. In fact roughly 40% of all hydration readings obtained in this study, are on Newberry period bifaces. The Newberry period is characterized by more extensive and wasteful processing of bifaces at the source starts, marked by an increased discard of late stage bifaces. As in the pre-Newberry period, early stage bifaces are most common. However all stage 4 and 5 bifaces dated by obsidian hydration can be attributed to the Newberry period.

The Newberry period also marks an increase in the use of the upland source zone relative to the lowland source zone. Pre-Newberry use shows roughly equal proportions of upland and lowland hydration values, but during the later part of the Newberry period, hydration values (3.7-3.0 microns) from the upland (n=135) out number lowland values (n=73) by nearly two to one. It is possible that at this time the availability of larger obsidian cobbles became scarce in the lowlands, requiring a shift to upland locations. This is supported by the higher frequencies of later hydration values in the upland zone, and the common occurrence of lowland debitage too large to have been made from cobbles that characterize the lowlands today. This indicates the material useful for biface production had been exhausted. An increase in upland zone use likely indicates the combination of two factors. During the late Newberry Period the pattern of subsistence intensification that is well documented throughout the region (i.e. Bettinger 1989, Delacorte 1990 Basgall 1989) began at Truman Meadows and resulted increased upland source use. A second possibility is that the increase in production is part of a pattern of lithic intensification requiring better lithic foraging return rates.

If cobbles of sufficient size for biface manufacture become rare in the lowlands, the search time for adequate material would increase effectively lowering the overall return rates for lithic procurement in the lowland zone. The average cobble size is larger in the upland zone, and would result in a higher return rate than the lowland zone. This would produce an increase in the use of the upland, where material of adequate size is more abundant. Thus, the increase in upland hydration readings during the Newberry period may be the result of more intensive biface production and not simply the result of a shift in settlement locations.

Unlike bifaces however, Newberry period cores were recovered from upland (n=36) and lowland (n=33) zones in virtually identical quantities. Thus during the Newberry period there is a zonal shift in the primary location of biface production but not core production. This suggests that biface production is more constrained by cobble size, and that material suitable for bifaces became scarce in the lowlands during the Newberry period.

As expected the debitage sample also is dominated by Newberry period hydration values. Of the 140 obsidian hydration readings on debitage, 70% (n=99) fall within Newberry period limits. Given the small sample size of pre-Newberry period debitage it is difficult to conclude that biface thinning flake stages changed in a significant way. The only inference regarding changes in reduction stages comes from bifaces, later stages showing lower hydration values. This indicates that bifaces were more extensively processed later in time, perhaps beginning in the Newberry period. It is also during the Newberry period that use of off-quarry sites becomes regularized. Prior to the Newberry period use of off-quarry loci for biface production was virtually nonexistent.

In summary the Newberry period is characterized as a period of increased intensity of lithic procurement. It is during this time that bifaces are the dominate tool form, but cores are also produced at their highest frequencies. Biface production occurs in all source contexts, but by the late Newberry it becomes more concentrated in the uplands. Secondary reduction loci and later stages of reduction are a regular part of the lithic procurement strategy by the late Newberry, indicating that lithic procurement was conducted over longer episodes during source visits. Collectively these indicate that the Newberry period is not just marked by increased levels of use but also differences in the intensity in which the source was being used and the initiation of a pattern of fully embedded lithic procurement.

Post-Newberry Period Use of the Truman/Queen Source

Post-Newberry times at the Truman/Queen source are represented by hydration values less than 2.9 microns. Use of the source during this time is drastically lower than the Newberry period, and represents only 12.4 % (n=66) of the total obsidian hydration readings. Unlike the pre-Newberry period the low levels of use during the post-Newberry cannot be attributed to low population numbers. There is nothing to indicate that regional populations declined in conjunction with obsidian source hydration profiles. In fact population levels are believed (Bettinger 1989) to continue to rise throughout the Holocene until the effects of European contact. It is this drop in quarry use, despite population increase, that archaeologists who study quarries have found most compelling.

The hydration sample representing post-Newberry times, includes 15 bifaces, 12 cores, 33 debitage, 5 projectile points and 1 flake tool. The period is marked by a substantial overall decline in use, shifting to heavier use of the upland zone. Of all post-Newberry period hydration values, 71% are from the upland zone, which is a substantial increase over the Newberry period (58%). A sharp reduction in biface production is evident. Only 5% of all biface hydration values (n=15) correspond to this period, the majority being from the upland (n=11).

Cores also display substantial reduction in production, with only 12% of all cores post dating the Newberry period. This is very similar to the biface relative frequency, but bifaces continue to dominate cores through this period, by a ratio of more than two to one. That bifaces vastly outnumber cores in post-Newberry times, is in direct opposition to the common assumption that cores replaced bifaces at the end of the Newberry period (i.e. Kelly 1988, Basgall and Giambastiani 1995, Gilreath and Hildebrandt 1995). Both of these technologies change over time in similar ways. It is simply that the biface change is amplified by the amount of waste generated during biface production.

It is difficult to determine whether cores vary by context during post-Newberry times because the sample is small (n=12). Cores do occur in both zones and both in quarry and off-quarry contexts, but not at levels which allow statistical inference. Although the sample size for bifaces is also small, it is interesting that no post-Newberry bifaces come from lowland off-quarry contexts. Secondary reduction of bifaces at off-quarry sites appears to increase in the post-Newberry period, at least off-quarry biface thinning flakes display the smallest mean hydration values. Collectively this indicates that during the Haiwee period biface production was less intensive, perhaps owing to increases in the amount of time that could be spent at the source for subsistence purposes. This is marked by increases in late stage biface reduction, the disuse of lowland off-quarry loci, and the increase in secondary reduction loci in the uplands.

This suggests that lithic procurement during the post-Newberry times was likely conducted in conjunction with use of the area for other resources. During this period groups in the area likely had a more centralized settlement pattern and use of the source was probably scheduled in conjunction with fall and winter use of the Pinyon Juniper Woodland. This likely supported larger group aggregates and lithic procurement could occur on site with relatively less time constraints than the Newberry period. This resulted in continued production of bifaces and cores, but at lower levels and greatly reduced levels of waste in comparison to the Newberry period. This is indicated by the persistence of biface production debris but substantially lower numbers of discarded bifaces in upland off-quarry contexts. Processing in this situation produced much less waste than Newberry lithic procurement activities.

Discussion: Examining Current Models of Quarry Use and Lithic Technology

The primary research objective of this project is to determine the degree to which variation in the use of western Great Basin quarries is driven by the processes archaeologists have previously identified. The models which continue to dominate archaeologist's perception of quarry use fall into two main categories. The first group are socio-technic arguments where exchange and non-local populations (i.e. central and southern California) are seen as a critical component of lithic procurement, and thus are primary causal factors in the pattern of quarry use. The second main type of argument examines the relationship of settlement patterns and mobility of local populations (i.e. western Great Basin inhabitants) to changes in lithic procurement and technological change evident at eastern California quarry sites.

Exchange models assume that major changes in the use of eastern California obsidian sources are due mainly to the change in importance of specialist produced items, for trans-Sierra Nevada inter-group exchange. Thus it is ultimately due to changes in non-local populations in central and southern California. This assumption can be seriously questioned on theoretical grounds, and is inconsistent with expectations given the context in which lithic procurement occurs. The process of exchange as described would require that the producing populations (i.e. Great Basin inhabitants) maintain lithic craft specialists that enjoyed privileged quarry access. However during the time (3500-

1350 B.P.) that the proposed organized biface production was at its peak (i.e. Singer and Ericson 1977; Ericson 1982), Great Basin populations are characterized by high residential mobility and little or no territoriality, making the management of an extensive trade system seem unlikely (Bouey and Basgall 1984). Additionally, there is no indication that the degree of specialization suggested by Ericson operated in the less complex egalitarian hunter-gatherer populations of the western Great Basin. Ericson asserts that limited field processing of toolstone corresponds with direct procurement, and extensive field processing with exchange, but does not indicate why this is so. Nor does he explain why a shift from luxury to utilitarian production would alter the economics of resource transport. The logic of Ericson's argument as it relates to field processing and transport decisions can also be questioned. It is unlikely given economic decisions regarding procurement costs, that the preferred unit of transport after 1350 B.P. is the unmodified form requiring lithic foragers to transport a load which is partially useless (Hall 1983; see also Holmes 1894; Elston 1990, Metcalfe and Barlow 1992). On the other hand nothing would have precluded its adoption by central and southern California populations prior to 1350 B.P., if this was more efficient. In short, there is nothing to indicate that a shift in production from luxury to utilitarian items would alter the economic considerations of resource transport, which is the basis of Ericson's argument.

Ultimately the presence of eastern California obsidian in California west of the Sierra Nevada, does not demonstrate anything other than the fact that the material was transported there. There are processes other than trade that could produce similar distributions of material. More importantly the focus on trans-Sierra Nevada exchange caused Singer and Ericson (i.e. Singer and Ericson 1977; Ericson 1982), and others (e.g.

Bouey and Basgall 1984) to ignore the equally salient record of lithic technology in non-quarry sites in eastern California and western Nevada, which mirrors the pattern at the quarries described here. In fact the number of bifaces found in association with high status burials in central and southern California is far less than the abundance of debris at eastern California quarries said to be the result of such production. Burial use likely contributed minimally to the patterns evident at eastern California obsidian sources. In addition the exchange model ignores the abundance of bifaces from eastern California sources that occur in utilitarian contexts in eastern California/western Great Basin sites (Basgall 1989, Basgall et. al. 1986).

The Bouey and Basgall version of the trade model as well as the trade component of the Gilreath and Hildebrandt model can be questioned on the same empirical grounds as Ericson's trade model. The majority of material from eastern California obsidian sources occurs in sites east of the Sierra Nevada. It follows that patterns evident at eastern California quarries are most affected by this eastern California system. Given that only a small proportion of eastern California obsidian makes it to the west side of the Sierra Nevada is sufficient grounds to question the trans-Sierra Nevada exchange model. Because trade models argue that outside populations are primarily responsible for producing variability at eastern California obsidian sources, the Truman/Queen source provides the perfect test case. The test implication is that if the Truman/Queen source were to show a pattern of use over time parallel to other sources, parsimony requires the assumption that its use was due to a similar set of causal factors. Given the notable absence of Truman/Queen obsidian west of the Sierra Nevada suggests these causal factors cannot be trans-Sierra Nevada trade as suggested by the three exchange based models.

It is clear from the cumulative obsidian hydration profile in Chapter 6 that the basic pattern of use observed at the Bodie Hills, Casa Diablo and Coso sources also occurred at the Truman/Queen source. At each source pre-Newberry period use was minimal with sharp increases during the Newberry period. All sources demonstrate major reductions in use toward the end of the Newberry period, and continued but very low levels of use through the post-Newberry periods.

The Casa Diablo and Truman/Queen sources are very similar in many other respects. Other than the shared general pattern of use, there were also small fluctuations in use at both sources at similar times as described in Chapter 6. Given the remarkable similarity of the overall curves from the two sources, it is likely that the same factors contributed to production variability at both sources. The same fluctuations are also apparent at Bodie Hills, however a larger hydration sample should still be obtained to add confidence and resolution to the production profile. Given the absence of Truman/Queen obsidian on the west side of the Sierra Nevada, external trans-Sierra Nevada exchange should no longer be viewed as a significant factor in eastern California obsidian quarry production variability.

It is more likely that changes in the archaeological record at eastern California obsidian quarries reflect a pattern of unrestricted access for utilitarian purposes by many different groups, primarily from east of the Sierra Nevada. Populations from west of the Sierra Nevada linked to the source through inter-regional luxury exchange contributed minimally to the pattern of eastern California obsidian source use, and most material that did make it over the Sierra Nevada likely doing so through direct access or informal exchange. It appears that the pattern of resource intensification and settlement centralization (ca. 1350 B.P.) is the key factor contributing to technological organization and quarry use. The question remains as to which part of this adaptive change would necessitate a change in technology to the degree observed in the record.

As described in Chapter 2, archaeologists have emphasized mobility (Bamforth 1986; Bleed 1986; Shott 1989; Kelly 1988), or the abundance of raw material (Bamforth 1991, 1992; Elston 1990; Andrefsky 1994) as the primary factors affecting the acquisition, production, maintenance, use and discard of stone tools. Many authors argue that bifaces are an efficient response to risks imposed by high mobility (Kelly 1988; Shott 1989; Elston 1990) because they are multipurpose tools with extended use lives (Bamforth 1986; Bleed 1986; Shott 1989; Kelly 1988), or because they are both maintainable and reliable (Bleed 1986). Highly mobile groups also incur greater transport costs, and bifacial tools are argued to be more efficient due to the high usable blade to weight ratio (Kelly 1988; Andrefsky 1994). Bifaces can also be used as cores (Kelly 1988) potentially requiring less weight to produce sufficient flake tools (Parry and Kelly 1987:298).

According to this logic less mobile populations have less opportunity for embedded procurement of high quality stone unless there is a high quality source within the range of their seasonal round. However more sedentary groups do not have the same transported weight restrictions faced by more mobile populations (Parry and Kelly 1987; Andrefsky 1994). Thus several authors have argued that technology should be organized around the production of cores and the use of informal flake tools, and a decrease in the frequency of formalized tools and tool pre-forms (Parry and Kelly 1987; Elston 1990).

There are aspects of these models that are appealing to those studying lithic technology in the western Great Basin. This is because of the major reduction in biface production evident in obsidian hydration profiles is contemporaneous with evidence for reductions in the mobility of groups in the area. It is no surprise then that some authors (Basgall 1989, Basgall and Giambastiani 1995, Kelly 1988) have recently applied this line of reasoning to interpret changes in source use in the western Great Basin. In this case, the technological change from bifaces to an enigmatic core/flake technology that is thought to occur roughly 1350 B.P. is the result of the pattern of reduced mobility and settlement centralization that is known to also have happened in the region at the same time. Evidence for this reduction in mobility is in the form of lower diversity of obsidian sources represented in post Newberry temporal components (Basgall 1989, Basgall and Giambastiani 1995). The emphasis on mobility as a conditioner of technology requires the assumption that toolstone acquisition and more importantly technological types are contingency decisions based on transport costs. High mobility equates to high transport costs and relatively unconstrained access (i.e. embedded procurement) and thus favors a particular technology. Low mobility equates to low transport cost but limited accessibility in the form of higher travel costs, thus requiring a different technology. The data from the Truman/Queen source indicate that the factors identified by the organization of technology models, such as levels of mobility and mode of procurement (i.e. logistical and embedded) had little effect on quarry use and likely even less effect on choices at the level of biface versus core.

In an area as rich in high quality lithic sources as eastern California, it is unlikely that the changes in lithic technology (e.g. biface to core/flake technology) that are routinely explained in terms of mobility and lithic availability are in fact the result of changes in these systems. The organization of technology models can also be questioned based on other empirical observations from this study. For example, if cores are an ideal sedentary technology they should be rare relative to bifaces in highly mobile pre-Newberry times, rather than equally abundant which is the pattern observed. Cores actually show about the same degree of change and at the same times as bifaces, and thus cannot be explained by differences in mobility.

Organization of technology models further contend that the actual mode of procurement may in part determine technology. Biface production is said to be associated with embedded procurement by highly mobile foragers (Binford 1980). However it is clear that bifaces were obtained by both logistical and embedded procurement in the past. Obsidian source profiles from various locations indicated this. Gilreath and Hildebrandt (1995) outline the history of use of the Coso source, summarizing hydration profiles from various sites throughout southern California and the western Great Basin. They identify the familiar Newberry period peak hydration profile in assemblages from the Coso source, the Kern Plateau, Antelope and Fremont Valley, and various locations in the greater Los Angeles/Orange County area (Gilreath and Hildebrandt 1995). In fact similar source profiles for the Casa Diablo source are evident at both the source proper and at non-quarry sites in Long Valley (Basgall 1989) as well as sites in Truckee Meadows (Elston 1986). There are many other occurrences of this Newberry period biface fluorescence. For example the majority of bifaces at Gatecliff shelter (Thomas 1983) correspond to the Reveille Period (ca. 1000 B.C. - A.D. 500), essentially coeval with the Newberry period.

The key point here is that the settlement systems of groups in the areas mentioned above were quite varied. In addition the modes of procurement given the varying distances from sources must have differed as well. For example, Newberry period inhabitants of Owens Valley clearly could have embedded lithic procurement in a seasonal round, as predicted by the organization of technology models. It is also probable that obsidian was an important motivation for groups traveling from what is now the greater Los Angeles area to the east side of the Sierra Nevada in Newberry times. In addition the degree to which these different groups moved around the landscape was different. For example, it is well documented that prehistoric inhabitants of Owens Valley California, and Central Nevada displayed different group compositions, and settlement patterns. For that mater, groups from Los Angeles who also used eastern California obsidians could not embed lithic procurement in a seasonal round, yet sites there produce obsidian hydration profiles nearly identical to the Casa Diablo source, Gatecliff Shelter, and Owens Valley, to name a few. Interestingly each area shows the same technological change at roughly the same time. Given the differences in mobility between these groups and the major differences in raw material availability between area such as Los Angeles and Truman/Meadows, there must be reasons why each area shows the same hydration profiles and technological shifts away from biface production. Simply put, the same technological change occurred in areas with major differences in population, group size and patterns of residential and logistical mobility, let alone access to obsidian sources.

Given that the occurrence of obsidian decreases as distance from the source increase, groups close to the source likely contributed more to variability at the source than more distant groups. It is further likely that the factors producing change in quarry use were adaptive ones (subsistence change, settlement centralization) rather that social ones. The different kinds of adaptive change, contributed to technology in different ways, and in varying degrees. First order determinants (such that necessitate a technological change at the level from a biface to a core/flake industry) are most likely subsistence driven, that is, specifically related to tasks and the ability of a specific tool form to contribute to resource return rates. Differential mobility likely contributes to technology in lesser ways affecting decisions regarding degrees of processing (i.e. biface stages, primary and secondary reduction loci) but not ultimately the type of tool.

Certain aspects of the organization of technology explanation for changes in lithic technology in eastern California are more appealing than the exchange alternative, particularly the view that bifaces served primarily utilitarian rather than luxury purposes. There is also an implied assumption that local populations produced the pattern at the source. However there are also certain aspects of the explanation that warrant further examination. The organization of technology explanations assume that technological decisions are centered around transport cost, and seek optimal solutions to problems of lithic production in the presence of mobility. This would suggest that the costs of transport are more important than the costs and benefits related to the actual use of the toolstone. This emphasis on mobility tends to remove technological organization from behaviors more directly related to subsistence and the actual task the tools are used for. Following this logic, technology could change regardless of its ability to contribute to the reduction of processing costs of particular resources. For this to make sense differences in toolstone transport costs would have to be greater than differences in resource processing costs, i.e., in order for changes in mobility to be more important than changes in subsistence in bringing about a technological change. Such a view underplays the degree to which a tool fail can perform its required function and in doing so increase the costs of important resources; the ones people actually ate. More recently, some archaeologists (Abbott et. al. 1996) have questioned the mobility part of the organization of technology model. Rather than viewing technology as being determined by mobility, Abbott, Leonard and Jones (1996) contend that "selective agents" cause both changes in mobility and technology. They reinterpret the transition from bifaces to flake tools in the American southwest as being due the replacement of a hunting technology with a flake technology linked to agriculture; given that selective forces favored the subsistence change technology changed in response. In other words the technological change was due to selective forces acting on subsistence strategies rather than the technology itself (Abbott et. al. 1996). This view of technology, as more directly related to the subsistence aspect of an adaptive system, is consistent with those presented here. However the "selectionist" view (Abbott et. al. 1996) does not indicate how subsistence and technology are related, only that they are.

Clearly a number of factors determine lithic technology, but ultimately tool procurement and use should be dictated by a simple economic relationship to resource return rates. Specifically the overall time and energy costs of a tool, which include travel to a source, primary reduction at the quarry, secondary reduction and finishing, and transporting the material, must all be outweighed by the benefit of using the tool. For this benefit to have adaptive significance it must in some way be related to the overall ability to extract energy from the environment. In this sense, lithic technology affects what is called handling costs in the diet breadth model (cf. MacArthur and Pianka 1966).

The diet breadth model ranks resources based on a relationship of net energetic yield per unit of handling time. In this model handling time is the total time to extract energy from the prey item including the time to capture or pursue the prey and the time to process it. When handling time is segregated into pursuit and processing time, it is clear that different technologies can contribute to handling times in differing ways. Thus decisions regarding projectile point manufacture (raw material acquisition, knapping, transport etc.) are likely related to lowering pursuit costs while biface manufacture is more likely related to reducing resource processing costs. Each of these trajectories however, has its own costs, including the time and energy to travel to a source, the primary reduction at the quarry, secondary reduction and finishing, and the cost of transporting the material. The combined total of these must be outweighed by the benefit of using the tool. This benefit can be viewed as the overall net reduction of post-encounter costs of a given resource by a certain technology. By definition, specialized tools produce an increased rate of return in a small range of circumstance, conversely generalized tools produce smaller benefits over a greater range of circumstances.

Looking at this another way, technology in part contributes to the ranking of resources in the diet breadth model because it can result in a reduction of post-encounter processing time. A critical element will obviously be the dietary contribution of the resources whose post-encounter time varies with technology. Technology is thus in part determined by the ability to contribute to a reduction in resource handling time and in part by the importance of the resource in the diet. In short the overall contribution of a tool to overall resource energy is directly related to the proportion of that resource in the diet.

Assuming that bifaces are manufactured to produce greater resource return rates requires fewer assumptions that the mobility argument. It does require one main assumption: that bifaces are a specialized technology rather than a generalized technology. During the process of resource intensification there is a potential for change in the proportion of a diet that is "chipped stone dependent." The overall benefit of using obsidian will change when the percentage of the diet requiring chipped stone tools changes. At a certain level it may not be economically feasible to incur procurement costs for a particular lithic technology even when those costs are minimized by such things as embedded procurement. My argument is that bifaces are primarily a butchering implement and that as the procurement of artiodactyls in the western Great Basin decreased, the overall reduction of resource handling time due to biface use was insufficient to warrant procurement and transport of bifaces. The cost of procurement exceeded cost reduction in subsistence (i.e. post-encounter handling time). This argument is in keeping with my larger argument that the effects of changes in diet are likely to have a more profound effect on technology than transport costs.

By this view technology is directly related to work, and the benefit of a tool is in the form of reduced labor expenditure in subsistence particularly. Thus the abundance of a tool in archaeological assemblages is directly proportional to it role in an adaptive system. Further, a generalized tool form is less likely to fluctuate in the face of subsistence change than a specialized tool form closely tied to a either a single resource or a small number of resources that require similar extractive methods.

The biface production in mobile hunter-gatherer societies may be governed by this relationship to processing costs. This may be tied to less frequent procurement of larger game which is thought to occur roughly 1000 B.P. in Owens Valley (c.f. Bettinger 1989) and other parts of the western Great Basin (Elston 1986). The concentration on larger game is well documented in the western Great Basin where it is a largely a Newberry period phenomenon, although the timing is similar in other areas. The same concentration on larger game primarily artiodactyls as well as intensive biface use is seen in Monitor Valley (Thomas 1983), in Deep Springs (Delacorte 1990), Owens Valley (Bettinger 1989, Basgall 1989) and along the entire Sierra Nevada front (Elston 1986). The Newberry biface peak for the Casa Diablo source is also evident at non-quarry sites in Long Valley (Basgall 1989) as well as sites in Truckee Meadows (Elston 1986).

Numerous authors have also identified similar focus on artiodactyls procurement limited to Newberry times and before, in various areas; on the Volcanic Tablelands (Basgall and Giambastiani 1995:251), in the western Mohave Desert (McGuire et al. 1982), and in eastern Nevada where the focus was on Mountain Sheep (Pippin 1979). The presence of bifaces and an emphasis on mountain sheep and mule deer were also identified further north in the Sierra Nevada at Bordertown near Lake Tahoe (Dansie 1979). Finally, as previously mentioned the same basic biface pattern was described by Gilreath and Hildebrandt (1995) while summarizing hydration profiles from various sites throughout southern California and the western Great Basin. They identify the familiar Newberry period peak hydration profiles and focus on bifaces in assemblages from the Coso source, the Kern Plateau, Antelope and Fremont Valley, and various locations in the greater Los Angeles/Orange County area (Gilreath and Hildebrandt 1995). There are many other occurrences of this Newberry period biface fluorescence.

The decline in hunting of artiodactyls likely contributed to the decline in biface use in each of these areas, and the reduction of biface production evident in the archaeological record at eastern California obsidian quarries. Viewing bifaces as a specialized technology, which was most beneficial for activities associated with processing of larger game animals likely accounts for the rise and fall of biface technology throughout the region. With this is mind the following history of technological change and source use is proposed on the basis of data from the Truman/Queen source.

Conclusion

The history of use of the Truman/Queen source demonstrates a pattern of intensification in the use of lithic material. Early use was the sparsest and cores and biface were produced in roughly equal proportions. Both lowland and upland portions of the site were used equally, but tool manufacturing was limited to primary quarry loci. During this time lithic procurement was likely conducted by small logistical groups that visited the source for very limited periods. Procurement may have been linked to settlement change but was more likely incidental in nature, and not organized scheduled procurement. The diversity of obsidian and other material in chipped stone assemblages is very high during these early periods, suggesting a free ranging settlement system (Basgall 1989).

During the early Newberry period lithic production dramatically intensifies, reaching the highest levels of use by the middle of the period. Unlike previous time periods, biface to core ratios are dramatically different during the Newberry period. Bifaces out number cores by more than three to one, but cores are also at their highest levels of production. Given the fact that both the Newberry and previous time periods are characterized by high mobility, the increase in bifaces cannot be attributed to mobility as argued in the organization of technology models. During the Newberry period lithic production becomes very intensive and use of secondary reduction loci becomes more regular. By the late Newberry period lowland portions of the Truman/Queen source no longer had sufficient numbers of large cobbles necessary to make lithic procurement in the zone worthwhile. There are cobbles of adequate size for biface manufacture present in the lowland today, but the quantity is low in comparison to the upland zone. It is likely that the return rates for lithic production, especially biface production, in the lowland zone became very low as the supply of larger cobbles diminished. Efforts to minimize the cost of lithic procurement may be marked by the permanent shift to primary use of upland portions of the source, where lithic production was organized in two stages. Intensive primary reduction, with massive culling and discard of early stage bifaces which occurred at the quarry proper, and secondary reduction with very low rates of biface discard occurred in the settlements in the Pinyon-Juniper Woodland zone. This indicates that quarry visits were for longer periods of time, which required some degree of subsistence support. Lithic procurement may have been conducted by larger logistical groups, who supported themselves at secondary reduction camp sites, while intensively procuring toolstone. During the Newberry period settlement patterns likely became more regularized, permitting fully embedded lithic procurement within scheduled subsistence and settlement patterns.

The increases use of Truman/Queen obsidian use during the Newberry period is likely the combination of two factors. The first is population increase, which likely resulting in an increase in the number of individuals dependent on material from the source. The second, and more profound, was the effects of subsistence intensification through out the Newberry period. During this period, hunting of artiodactyls reached its highest levels of intensity. This dietary emphasis is very "chipped stone dependent," hence the intensive nature of lithic procurement during the Newberry period. By this view bifaces served a specialized role in reducing the processing costs of artiodactyls. Because artiodactyls represented a relatively large proportion of the diet, the benefit of bifacial tools in reducing overall processing costs was substantial. Since bifaces are linked to high ranked resource, their overall contribution to foraging returns rates are larger than other technologies when resources are abundant and, and as return rates drop the role of bifaces becomes critical in maintaining the ranking of the resource. In other words efforts to maximize return rates requires technological efficiency that is in this case accomplished through production of bifaces.

The archaeological record throughout central and western Great Basin (i.e. Bettinger 1989, Thomas 1985, Delacorte 1990) indicates that this reliance on large game decreases dramatically as plant products become more important later in time. Major declines in the procurement of large game primarily artiodactyls, and biface use, have been noted in many areas; Monitor Valley (Thomas 1983), Deep Springs (Delacorte 1990) Owens Valley (Bettinger 1989, Basgall 1989) and along the entire Sierra Nevada front (Elston 1986), to name a few. Most of these areas used eastern California obsidian sources, and thus were the primary reasons for the decline in production evident in hydration profiles. This post-Newberry decline in quarry use is, of course seen at the Truman/Queen source where use falls to pre-Newberry levels.

As diet changed to an emphasis on plant food the beneficial contribution of bifaces to resource return rates fell below the cost of procuring, making and transporting them. Bifaces thus became less frequent and the pattern of intensive biface production ended at about 1350 B.P. Again, this suggest that bifaces were a specialized tool form and were tied to relatively very few high ranked resources. As diet breadth increases the proportion of the diet represented by these resources shrinks. When the total cost of a technology (travel to source, processing, maintenance etc.) exceeds its beneficial reduction in post-encounter handling time, it is discarded. That is, as a food resource becomes rare in the diet the overall benefit from any technology linked to that resource decreases. When this overall benefit is lower than the total cost of acquiring the technology, it is discontinued not necessarily replaced. The decline in biface production in the face of subsistence change indicates that they are not as generalized of a tool form as the organization of technology models describe them. However cores are generalized tools and thus experience very little change over time. In fact archaeologist should re-examine the supposed transition from biface to core/flake technology at the end of the Newberry Period and at similar times elsewhere. The data from this project indicate that this transition is more apparent than real and is the result the fact that cores are more visible in post-Newberry contexts given the discontinuation of highly wasteful (thus highly visible in the archaeological record) production of bifaces at the end of the Newberry period.

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APPENDIX A: METRIC ATTRIBUTES OF ARTIFACTS RECOVERED DURING PROJECT

Biface, Biface/Point, Uniface-B and Uniface Analysis Codes
(From Gilreath and Hildebrandt 1995)

Field Name	
Wt	Weight in grams
Len	Length in mm. - value indicates incomplete measurement
Wid	Width in mm. - value indicates incomplete measurement
Th	Thickness in mm. - value indicates incomplete measurement
Type	Fragment Type 1. whole 2. base 3. distal (tip) 4. indeterminate end 5. medial (midsection) 6. margin (also includes end corner fragments) 7. interior fragment (no margins) 8. transverse longitudinal
Stg	Stage 1. rough bifacial edge, thick sinuous margin 2. percussion shaped biface, rough outline 3. percussion thinned biface, well formed 4. intermittent pressure flaked biface, thin 5. extensively pressure flaked final bifacial tool (knife or point) 8. indeterminate
Var	Variety 1. could easily be identified as a core 2. bifacial working dominate 3. unifacial working dominate 8. bifacial microchipping 9. indeterminate
Org	Origin 1. nodule 2. chunk of nodule 3. flake 4. biface, ie. reworked from larger piece 8. indeterminate

Biface, Biface/Point, Uniface-B and Uniface Analysis Codes (cont.)
(From Gilreath and Hildebrandt 1995)

Field Name	
Shp	Planar Shape (whole)
	1. triangular
	2. lancelet
	3. rounded elongate
	4. rectangular
	5. circular
	6. wide-shouldered
	8. irregular
	Planar Shape (base, distal or end fragments)
	1. triangular
	2. rectangular
	3. blunted cornerless
	6. looks like came from a #6 whole
	7. pointed
	8. irregular
	9. indeterminate
	11. expanding end
	Planar Shape (margins)
	4. arced
	5. cornered
	6. straight
Xsec	Cross-section Shape
	1. domed, steep triangular
	2. biconvex
	3. plano-convex
	4. bi-planar with edges (plate)
	9. indeterminate (e.g., margins, interior fragments)
Rew	Reworking
	0. no evidence
	1. break line chipped, worked on internal fracture
	2. bruises (series of cones) present in attempt to rework

Biface, Biface/Point, Uniface-B and Uniface Analysis Codes (cont.)
(From Gilreath and Hildebrandt 1995)

Rej	Rejection
	0. no reason evident, the piece looks good 1. human error, manufacturing break 2. structural flaw, manufacturing break (material bad) 3. could not control planar shape 4. could not control cross-section 5. human error, outrepasse 8. indeterminate

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0043	237	U-80b	Reconn	N100/E300	Reconn	10.2	-42	29	9	2	3	2	3	3	2	0	8	N
468-0049	242	L-11	Reconn	N250/E375	Reconn	26.7	-70	48	9	1	3	3	3	8	3	0	0	N
468-0053	5	L-4	NW 1/4	N375/E100	Ancillary	152.5	-102	-69	23	1	1	1	2	6	2	0	0	Y
468-0056	6	L-4	NE 1/4	N375/E350	Ancillary	42.6	60	60	13	4	4	2	3	7	2	0	1	N
468-0057	6	L-4	NE 1/4	N375/E350	Ancillary	163.7	94	72	28	1	2	2	3	6	2	0	8	Y
468-0058	6	L-4	NE 1/4	N375/E350	Ancillary	77.2	98	53	12	1	2	2	3	3	3	0	3	Y
468-0060	6	L-4	NE 1/4	N375/E350	Ancillary	372.4	109	85	44	1	1	2	3	2	3	0	8	Y
468-0065	8	L-4	SE 1/4	N125/E350	50 Count	50.3	78	22	1	2	3	3	3	2	1	0	0	Y
468-0066	8	L-4	SE 1/4	N125/E350	Ancillary	104.5	-76	-64	23	4	2	2	3	11	2	0	1	N
468-0067	8	L-4	SE 1/4	N125/E350	Ancillary	198.6	101	67	38	1	2	2	3	3	2	0	8	N
468-0068	8	L-4	SE 1/4	N125/E350	Ancillary	30.2	-60	-40	10	3	3	2	3	7	2	0	1	N
468-0069	8	L-4	SE 1/4	N125/E350	Ancillary	70.1	-58	-66	20	4	2	1	3	7	3	0	1	N
468-0070	8	L-4	SE 1/4	N125/E350	Ancillary	110.1	90	58	27	1	1	1	1	2	1	0	4	N
468-0071	8	L-4	SE 1/4	N125/E350	Ancillary	133.6	94	68	34	1	2	2	3	6	1	0	4	N
468-0080	9	L-5	NW 1/4	N375/E100	50 Count	42.5	59	41	21	1	2	2	3	8	3	0	8	Y
468-0081	9	L-5	NW 1/4	N375/E100	Ancillary	110.6	104	52	24	1	2	2	3	6	2	0	3	Y
468-0082	9	L-5	NW 1/4	N375/E100	Ancillary	128.4	104	50	24	1	2	2	3	3	2	0	8	Y
468-0083	9	L-5	NW 1/4	N375/E100	Ancillary	56.2	101	48	12	4	2	9	3	8	3	0	0	N
468-0084	9	L-5	NW 1/4	N375/E100	Ancillary	351.7	112	76	37	1	1	2	1	6	4	0	4	Y
468-0085	9	L-5	NW 1/4	N375/E100	Ancillary	194.7	114	69	34	2	2	2	3	2	1	0	1	Y
468-0090	9	L-5	NW 1/4	N375/E100	Ancillary	79.1	88	52	18	1	1	3	3	8	3	0	8	Y
468-0091	10	L-5	NE 1/4	N375/E350	Ancillary	71.3	74	52	23	4	2	2	3	8	2	0	3	Y
468-0092	10	L-5	NE 1/4	N375/E350	50 Count	114.8	114	59	18	1	1	3	3	3	3	0	4	N
468-0093	10	L-5	NE 1/4	N375/E350	50 Count	42.3	56	40	16	1	2	2	3	8	2	0	8	Y
468-0096	10	L-5	NE 1/4	N375/E350	Ancillary	78	67	62	15	4	2	2	3	2	4	0	3	Y
468-0097	10	L-5	NE 1/4	N375/E350	Ancillary	54.5	66	57	15	4	2	2	3	2	2	0	3	Y
468-0100	12	L-5	SE 1/4	N125/E350	50 Count	313.7	118	77	51	1	1	1	3	8	1	0	8	Y
468-0102	12	L-5	SE 1/4	N125/E350	Ancillary	181	101	52	34	1	2	2	3	3	1	0	4	N
468-0103	12	L-5	SE 1/4	N125/E350	Ancillary	13.3	-59	-37	6	3	4	2	3	7	2	1	1	N
468-0105	12	L-5	SE 1/4	N125/E350	Ancillary	34.4	-81	-43	9	6	3	2	3	4	9	0	1	Y
468-0106	15	L-6	SW 1/4	N125/E100	Ancillary	738.4	161	87	62	1	1	2	3	3	2	0	0	N

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0110	14	L-6	NE 1/4	N375/E350	Ancillary	33.6	59	42	15	1	1	2	3	3	2	0	4	N
468-0111	14	L-6	NE 1/4	N375/E350	Ancillary	98.6	67	51	27	1	1	2	1	8	2	0	8	Y
468-0112	14	L-6	NE 1/4	N375/E350	Ancillary	46.1	-50	-51	14	4	2	2	3	9	3	1	2	N
468-0114	14	L-6	NE 1/4	N375/E350	50 Count	38.3	-60	-41	14	3	2	2	3	7	3	0	1	N
468-0117	17	L-8	NE 1/4	N350/E375	Ancillary	290.4	123	79	33	1	2	2	3	6	2	0	4	Y
468-0118	17	L-8	NE 1/4	N350/E375	Ancillary	61.8	-79	-44	-19	3	1	2	3	7	3	0	1	Y
468-0120	17	L-8	NE 1/4	N350/E375	Ancillary	97.1	67	63	19	4	2	2	3	8	3	0	3	Y
468-0121	18	L-8	SW 1/4	N150/E125	50 Count	5.6	-32	-30	-8	3	4	2	3	7	2	0	1	N
468-0122	18	L-8	SW 1/4	N150/E125	50 Count	10.7	-48	-28	-9	6	3	2	3	4	4	0	1	N
468-0123	20	L-9	NW 1/4	N375/E100	Ancillary	4.2	-41	-16	-4	3	5	2	3	7	2	0	1	N
468-0125	20	L-9	NW 1/4	N375/E100	Ancillary	29.1	68	47	11	1	2	2	3	2	3	0	0	N
468-0127	20	L-9	NW 1/4	N375/E100	Ancillary	117.9	89	56	28	4	2	2	3	8	1	0	3	N
468-0128	20	L-9	NW 1/4	N375/E100	Ancillary	49.6	70	46	20	1	2	2	3	8	2	0	8	Y
468-0129	20	L-9	NW 1/4	N375/E100	Ancillary	132.3	87	58	31	1	1	2	3	3	2	0	8	N
468-0134	20	L-9	NW 1/4	N375/E100	Ancillary	146.6	96	61	31	1	1	2	3	3	1	0	3	Y
468-0135	20	L-9	NW 1/4	N375/E100	Ancillary	116.1	68	58	26	4	1	2	3	3	2	0	3	Y
468-0136	20	L-9	NW 1/4	N375/E100	Ancillary	61.6	-76	-55	14	4	2	2	3	3	3	0	4	N
468-0138	21	L-9	NE 1/4	N375/E350	Ancillary	5.7	-27	-34	8	6	1	2	3	5	2	0	1	Y
468-0139	23	L-9	SE 1/4	N125/E350	Ancillary	174.5	91	65	28	1	2	2	3	5	2	0	3	Y
468-0140	23	L-9	SE 1/4	N125/E350	Ancillary	101.3	79	99	26	1	1	2	3	6	3	0	4	Y
468-0146	23	L-9	SE 1/4	N125/E350	50 Count	82.2	77	52	22	7	1	2	3	8	2	0	8	N
468-0150	24	L-10	NW 1/4	N375/E100	Ancillary	90.1	71	59	19	7	1	2	3	8	2	0	8	N
468-0151	24	L-10	NW 1/4	N375/E100	50 Count	41.6	-64	-43	15	3	3	2	3	7	3	0	1	N
468-0152	24	L-10	NW 1/4	N375/E100	Ancillary	90.5	60	60	21	1	2	2	3	6	3	0	8	N
468-0153	24	L-10	NW 1/4	N375/E100	Ancillary	131.5	90	60	26	4	1	2	3	11	2	0	3	N
468-0155	24	L-10	NW 1/4	N375/E100	Ancillary	86.2	77	65	19	1	1	2	3	8	2	0	4	Y
468-0158	24	L-10	NW 1/4	N375/E100	Ancillary	147.2	88	61	32	1	1	2	3	8	2	0	8	Y
468-0160	24	L-10	NW 1/4	N375/E100	Ancillary	155	91	57	26	1	2	2	3	4	2	0	8	Y
468-0162	24	L-10	NW 1/4	N375/E100	Ancillary	27.6	-44	-54	-11	4	3	2	3	3	2	0	1	N
468-0163	24	L-10	NW 1/4	N375/E100	Ancillary	354.1	110	79	51	1	1	1	8	8	1	0	8	Y
468-0164	25	L-10	NE 1/4	N375/E350	50 Count	24.2	-77	-38	10	3	3	2	3	7	2	0	1	N

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0165	25	L-10	NE 1/4	N375/E350	Ancillary	9.6	-47	-20	11	6	2	2	8	4	2	0	1	N
468-0166	25	L-10	NE 1/4	N375/E350	Ancillary	10.5	-52	-31	7	4	4	2	3	7	2	0	1	N
468-0167	25	L-10	NE 1/4	N375/E350	Ancillary	33	-58	-39	13	2	2	2	3	3	3	0	1	Y
468-0168	25	L-10	NE 1/4	N375/E350	Ancillary	30.9	-52	-47	14	2	4	2	3	3	3	0	1	N
468-0169	25	L-10	NE 1/4	N375/E350	Ancillary	116.2	61	79	17	4	1	2	3	5	2	0	3	Y
468-0170	25	L-10	NE 1/4	N375/E350	Ancillary	114.2	54	83	28	4	1	2	3	3	2	0	3	Y
468-0172	25	L-10	NE 1/4	N375/E350	Ancillary	43.6	66	42	18	1	3	2	3	6	2	0	0	Y
468-0174	27	L-10	SE 1/4	N125/E375	50 Count	87.5	77	56	24	1	1	2	3	3	2	0	4	Y
468-0176	26	L-10	SW 1/4	N125/E100	Ancillary	63.7	-74	-49	19	4	1	2	3	2	2	0	3	Y
468-0177	26	L-10	SW 1/4	N125/E100	Ancillary	125.2	78	64	28	1	1	2	1	5	2	0	4	Y
468-0179	26	L-10	SW 1/4	N125/E100	Ancillary	102.5	79	51	31	1	1	2	1	6	2	0	3	Y
468-0180	26	L-10	SW 1/4	N125/E100	Ancillary	82.5	79	53	22	1	2	3	3	3	3	0	0	N
468-0181	26	L-10	SW 1/4	N125/E100	Ancillary	148.6	92	55	31	1	1	2	3	6	1	0	3	Y
468-0182	26	L-10	SW 1/4	N125/E100	Ancillary	42.7	-71	-51	-14	3	2	2	3	7	3	0	1	N
468-0183	26	L-10	SW 1/4	N125/E100	Ancillary	150.3	75	76	25	2	2	2	3	3	2	0	1	Y
468-0184	26	L-10	SW 1/4	N125/E100	Ancillary	173.5	99	68	27	1	1	1	8	3	2	0	4	Y
468-0191	28	L-11	NW 1/4	N375/E100	50 Count	109.5	84	64	32	4	2	3	3	3	3	0	4	Y
468-0192	32	L-12	NW 1/4	N375/E125	Ancillary	16.9	-77	-32	7	3	3	2	3	2	2	0	1	N
468-0193	32	L-12	NW 1/4	N375/E125	Ancillary	124.1	-94	-65	24	4	1	2	3	3	2	0	4	N
468-0194	33	L-12	NE 1/4	N350/E325	Ancillary	146	118	62	22	2	2	2	3	3	2	0	1	N
468-0195	33	L-12	NE 1/4	N350/E325	50 Count	140.8	82	80	26	1	1	2	3	8	4	0	8	Y
468-0196	33	L-12	NE 1/4	N350/E325	Ancillary	159.1	92	62	27	1	1	2	3	8	3	0	8	N
468-0197	33	L-12	NE 1/4	N350/E325	Ancillary	23.6	56	29	14	1	2	2	3	2	3	0	4	N
468-0199	33	L-12	NE 1/4	N350/E325	Ancillary	70.3	76	61	14	1	3	2	3	6	2	0	0	N
468-0201	35	L-12	SE 1/4	N75/E375	Ancillary	15.1	-59	-29	8	6	2	2	3	4	2	0	1	N
468-0202	39	U-02	NW 1/4	N375/E100	Ancillary	64.8	52	60	26	4	1	2	3	8	1	0	8	Y
468-0203	39	U-02	NW 1/4	N375/E100	Ancillary	130.3	88	61	28	1	1	2	3	8	4	0	8	Y
468-0206	39	U-02	NW 1/4	N375/E100	Ancillary	86.6	48	68	24	4	1	2	3	2	2	0	1	Y
468-0207	39	U-02	NW 1/4	N375/E100	Ancillary	68.1	74	54	15	1	2	3	3	1	3	0	4	Y
468-0208	39	U-02	NW 1/4	N375/E100	Ancillary	47.2	60	51	16	4	2	2	3	3	2	0	1	Y
468-0209	39	U-02	NW 1/4	N375/E100	Ancillary	18	-46	-43	10	4	3	2	3	3	2	0	1	N

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0210	39	U-02	NW 1/4	N375/E100	Ancillary	175.5	106	75	28	1	2	2	3	3	2	0	1	N
468-0211	39	U-02	NW 1/4	N375/E100	Ancillary	110.9	82	57	25	2	2	2	3	8	3	0	1	Y
468-0212	39	U-02	NW 1/4	N375/E100	Ancillary	192.7	81	78	34	2	2	2	3	3	2	0	1	Y
468-0213	39	U-02	NW 1/4	N375/E100	Ancillary	111.9	89	56	26	1	1	2	3	8	1	0	8	N
468-0214	39	U-02	NW 1/4	N375/E100	Ancillary	16.2	-39	36	12	4	2	2	3	3	2	0	1	N
468-0215	39	U-02	NW 1/4	N375/E100	Ancillary	13	-43	-41	8	2	3	2	3	3	2	0	1	N
468-0216	41	U-02	SW 1/4	N125/E100	Ancillary	8.4	-41	-35	7	3	3	2	3	7	2	0	1	N
468-0218	41	U-02	SW 1/4	N125/E100	Ancillary	10.9	-27	-34	12	4	2	2	3	3	2	0	8	N
468-0219	41	U-02	SW 1/4	N125/E100	Ancillary	23.9	-42	-36	13	4	3	3	3	9	2	0	1	N
468-0220	41	U-02	SW 1/4	N125/E100	Ancillary	5.1	-26	-27	6	2	5	2	3	2	2	0	1	N
468-0221	41	U-02	SW 1/4	N125/E100	Ancillary	1.6	-20	-16	4	3	4	2	3	7	2	0	1	N
468-0222	41	U-02	SW 1/4	N125/E100	Ancillary	4.2	-43	-21	5	3	5	8	3	7	2	0	1	N
468-0223	40	U-02	NE 1/4	N375/E275	50 Count	97.4	86	51	24	1	1	2	3	6	2	0	8	Y
468-0226	40	U-02	NE 1/4	N375/E275	Ancillary	126.9	79	62	22	1	1	2	3	8	3	0	8	N
468-0228	42	U-02	SE 1/4	N100/E375	Ancillary	21.1	-55	-30	16	6	1	2	8	4	9	0	1	N
468-0229	42	U-02	SE 1/4	N100/E375	Ancillary	9.1	-42	-31	7	3	3	2	3	7	2	1	1	N
468-0230	42	U-02	SE 1/4	N100/E375	Ancillary	16.4	-40	-42	8	5	3	2	3	1	2	0	1	N
468-0231	42	U-02	SE 1/4	N100/E375	Ancillary	8.5	-33	-33	7	3	3	2	3	1	2	0	1	N
468-0232	42	U-02	SE 1/4	N100/E375	50 Count	52	-71	-42	21	4	1	9	3	4	9	0	1	Y
468-0233	42	U-02	SE 1/4	N100/E375	50 Count	69.6	-72	-46	15	4	2	2	3	8	2	0	1	N
468-0235	43	U-07	NW 1/4	N375/E100	Ancillary	36.9	-51	-52	12	2	2	2	3	3	3	0	1	N
468-0236	43	U-07	NW 1/4	N375/E100	Ancillary	29.2	-44	-56	11	3	4	2	3	3	2	0	1	N
468-0238	43	U-07	NW 1/4	N375/E100	Ancillary	4.7	-36	-33	5	3	5	8	3	7	2	0	1	N
468-0239	43	U-07	NW 1/4	N375/E100	Ancillary	12.1	-41	-41	9	3	4	2	3	7	3	0	1	N
468-0240	43	U-07	NW 1/4	N375/E100	Ancillary	17	-51	-39	9	3	4	2	3	7	2	0	1	N
468-0241	43	U-07	NW 1/4	N375/E100	Ancillary	4.6	-20	-33	7	6	4	2	3	6	2	0	1	N
468-0242	43	U-07	NW 1/4	N375/E100	Ancillary	3.2	-25	-21	5	6	4	2	3	4	2	0	1	N
468-0243	45	U-07	SW 1/4	N100/E125	Ancillary	23.6	-29	-65	12	4	2	2	3	2	2	0	1	N
468-0244	45	U-07	SW 1/4	N100/E125	Ancillary	2.4	-34	-11	4	3	5	8	3	7	2	0	1	N
468-0245	45	U-07	SW 1/4	N100/E125	Ancillary	29.2	-60	-44	12	4	1	1	3	3	3	0	1	Y
468-0250	44	U-07	NE 1/4	N350/E325	Ancillary	130.4	81	56	24	4	1	2	3	3	2	0	1	Y

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0252	46	U-07	SE 1/4	N125/E350	50 Count	109.6	81	62	25	4	1	2	1	7	3	0	1	Y
468-0255	46	U-07	SE 1/4	N125/E350	Ancillary	63.5	73	43	24	1	1	2	3	6	2	0	8	N
468-0256	46	U-07	SE 1/4	N125/E350	Ancillary	99.1	-94	-51	24	4	1	2	3	3	3	0	3	N
468-0259	46	U-07	SE 1/4	N125/E350	Ancillary	165.3	88	63	26	1	1	2	3	6	2	0	8	Y
468-0260	46	U-07	SE 1/4	N125/E350	Ancillary	52.6	-78	-43	17	2	1	2	3	3	2	0	3	N
468-0261	46	U-07	SE 1/4	N125/E350	Ancillary	80.7	71	56	16	4	1	2	3	4	2	0	1	N
468-0263	47	U-86	NW 1/4	N375/E100	Ancillary	25.6	-44	-42	12	2	2	2	8	2	2	0	1	N
468-0266	47	U-86	NW 1/4	N375/E100	Ancillary	68.9	73	44	21	1	1	2	3	8	4	0	8	Y
468-0267	49	U-86	SW 1/4	N125/E100	Ancillary	60.1	-85	-50	16	6	1	2	3	6	9	0	1	N
468-0268	49	U-86	SW 1/4	N125/E100	Ancillary	144.8	92	75	24	1	2	2	3	5	3	0	1	N
468-0269	49	U-86	SW 1/4	N125/E100	Ancillary	110	-83	-71	21	5	2	2	3	6	2	0	1	N
468-0270	49	U-86	SW 1/4	N125/E100	Ancillary	99.9	-70	68	23	4	2	2	3	11	2	0	1	N
468-0272	49	U-86	SW 1/4	N125/E100	Ancillary	185	102	70	30	4	2	2	3	3	2	0	1	Y
468-0275	49	U-86	SW 1/4	N125/E100	Ancillary	25.6	-50	-40	13	5	2	2	3	8	2	0	1	N
468-0276	49	U-86	SW 1/4	N125/E100	Ancillary	45.8	71	35	20	1	1	2	3	4	2	0	8	N
468-0279	50	U-86	SE 1/4	N125/E375	50 Count	151.1	97	64	29	1	1	2	3	1	3	0	8	Y
468-0280	50	U-86	SE 1/4	N125/E375	50 Count	27.3	-59	34	11	2	3	2	8	2	2	0	1	N
468-0281	50	U-86	SE 1/4	N125/E375	50 Count	253.5	102	77	50	1	1	2	3	5	2	0	1	Y
468-0284	50	U-86	SE 1/4	N125/E375	Ancillary	60.6	70	46	17	1	2	2	3	3	3	0	0	Y
468-0287	50	U-86	SE 1/4	N125/E375	Ancillary	149.1	73	68	29	1	2	2	8	4	2	0	8	Y
468-0288	50	U-86	SE 1/4	N125/E375	Ancillary	648.2	142	96	51	1	1	2	1	6	2	0	0	Y
468-0290	50	U-86	SE 1/4	N125/E375	Ancillary	174.7	86	63	33	1	1	2	3	8	1	0	8	Y
468-0292	50	U-86	SE 1/4	N125/E375	Ancillary	183.3	97	66	27	1	1	2	3	2	3	0	8	Y
468-0294	50	U-86	SE 1/4	N125/E375	Ancillary	130	76	67	15	1	1	2	3	4	4	0	8	Y
468-0295	50	U-86	SE 1/4	N125/E375	Ancillary	151.8	-75	-75	32	2	1	1	3	3	2	0	1	Y
468-0296	51	U-87	NW 1/4	N350/E125	50 Count	71.3	73	45	23	1	3	2	8	2	2	0	0	Y
468-0297	51	U-87	NW 1/4	N350/E125	50 Count	29.1	-41	-51	13	6	1	2	3	9	9	0	1	N
468-0298	51	U-87	NW 1/4	N350/E125	50 Count	2.1	-21	-18	5	6	4	8	3	6	2	0	1	N
468-0299	53	U-87	SW 1/4	N125/E100	50 Count	138.4	104	49	31	1	1	2	3	3	2	0	8	Y
468-0300	53	U-87	SW 1/4	N125/E100	50 Count	86	85	51	24	1	2	2	3	3	2	0	3	N
468-0301	52	U-87	NE 1/4	N375/E350	Ancillary	12.5	-24	-47	10	3	3	2	3	3	3	0	1	N

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0302	52	U-87	NE 1/4	N375/E350	Ancillary	85.9	-60	-60	22	3	1	2	3	3	2	0	1	N
468-0303	52	U-87	NE 1/4	N375/E350	Ancillary	76.7	72	56	22	1	1	2	3	5	3	0	8	Y
468-0304	52	U-87	NE 1/4	N375/E350	Ancillary	218.3	95	69	31	1	1	2	3	8	2	0	8	Y
468-0306	52	U-87	NE 1/4	N375/E350	Ancillary	120.1	102	51	21	1	2	2	8	2	3	0	0	N
468-0310	52	U-87	NE 1/4	N375/E350	Ancillary	98.6	78	56	22	1	2	2	3	8	2	0	8	N
468-0311	52	U-87	NE 1/4	N375/E350	Ancillary	63.9	-78	-42	17	6	3	2	3	8	2	0	8	N
468-0314	54	U-87	SE 1/4	N125/E350	Ancillary	74.4	-84	49	18	2	1	2	3	3	3	0	1	N
468-0315	54	U-87	SE 1/4	N125/E350	Ancillary	52.3	-82	-44	17	4	2	2	8	3	2	1	1	N
468-0316	54	U-87	SE 1/4	N125/E350	Ancillary	157.4	107	65	26	1	2	1	3	2	3	0	3	Y
468-0317	54	U-87	SE 1/4	N125/E350	Ancillary	78.4	-83	-71	14	4	1	2	3	11	2	0	1	Y
468-0318	54	U-87	SE 1/4	N125/E350	Ancillary	53	-85	-54	11	3	2	2	3	7	2	1	1	N
468-0319	54	U-87	SE 1/4	N125/E350	Ancillary	69.9	74	54	17	1	1	2	3	6	2	0	0	Y
468-0321	54	U-87	SE 1/4	N125/E350	Ancillary	209.5	89	74	28	4	1	2	3	3	2	0	3	N
468-0322	54	U-87	SE 1/4	N125/E350	Ancillary	93.1	88	52	29	1	2	2	3	6	1	0	4	Y
468-0323	54	U-87	SE 1/4	N125/E350	Ancillary	194	135	51	32	1	2	2	3	6	1	0	8	Y
468-0324	54	U-87	SE 1/4	N125/E350	Ancillary	108.1	90	53	25	1	1	2	3	6	1	0	8	Y
468-0325	54	U-87	SE 1/4	N125/E350	Ancillary	52.3	-46	67	12	2	3	2	8	3	2	0	1	N
468-0326	54	U-87	SE 1/4	N125/E350	Ancillary	13.1	-46	-37	8	3	2	2	3	7	2	0	1	N
468-0327	54	U-87	SE 1/4	N125/E350	Ancillary	33.4	-43	-57	11	4	2	2	8	3	2	0	1	N
468-0328	54	U-87	SE 1/4	N125/E350	Ancillary	66.1	78	43	19	4	1	2	3	3	2	0	1	N
468-0329	53	U-87	SW 1/4	N125/E100	Ancillary	63.5	-84	-44	11	1	1	2	3	3	2	0	1	N
468-0330	53	U-87	SW 1/4	N125/E100	Ancillary	22.9	-41	-51	8	2	3	2	3	2	2	0	1	N
468-0331	53	U-87	SW 1/4	N125/E100	Ancillary	204.6	115	61	32	1	1	2	1	8	2	0	8	Y
468-0333	53	U-87	SW 1/4	N125/E100	Ancillary	92.4	-51	-71	21	2	2	3	3	3	2	0	1	N
468-0334	53	U-87	SW 1/4	N125/E100	Ancillary	138.8	93	61	23	1	1	2	3	8	3	0	8	Y
468-0335	53	U-87	SW 1/4	N125/E100	Ancillary	153.3	84	69	33	1	1	2	3	5	2	0	3	Y
468-0336	53	U-87	SW 1/4	N125/E100	Ancillary	449.6	136	91	46	1	1	2	3	8	1	0	8	Y
468-0337	53	U-87	SW 1/4	N125/E100	Ancillary	58	-89	-49	15	6	2	2	8	8	2	0	4	N
468-0338	53	U-87	SW 1/4	N125/E100	Ancillary	270.2	97	68	47	1	1	2	8	8	1	0	8	N
468-0339	53	U-87	SW 1/4	N125/E100	Ancillary	140	123	47	25	1	1	2	3	6	1	0	8	Y
468-0340	53	U-87	SW 1/4	N125/E100	Ancillary	274.4	128	52	43	1	1	2	3	3	2	0	8	Y

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0341	57	U-88	SW 1/4	N125/E100	Ancillary	85.5	-77	-56	24	4	2	2	3	7	3	0	1	N
468-0342	57	U-88	SW 1/4	N125/E100	Ancillary	27.2	-96	-47	-11	6	3	2	8	6	2	0	5	N
468-0343	57	U-88	SW 1/4	N125/E100	Ancillary	80.6	61	71	21	4	2	2	3	8	2	0	8	Y
468-0344	57	U-88	SW 1/4	N125/E100	Ancillary	303.2	112	71	55	1	1	2	8	8	1	0	8	Y
468-0345	57	U-88	SW 1/4	N125/E100	Ancillary	52.8	-54	-49	21	3	1	1	8	2	2	0	1	N
468-0346	57	U-88	SW 1/4	N125/E100	Ancillary	28.1	-38	-55	12	2	1	2	3	3	3	0	1	N
468-0347	57	U-88	SW 1/4	N125/E100	Ancillary	37.1	-70	-57	8	4	3	2	8	7	2	0	1	N
468-0348	58	U-88	SE 1/4	N100/E325	Ancillary	17.1	-50	-34	11	6	4	8	8	5	2	1	1	N
468-0349	58	U-88	SE 1/4	N100/E325	Ancillary	28.4	-59	-46	12	4	3	2	3	3	2	0	1	N
468-0351	58	U-88	SE 1/4	N100/E325	Ancillary	16.1	-54	-33	10	3	3	2	3	11	2	0	1	N
468-0352	58	U-88	SE 1/4	N100/E325	Ancillary	33	66	40	11	1	3	2	3	2	2	0	0	N
468-0354	58	U-88	SE 1/4	N100/E325	Ancillary	18.2	-62	-33	9	4	3	2	8	11	2	0	1	N
468-0355	58	U-88	SE 1/4	N100/E325	Ancillary	70.7	72	46	23	1	2	1	3	2	3	0	0	Y
468-0356	58	U-88	SE 1/4	N100/E325	Ancillary	32.3	91	-34	13	6	2	2	3	1	2	0	1	N
468-0357	59	U-89	NW 1/4	N350/E100	50 Count	146.1	92	64	25	1	1	3	3	3	4	0	8	Y
468-0358	59	U-89	NW 1/4	N350/E100	Ancillary	203.1	115	59	30	1	2	2	3	3	2	0	8	N
468-0359	59	U-89	NW 1/4	N350/E100	Ancillary	72.1	-87	-46	22	4	2	1	8	11	2	0	1	Y
468-0361	59	U-89	NW 1/4	N350/E100	Ancillary	126.4	103	52	27	6	1	2	3	4	2	0	8	N
468-0363	59	U-89	NW 1/4	N350/E100	Ancillary	91.1	71	75	28	4	1	2	3	8	2	0	8	Y
468-0366	59	U-89	NW 1/4	N350/E100	Ancillary	6.7	-29	-32	6	5	4	2	3	9	2	0	1	N
468-0367	59	U-89	NW 1/4	N350/E100	Ancillary	151.8	121	56	26	1	2	1	8	6	2	0	4	Y
468-0368	59	U-89	NW 1/4	N350/E100	Ancillary	639.9	152	87	58	1	1	2	1	6	1	0	8	Y
468-0369	59	U-89	NW 1/4	N350/E100	Ancillary	217.6	114	73	28	1	1	2	3	6	3	0	8	Y
468-0374	62	U-89	SE 1/4	N125/E375	Ancillary	25.8	46	36	13	6	1	2	3	4	4	0	8	N
468-0375	60	U-89	NE 1/4	N325/E375	Ancillary	27.8	-74	-40	11	4	4	2	3	7	2	0	1	N
468-0376	60	U-89	NE 1/4	N325/E375	Ancillary	28.9	-58	-49	11	4	3	2	3	3	2	0	1	N
468-0377	60	U-89	NE 1/4	N325/E375	Ancillary	37.4	-69	-46	13	3	4	2	3	7	2	0	1	N
468-0378	60	U-89	NE 1/4	N325/E375	Ancillary	25.5	-68	-42	10	1	2	2	3	1	2	0	3	N
468-0379	60	U-89	NE 1/4	N325/E375	Ancillary	44.5	-68	-46	13	4	2	2	3	3	3	0	8	N
468-0380	60	U-89	NE 1/4	N325/E375	Ancillary	8.8	-37	-27	-11	6	3	2	3	6	2	0	8	N
468-0381	60	U-89	NE 1/4	N325/E375	Ancillary	26.7	-69	-59	11	4	3	2	3	3	2	0	1	N

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0382	60	U-89	NE 1/4	N325/E375	Ancillary	90.6	-62	-58	20	2	2	2	8	2	2	1	8	Y
468-0383	60	U-89	NE 1/4	N325/E375	Ancillary	5.4	-44	-26	-7	3	4	8	3	7	2	0	8	N
468-0384	60	U-89	NE 1/4	N325/E375	Ancillary	141.8	-104-	54	32	1	1	2	3	3	2	0	8	Y
468-0385	60	U-89	NE 1/4	N325/E375	Ancillary	24.7	-60	-41	8	1	3	2	3	8	2	2	3	N
468-0387	60	U-89	NE 1/4	N325/E375	Ancillary	123.6	91	59	29	1	1	2	3	3	2	0	8	N
468-0388	60	U-89	NE 1/4	N325/E375	Ancillary	85.3	62	61	17	4	1	2	3	3	4	0	1	Y
468-0389	60	U-89	NE 1/4	N325/E375	Ancillary	60.3	-71	46	29	1	1	1	3	6	3	0	1	N
468-0390	60	U-89	NE 1/4	N325/E375	Ancillary	114.2	110	49	24	1	1	2	3	3	1	0	8	N
468-0391	60	U-89	NE 1/4	N325/E375	Ancillary	143.9	62	92	28	2	2	2	3	3	3	0	2	N
468-0395	63	U-95	NW 1/4	N375/E100	50 Count	6.4	-27	-45	9	5	4	8	3	9	3	0	1	N
468-0396	63	U-95	NW 1/4	N375/E100	50 Count	44.1	-85	-34	-17	3	2	2	8	7	2	0	4	Y
468-0397	64	U-95	NE 1/4	N375/E375	Ancillary	7.3	-26	-34	7	4	3	2	3	3	2	0	8	N
468-0398	64	U-95	NE 1/4	N375/E375	Ancillary	6.1	-35	-24	6	2	3	2	3	2	2	0	8	N
468-0399	65	U-95	SW 1/4	N125/E125	Ancillary	1.9	-21	-16	6	6	3	2	8	4	9	0	8	N
468-0400	65	U-95	SW 1/4	N125/E125	Ancillary	14.2	-38	-40	9	4	2	2	3	2	3	1	8	Y
468-0405	67	U-97	NW 1/4	N375/E100	Ancillary	132.9	85	56	30	4	1	2	3	11	2	0	1	Y
468-0406	67	U-97	NW 1/4	N375/E100	Ancillary	42.5	-77	-63	10	2	3	2	3	3	2	0	1	N
468-0407	67	U-97	NW 1/4	N375/E100	Ancillary	200.6	92	71	37	1	1	2	3	6	3	0	8	Y
468-0408	67	U-97	NW 1/4	N375/E100	Ancillary	257	131	76	34	1	1	2	3	8	2	0	8	Y
468-0409	67	U-97	NW 1/4	N375/E100	Ancillary	125.1	94	56	37	1	1	2	3	3	2	0	8	Y
468-0411	67	U-97	NW 1/4	N375/E100	Ancillary	127.9	98	50	28	1	1	2	3	3	2	0	8	Y
468-0412	67	U-97	NW 1/4	N375/E100	Ancillary	146.2	-74	-81	19	2	2	2	8	11	2	0	2	Y
468-0417	68	U-97	NE 1/4	N375/E350	Ancillary	4.9	-47	-20	6	3	4	8	3	7	2	0	8	N
468-0418	68	U-97	NE 1/4	N375/E350	Ancillary	8.9	-31	34	10	2	3	2	3	2	2	0	1	N
468-0420	68	U-97	NE 1/4	N375/E350	Ancillary	4.1	-21	30	6	2	4	8	3	2	2	0	8	N
468-0421	68	U-97	NE 1/4	N375/E350	Ancillary	42.8	-61	-52	12	4	2	2	3	11	2	0	8	N
468-0422	68	U-97	NE 1/4	N375/E350	Ancillary	8	-45	28	6	4	5	8	3	2	2	0	8	N
468-0423	68	U-97	NE 1/4	N375/E350	Ancillary	7.6	-47	-25	7	4	3	2	3	11	2	0	8	N
468-0424	68	U-97	NE 1/4	N375/E350	Ancillary	52.5	-80	-54	16	4	3	2	8	8	3	0	3	N
468-0425	68	U-97	NE 1/4	N375/E350	Ancillary	30.7	-52	-37	16	6	2	9	8	9	2	0	1	N
468-0427	68	U-97	NE 1/4	N375/E350	Ancillary	5.8	-29	-29	6	2	4	2	3	2	2	0	8	N

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0430	68	U-97	NE 1/4	N375/E350	Ancillary	7.6	-37	32	7	2	4	8	3	1	3	0	8	N
468-0431	68	U-97	NE 1/4	N375/E350	Ancillary	3.6	-31	-24	4	5	5	8	3	6	2	0	8	N
468-0432	68	U-97	NE 1/4	N375/E350	Ancillary	101.9	-76	71	21	4	2	2	3	3	2	0	0	N
468-0433	68	U-97	NE 1/4	N375/E350	Ancillary	49.7	-74	41	18	4	2	2	3	3	2	0	8	N
468-0434	68	U-97	NE 1/4	N375/E350	Ancillary	82.6	95	49	18	1	2	2	3	6	2	0	0	Y
468-0435	69	U-97	SW 1/4	N125/E125	Ancillary	270.1	111	67	36	1	1	2	3	8	2	0	8	Y
468-0437	69	U-97	SW 1/4	N125/E125	Ancillary	80.3	-78	53	20	2	2	2	3	3	2	0	8	N
468-0438	69	U-97	SW 1/4	N125/E125	Ancillary	155.9	99	58	27	1	1	2	3	8	2	0	8	Y
468-0439	69	U-97	SW 1/4	N125/E125	Ancillary	143.7	93	72	25	4	1	2	3	11	2	0	1	N
468-0440	69	U-97	SW 1/4	N125/E125	Ancillary	98.2	80	46	28	1	1	2	3	6	3	0	8	Y
468-0441	69	U-97	SW 1/4	N125/E125	Ancillary	195.1	111	65	41	1	1	2	3	6	1	0	8	Y
468-0442	69	U-97	SW 1/4	N125/E125	Ancillary	241.5	94	76	38	6	1	2	3	8	2	0	8	Y
468-0443	69	U-97	SW 1/4	N125/E125	Ancillary	56.9	-57	-63	16	4	1	3	3	11	3	0	8	N
468-0444	70	U-97	SE 1/4	N125/E350	50 Count	8.2	-59	-19	7	3	3	2	3	7	2	0	1	N
468-0445	70	U-97	SE 1/4	N125/E350	Ancillary	134.6	97	58	27	1	2	2	3	2	3	0	4	N
468-0446	70	U-97	SE 1/4	N125/E350	Ancillary	113.5	-73	-68	21	4	1	1	3	11	2	0	8	Y
468-0449	70	U-97	SE 1/4	N125/E350	Ancillary	5.1	-29	-31	5	2	4	8	3	1	2	0	8	N
468-0452	72	U-100	NE 1/4	N425/E350	50 Count	37.9	-71	-41	16	6	2	9	8	5	9	0	5	Y
468-0455	75	U-101	NW 1/4	N375/E100	50 Count	49.8	-53	-49	24	4	2	3	3	3	3	0	1	N
468-0456	75	U-101	NW 1/4	N375/E100	Ancillary	77.6	79	59	12	1	1	3	8	6	2	0	8	Y
468-0458	75	U-101	NW 1/4	N375/E100	Ancillary	34.4	59	47	12	1	1	1	3	6	3	0	8	N
468-0459	77	U-101	SE 1/4	N50/E450	50 Count	48	76	46	17	1	1	3	3	6	2	0	0	Y
468-0461	77	U-101	SE 1/4	N50/E450	50 Count	100.3	75	59	21	4	1	2	3	3	2	0	8	Y
468-0462	77	U-101	SE 1/4	N50/E450	50 Count	33.1	-32	-49	17	5	2	2	8	9	2	0	8	N
468-0463	77	U-101	SE 1/4	N50/E450	50 Count	12.6	-29	-31	13	6	2	9	8	5	9	0	8	N
468-0464	77	U-101	SE 1/4	N50/E450	50 Count	22.5	-47	-37	11	4	2	2	3	11	2	0	8	N
468-0466	76	U-101	NE 1/4	N375/E350	50 Count	7.1	-38	-22	7	3	3	2	8	7	2	0	8	N
468-0564	50	U-86	SE 1/4	N125/E375	50 Count	150.3	89	77	26	4	1	2	3	8	4	0	8	Y
468-0566	52	U-87	NE 1/4	N375/E350	50 Count	102.2	78	61	28	6	1	2	8	8	4	0	8	Y
468-0567	8	L-4	SE 1/4	N125/E350	50 Count	109.1	74	64	28	4	1	2	3	7	1	0	8	N
468-0570	5	L-4	NW 1/4	N375/E100	Ancillary	23.8	73	40	9	1	2	3	3	3	3	0	0	N

METRIC ATTRIBUTES OF BIFACES RECOVERED DURING PROJECT (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0572	5	L-4	NW 1/4	N375/E100	Ancillary	37.2	-54	46	16	4	2	3	3	3	3	0	2	Y
468-0573	18	L-8	SW 1/4	N150/E125	50 Count	2.5	-28	-16	6	6	8	2	3	6	2	0	8	N
468-0574	39	U-02	NW 1/4	N375/E100	50 Count	9.4	-52	-25	11	6	8	9	8	4	3	0	8	N
468-0575	41	U-02	SW 1/4	N125/E100	50 Count	6.7	-34	-28	8	4	3	2	3	11	2	0	8	N
468-0578	50	U-86	SE 1/4	N125/E375	50 Count	79.2	-74	60	19	4	1	3	3	11	3	0	4	Y
468-0580	52	U-87	NE 1/4	N375/E350	50 Count	14.4	67	-26	8	1	4	3	3	3	3	0	8	N
468-0581	53	U-87	SW 1/4	N125/E100	50 Count	165.2	109	66	27	1	2	3	3	6	3	0	8	Y
468-0582	61	U-89	SW 1/4	N100/E125	50 Count	10.3	-37	25	10	1	2	3	3	6	3	0	8	Y
468-0583	61	U-89	SW 1/4	N100/E125	50 Count	39.1	-51	-56	14	4	2	3	8	7	4	0	8	N
468-0584	63	U-95	NW 1/4	N375/E100	50 Count	15.6	-42	-41	9	4	1	3	3	2	4	0	8	N

METRIC ATTRIBUTES OF UNIFACES RECOVERED DURING PROJECT

Cat #	Lot#	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	ML	WID	TH	WT	Type	Origin	Shp	Wear	Rej	CRT
468-0113	14	L-6	NE 1/4	N375/E350	Ancillary	67	42	19	49.4	1	3	6	2	0	Y
468-0253	46	U-07	SE 1/4	N125/E350	Ancillary	89	60	23	140.9	1	3	6	2	4	Y
468-0257	46	U-07	SE 1/4	N125/E350	Ancillary	83	51	22	82.9	1	3	6	2	4	Y
468-0265	47	U-86	NW 1/4	N375/E100	Ancillary	-60	43	21	59.2	4	3	7	2	1	Y
468-0305	52	U-87	NE 1/4	N375/E350	Ancillary	65	39	17	49.3	1	3	6	2	0	Y
468-0312	52	U-87	NE 1/4	N375/E350	Ancillary	74	49	9	66.9	1	3	3	1	0	Y
468-0320	54	U-87	SE 1/4	N125/E350	Ancillary	75	41	13	43.3	1	3	3	0	4	Y
468-0350	58	U-88	SE 1/4	N100/E325	Ancillary	-72	55	16	68.3	4	3	3	1	1	N
468-0557	52	U-87	NE 1/4	N375/E350	50 Count	55	43	21	40.1	1	3	8	0	0	N
468-0558	51	U-87	NW 1/4	N350/E125	50 Count	58	36	16	41.3	1	3	3	2	0	Y
468-0559	43	U-07	NW 1/4	N375/E100	50 Count	71	21	18	27.5	1	3	6	2	0	Y
468-0560	43	U-07	NW 1/4	N375/E100	50 Count	54	20	15	16.7	1	3	3	2	0	Y

Quadrat Number L-22 Provenience 4196000/372000

500x500 Meters (Each square = 25m)

s	s	s	m				m	m	s										
							s												
s		r				s	s				s								
r	s																		
r																			
r																			
m																			
r																			
s																			
				s															
s	s	s	s	s	s				s	s	s		s	s	s				
s	s														s			s	
			s																
		s																	
s	s						s												
				s					s										

Quadrat Number L-23 Provenience 4195500/371000

500x500 Meters (Each square = 25m)

										s	s	s	s			r			
								s	s	s	s	s		m	m	s			
							s		m	m	m		r	r	m				
r	r	r	r	m	m	m	m	m		m	m	m	m					m	
s		s			s	s	s	m	m	m	m	r							
s	s	s	s			s	m	m	m	m	m	r	r			s		s	
s	s					m	M	m	m	r	r		m			r			
m	m	m	m	m	m	m	m		m	m	m		m	m	m				
r	m	m	s	m		r	s	m	m	m	r								
m	m	m	m	m	m	m	m	m	m	m									
S	m		S	S		r													
	m	m	m	m	m	m	m												
			r																
m	m	m													s	s	s		
						s	s	s	s	s	s								
S	S	S	s	s	s		s	s											
			s	s															
								m	m	m	m				m				

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

☐ Denotes Rock Ring, Number Indicates Quantity

Quadrat Number L-24 Provenience 4195500/371500

500x500 Meters (Each square = 25m)

						m	r		m	s	m	s		s					
					m		s	s			s	s		s					
			s	r			s	s	s	s				s					
s	s		r																
	r					s		s											
			s	s	s	s	s	s		s									
				s	s														
						s													

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-01 Provenience 4200500/373000

500x500 Meters (Each square = 25m)

	M		M	M															
M	M	M	M	M	F		F	F											
		M	M	M		M	M	M											
F	F	F	M	F	M	M	F	F											
M	M	M	M	F	F	M	F	F	M										
	F	M		M	F	F	M	F	M	F	F	F	M	M					
M	M	M	M	F	F	F	F	M	M	M	M	M	M	M	M				
M	M	A	A	A	M	M	M	M	M	M	F	F	F	M	M	M	M	M	M
F	F	M	M	M	M	M	M	F	F	M	F	F	F	M	M	M	M	M	M
F	M	M	A	A	A	M	M	A	M	M	M	A	M	A	M	M	M	M	M
M	A	M	M	M	M	F	M	M	M	F	M	M	M	M	M	M	M	F	M
M	M	M.	M	M	M	M	M	M	M	F	M	M	M	M	M			F	M
M	M	M	M	F	M	M	M	M	M	M	A	A	A	M				F	M
M	M	F	M	M	F	M	M	F	M										
M	F	F	F	F	M	M	M	M	M	M									
F	F	F	F	f	M	f	m	m	fl	a	a							s3	s
F	M	M	M	F	F	M	M	R	R	M	M	M	s	f	f	f	f	f	f
F	F	F	F	M	M	M	a	a	a	a	a								s
F	F	F	M	m	m	m	m	m	m									f	s
M	M	M	F	s	m	m	m	m	m			m	m	m	m			m	m

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Quadrat Number U-02 Provenience 4200000/373000

500x500 Meters (Each square = 25m)

F	M	M	M	r	M	M	M	M	M	M	M	M	f	f	M	r	r	r	M
M	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	r	m	m	m	a	M	m	M	M	M								
m	m	m	s	s	s	F	F	F	m	M	M								
a	m	m	m		M	M	M	M	M	m								s	s
				s	M	M	A	A	a	r								s	f
			s	s	M	m	m	m		s								s	sl
			s	s	s	A												s	s
	m											sl	M						
					m	m		m						m	m	m			
									sl			s		m	s		m	s	s
			sl						s	s		s		r				s	s
		s	s	sl	s			s	s								s	s	s
s	s	s	s	s	sl				s				s	s				s	s
s	s	s	s		s	s	s	s	s	s		s					s		
s	s	s	s	s	s	s	s	s	f	m	s	s	s	s		s	s		s
s	s	s	s	s	s	s	s	s	s	s					m				
							s		s									s2	
		s																s2	
															s				s

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number U-03 Provenience 4200500/372500

500x500 Meters (Each square = 25m)

s							A	M	M		A	M	M	M	M	M	M	a	m
M							M	R	R	M	M	M	F	F	M	M	F	F	M
M	A	A						a		s	s	f	F	M	M	M	M	M	M
M	M	a	M	r		a	a	R	R	F	F	F	F	M	M	M	M	M	M
f	M		M					F	F	F	F	F	F	M	M	M	M	M	F
M	m	r		r	r	s	s	f	f	F	f	f	f	r	r	M	M	m	M
m	r			m	m	m	s	s	s	M	M	M	M		m	m	M	M	M
M						M	M	M	M	M	M	M	s	s			m	m	M
M				M	M	F	F	sl	F	F	f	f	m	m	m	m	M	F	F
			s	s	s	s	s	s	s	s	s	s				m	m	m	A
			m	s	s	m	m	m	m	m	m	m	m		m	m	M	M	M
			s	sl		s	f	ml	M	M	f	sl			ml	m	m	M	M
	s	sl	s	f	F	s	s	f	M	M	F	M	M	f	s	s	M	M	M
			sl	s	s	s	m	m	m	m	m	m	m	m	m	M	M	M	M
		s	s	s	s	s		m	m	M	ml	m	M	m	m	m	F	M	M
s	s	s			s	M	s	s	s	s	M	M	M	M	M	A	M	M	M
	sl	s		s	s	s					M	M	M	M	M	M	M	M	M
	s	s		s	s	s	s	m		s	m	s	m	F	m	m	m	m	m
				s	s	s	s	s		s	s	s	M	A	a	m	m	M	M
	M			M	s	M			s	m	s	f	F	M	M	M	M	F	M

Quadrat Number U-04 Provenience 4200000/372500

500x500 Meters (Each square = 25m)

M						M	M	M	M	M	M	m	s	s			m	M	M
					s	s	s	m	m	s	m	m	m	m	m	m	R	M	M
					s	s	s	s			s	m	f	m	M	R	M	M	M
					s	s	s	s	s	F	F	F	F	R	M	M	M	M	M
	a	a	a	m	f	m	m	m	m	m	m	R	R	r	r	a	a	a	a
				s	s	a	m	m	a	m	m	m							
			m	m	m	F	M	M	M	M	M								
				F	F	F	M	m	m	m	m								
			s	m	m	M	M	M	M	M	M								
		s	s	M	M	M	M	M	F	M	A	A							
M	M	M	M	M	M	M	M	M	M	F	F	F							
	M	M	M	M	M	M	M	M	M	M	A		s				s	s	s
	r	m	m	m	m	s	s				m								
	m	m	m	m	m	m		ml	m		m	m	m	m	m	s			s
M	M	m	m	m	m	M			s		M	M	F		r		s	s	
			m								r	r		r					
s	s	R	R							s	r			R			R	r	
	s	s	M			s													
m	m	m	m				s	s	s	s	s	s	s						
	M	m	r	m	m				m	s	s	s							

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-05 Provenience 4199500/372500

500x500 Meters (Each square = 25m)

s																			
																R			
														A	M	M		F	F
											R	m	M	M	m	m	M	M	M
										R	m	m1	s	R	M	M	s	s	s
					s	s				m	r	r	R	m	m	m	m	s	s
																	s	s	s
																	s		
															s				
									s3						s1				s
															s				s
										s2									r
									s1										
	s					s													

Quadrat Number U-06 Provenience 4199500/372000

500x500 Meters (Each square = 25m)

		r	r	r	r														
																M		F	
																M	M	s	
				s1							s1			s1					
											M								
								R							s	s	s		
					M											s	s		
																	s		
																	s		
																	s		
							s1												
R																			
																		s	
a										s	s								
a							s					s	s						
	r						s	s	s	s	s				s				

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-07 Provenience 4201000/374000

500x500 Meters (Each square = 25m)

s		s	s				a		m		m	m	m	m					sl
		s	F	s	a	r	r	a	a	sl	M	M	M	M	a		a	a	m
	s	s	F	F	R	R	R			R	F	R		s					s
r	r	s	M	M	M	m	m	M	sl	M	m	s	m	m	m			s	s
	s2		m		m	m	m	m	s	m	s	sl	s						
sl		sl	M	M	M	sl	M	s	M	s	s	s					sl	s	s
r	r	M	R	M	M	M		M	s	s	F	s			M	sl	sl	M	A
M	M	M	M	M	M	s		s	s	s	s								M
s	s	s	s	s	s	s	s	s			M			m	m	M		M	M
M	M				sl		s	s		s	s					s			
M	M	a	a		s	s	s	s	s	s	s	s	s	a	A	a	r	R	R
			A		s			s	s			s				A	A	A	A
A	A	A	A		a		s	s	s	s	s	s	s	s	s			A	A
		m			s	s	s			s	s	s	s	a	r	a	s	s	
									s	s	s	m	m				m	m	m
			s	s		s	s	s	s	s		s	s	s	s	M	M	M	M
		r	s	m			s	s	s			s	s	s	m	M	M	M	
		F	F	M			s	s			s	s	s	s	sl	M	M	M	M
		s			s	s	s	s			s	s	M	M	M	M	M	M	M
F	F		s	s	s	s	s			M	s	M	M	M	F	F	M	M	M

Quadrat Number U-08 Provenience 4201000/374500

500x500 Meters (Each square = 25m)

A		s		A	s			sl		s	s	r							s
M	a	M	-M	M	s	a				sl	s	s				M	M	r	r.
m	M	F	M	M	M		M		s		s								s
M	M	M	M	M	M	sl	M				s	s	s	s	s	s	s	s	
M	M	M	M	M	M	M	M			s3			A		s				
M	M	m	A	M	M	M	M	F	s4		s3			s	s	s			
A	r	A	a	M	s	s	s	s	s	m	s	s			s		s		
M	M	M	M	F	m	s	s	s	m										
M	M	M	M	M	s	s	s	M	M						s		s		
			m						r										
									a	a				s					
A			A		A		A	a						r	m				
A	A	A	A			A	r		s	A					r	A	A		
	R	r	R	r	s	s	s	s	s	s									
M		M				R	s2												
M	M	M	M	M	M	M	M		M	M	M					M	s	s	M
M	M	M	M	M	M	r	M	M		r	r					R	R	a	a
M	M	M	M	M	M	M	M	M			r				a		a	A	
M	M	M	M	M	M		M	M	M		M					m	m	m	m
M	M	M	M	M	M	A	A	R		A	R						M	M	M

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

286

Quadrat Number U-76 Provenience 4201500/374000

500x500 Meters (Each square = 25m)

									s	s									
m		m					m	m											S
							s									s		s	s
				m	m	m	m					S	s	s			sl		
s					s														
	m	m		s	s	m	m					sl	S		s	s	sl		s
s	s	s								s	s	sl	s	s	s	sl	s	s	s
s	s	s	s2	s	S	s	sl	s	s	s	s	s	s	sl	sl	s	m	s	sl
			s	sl	s	s	s	s	sl	s	s		s				s		s
s	s	s	s	s	s	s	sl	s	s	sl	sl	s	s	sl	sl	s	s	s	sl
m				s	s			s				s				s			
	s	s	s	sl	S	s	s	sl	s	sl	S	S	S	S	S	S	s	S	s
		s	S	s	S	S	s	f	f	s	s	m			S	sl	s		s
					S	S	S	s	S	S	S	S	S	m	m	S	S		m
			s	s	s	sl	s	s		s	m	m	m	m	m	m	m	m	m
				s	m	m	s	s	m	m	m	M	M	sl	m	m	m	m	m
				s	m	m	m	m	m	m	m	m	m	m	s	r	m	m	m
s	s	s	s	s	s	m	s	s	m	S	f	m	m	m	ml	m	m	m	m
	s	s	m	s	s	s	s	s		sl	M	m			m	m	m	m	m

Quadrat Number U-77 Provenience 4201500/374500

500x500 Meters (Each square = 25m)

	m	m	m	m	m	s							s	s	s	s		s	sl
		s	m	m̃	sl				s	s			s	s	sl	s	s	f	s
S		s		m	m	m			m	m	m		m	m	s	m	m	m	m
s	m		s	s			m	s	s	m	m	s	s	f	f	m	m	m	ml
	m	m	m	m	m		s	s				m	m	m	m	m	m	m	m
	m				sl								Sl	S	m	sl	f	f	f
m			m	m	sl	m	s	s	s		s	m	m	s	m	M	M	M	M
s	s	s		s	s	s	S	s	s	S	m	m	m	m	m	m	m	m	m
s	sl	sl	sl	s	s	sl	s	S	S			ml	m	m	M	m	M	M	F
sl	s	s	sl	s	s	sl	s	s	s			m	m	m	M	m	m	M	M
s		sl	s	s	sl	s	s	s	s	s	s	s	s	m	m	F	F	F	F
			s		S	sl	s				s	s	S	M	M	M	M	M	M
s	s	s	S	S	s	S	S	s			s	s	s	S	m	M	m	m	s
s		s		S	s	s	M	s		s	s	s	m	F	m	m	s	s	
s	s		s		s	S	m	s			s	S	f	M	M	m			s
s			s	s	s			s	s	s		s	m	s	s		sl	S	S
s	s	m	m	s	s		s	s	S	s	s	M	m	s			s	s	s
		m	m	m	s	s	s	S	S	S	S	m	m	s	s				s
s	s	m	m	s	s	sl	s	s	s	s	m	m	m	s	s	s	s	S	S
s	S	s	m		s	s	s		s	s	s				s	s	m	m	m

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

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S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

☐ Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-78 Provenience 4201500/375000

500x500 Meters (Each square = 25m)

f	f	f	f	S	S	s		sl			s					sl			
m	m	m	s	m	m	m	s							sl	sl				
m	m	f	m	m	m	f			s	S	s	s	s	m	m				
m	f	m	f	m	m	m					sl	s2		m	r				
M	m	m	m	m	m	S			s	s	S	s	s						s
m	m	m	m	m	m					S2			m	m			sl	sl	
M	M	M	M	s				s											
M	M	M	M	S	s	s												s	s
M	M	m	m	s		s	sl	s	s	s									
M	M	M	M	m	s		s	s	sl				s						
F	F	F	S	s	s	sl	s	sl	sl										
M	M	m	m					sl						sl					
M	m	m									S	s			s		s		
m	m		s	m						s	sl	s			s				
s	m	m	m	m	m	m		s	s	s					m				
sl	s	m	m	r	r	m	r		m	s	m				sl				
s	s			m	m	M	M	m	m					m	m				m
s	s	S	S	S	S	S	S	s	m		s	s	s	s	s	s			
s	S	s	s	S	S	s	S1			r	m	ml	s	m	ml	m2	m	A	A
		s	s	s	s	s					s		m		m	r	M	M	

Quadrat Number U-79 Provenience 4201500/375500

500x500 Meters (Each square = 25m)

						s	S	s	r		s				S	S			
	s				s	s	s	m	m		s			s	s	m			
						m	m					m	m	S	s	s			
	s											s	m	m	m				
	s																		
	S	r	s						s	S	f	m	s						
		m		m					f	m	m	m	s						
				s			s		s	m	s		m	m	S				
							s	s	m	m	s	s			m				
						sl	s		s	s	sl		s	m					
								s	r	m	s			r					
						m	m	s	s	Sl	s	m					r	m	
m	m	s	s	s		s	S	S	s	S	S	s					r	r	
		m	m	m					s	S	S	s	s					r	r	r
m	m	m	m					m		m	m	s							
r		r	r	s						s		s	s	s					
m									m	f	f	f		m					
s	s	s	s	S		s				s		s	s						
m	m	S	s		s														
m	m	m	m				m						m						

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

☐ Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-81 Provenience 4201000/373000

500x500 Meters (Each square = 25m)

							s									s	s3	s	s
					m	m	m									s	sl	sl	S
					s	s	s									s	s	sl	s
				s			S	s							s				
			s	S	S	S	S	S	s										S
s	S	S	S1	S	S	S	S	s	s	s	s			r		r		s	S
S	S	S	S1	S	S	S	S	S	S	s		s				s	s	m	m
S	S	S2	S2	S2	S	S	S1	S	S	S	S	s			s	S	S	S	m
f	f	S	s	s	s	s	sl								s	s	s	m	m
S	f	f	f	f	f	m			s	s		s	s	s	s	S	s	s	s
			s	s	s	m	s	sl								f	f	m	m
	s	s	s	m	m	m	m	m									s	s	m
m	m	m	s	s	M						s2			s	s	S1		s	S
	s	m	m	s							s			s	s	S	s	s	s
m			m	m	m									s	s	S	S	s	s
m	m	S	S	S	s	s							s		m	m	s	s	s
m	m	m	m	m	S	S	s		s			s	s		s		s		s
m	m	m	f	S	S	S	S	S	S	f	s		S		s				
M	M	M	M	m	m	m	s	s	s	s	s		m						
M	M	M	M	M	M	m	m	m	m	m	f	m	m	m	f3	s	s	s	s

Quadrat Number U-82 Provenience 4201000/373500

500x500 Meters (Each square = 25m)

s	S	S	S	F	F	M	m	m	S1			s	sl				s	s	s
S	S	S	S	r	m	m	m	f	m	m	m					f	m		s
s	s	S	S	S	S	M	M	m	m	m	m						m	m	m
s	S	S	S	S	S	S	S	s	s	S	S	M	M		M	M			
S	S	S	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
S	M	M	M	M	R	M	M	m	m	f	f	f	m	m	m	m	m	m	A
m	m	r	m	m	m	m	m	m	m	m	f	f	f	m	m	m	r	A	A
m	m	m	m	M	M	M	M	M	f	f	f	f	m	M	M	M	M	M	M
m	m	m	m	m	m	m	m	m	m	m	m	f	m	m	m	m	m	m	m
f	f	m	m	m	m	f	f	f	f	f	f	f	s	S		s	s	s	m
m	m	m	m	m	m	M	M	M	m	f	f	m	m	m	m	sl	m	m	m
m	m	m	m	m	m	m	f	m	f	f	f	f	m	m	m	m	m	f	f
S	s	S	S	s	S	S	S	S	S	S	S	m	m	m	sl	m	m	m	r
s	s	s	s	m	s	m	M	S	s	S	S	s	S	s	s				
s	s	s	S	s	s	s	m	m	S	S	s								
S	s	f	m	s	S	fl	f	f	S	S	S	s		s	fl	s	s	s	s
s	s	s	s	S	S	s	S	s		s	S	S		s	s		m	s	s
		s	s	s	s	s	s	s	s	S	f	S	s	s	s				F
	s		m	m	s	s	s	s	s	f	s	s	m	f			s	m	m
	s	M	m	m	s	s	f	s	f	f	f	fl	S	f	f	f2	f	f	f

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-83 Provenience 4201000/375000

500x500 Meters (Each square = 25m)

s		s	s	s	s			s		m	m		m	m	m	m	m	M	R
s									s						M	M	M	M	M
s2	s2	m	s1	s					s1	m		R	m	R	M	M	M	M	M
s									r	m	m	m	m	m	m	m	m	m	m
									m	m	m	m	m	m	M	M	M	M	M
								m	m	m	m	m	m	m	M	M	M	m	s
		r	r	r	r	s	s	m	m	m	m	m	m	M	M	M	m	m	m
							m	m	m	m	m	m	m	m	m	m	m	s	s
			r			m	m	M	M	M	M	M	M	M	M	M	m	m	f
					m	m	M	m	m	M	M	M	M	M	M	M	m	m	r
			m	r	m	M	M	M	m	m	m	R	m	m	m	M	m	m	s
			R		s	M	M	M	r	M	M	M	M	M	M	M	M	M	s
		m	r			m	M	M	M	M	M	M	M	M	M	M	m	m	m
							f	M	M	M	M	m	m	m	m	s1	m	s	s
s	s	s	m	m	m	f	f	f	F	F	F	M	M	M	F	M1	m	m	m1
	m	m	m			M	M	M	M	M	M	M	M	M	M1	M	m	m	m
r	r	m	r	m	m	m	M	M	M	m	m	m	m	m	m	M1	M	M	M
m	m	r	r	r	m	r	m	M	M	m	m	m	m	S	m	m	M	M	M
r	M	M	M	m	m	M	F	M	M	M	M	M	M	M	M	M	M	m	m
r	m	s	s	s	m	m	M	M	M	M	M	M	M	M	M	M	m	r	r

Quadrat Number U-86 Provenience 4200500/373500

500x500 Meters (Each square = 25m)

s	s	S	f	f	f	f		f	F1	f	f	s			s		f	f	f
	s	s	m	f	m		m	f	f	m		m	f1	m1	m2	m1	m2	f4	f
		s			r		s1	s	s2	s1	s	s1	s1	s2	s	S2	S2		s2
	s	s	s	m	s		s	s2	F	F	s	s	s	S1	S	m	S	m	M
	s	f	s			s	s	s	S	f	s		s		s	S	S	s	s
								M	M	m		s	s1		m	m	m	m	m
s	s					s		M	F				s	r	r	S	M	m	m
s	m	m	s	s	s	s	m	M	M	m	s	s			m	m	m	m	s
s	s	s	s	s	s	m	m	F	f	s	s	s	s	s	s	m	m	m	f
s	S	S	s	S	S	f	F	F	M	f	f1	s	s	s	s	f	f	m	F
f	f	f	f	f	m	m	M	M	M	M	M	M	M	M	M	m	m	m	m
m	m	f	f	m	m	m	m	M	M	M	M	M	M	M	M	M	m	m	m
m	m	f	f	m	m	m	m	M	M	M	M	m	M	r	m	m	m	r	r
M	f	f	f	S	s	s	F	M	M	M	M	M	M	M	M	M	m	m	
S	s	s	s		s	f	f	m	m	R	m	m	m	R		m	m	m	m
f	f	s	s	f	f	f	F	M	M	M	M	M	M	M	M	M	M	m	s
f	S	S	S	s	F	F	F	F	F	F	M	M	M	M	M	M	M	r	
S	s	s	s	s	s	F	F	F	M	M	M	m	M	M	M	m	m	m	m
s	S	s	s	S	f	f	f	f	f	f	M	M	M	M	M	m	m	M	m
S	s	s	s	s	s	m	M	F	F	M	M	M	M	M	M	M	M	M	M

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number U-87 Provenience 4200500/374000

500x500 Meters (Each square = 25m)

m	sl							f	f	f	m	m	m	m	m	m	m		
m							s	S	m	m	m	M	M	M1	M	m	m	m	m
		s		s	s		m	S	s	s	m	M	M	M	M	M	m	m	r
s					s	m	m		s		m	M	M	M	M	s	s	s	s
s		s	s			s			s		m	M	m		M	m	m	M	M
s	s	s	m	m		s	m	s	s	s	m	m	m	m	m	M	M	F	sl
			m			m	m				S3	S2	m	M1	M	M	F	F	F
		s	s	s	S	m	m	m	r	m	m	m	m	m	m	m	M	M	F
		r	m	m	s	m	m	m	m	m	m3	m1	m	m	M	F	F	F	F
			s	s	m	M	F	f	m	m	m	m	F	M	M	F	F	F	F
				m	m	f	f	m	m	m	M	M	F	M	M	F	F	M	M
	s	s	m	m	F	M	m	m	m	m	m	F	M	M	M	M	M	m	m
	m	r	m	m	m	M	M	M	M	M	M	M1	F	M	M	M	M	M	M
	M	m	m	M	F	M	M	M	m	m	M	F	M	M	M	F	F	M	M
	m	m	m		M	M	M	F	M	M	M	F	F		M	F	f	f	M
m	m	m	m	M	M	M	M	M	M	M	F	F	F	F	M	F	M	M	M
m	m	M	M	M	M	M	M	M	M	M	M	F	F	F	F	F	M	M	M
M	m	M	m	M	M	f	F	m	m	m	m	M	M	M	F	f	m	M	M
M	M	F	F	f	m	M	m	m	M	M	M	m	M	M	F	m	M	M	M
F	F	F	f	F	F	F	M	m	M	M	m	M	M	M	M	M	M	M	M

Quadrat Number U-88 Provenience 4200500/374500

500x500 Meters (Each square = 25m)

s			s							m	m				r			r	r
m	m		s						r	m	m		r	r				m	m
m	m	m	r						m	m	m	m	m	r	s	r	r		m
f	m	m							m	m	m	m							m
m	m	s					s	s	s	m	m	m						s	s
s	r	s						m	m	m	m	s				m	m	m	m
F	F	F	F	M	m	f	m	m	m	m	m	m						m	
F	F	F	M	M	m	m	m	m	m	m	m								
M	M	M	m	m	m	m	m	m	m										
F	F	f	f	m	m	m	m	m	m	m									
M	M	m	m	m	m	m	m	m	m	f	m								m
M	M	m	m	m	m	m	m	m	m	m	m	s	m	m	m				
M	M	m	m	m	m	m	s	s	s	s	s	m							
F	F	M	f	m	m	f	f	m	r	r	m	f							
F	M	F	f		f	m	m	m	s	s	f	f	s						
F	F	F	F	f	m	M	m	m	m	m	s	F							
F	F	F	F	F	F	M	M	M	M	m	f	F	f	s	s				
F	F	F	F	F	F	F	F	F	F	M	M	f	f	s					
F	f	F	F	f	f	M	M	M	m	m	m								
F	M	M	M	M	M	M	M	M	m	m	m	m							

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number U-89 Provenience 4200500/375000

500x500 Meters (Each square = 25m)

m	m	s	m	s	s	s	m	M	F	M	M	M	M	R	M	M	r	m	f
	R	R	f	f	f	M	M	M	M	M	M	M	M	M	M	m	m	m	r
m	m	m	m	m	r	m	M	M	M	M	M	M	M	M	M	M	r	R	
sl	m	r	m	m	r	m	m	m	ml	M	ml	M					m	r	
r		m	r	r	r	m	m	m	M	F	F	f					r	r	r
	m	m	m				m	m	m	m	m	m					m	m	
r	m	m	m	m	m	m	m	m	A	M	M	M	M	M			R	r	
m	M	m	m						m	M	M	M	r	M	M	M	m	m	m
M	m	m	s						M	M	M	M	M	M	M	M	M	M	M
		r						r	m	m	m	M	M	M	M	M	M	M	s
	m			s		r		r	r	r	r	r	m	m	m	m	m	m	m
					m	M	r		r	s	s	S	S	m	m	m			s
						m	m	m	m	m	f	M	M	m	m	M	m	m	m
					r				m	m	m	f			m	r	m	m	m
s									m	m	m	f	f			f	r	r	r
	m	m	m	m		m	m	m	M	M	M	M	M	M	M	m	r	r	
s	m	m	m	s	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
S	s		s	m		m			m								m	r	r
m	s	s	s	s						r		s	r	m	m	r	r	m	r
s	S	S	s	s	s	s	s							s				r	r

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Quadrat Number U-89a Provenience 4200500/375500

500x500 Meters (Each square = 25m)

										s	S	S		s	S	S	S	S	S
										s					S	S	s	s	s
							s			sl	s	s	s	S	S	S	S	sl	S
					s				s	S	S	S	S	S	S			s	s
											s		s	S	m	s	S		
											s	sl	m	m	m				
														m	m				
											s	s	S	S	s	s			
												s	s	S	S				
												s				s			
s					s														
																			s
																		s	
s	S	s			s	s	sl							s					s
		S	S	s		s		s	s	s									
		s					s	s	s	s	s		s						
	s					s		s	s			s		s					
	s	m	m	s	r	s	s	s	s	m	s	m	s	s	s	s		s	
S	S	R	R	R	s	S	S	S	s										
s					r	m	m	m	S	s									

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number U-90 Provenience 4200000/373500

500x500 Meters (Each square = 25m)

s	s	s	s			f	F	F	F	F	f	m	m	m	m	M	m	M	M
s		s				s	F	F	F	f	m	m	m	m	m	m	M	M	F
s	m	s	s		s	m	M	M	M	m	m	m	m			m	m	M	M
s	s	s			s	s		s	S	S	S					s	R	F	F
									m	m	f					M	R	M	M
	s	s		s	s		s			r	s	m	m	m	r	m	m	F	F
			s	s									s	m	m	m	M	M	M
	s	s	s	s				s				m	m	m	m	R	M	M	M
sl	m	m	m	s	s						m		m	R	R	M	M	M	M
		m		s		s				s				M	M	M	M	M	M
	s	m		f	f			s						s	f	M	M	M	M
m	f	m	s	s	s	s	s		s				s	s	s	s	s	M	M
m	m	m	s	s		s			s		s				r	r	r	m	m
	s	S	s	s	s	s	s	s	r	r	r		s	s			s	s	r
				s	s	s				m	m	m	f						
s	m	s	s	S	r	s		s					s	s	S	m	m	r	
m	m	s	s	s		s					s	S	S	s					M
m	m	m	s	s	r							s	sl	s	s	s	s		r
M	m	m	r	r	m						sl	s	s	m	m	m	m		r
M	M	M		m	m	m		m	m	m	m	m	s				s	M	M

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Quadrat Number U-91 Provenience 4200000/374000

500x500 Meters (Each square = 25m)

M	M	M	M	M	M	M	M	M	m	m	M	m	F	M	M	M	M	M	M
M	M	M	M	M	M	M	M	M	M	m	m	M	M	M	M	M	M	M	M
M	M	M	M	M	M	M	M	M	M	F	f	F	f	m	m	M	M	M	M
M	M	M	M	M	M	M	M	M	f	f	f	F	m	m	M	M	M	F	F
M	M	F	m	M	f	M	M	m	f	f	f	f	f	m	M	M	M	f	F
m	M	M	M	M	M	M	M	m	m	m	m	m	f	m	M	M	M	M	F
M	M	M	M	F	F	M	M	m	m	m	m	M	M	M	M	F	F	F	F
f	M	M	F	M	M	M	M	m	m	f	f	f	F	f	m	m	F	F	F
M	M	M	M	m	M	M	F	m	m	m	M	M	f	m	m		F	F	F
M	M	M	M	M	M	M	M	M	M	F	F	F	m			f	M	M	M
M	M	M	M	M	M	M	m	m	M	M	M	M	m			M	M	M	M
M	M	M	M	M	M	M	M	M	M	M	R	M	m	m	m	M	M	M	M
m	M	M	M	M	M	M	M	M	R	R	M	M	M	m	M	M	M	M	
m	m	m	m	R	M	M	M	m	m	M	M	M	m	m	m	m	m	M	F
r	M	M	M	M	F	M	M	M	M	M	M	M	m	r	M	m	M	M	M
m	m	m	M	m	f	F	F	F	M	M	M	M	M	R	m	m	M	M	F
m	M	M	M	M	M	M	F	F	F	f	f	m	M	M	M	m	M	M	F
m	m	M	M	M	F	f	m	f	f	f	s	s		m	m	m	f	f	f
m	m	M	F	M	m	m	f	f	f	f	m	m	r	r	m	m	m	m	M
m	M	M	M	m	m	f		f	f	f	f	r	m	m	M	m	M	m	m

Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-92 Provenience 4200000/374500

500x500 Meters (Each square = 25m)

F	f	F	F	F	F	F	F	M	m	m	M	m	m						
M	M	M	M	M	M	M	F	F	F	S	s	s	s						
M	M	M	M	F	F	F	F	m	f	F	M	m	M	s					
F	F	M	F	F1	F	F	F	F1	M	f	m	f	s	f		m	m	m	
F	M	M	M	M	M	F	M	F	M	M	m	m	M	m	m	s	s	s	m
F	M	M	F	M	M	M	m	f	F	M	m	m	m	m	f	s	s	s	
F	F	F	F	F	F	F	M	F	F	F	F	M	m	M	M	m			
F	f	m	M	f	F	M	m	M	F	F	F	f	m	m	m	m	m	m	
f	m	f	m	F	M	M	M	M	F	F	M	m	m	m	m	m	m	m	m
	f	f	f	fl	M	M	M	M	F	F	M	M	m	m	m	m	m		
f		s	s	F	F	F	M	M	F	F	F	f	M	F	M	m	m	m	m
		s	s	F	F	M	F	M	M	M	s	M	M	M	M	m	m	m	m
s	s	s	S	f	F	S	F	f	m	M	m	M	M	M	M	M	m	m	m
m	f	f	M	F	F	F	F	f	f	f	f	m	f	f	f	m	M	m	m
F	M	m	M	F	M	M	M	m	m		s	m	m	m	m	M	M	m	m
F	F	F	F	F	F	F	F	f	f	f	s	f	f	m	m	m	f	m	m
F	M	M	M	F	F	F	f	f	f	m	m	m	r	m	m	M	F	F	m
M	M	M	M	F	F	f	m	f	m	m	m		m	r	m	m	f	F	m
M	M	M	M	m	m	m	m	m	m	m	m	m	m	m	m	m	M	m	M
M	M	M	m	m	m	f	m	m	m		m	m			m	m	m	M	F

Quadrat Number U-93 Provenience 4200000/375000

500x500 Meters (Each square = 25m)

s	s	s	m	s	s	s	s		s	s	s	m		m	s		s	m	m
s				s					s										
s									s					m	m				m
S	S	S	m					s							s	s			
S	S	S	m																
S	S	S	m	m															
s	s	S																	
								s											
		m	m			s	s	s											
				s															
s	s	s	s	m				s					s						
M	s	s		s			m	M	M	M	M								
M	m	m	M	m	m	f	f	f	M	M	M	m	m	m	m	m			m
M	M	M	M	M	S	s	m	m	m	m	m	m	m	m		r			
M	M	M	M	M	F	S	S	s	s				r	r	r	r			
m	M	M	M	M	M	m	m		m	m	m	m	m	m	m	m			
M	M	M	M	m	m		m			m		m	m	m	m	m	m		
M	M	M	M	m	m	M	m	s	m	m	m	M	M	m	r	m	m	m	r
F	M	F	M	m	m	m	M	m	m	m	m	M	M	M	r	M	M	R	r
M	M	M	M	m	m	m	M	M	m	m	m	M	M	R		r	r		

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

☐ Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-94 Provenience 4200000/375500

500x500 Meters (Each square = 25m)

							s	m	r	m	m	m	r		s				s2
								m	r	r	R	R	S	S	R	m	m		
							r	R	R	M	M	M	m	m	m	m	m		
						m		s	M	M	M	M	M	M	m	m		s1	
			r					r	r	r	r	m	m	r					
						r					m	m	m	m	m	r	m	m	
						r						r	r						
			s																
																	m	m	r
m	r	r	R	r	m														m
R	R	R	R	R	R	r	r						m	m			m	m	
R	R	R	R	R	R	r	r												

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Quadrat Number U-94a Provenience 4200000/376000

500x500 Meters (Each square = 25m)

																		s	
r	r																		
m	r	r																	
r	r	r																	
r	r																		
	r																		
	r																		
r	r																		
s	m			r				s											
s	r																		
	r																		

Denotes Rock Ring, Number Indicates Quantity

Quadrat Number U-95 Provenience 4199500/373000

500x500 Meters (Each square = 25m)

s																		r	m
												s	s	s	s	s	s	s	s
						s						s	s		s	s		s	s
				s	s	s	s		S	s	s	s		s	s	s		s	s
					■				s	s					■	S	S	s	s
			s							s	s	s			s1	s	S	S	s
s		s		f	F	f	s		s	s	s							s	f
s	s	s	s	s	s	s	s	s	s	s					s		s	s	s
	s			S	S	s													
s	s	s	s	s	s	s		s	s1		s							s	
															s	s			
																s			
										s									
			s		■														
s1					m			s				s	s	m	■				
													m	m	m		m	s	s
												m	m	m	m	m	m	m	s
											r	r			s	s	s	s	
												m	s		s	s	s	m	s

Quadrat Number U-96 Provenience 4199500/373500

500x500 Meters (Each square = 25m)

m	m		m									m				m	m	R	m
M	M	m	m		s2													M	M
M	m	m	m	m							s							R	M
S	S	S	S														M	M	M
					s													r	m
s	s	s			s	s	s				s							m	m
f	s		s	f														m	m
		s	s	s		s													
		m	s		s											s	m	m	m
	s				s	s								s		m	s		
			r	r	s														
				m	m	s											s		
								s					s						
		s		s															
												s					s		
s			s	s	s	s	s	s				m	m	s	s		s		
s	s	f	f	f	f	f	f	s					m						
S	S	S	S	S	S	S	s	s	s	s	s	s	s	s		m	m	s	s

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

☐ Denotes Rock Ring, Number Indicates Quantity

■ Denotes surface collection loci

Quadrat Number U-97 Provenience 4199500/374000

500x500 Meters (Each square = 25m)

R	m	M	M	M	M	m	m	m	f	m	m		s	s	m	M	M	M	M
M	M	M	M	M	M	m	m	m	m	m	m	m	f	m	m	M	M	m	m
M	M	M	M	m	m	M	m	m	m	m	m	m	m	m	m	m	M	M	M
M	M	M	M	M	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	m	m		m	f	f	m	m	m	m	M	m		f	f	m	f	F
r	r	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	s	m
	m	m	m	m	m	m		m	m	m	m	m	m	m	m	m	m	m	m
m	m	m	r	s	s	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	r	m	m	m	m	m	m	m	m	m	m	f	m	m	m	f	f	f	f
	m	m	m	m	m	m	m	m	m	m	m	f	m	f	f	f	f	m	m
		R	r	m	m	m	m	m	r	m	m	m	m	m	m			m	m
			m	m	m	m	m	m	m	m	m	m	m	m	m	s	m	m	m
		f	r	m	m	R	M	M	M	m	m	m	m	m	m	s	s	m	m
	s	m	M	M	m	m	M	m	m	m	m	m	m	m	m	m	m	m	m
		s	m	r		m	m			s	m		m		m	m	m	m	m
				m	m	s	s			s	s	s	m	m	m	m	m	m	m
						m						m	m	m	m	m	m	m	m
								m	m	m	m	m	m	m	m	m	m	m	m
					m	m			m			m	m	m	m	m	m	m	m
m	m	m	r	r	m	m	m	r	r	r	r	m	m	m	m	m	m	m	m

Quadrat Number U-98 Provenience 4199500/374500

500x500 Meters (Each square = 25m)

F	F	M	m	f	F	f	F	F	F	F	M	f		s	m	M	F	F	F
F	F	M	M	M	f	f	f	f	m	M	F	f			M	m	M	F	F
R	M	M	M	F	m	f	m	f	F	f	f	m	m	m	m	f	F	F	F
m	m	f	F	F	f	f	m	m	m	f	m	m	m	m	m	f	F	f	f
m	m	M	F	F	M	F	M	m	m	m	m	m	m	m	m	m	F	F	F
R	m	M	M	F	M	M	M	M	F	M	M	m	m	m	m	M	F	M	F
M	M	M	F	F	F	M	M	M	M	m	m	m	m	m	M	M	F	F	F
M	m	r	M	M	F	f	M	M	m	m	m	m	f	m	m	m	m	M	M
m	M	r	M	m	m	m	m	m	m	m	m	m	m	m	r	m	m	m	m
f	F	M	M	m	m	m	m	m	m	m	m			m	m	m	m	m	m
m	r	r	r	r	r	r	r	r	r	r	m	r	r	f	f	m	r	m	m
r	r	r	r	r	m	m			m		m	m	r	M	m	m	m	r	
r	r	m	m	r	r	m	m	m	r	m	r	m	R	R	M	M	m	M	m
M	s	s	m		m	m	m	m	m	m	m	m	m	M	M	m	m	f	
m	m	m	m	m	s	m	m	m	m	m	m	m	M	M	M	m	m	m	m
m	m	m	m	M	m	m	m	m	f	m	m	r	r	m	m	m	m	s	
M	M	M	M	M	M	M	M	M	M	M	M	M	m	m	f	sl	s	s	
M	M	M	m	M	m	m	M	M	M	M	M	f	M	m	m	s			
m	m	m	m	m	m	m	m	m	m	m	m	m	m	M	M	m	m		
m	m	m	m	m	m	m	m	m	m	M	m	m	M	M	M	m	m	m	

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number U-99 Provenience 4199500/375000

500x500 Meters (Each square = 25m)

F	F	F	F	F	M	m		s	s		f		m	m	M	M	m	m	m
F	F	F	F	F	F	f		m	m	m	m		m	M	M			m	m
F	F	M	M	M	m	m	s	M	M	m	m	m	s	s	m	m		m	
F	F	F	m	m	m	f	s	m	M	M	M	m		s	s		m	m	m
F	F	f	f		s	s	f	m	m	M	M							r	R
M	M	M	m	m	m	m	m	m	s	m	m				s			s	m
m	m	m	m	m	m			m	m	m									s
m	m	m	m	m	m	m	m	m	m	m								s	m
M	M	M	m	m			m	m	m	m					s				m
r	m	m	m	r	r					r	m							r	m
r	r	r	r	r	r		r	r	r					r	m	m	m	m	m
M	M	M	M	m	m			m	m	m	m		m	m	M	m	M	M	M
					m	m	m	m	m	r	m	m	m	m	m	m	m	m	m
m	m	s	s	s	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
		r	r	r	m	m	m	m	m	m	R	R	m	m	m	m	m	m	m
s	m	m	m	m	m	m	m	m	m	m	m	r	m	m	m	m	m	m	m
m	m	m	m	m	m	m	M	M	M	M	M	m	m	m	M	M	m	m	M
		f	m	m	m	m	m	m	f	m	m	m	m	m	m	m	f	m	m
r	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	f	f	f
m	r	m	m	m	m	m	m	m	m	m	m	m	m	m	f	m	m	f	m

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Quadrat Number U-100 Provenience 4199000/373000

500x500 Meters (Each square = 25m)

m	m															r	r	m	s
r																s	m	s	
																m	m		
	s																r		
s			sl																
r	r																r		r
		s													m			m	
	m					s				m							m		m
s	r	s			m	s		m	s	m								s	
					m					m									
					r	r	s	s	r	s								sl	
					s	m	r	s	s	s									
						m			s	s									s
									s										
		s	s	s	s	s													

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number U-101 Provenience 4199000/373500

500x500 Meters (Each square = 25m)

S	S	s	s	S	S	S	S	S	S	S	s					s		s	s
s		S	S	S	S	S	S	S	m			s			s	m	m	m	m
m	m	m	m	m	m	m	m	m	s				m	m	m	r	r	r	m
	r	r	r	m	m	m	m	s	s			r	r	m	m	m	m	m	m
		r	r		m				s	s		m	m		m	m	m	m	m
		r			r				r	m	m	m	s	m	m				
	r	r	r	r	r	r			m	m	m	m	m	m	m	m		m	m
			s	s	s	m			s	m	m		m	m			m	r	
	s	m	m		s	m	m	m	m	m	m	m	m	m	m			s	
s		s	s	s		s	m	r	r	r	m	r	r	r	r		r		r
																			m
																			r
										r									
																			m
																			m
																		m	m
										s			m	m	s				m

Quadrat Number U-102 Provenience 4199000/374000

500x500 Meters (Each square = 25m)

s	s	s	s	s	s	s	s	S	S	m	M	r	r	m	m	M	M	M	M
m	m	m	m	m	m	m	s	s	m	m	M	M	M	m	M	M	M	M	M
m	m	r	r	r	r	m	m	S	S	f	M	M	M	M	m	M	A	m	M
m	m	m	r	r	r	r	r	m	m	S	m	M	M	M	M	M	M	m	m
m	m	r	r	r	r	r	m	m	m	m	m	M	M	M	M	M	m	m	m
r	m	s	r	m	m	r	m	m	m		m	m	m	m	m	m	m	m	M
m	m	r	r	m	m	r	m	m	m	m	m	m	M	M	M	M	m	m	m
	m	m	m	m	m				m	m	m	m	M	M	m	m	m	m	f
		m		m	m	r	m				m	m	M	M	m		m	s	m
		r	r	m	r	m	m		m	m	m	m	M	m	m	m	m	m	m
			m			m	r	s	m	m	M	M	m	m				s	m
	r		r	r	r	m	s	m	m	M	M	M	M	m		s	m	m	m
	r	r	r	r	r	m	m	m	m	M	M	M	m	m	m	s	m	m	m
	s	s	r	s	m	m	m	m	M	M	M	m	m	M	m	s	m	m	s
		m			m	m	m	m	M	m	m	m	m	R				m	m
r	S	m	r	s	m	m	m	m	M	m	m	m	r				S	m	m
m	m	r		m	m	m	m	M	M	M	M	M	m					m	m
m	m	m	m		m	m	m	m	m	m	m	r			m	m			
	s	m	m	m	m	m	m	m	M	M	M	m	m						
	m	m	m	m	m	m	m	m	m	m	m	m	r	m					

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

APPENDIX D: SURFACE COLLECTION DATA

Suface Collection Quadrat Summaries

Survey Quadrat	Lot #	Collection Quarter	Unit	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
L-2	1	NW 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
			Ancillary	-	1	-	-	-	-	-	-	1	
	2	NE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	3	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	4	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	241	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	-	1	4	-	-	1	-	-	6	
L-4	5	NW 1/4	50 Count	-	-	1	-	-	-	1	-	2	m
			Ancillary	3	2	-	-	1	-	-	-	6	
	6	NE 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
			Ancillary	4	1	-	-	1	-	1	-	7	
	7	SW 1/4	50 Count	-	1	1	-	-	-	1	-	3	m
			Ancillary	-	-	-	-	1	-	1	-	2	
	8	SE 1/4	50 Count	2	1	1	-	-	-	-	-	4	m
			Ancillary	6	8	-	-	1	-	-	-	15	
			Total	15	13	4	-	4	-	4	-	40	
L-5	9	NW 1/4	50 Count	1	-	1	-	-	-	-	-	2	M
			Ancillary	6	3	-	-	-	-	1	-	10	
	10	NE 1/4	50 Count	2	-	1	-	-	-	1	-	4	M
			Ancillary	3	1	-	-	-	-	-	-	4	
	11	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
			Ancillary	-	1	-	-	-	-	1	-	2	
	12	SE 1/4	50 Count	1	1	1	-	-	-	-	-	3	m
			Ancillary	3	-	-	-	-	-	1	-	4	
			Total	16	6	4	-	-	-	4	-	30	

Suface Collection Quadrat Summaries (Cont.)

Survey Quadrat	Lot #	Collection Quarter	Unit	Biface	Core	Debitage lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
L-6	13	NW 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
	14	NE 1/4	50 Count	1	-	1	-	-	-	-	-	2	m
			Ancillary	3	-	-	-	-	-	-	1	4	
	15	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
			Ancillary	1	-	-	-	-	-	-	-	1	
	16	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
			Ancillary	-	1	-	-	1	-	1	-	3	
			Total	5	1	4	-	1	-	1	1	13	
L-8	17	NE 1/4	50 Count	-	1	1	-	-	-	-	-	2	m
			Ancillary	3	2	-	-	-	-	-	-	5	
	18	SW 1/4	50 Count	3	-	1	-	-	-	-	-	4	s
	19	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
			Total	6	3	3	-	-	-	-	-	12	
L-9	20	NW 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
			Ancillary	8	5	-	-	2	-	-	-	15	
	21	NE 1/4	50 Count	-	1	1	-	-	-	1	-	3	m
			Ancillary	1	-	-	-	-	-	-	-	1	
	22	SW 1/4	50 Count	-	2	1	-	-	-	-	-	3	s
	23	SE 1/4	50 Count	1	-	1	-	2	-	-	-	4	m
			Ancillary	2	-	-	-	2	-	-	-	4	
	213	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	12	8	4	-	6	1	1	-	32	

Suface Collection Quadrat Summaries (Cont.)

Survey Quadrat	Lot #	Collection Quarter	Unit	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
L-10	24	NW 1/4	50 Count	1	-	1	-	-	-	-	-	2	M
			Ancillary	8	4	-	-	-	-	1	-	13	
	25	NE 1/4	50 Count	1	-	1	-	-	-	-	-	2	m
			Ancillary	7	-	-	-	-	-	1	-	8	
	26	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	M
			Ancillary	8	4	-	-	1	-	1	-	14	
	27	SE 1/4	50 Count	1	-	1	-	-	-	-	-	2	S
			Ancillary	-	1	-	-	-	-	-	-	1	
	204	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	26	9	4	-	1	1	3	-	44	
L-11	28	NW 1/4	50 Count	1	1	1	1	-	-	-	-	4	m
	29	NE 1/4	50 Count	-	1	1	-	-	-	-	-	2	m
	30	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	31	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	242	Reconn	Reconn	1	-	-	-	-	-	-	-	1	
			Total	2	2	4	1	-	-	-	-	9	
L-12	32	NW 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
			Ancillary	2	-	-	-	-	-	-	-	2	
	33	NE 1/4	50 Count	1	-	1	-	-	-	-	-	2	m
			Ancillary	4	-	-	-	-	-	1	-	5	
	34	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
			Ancillary	-	-	-	-	-	1	-	-	1	
	35	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
			Ancillary	1	1	-	-	-	-	-	-	2	
	200	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
	201	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	8	1	4	-	-	3	1	-	17	

Suface Collection Quadrat Summaries (Cont.)

Survey Quadrat	Lot #	Collection Quarter	Unit	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
L-14	36	NE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	37	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	38	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	209	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	-	-	3	-	-	1	-	-	4	
U-02	39	NW 1/4	50 Count	1	-	1	-	-	-	-	-	2	M
			Ancillary	12	2	-	-	-	-	-	-	14	
	40	NE 1/4	50 Count	1	-	1	-	-	-	-	-	2	m
			Ancillary	1	1	-	-	1	-	-	-	3	
	41	SW 1/4	50 Count	1	-	1	-	-	-	-	-	2	S
			Ancillary	6	1	-	-	-	-	-	-	7	
	42	SE 1/4	50 Count	2	-	1	-	-	-	-	-	3	S
			Ancillary	4	1	-	-	-	1	-	-	6	
	227	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	28	5	4	-	1	2	-	-	40	
U-07	43	NW 1/4	50 Count	-	-	1	-	-	-	-	2	3	m
			Ancillary	7	1	-	-	-	-	2	-	10	
	44	NE 1/4	50 Count	-	1	1	-	1	-	-	-	3	M
			Ancillary	1	1	-	-	-	-	-	-	2	
	45	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	S
			Ancillary	3	-	-	1	1	-	-	-	5	
	46	SE 1/4	50 Count	1	1	1	-	-	-	-	-	3	m
			Ancillary	5	1	-	1	-	-	-	2	9	
			Total	17	5	4	2	2	-	2	4	36	

Suface Collection Quadrat Summaries (Cont.)

	Lot #	Collection Quarter	Unit	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
U-87	51	NW 1/4	50 Count	3	1	1	-	-	-	1	1	7	m
	52	NE 1/4	50 Count	2	1	1	-	-	-	-	1	5	M
			Ancillary	7	2	-	1	-	-	-	2	12	
	53	SW 1/4	50 Count	3	-	1	-	-	-	-	-	4	M
			Ancillary	11	-	-	-	-	-	1	-	12	
	54	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	F
			Ancillary	14	-	-	-	-	-	1	1	16	
			Total	40	4	4	1	-	-	3	5	57	
U-88	55	NW 1/4	50 Count	-	-	1	-	2	-	-	-	3	m
	56	NE 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
	57	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	m
			Ancillary	7	-	-	-	-	-	-	-	7	
	58	SE 1/4	50 Count	-	-	1	1	-	-	-	-	2	s
			Ancillary	7	-	-	1	-	2	-	1	11	
			Total	14	-	4	2	2	2	-	1	25	
U-95	63	NW 1/4	50 Count	3	-	1	-	-	-	-	-	4	s
			Ancillary	-	1	-	-	-	-	-	-	1	
	64	NE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
			Ancillary	2	-	-	-	-	-	-	-	2	
	65	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
			Ancillary	2	-	-	-	1	-	1	-	4	
	66	SE 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
	217	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	7	1	4	-	1	1	1	-	15	

Suface Collection Quadrat Summaries (Cont.)

	Lot #	Collection Quarter	Unit	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
U-100	71	NW 1/4	50 Count	-	-	1	-	-	-	1	-	2	s
			Ancillary	-	1	-	-	-	1	-	-	2	
	72	NE 1/4	50 Count	1	-	1	-	-	-	-	-	2	s
	73	SW 1/4	50 Count	-	-	1	-	-	-	-	-	1	s
			Ancillary	-	1	-	-	1	-	-	-	2	
	74	SE 1/4	50 Count	-	-	1	1	-	-	-	-	2	s
	212	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
	233	Reconn	Reconn	-	-	-	-	-	1	-	-	1	
			Total	1	2	4	1	1	3	1	-	13	

Suface Collection Quadrat Summaries (Cont.)

Survey Quadrat	Lot #	Collection Quarter	Unit	BIF/P PT	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
U-86	47	NW 1/4	50 Count	1	-	-	1	1	-	-	1	-	4	s
			Ancillary	-	2	2	-	1	-	-	-	1	6	
	48	NE 1/4	50 Count	-	-	-	1	-	2	-	-	-	3	s
	49	SW 1/4	50 Count	-	-	-	1	-	-	-	-	-	1	f
			Ancillary	-	7	3	-	-	-	-	-	-	10	
	50	SE 1/4	50 Count	-	5	1	1	-	-	-	-	-	7	m
			Ancillary	-	7	6	-	-	-	-	1	-	14	
	202	Reconn	Reconn	-	-	-	-	-	-	1	-	-	1	
			Total	1	21	12	4	2	2	1	2	1	46	
	59	NW 1/4	50 Count	-	1	-	1	-	-	-	-	-	2	m
			Ancillary	-	8	4	-	-	1	-	1	-	14	
U-89	60	NE 1/4	50 Count	-	-	-	1	-	-	-	-	-	1	M
			Ancillary	-	16	2	-	-	1	-	1	-	20	
	61	SW 1/4	50 Count	-	2	-	1	-	-	-	-	-	3	m
	62	SE 1/4	50 Count	-	-	-	1	-	-	-	-	-	1	m
			Ancillary	1	1	1	-	-	-	-	-	-	3	
			Total	1	28	7	4	-	2	-	2	-	44	
	67	NW 1/4	50 Count	-	-	-	1	-	-	-	-	-	1	m
			Ancillary	-	7	3	-	-	-	-	-	-	10	
U-97	68	NE 1/4	50 Count	-	-	-	1	-	-	-	-	-	1	f
			Ancillary	6	14	-	-	-	-	-	1	-	21	
	69	SW 1/4	50 Count	-	-	-	1	-	-	-	-	-	1	m
			Ancillary	-	8	1	-	-	-	-	-	-	9	
	70	SE 1/4	50 Count	-	1	-	1	-	-	-	-	-	2	m
			Ancillary	-	3	2	-	-	-	-	-	-	5	
			Total	6	33	6	4	-	-	-	1	-	50	

Suface Collection Quadrat Summaries (Cont.)

Survey Quadrat	Lot #	Collection Quarter	Unit	BIF/P PT	Biface	Core	Debitage Lots	Flake Tool	Modified Flake	PPT	Uni-B	Uniface	Total	Survey Desig.
	75	NW 1/4	50 Count	-	1	-	1	-	-	-	-	-	2	m
			Ancillary	-	2	1	-	-	-	-	-	-	3	
U-101	76	NE 1/4	50 Count	2	1	-	1	1	-	-	-	-	5	m
	77	SE 1/4	50 Count	-	5	1	1	-	-	-	-	-	7	m
			Total	2	9	2	3	1	-	-	-	-	17	

APPENDIX E: RAW MATERIAL COBBLE MEASUREMENTS

Appendix E Cobble Measurements

	Lowland Zone		Cobble Size				
Lot #	Quad	Collection Quadrant	0-4 cm	5-8 cm	9-12 cm	13-16 cm	17-20 cm
5	L-4	NW 1/4	14	25	11		
6	L-4	NE 1/4	45	5			
7	L-4	SW 1/4	19	30	1		
8	L-4	SE 1/4	2	27	20	1	
9	L-5	NW 1/4	1	29	20		
10	L-5	NE 1/4	15	29	6		
11	L-5	SW 1/4	20	23	7		
12	L-5	SE 1/4	34	15		1	
13	L-6	NW 1/4	13	35	2		
14	L-6	NE 1/4	9	37	4		
15	L-6	SW 1/4	5	37	7	1	
16	L-6	SE 1/4	28	21	1		
17	L-8	NE 1/4	4	41	5		
20	L-9	NW 1/4	16	31	3		
21	L-9	NE 1/4	9	37	4		
23	L-9	SE 1/4	2	37	8	3	
24	L-10	NW 1/4	26	23	1		
25	L-10	NE 1/4	25	24	1		
26	L-10	SW 1/4	17	30	3		
28	L-11	NW 1/4	14	30	6		
29	L-11	NE 1/4	38	10	2		
32	L-12	NW 1/4	14	25	9	2	
33	L-12	NE 1/4	11	34	4	1	

Appendix E (Cont.) Cobble Measurements

Upland Zone			Cobble Size				
Lot #	Quad	Collection Quadrant	0-4 cm	5-8 cm	9-12 cm	13-16 cm	17-20 cm
39	U-02	NW 1/4	4	28	16	2	
40	U-02	NE 1/4	17	30	3		
43	U-07	NW 1/4	1	42	7		
44	U-07	NE 1/4	13	31	5		1
46	U-07	SE 1/4	5	34	10	1	
49	U-86	SW 1/4	2	28	17	3	
50	U-86	SE 1/4		19	25	5	1
51	U-87	NW 1/4	17	29	3	1	
52	U-87	NE 1/4	2	31	17		
53	U-87	SW 1/4	29	18	3		
54	U-87	SE 1/4		24	24	2	
55	U-88	NW 1/4	17	27	6		
56	U-88	NE 1/4	2	40	8		
57	U-88	SW 1/4	1	30	15	2	2
59	U-89	NW 1/4	14	29	7		
60	U-89	NE 1/4	3	33	13	1	
61	U-89	SW 1/4	18	28	4		
62	U-89	SE 1/4	3	31	14	2	
67	U-97	NW 1/4	3	36	10	1	
68	U-97	NE 1/4	8	27	15		
69	U-97	SW 1/4	2	32	15	1	
70	U-97	SE 1/4	4	34	11	1	
75	U-101	NW 1/4	15	31	4		
76	U-101	NE 1/4	18	28	4		
77	U-101	SE 1/4	31	15	4		

METRIC ATTRIBUTES OF UNIFACE-B's RECOVERED DURING PROJECT

Cat #	Lot#	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Type	Stg	Var	Org	Shp	Xsec	Rew	Rej	Cort
468-0055	6	L-4	NE 1/4	N375/E350	Ancillary	88.5	93	-69	19	3	2	3	3	7	2	0	1	N
468-0061	7	L-4	SW 1/4	N125/E100	Ancillary	126.3	94	66	23	1	1	2	3	2	1	0	3	N
468-0063	7	L-4	SW 1/4	N125/E100	50 Count	130.5	-94	-63	-26	4	1	2	3	3	2	0	1	Y
468-0086	9	L-5	NW 1/4	N375/E100	Ancillary	105.4	-79	69	21	2	3	3	3	3	2	1	4	N
468-0094	10	L-5	NE 1/4	N375/E350	50 Count	179.4	107	165	25	1	1	3	8	8	3	0	4	Y
468-0098	11	L-5	SW 1/4	N125/E100	Ancillary	122.9	99	71	25	1	1	2	3	3	1	0	4	Y
468-0104	12	L-5	SE 1/4	N125/E350	Ancillary	24	-56	-46	10	4	3	3	3	3	3	0	1	N
468-0108	16	L-6	SE 1/4	N100/E325	Ancillary	50.5	-48	-60	16	2	2	3	3	3	3	0	1	N
468-0148	21	L-9	NE 1/4	N375/E350	50 Count	107.6	87	54	25	1	2	3	3	6	3	0	0	N
468-0156	24	L-10	NW 1/4	N375/E100	Ancillary	65.6	-56	-67	-22	4	2	3	3	3	3	0	1	Y
468-0171	25	L-10	NE 1/4	N375/E350	Ancillary	15.9	-74	-31	8	4	4	2	3	7	2	0	1	N
468-0187	26	L-10	SW 1/4	N125/E100	Ancillary	99.4	91	53	21	1	1	3	3	3	3	0	4	Y
468-0198	33	L-12	NE 1/4	N350/E325	Ancillary	87.3	67	61	23	1	2	3	3	5	3	0	0	Y
468-0234	43	U-07	NW 1/4	N375/E100	Ancillary	50.5	-58	-59	16	4	1	3	3	3	4	0	1	N
468-0293	50	U-86	SE 1/4	N125/E375	Ancillary	226.6	116	78	25	1	2	2	3	3	2	0	1	N
468-0313	54	U-87	SE 1/4	N125/E350	Ancillary	162.6	96	57	28	1	2	3	3	3	3	0	0	Y
468-0332	53	U-87	SW 1/4	N125/E100	Ancillary	57.9	-62	-58	15	2	1	2	3	3	3	0	1	Y
468-0365	59	U-89	NW 1/4	N350/E100	Ancillary	24.8	-54	44	12	4	2	3	3	9	2	0	8	N
468-0394	60	U-89	NE 1/4	N325/E375	Ancillary	66.8	-50	-64	23	2	2	3	3	3	3	0	1	Y
468-0402	65	U-95	SW 1/4	N125/E125	Ancillary	65.4	82	56	15	1	1	3	3	6	3	0	8	Y
468-0426	68	U-97	NE 1/4	N375/E350	Ancillary	42.6	-52	-46	-18	4	2	3	3	3	3	0	8	N
468-0450	71	U-100	NW 1/4	N325/E50	50 Count	48.2	-46	-49	19	4	2	3	3	3	3	0	1	N
468-0571	5	L-4	NW 1/4	N375/E100	50 Count	82.2	78	53	19	1	1	3	3	4	3	0	3	Y
468-0576	43	U-07	NW 1/4	N375/E100	Ancillary	53.5	-95	-34	19	1	2	3	3	8	2	0	8	N
468-0577	47	U-86	NW 1/4	N375/E100	50 Count	123.3	97	67	28	1	1	3	3	6	3	0	0	Y
468-0579	51	U-87	NW 1/4	N350/E125	50 Count	279.9	119	79	30	1	1	3	3	8	3	0	0	Y

METRIC ATTRIBUTES OF BIFACE/POINTS RECOVERED DURING PROJECT

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	COND	WT	ML	MW	Th	MAT	Comments
468-0045	240	U-80b	Reconn	N100/E350	Reconn	Frag	-2.4	-26.2	19.8	4.2	Obs	arrow size
468-0047	241	U-77	Reconn	N275/E175	Reconn	Frag	-2.7	-18.6	-22	5.7	Obs	indeterm.
468-0050	244	U-82	Reconn	N0/E175	Reconn	Frag	-1.1	-14.3	-17.6	4.2	Obs	arrow size
468-0277	47	U-86	NW 1/4	N375/E100	50 Count	Frag	-6.4	-48.6	-33.1	-6.3	Obs	dart size
468-0373	62	U-89	SE 1/4	N125/E375	Ancillary	Frag	-2.8	-28.3	-19.4	5.1	Obs	indeterm.
468-0414	68	U-97	NE 1/4	N375/E350	Ancillary	Frag	-6.3	-39.8	30.9	6.1	Obs	dart size
468-0415	68	U-97	NE 1/4	N375/E350	Ancillary	Frag	-4.3	-26.4	27.7	6.2	Obs	arrow size
468-0416	68	U-97	NE 1/4	N375/E350	Ancillary	Frag	-2	-21.9	-19.9	-4.4	Obs	intermed.
468-0419	68	U-97	NE 1/4	N375/E350	Ancillary	Whole	2.4	42.3	10.7	3.5	Obs	arrow size
468-0428	68	U-97	NE 1/4	N375/E350	Ancillary	Frag	-3.9	-46.7	-21.6	-5	Obs	dart size
468-0429	68	U-97	NE 1/4	N375/E350	Ancillary	Frag	-3.6	-30.1	-21.8	-5.1	Obs	dart size
468-0467	76	U-101	NE 1/4	N375/E350	50 Count	Frag	-2.4	-33.4	-18.1	-4.1	Obs	intermed.
468-0468	76	U-101	NE 1/4	N375/E350	50 Count	Frag	-2.6	-21.4	-20.8	-4.1	Obs	dart size

Core Analysis Catalog Codes
(from Gilreath and Hildebrandt 1995 pgs. B85-B87)

Field Name

Wt	Weight in grams
Len	Length in mm.
Wid	Width in mm.
Th	Thickness in mm.
Atype	Artifact type

2. bidirectional core
3. non-patterned core
4. unidirectional core
5. cobble test (split cobble, few flakes removed)
6 chuck test

Ftype — Fragment Type

1. whole
2. near complete
4. indeterminate end
5. medial
6. margin
9. indeterminate fragment

Aform — Artifact Form

1. tabular cobble
2. plate cobble
3. globular/rounded cobble
4. angular cobble
5. chunk/shatter
6. flake
7. split cobble (1/3 or 1/2)
9. indeterminate

Core Analysis Catalog Codes (cont.)

Field Name

Cort — Cortex Type

0. no cortex present
1. incipient cone cortex
2. weathered, hydrated flat rind
3. stretched or rippled
4. combination of cortex types
5. ash encrusted
6. orange (desert varnish) patina
7. caliche coated
8. decomposing, eroded cortex

Plts — Number of Contiguous Platforms

Ppt — Primary Platform Type

1. cortical
2. interior
3. prepared

Spt — Secondary Platform Type

0. no secondary platform
1. cortical
2. interior
3. prepared

Wear — Evidence of Tool Wear

0. none
1. present
2. equivocal

Core Analysis Catalog Codes (cont.)

Field Name

Shp — Planar Shape

(Whole)

1. triangular
2. rhomboidal
3. rounded elongate
4. blocky rectangular
5. circular
6. wide-shouldered
8. irregular

(Fragments)

1. triangular end
2. blunted, rectangular end
3. blunted cornerless
4. arc
5. corner fragment
6. looks like a #6 whole
7. pointed
8. irregular
9. indeterminate
10. straight edge
11. arc expanding

Xsec — Cross-section Shape

1. domed steep triangular
2. biconvex
3. plano-convex (thin)
4. bi-planar with edges (plate)
5. angular thick
6. plano-convex (thick)
8. irregular
9. indeterminate (margin, interior, etc.)

METRIC ATTRIBUTES OF CORES RECOVERED DURING PROJECT

Cat #	Lot #	Survey Quadra	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Atype	Ftype	Aform	Cort	Plts	Ppt	Spt	Wear	Shp	Xsec
468-0051	1	L-2	NW 1/4	N325/E25	Ancillary	924.6	166	121	62	3	1	1	1	1	1	0	0	8	6
468-0052	5	L-4	NW 1/4	N375/E100	Ancillary	218.9	106	69	36	4	1	9	3	1	2	0	2	1	6
468-0054	5	L-4	NW 1/4	N375/E100	Ancillary	172.3	97	62	37	2	2	9	3	2	2	2	0	8	1
468-0059	6	L-4	NE 1/4	N375/E350	Ancillary	37.1	64	34	20	3	1	9	0	2	2	2	0	1	8
468-0062	7	L-4	SW 1/4	N125/E100	50 Count	176.6	78	77	38	4	9	9	3	3	2	2	0	8	8
468-0064	8	L-4	SE 1/4	N125/E350	50 Count	137.3	78	67	35	3	9	9	3	2	2	1	0	8	8
468-0072	8	L-4	SE 1/4	N125/E350	Ancillary	152.7	95	72	26	5	1	6	1	2	1	2	0	8	3
468-0073	8	L-4	SE 1/4	N125/E350	Ancillary	572.6	72	87	78	4	1	7	4	1	2	0	0	8	5
468-0074	8	L-4	SE 1/4	N125/E350	Ancillary	302	93	67	36	5	1	7	4	2	1	2	2	8	5
468-0075	8	L-4	SE 1/4	N125/E350	Ancillary	462.1	124	78	51	4	1	4	1	7	1	2	0	8	8
468-0076	8	L-4	SE 1/4	N125/E350	Ancillary	479.7	111	100	58	3	2	4	1	5	1	2	0	8	8
468-0077	8	L-4	SE 1/4	N125/E350	Ancillary	241.8	109	69	38	4	1	6	3	1	2	0	0	8	1
468-0078	8	L-4	SE 1/4	N125/E350	Ancillary	208.2	104	50	43	2	9	9	3	2	1	2	0	8	5
468-0079	8	L-4	SE 1/4	N125/E350	Ancillary	212.7	132	62	32	4	1	6	0	1	2	0	2	1	1
468-0087	9	L-5	NW 1/4	N375/E100	Ancillary	22.8	90	68	34	2	1	4	3	3	2	1	0	2	4
468-0088	9	L-5	NW 1/4	N375/E100	Ancillary	291.9	122	79	46	2	1	9	3	2	2	2	0	8	6
468-0089	9	L-5	NW 1/4	N375/E100	Ancillary	145	82	72	32	2	1	6	3	2	1	2	0	8	6
468-0095	10	L-5	NE 1/4	N375/E350	Ancillary	183.2	74	68	44	4	1	4	4	2	2	1	0	8	6
468-0099	11	L-5	SW 1/4	N125/E100	Ancillary	156.4	80	74	31	6	9	5	1	2	2	2	0	8	8
468-0101	12	L-5	SE 1/4	N125/E350	50 Count	124.2	66	72	34	3	9	5	3	2	1	2	0	8	2
468-0109	16	L-6	SE 1/4	N100/E325	Ancillary	73.7	74	52	18	5	1	2	4	1	1	0	0	3	2
468-0115	17	L-8	NE 1/4	N350/E375	Ancillary	196.9	95	61	34	4	1	7	4	1	2	0	0	8	6
468-0116	17	L-8	NE 1/4	N350/E375	Ancillary	290.9	89	68	64	5	1	4	4	1	1	0	0	8	8
468-0119	17	L-8	NE 1/4	N350/E375	50 Count	359.1	110	88	44	2	1	7	3	2	1	2	2	8	8
468-0126	20	L-9	NW 1/4	N375/E100	Ancillary	254.1	88	76	52	2	1	9	1	2	2	2	0	8	6
468-0130	20	L-9	NW 1/4	N375/E100	Ancillary	82.7	76	47	27	2	1	9	3	3	2	1	0	1	2
468-0131	20	L-9	NW 1/4	N375/E100	Ancillary	316.3	74	71	59	3	1	3	3	2	1	1	0	8	8
468-0133	20	L-9	NW 1/4	N375/E100	Ancillary	227.9	100	76	29	5	1	2	3	2	1	1	0	3	2
468-0137	20	L-9	NW 1/4	N375/E100	Ancillary	602.5	107	99	69	2	1	7	3	2	1	2	0	8	8
468-0143	22	L-9	SW 1/4	N100/E100	50 Count	129.9	79	47	47	4	1	9	1	1	2	0	2	8	5
468-0144	22	L-9	SW 1/4	N100/E100	50 Count	297.1	92	80	60	4	1	9	0	3	1	2	0	8	8
468-0149	21	L-9	NE 1/4	N375/E350	50 Count	103.2	68	49	34	4	2	9	3	3	2	2	2	8	8
468-0154	24	L-10	NW 1/4	N375/E100	Ancillary	105.1	82	56	27	3	4	9	0	3	2	2	2	8	4
468-0157	24	L-10	NW 1/4	N375/E100	Ancillary	324	104	67	60	3	1	3	3	2	2	2	0	8	5

METRIC ATTRIBUTES OF CORES RECOVERED DURING PROJECT (CONT.)

Cat #	Lot #	Survey Quadra	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Atype	Ftype	Aform	Cort	Plts	Ppt	Spt	Wear	Shp	Xsec
468-0159	24	L-10	NW 1/4	N375/E100	Ancillary	291.5	112	70	54	4	1	9	3	2	2	1	0	8	5
468-0161	24	L-10	NW 1/4	N375/E100	Ancillary	347.1	112	68	49	4	1	4	3	3	1	2	0	8	8
468-0173	27	L-10	SE 1/4	N125/E375	Ancillary	106.7	68	57	36	4	1	7	1	1	2	0	0	8	5
468-0175	26	L-10	SW 1/4	N125/E100	Ancillary	100.8	72	61	26	5	4	2	4	1	2	0	0	3	2
468-0178	26	L-10	SW 1/4	N125/E100	Ancillary	214.5	117	73	30	3	1	9	3	3	1	2	2	1	8
468-0185	26	L-10	SW 1/4	N125/E100	Ancillary	632.9	144	90	58	3	1	7	4	3	1	2	2	8	8
468-0186	26	L-10	SW 1/4	N125/E100	Ancillary	39.6	82	41	20	6	9	9	0	2	2	2	0	3	3
468-0190	28	L-11	NW 1/4	N375/E100	50 Count	171.3	82	61	38	3	1	3	3	3	1	1	0	8	8
468-0200	35	L-12	SE 1/4	N75/E375	Ancillary	157.8	85	61	34	4	1	7	1	1	1	0	2	3	6
468-0204	39	U-02	NW 1/4	N375/E100	Ancillary	75.4	47	42	39	4	1	9	3	3	1	2	0	8	8
468-0205	39	U-02	NW 1/4	N375/E100	Ancillary	290	81	60	63	3	1	3	3	3	2	2	1	8	5
468-0217	41	U-02	SW 1/4	N125/E100	Ancillary	178.7	68	53	46	3	1	3	1	2	2	2	0	2	5
468-0224	40	U-02	NE 1/4	N375/E275	Ancillary	116.7	87	65	22	2	4	6	2	2	2	2	2	3	3
468-0227	42	U-02	SE 1/4	N100/E375	Ancillary	64.8	101	33	27	3	1	9	3	3	2	2	2	1	6
468-0237	43	U-07	NW 1/4	N375/E100	Ancillary	238.2	85	68	60	3	1	7	3	3	2	2	0	8	1
468-0248	44	U-07	NE 1/4	N350/E325	Ancillary	101.6	92	55	25	5	4	7	3	2	2	2	0	3	3
468-0249	44	U-07	NE 1/4	N350/E325	50 Count	26.8	44	38	18	6	9	9	0	2	2	2	0	8	2
468-0251	46	U-07	SE 1/4	N125/E350	50 Count	352	84	71	66	3	9	9	3	2	1	2	0	8	5
468-0258	46	U-07	SE 1/4	N125/E350	Ancillary	141.1	84	62	35	4	1	6	3	2	2	2	2	1	5
468-0264	47	U-86	NW 1/4	N375/E100	Ancillary	137.2	74	54	33	4	1	6	2	1	2	0	1	3	5
468-0271	49	U-86	SW 1/4	N125/E100	Ancillary	172.3	100	57	32	4	2	6	5	1	2	0	2	4	5
468-0273	49	U-86	SW 1/4	N125/E100	Ancillary	275.8	79	71	51	3	1	7	1	2	2	2	0	8	5
468-0274	49	U-86	SW 1/4	N125/E100	Ancillary	332.7	95	69	64	3	1	3	3	3	2	2	0	8	5
468-0278	50	U-86	SE 1/4	N125/E375	50 Count	331.1	93	82	53	3	4	9	0	2	2	2	0	3	6
468-0282	50	U-86	SE 1/4	N125/E375	Ancillary	277	105	62	52	3	1	9	0	4	2	2	0	8	8
468-0283	50	U-86	SE 1/4	N125/E375	Ancillary	307.4	98	57	70	3	1	9	2	3	2	2	0	8	8
468-0285	50	U-86	SE 1/4	N125/E375	Ancillary	498.8	93	88	74	3	1	4	5	4	2	2	0	8	8
468-0286	50	U-86	SE 1/4	N125/E375	Ancillary	287.9	96	61	53	3	1	3	4	2	1	2	0	4	8
468-0289	50	U-86	SE 1/4	N125/E375	Ancillary	104.8	70	61	30	6	9	9	0	2	2	2	0	8	2
468-0291	50	U-86	SE 1/4	N125/E375	Ancillary	177.5	69	64	42	6	2	7	4	2	2	2	0	8	8
468-0308	52	U-87	NE 1/4	N375/E350	Ancillary	462.6	102	86	69	3	1	5	0	4	2	2	0	8	8
468-0309	52	U-87	NE 1/4	N375/E350	Ancillary	388.5	112	100	42	3	1	7	4	3	2	2	0	8	8
468-0360	59	U-89	NW 1/4	N350/E100	Ancillary	165.7	62	48	54	3	1	9	4	3	2	2	0	8	5
468-0364	59	U-89	NW 1/4	N350/E100	Ancillary	352.4	105	83	45	5	1	7	3	2	2	2	0	8	6

METRIC ATTRIBUTES OF CORES RECOVERED DURING PROJECT (CONT.) .

Cat #	Lot #	Survey Quadra	Collect Quadrant	Unit Prov	Unit	Wt	Len	Wid	Th	Atype	Ftype	Aform	Cort	Plts	Ppt	Spt	Wear	Shp	Xsec
468-0370	59	U-89	NW 1/4	N350/E100	Ancillary	534.8	124	87	48	3	1	7	2	3	1	2	0	8	8
468-0371	59	U-89	NW 1/4	N350/E100	Ancillary	102	76	47	28	3	1	9	2	2	2	2	0	8	8
468-0372	62	U-89	SE 1/4	N125/E375	Ancillary	455.9	120	90	52	3	4	4	5	1	1	0	0	7	6
468-0386	60	U-89	NE 1/4	N325/E375	Ancillary	66.1	74	41	21	6	1	6	1	2	2	2	0	8	3
468-0392	60	U-89	NE 1/4	N325/E375	Ancillary	173	109	72	25	3	2	6	0	3	2	2	0	8	4
468-0403	63	U-95	NW 1/4	N375/E100	Ancillary	284	95	74	37	5	1	1	4	1	1	0	0	8	4
468-0404	67	U-97	NW 1/4	N375/E100	Ancillary	423.9	134	62	55	3	2	9	3	2	2	2	0	2	6
468-0410	67	U-97	NW 1/4	N375/E100	Ancillary	369.4	100	66	56	4	1	4	4	2	2	2	0	8	5
468-0413	67	U-97	NW 1/4	N375/E100	Ancillary	468.3	127	72	49	3	1	4	4	3	2	2	2	8	8
468-0436	69	U-97	SW 1/4	N125/E125	Ancillary	380.7	89	72	63	3	1	3	3	5	2	2	0	8	8
468-0447	70	U-97	SE 1/4	N125/E350	Ancillary	275.3	82	79	43	4	1	7	3	1	2	0	0	5	5
468-0448	70	U-97	SE 1/4	N125/E350	Ancillary	248.1	99	66	47	3	2	6	1	3	2	2	0	8	6
468-0451	71	U-100	NW 1/4	N325/E50	Ancillary	141.9	77	52	39	3	4	1	1	2	2	2	0	4	2
468-0453	73	U-100	SW 1/4	N150/E100	Ancillary	159.5	75	70	35	3	1	9	1	3	2	2	0	8	6
468-0457	75	U-101	NW 1/4	N375/E100	Ancillary	203.4	79	68	45	3	1	9	4	2	2	2	0	5	5
468-0460	77	U-101	SE 1/4	N50/E450	50 Count	148	84	61	40	3	2	9	0	2	2	2	2	8	5
468-0469	47	U-86	NW 1/4	N375/E100	Ancillary	59.2	51	41	24	6	9	9	0	2	2	2	0	8	8
468-0565	52	U-87	NE 1/4	N375/E350	50 Count	135.4	74	60	31	3	1	7	1	3	1	2	0	4	8
468-0568	29	L-11	NE 1/4	N375/E350	50 Count	127.2	94	51	24	4	2	6	2	1	2	0	0	8	8
468-0569	51	U-87	NW 1/4	N350/E125	50 Count	558.1	152	67	51	3	1	7	1	1	2	0	0	8	6

Debitage Appendix

Cat #	BIF PD	BIF SD	EBT	MBT	LBT	Press	Core PD	Core SD	Core SI	Core CI	Rect	Indet Perc	Edge Prep	Grav	Total	Lot #
468-0470		1	4	6			13	9	5	3		10				1
468-0471			5	17	3		1		9			15				2
468-0472		2	3	5		1	7	5	6	4		11		7		3
468-0473			3	8			6	4	1	4	1	24				4
468-0474			5				14	16	7	3		4				5
468-0475			2	6			5	11	15	4		6				6
468-0476		2	2	2			12	13	6	3		8				7
468-0477		4	1	2			12	5	11	3		7				8
468-0478		2	4	4			16	4	8	6		7				9
468-0479			9	2			8	9	6	7		9				10
468-0480			7	2			9	5	9	9		13				11
468-0481			4	2			18	11	8	1		9				12
468-0482			2	4			14	13	3	5		8				13
468-0483		2	2	8			6	5	8	10		8				14
468-0484			5	2			13	7	5	4		12		3		15
468-0485			4	5			13	7	5	7	1	9				16
468-0486		3	4			1	14	12	2	5		7				17
468-0487			3	12	5		3		4			19				18
468-0488			4	4				3	6	6		22	5			19
468-0489			4	2			13	9	8	6		8				20
468-0490		1	4				18	15	6	1		3				21

BIF PD = Biface pimary decortication flakes, BIF SD = Biface secondary decortication flakes, EBT = early biface thinning flake, MBT = Middle Stage Biface Thinning Flake, LBT = Late Stage Biface Thinning Flakes, Press = Pressure Flakes, Core PD=Core primary decortication flakes, Core SD = Core secondary decortication flakes, Core SI=simple interior flakes, Core CI =complex interior flakes, Rect=Rectangular Blade-like flake,Indet Perc = Indeterminant Percussion Flake, Grav = Gravel

Debitage Appendix (Cont.)

Cat #	BIF PD	BIF SD	EBT	MBT	LBT	Press	Core PD	Core SD	Core SI	Core CI	Rect	Indet Perc	Edge Prep	Grav	Total	Lot #
468-0491			7	4			13	3	9	1		11				22
468-0492	3			4			18	14	3		1	7				23
468-0493		2	4				22	3	5	5	1	8				24
468-0494	2		5	8	4		9	6	4	5		5				25
468-0495		1	3	4			15	8	8	1		9				26
468-0496		2	2	4			9	7	3	6		14				27
468-0497	2		5	1			19	7	5	3		10				28
468-0498			5	6			8	4	7	4		17				29
468-0499			3	4			11	3	2	4		23				30
468-0500				3			12	11	5	3	5	15				31
468-0501			4				15	10	6	4		9				32
468-0502			6	3			13	6	6	4		11				33
468-0503			2	3			11	6	8	7		18				34
468-0504			6	6			8		8	4		15				35
468-0505			7	5			7	2	9	4	1	16				36
468-0506				5	7	3	2	2	4			15	4	6		37
468-0507			5	6			15	5	5	3		10	4			38
468-0508		2	10	9			3	14	6		1	5				39
468-0509			4	7			11	8	6		1	10	5			40
468-0510			4	23	6		3					10	3			41
468-0511		6	5	8			8	6	2	3	1	9				42

BIF PD = Biface pimary decortication flakes, BIF SD = Biface secondary decortication flakes, EBT = early biface thinning flake,
MBT = Middle Stage Biface Thinning Flake, LBT = Late Stage Biface Thinning Flakes, Press = Pressure Flakes,
Core PD=Core primary decortication flakes, Core SD = Core secondary decortication flakes, Core SI=simple interior flakes,
Core CI =complex interior flakes, Rect=Rectangular Blade-like flake,Indet Perc = Indeterminant Percussion Flake, Grav = Gravel

Debitage Appendix (Cont.)

Cat #	BIF PD	BIF SD	EBT	MBT	LBT	Press	Core PD	Core SD	Core SI	Core CI	Rect	Indet Perc	Edge Prep	Grav	Total	Lot #
468-0513			6	9			17	6	6	4		5	2			43
468-0514			5	11	4		6	4	4			12	4			44
468-0515				13	32	1		6								45
468-0516			5				19	12	5	2		5				46
468-0517			6	17			7	4	6	2		7				47
468-0518			12	8			13	4	3	2		6				48
468-0519	3		34	8			1					1				49
468-0520		3	6	4			9	8	5	2	1	2	3	1		50
468-0521			2	7			11	6	7	3		7	3			51
468-0522			6	8			12	8	4	3		5				52
468-0523			8	4			11	11	9			5				53
468-0524			7	4			11	12	11	3		2	1			54
468-0525		2	1	6			12	7	7			11	2			55
468-0526				6			19	7	6			8	1	2		56
468-0527			7	4			21	10	5			3				57
468-0528		4	16	6			8	7	6	2						58
468-0529			2	8	2		3	8	2	4		12	7	1		59
468-0530			6	11			10	5		2		12		3		60
468-0531				3			18	6	3	5		5		8		61
468-0532		3	1	2			19	2	1	2		10	1	10		62
468-0533			5	6			9	8	6	3	1	7	2			67

BIF PD = Biface pimary decortication flakes, BIF SD = Biface secondary decortication flakes, EBT = early biface thinning flake,
MBT = Middle Stage Biface Thinning Flake, LBT = Late Stage Biface Thinning Flakes, Press = Pressure Flakes,
Core PD=Core primary decortication flakes, Core SD = Core secondary decortication flakes, Core SI=simple interior flakes,
Core CI =complex interior flakes, Rect=Rectangular Blade-like flake,Indet Perc = Indeterminant Percussion Flake, Grav = Gravel

Debitage Appendix (Cont.)

Cat #	BIF PD	BIF SD	EBT	MBT	LBT	Press	Core PD	Core SD	Core SI	Core CI	Rect	Indet Perc	Edge Prep	Grav	Total	Lot #
468-0534	2	2	7	16	4			7	3	4		5				68
468-0535		2	7	6			11	15	4	2		4				69
468-0536		3	14	9			2	12	4			4	1			70
468-0537		3	8	5	5		5	5	4	2		10				63
468-0538			3	14	6			4	2	1		17	3			64
468-0539				11	6		5	6	5	2		12	4			65
468-0540		5	7	5	7		14	4	2	2		4				66
468-0541		1		6			18	5	2	2		6		10		71
468-0542				1			19	9	2		1	8	3	6		72
468-0543				19	6	2	1	2		2		15	3			73
468-0544				8	2		7	15	6			5	2	6		74
468-0545		1		17			6	9	9	4	1		2			75
468-0546		3	5	5	2	1	12	9	4	3		2	2			76
468-0547			3	4			14	11	5	1		7				77

BIF PD = iface Rpimary decortication flakes, BIF SD = Biface secondary decortication flakes, EBT = early biface thinning flake, MBT = Middle Stage Biface Thinning Flake, LBT = Late Stage Biface Thinning Flakes, Press = Pressure Flakes, Core PD=Core primary decortication flakes, Core SD = Core secondary decortication flakes, Core SI=simple interior flakes, Core CI =complex interior flakes, Rect=Rectangular Blade-like flake,Indet Perc = Indeterminant Percussion Flake, Grav = Gravel

Flake Tool Metric Attributes Appendix

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit	WT	FRG	Len	Wid	Thk	Edges
468-0189	28	L-11	NW 1/4	50 Count	140.5	2	90	71	21	1
468-0246	45	U-07	SW 1/4	Ancillary	20.6	3	-60	30	9	2
468-0254	46	U-07	SE 1/4	Ancillary	13.2	1	59	31	9	2
468-0262	47	U-86	NW 1/4	Ancillary	55.4	1	74	46	18	1
468-0307	52	U-87	NE 1/4	Ancillary	93.9	6	-74	51	28	2
468-0353	58	U-88	SE 1/4	Ancillary	65.3	6	-77	-47	16	1
468-0465	76	U-101	NE 1/4	50 Count	15.9	2	34	26	16	2
468-0561	58	U-88	SE 1/4	50 Count	64	2	98	42	17	2
468-0562	74	U-100	SE 1/4	50 Count	8.4	2	42	25	8	1
468-0563	47	U-86	NW 1/4	50 Count	8.3	1	55	29	6	1

WT= weight in grams
FRG=Fragment Type
1 = whole
2 = flake base
3 = flake tip
6 = flake side fragment

Len = Length in mm
Wid = Width in mm
Thk = Thickness in mm
Edges = Number of utilized edges

Projectile Point Metric Attributes

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Cond	ML	AL	MW	Th	WT	BW	NW	DSA	PSA	NOA	STL	Type	Mat
468-0001	200	L-12	Reconn	N300/E0	Reconn	WHL	68.9	64.9	31.9	7.2	11.7	28.9	18.8	145	125	20	11.7	EE	Obs
468-0002	201	L-12	Reconn	N0/E0	Reconn	WHL	30.1	30.1	11.9	2.7	0.8	10.1	5	190	165	25	7.3	DSN	Obs
468-0003	202	U-86	Reconn	N0/E25	Reconn	FRG	-21.9	-21.9	-20.5	5.5	-2.5	-11.8	11.1	-	-	-	6.1	RS	Obs
468-0004	203	L-3	Reconn	N125/E450	Reconn	FRG	-47.4	-42.1	29.7	5.2	-6.4	29.7	11.6	150	60	90	9.5	ECS	Obs
468-0005	204	L-10	Reconn	N375/E350	Reconn	WHL	30.6	29.3	10.9	2.8	0.7	11.7	6	205	175	30	12.6	DSN	Obs
468-0006	205	U-81	Reconn	N350/E200	Reconn	WHL	21.1	18.9	12.1	2.7	0.5	12.1	-	-	-	-	-	CW	Obs
468-0007	206	U-90	Reconn	N275/E125	Reconn	FRG	-41.3	-40.3	29.8	5.6	-7.2	22.5	11.8	140	170	30	8.5	EE	Obs
468-0008	207	U-77	Reconn	N300/E175	Reconn	FRG	-22.1	-15.6	30.2	4.4	-3.6	29	21.7	170	140	30	8.6	EE	Obs
468-0009	208	U-79a	Reconn	N175/E275	Reconn	WHL	36	35	-21.1	4.1	2.2	-13.3	-11.5	140	120	20	5.1	RS	Obs
468-0010	209	L-14	Reconn	N325/E0	Reconn	WHL	59.4	59.4	32.1	7.1	-10.6	-32.1	14.6	-	-	-	-6.1	ECS	Obs
468-0011	34	L-12	SW 1/4	N100/E125	Ancillary	WHL	60.3	60.3	32.2	7.5	12.5	-	-	-	-	-	35.7	GBS	Obs
468-0012	42	U-02	SE 1/4	N100/E375	Ancillary	FRG	-25	-22.5	-14.1	4.8	-1.5	4.1	7.3	140	120	20	5.7	RS	Obs
468-0013	210	U-81	Reconn	N375/E200	Reconn	FRG	-35.6	-35.6	-16.7	3.8	2	16.4	7.3	120	110	10	6.1	RS	Obs
468-0014	211	U-79b	Reconn	N200/E325	Reconn	FRG	-22	-15.7	32.1	4.6	-2.9	25.6	18	140	130	10	9.2	EE	Obs
468-0015	212	U-100	Reconn	N425/E0	Reconn	FRG	-47.7	-44.1	25.5	9.6	-10.1	23.3	18.8	180	140	40	10.4	LL	Obs
468-0016	213	L-9	Reconn	N450/E300	Reconn	FRG	-27.3	-23.4	-31.3	7.8	-5.1	27.3	15.9	170	160	10	12.4	ESN	Obs
468-0017	214	U-77	Reconn	N375/E475	Reconn	FRG	-26	-20.4	-31.4	-6.2	-4.4	16.4	14.8	135	105	30	7.4	LL	Obs
468-0018	215	U-80	Reconn	N200/E225	Reconn	FRG	-32.6	-30.4	-26.5	5.8	-4.3	26.1	11.9	150	70	80	11.3	ECS	Obs
468-0019	216	U-79c	Reconn	N100/E400	Reconn	FRG	-18.4	-15	-15	3.6	-0.7	-	9.4	180	170	10	-	DSN	Obs
468-0020	217	U-95	Reconn	N250/E475	Reconn	FRG	-37.9	-37.9	31.4	6.5	-8.8	-	15.9	-	-	-	-	UNK	Obs
468-0021	218	U-83	Reconn	N0/E0	Reconn	FRG	-39.8	-34.7	-20.9	-6.7	-5.4	-20.9	-	-	-	-	-	HBN	Obs
468-0022	219	U-08	Reconn	N300/E200	Reconn	WHL	25.3	23.7	22.1	5.9	2.1	22.1	-	-	-	-	-	UNK	Obs
468-0023	58	U-88	SE 1/4	N100/E325	Ancillary	FRG	-38.2	-38.2	-29.9	5.1	-5.4	10.4	-	-	-	-	-	UNK	Obs
468-0024	220	U-77	Reconn	N400/E450	Reconn	FRG	-28.6	-28.6	-27.6	6.3	-4.5	-21.6	11.1	-	-	-	-11.8	UNK	Obs
468-0025	221	U-84	Reconn	N0/E0	Reconn	FRG	-11.1	-11.1	-25.2	5.9	-2.2	-	12.3	190	160	30	-	EE	Obs
468-0026	222	U-76	Reconn	N125/E475	Reconn	WHL	-20.1	-19.7	11.6	2.3	0.6	11.6	-	-	-	-	-	CW	CCR
468-0027	223	L-16	Reconn	N75/E275	Reconn	WHL	29.8	28.8	-17.7	6	2.3	18	11.9	-	-	-	8.4	ECN	Obs
468-0028	224	U-89a	Reconn	N325/E225	Reconn	WHL	47.7	43.6	22.6	5.6	5.2	16.9	16.3	-	-	-	8.5	LL	Obs
468-0029	225	U-79b	Reconn	N200/E0	Reconn	FRG	-37.6	-37.6	-31.3	-6.5	-7.3	-	-	-	-	-	-	UNK	Obs
468-0030	58	U-88	SE 1/4	N100/E325	Ancillary	WHL	76.2	74.2	36.8	10.1	25.6	24	24	160	85	75	15.8	GBS	Obs

Projectile Point Metric Attributes (Cont.)

Cat #	Lot #	Survey Quadrat	Collect Quadrant	Unit Prov	Unit	Cond	ML	AL	MW	Th	WT	BW	NW	DSA	PSA	NOA	STL	Type	Mat
468-0031	226	U-89a	Reconn	N150/E0	Reconn	FRG	-34.5	-32.7	-26.3	-6	-6	-16	15.7	180	120	60	6.2	LL	Obs
468-0032	227	U-02	Reconn	N375/E350	Reconn	FRG	-17.6	-17.6	-21.8	-5.7	-2.1	-11.6	10.9	155	115	40	-5.2	UNK	Obs
468-0033	228	U-85	Reconn	N350/E250	Reconn	FRG	-36.6	-36.6	-28	7.6	-7.1	17.9	17.9	180	85	95	15.5	GBS	Obs
468-0034	229	U-79a	Reconn	N300/E250	Reconn	FRG	-34.9	-34.9	-27.2	4.7	-4.5	-	-	-	-	-	-	LL	Obs
468-0035	230	L-17	Reconn	N325/E475	Reconn	FRG	-36.1	-36.1	-27.7	6.1	-5.8	-	-	120	110	10	-	UNK	Obs
468-0036	231	U-83	Reconn	N250/E475	Reconn	FRG	-37.8	-37.8	-26.9	6.3	-4.9	-	-	-	-	-	-	Elko	Obs
468-0037	232	U-94a	Reconn	N0/E0	Reconn	FRG	-28	-28	14.7	3.8	1.9	-8.4	7.9	140	100	40	4.7	RS	CCR
468-0038	233	U-100	Reconn	N325/E75	Reconn	FRG	-33.8	-33.8	-24.8	4.5	-3.4	-	-	-	-	-	-7.2	UNK	Obs
468-0039	234	U-76	Reconn	N275/E100	Reconn	FRG	-20.3	-20.3	-27.7	5.1	-2.7	-	-	-	-	-	-	UNK	Obs
468-0040	235	U-76	Reconn	N150/E200	Reconn	FRG	-28.4	-28.4	-32	6.9	-5	-	-	-	-	-	-	UNK	Obs
468-0041	236	U-89b	Reconn	N475/E250	Reconn	FRG	-29.9	-29.1	-26.9	5.9	-4.2	-	-	-	-	-	-	LL	Obs
468-0042	216	U-79c	Reconn	N100/E400	Reconn	WHL	23.2	22.6	-14.9	2.8	0.7	-14.9	-	-	-	-	-	CW	Obs
468-0044	238	U-89a	Reconn	N50/E400	Reconn	FRG	-28.9	-28.9	-23	5.1	-4.1	-	-	-	-	-	-	UNK	Obs
468-0046	71	U-100	NW 1/4	N325/E50	Ancillary	FRG	-24.8	-24.8	-26.3	6.1	-4.3	17.8	17.8	-	-	-	8.4	Elko	Obs
468-0048	241	L-2	Reconn	N275/E450	Reconn	FRG	-27.8	-18.6	-25.8	4.7	-2.9	18.1	-18.9	170	160	10	-	EE	Obs

APPENDIX B: OBSIDIAN HYDRATION MEASUREMENTS OF ARTIFACTS COLLECTED DURING PROJECT

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean	
468-0001		200	PPT	3.8	3.8	4.0	3.7	3.9	3.8	3.8	
468-0002		201	PPT	2.7	2.4	2.7	2.5	2.5	2.4	2.5	
468-0003		202	PPT	2.9	2.9	2.9	2.9	2.9	3.0	2.9	
468-0004		203	PPT	2.9	2.9	3.1	2.9	3.1	2.9	3.0	
468-0005		204	PPT	2.9	2.9	2.7	2.9	2.7	2.9	2.8	
468-0006		205	PPT	1.5	1.7	1.5	1.5	1.5	1.5	1.5	
468-0007		206	PPT	2.9	2.9	2.9	3.2	3.1	3.1	3.0	
468-0008		207	PPT	2.5	2.5	2.5	2.7	2.7	2.7	2.6	
468-0009		208	PPT	3.2	3.1	3.1	3.1	3.1	3.3	3.1	
468-0010		209	PPT	3.9	3.7	3.9	3.7	4.0	4.0	3.9	
468-0011		34	PPT	5.6	5.8	5.4	5.6	5.4	5.6	5.6	
468-0012		42	PPT	3.8	3.7	3.7	3.5	3.8	3.7	3.7	
468-0013		210	PPT	2.7	2.7	2.7	2.8	2.8	2.9	2.8	
468-0014		211	PPT	3.3	3.5	3.5	3.3	3.3	3.3	3.4	
468-0015		212	PPT	4.4	4.4	4.2	4.3	4.4	4.4	4.4	
468-0016		213	PPT	4.7	4.5	4.5	4.6	4.5	4.5	4.5	
468-0017		214	PPT	2.9	2.9	3.0	2.9	2.9	2.8	2.9	
468-0018		215	PPT	3.1	3.1	3.1	3.1	2.9	3.1	3.1	
468-0019		216	PPT	2.5	2.5	2.5	2.5	2.5	2.6	2.5	
468-0020		217	PPT	4.0	4.1	4.3	4.0	4.2	4.2	4.1	
468-0021		218	PPT	3.3	3.3	3.3	3.2	3.3	3.3	3.3	
468-0022		219	PPT	4.0	4.2	4.2	4.0	4.2	4.0	4.1	
468-0025		221	PPT								no band
468-0027		223	PPT	6.0	6.3	6.3	6.2	6.0	6.3	6.2	
468-0028		224	PPT	5.6	5.8	5.4	5.4	5.4	5.4	5.5	
468-0030		58	PPT	4.0	4.2	4.2	4.3	4.2	4.2	4.2	
468-0031		226	PPT	4.6	4.4	4.5	4.4	4.5	4.5	4.5	
468-0032		227	PPT	3.6	3.5	3.5	3.6	3.5	3.5	3.5	
468-0033		228	PPT	3.8	3.6	3.8	3.7	3.6	3.8	3.7	
468-0034		229	PPT	3.0	2.9	2.9	2.9	3.1	3.1	3.0	
468-0036		231	PPT	5.6	5.8	5.8	6.0	5.8	5.8	5.8	
468-0041		236	PPT	3.6	3.8	3.7	3.7	3.8	3.8	3.7	
468-0042		216	PPT	1.4	1.5	1.4	1.5	1.3	1.3	1.4	
468-0046		71	PPT	5.6	5.6	5.8	5.4	5.8	5.3	5.7	
468-0048		241	PPT	4.2	4.0	4.1	4.0	4.1	4.2	4.1	
468-0051		1	Core	2.5	2.5	2.4	2.4	2.6	2.5	2.5	
468-0052		5	Core	3.1	3.1	3.1	3.1	3.0	2.9	3.1	
468-0053		5	Biface	3.4	3.3	3.1	3.3	3.3	3.2	3.3	
468-0054		5	Core	3.8	4.0	3.6	4.0	4.0	3.6	3.8	
468-0054	*	5	Core	7.1	6.9	6.9	6.7	6.5	6.5	6.8	
468-0055		6	Uni-B	6.9	6.7	6.9	6.9	7.1	7.2	6.9	
468-0057		6	Biface	4.9	4.9	4.7	4.9	4.9	4.7	4.8	
468-0059		6	Core	3.9	4.4	4.0	4.4	4.0	4.0	4.1	
468-0060		6	Biface	3.3	3.4	3.5	3.5	3.6	3.6	3.5	
468-0061		7	Uni-B	3.6	3.8	3.6	3.7	3.8	3.5	3.7	
468-0062		7	Core	3.5	3.5	3.6	3.5	4.0	3.8	3.7	
468-0063		7	Uni-B	3.0	3.1	2.9	3.1	3.1	2.8	3.0	
468-0064		8	Core	3.3	3.3	3.1	3.1	3.1	3.1	3.2	
468-0065		8	Biface	3.3	2.9	3.1	2.9	3.1	2.9	3.0	
468-0067		8	Biface	2.9	3.1	3.3	2.9	3.1	2.9	3.0	
468-0068		8	Biface	3.6	3.6	3.8	3.8	3.8	3.6	3.7	

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0069		8	Biface	8.7	8.9	8.5	8.9	8.7	8.5	8.8
468-0071		8	Biface	5.6	5.4	5.3	5.3	5.6	5.6	5.5
468-0072		8	Core	3.8	4.0	4.0	3.8	3.6	4.2	3.9
468-0073		8	Core	6.0	5.9	6.0	6.0	6.2	5.6	6.0
468-0074		8	Core	4.0	3.7	4.2	4.2	3.8	3.9	4.0
468-0075		8	Core	3.8	3.8	3.8	3.8	3.8	4.0	3.8
468-0076		8	Core	1.6	1.9	2.3	1.8	1.6	2.0	1.9
468-0077		8	Core	6.7	6.7	7.1	6.7	6.7	6.7	6.7
468-0078		8	Core	6.5	6.4	6.2	6.4	6.4	6.4	6.4
468-0079		8	Core	6.8	6.9	6.8	6.5	6.8	6.8	6.8
468-0080		9	Biface	3.4	3.5	3.4	3.5	3.4	3.5	3.4
468-0081		9	Biface	4.5	4.5	4.6	4.6	4.5	4.5	4.5
468-0082		9	Biface	2.0	2.0	2.0	2.0	2.2	1.8	2.0
468-0082	*	9	Biface	4.4	4.5	4.4	4.4	4.3	4.2	4.4
468-0083		9	Biface	4.7	4.4	4.6	4.5	4.5	4.9	4.6
468-0084		9	Biface	4.9	4.9	4.9	5.1	5.1	4.9	5.0
468-0085		9	Biface	4.4	4.5	4.4	4.2	4.2	4.4	4.4
468-0086		9	Uni-B	3.8	3.6	3.8	3.7	3.9	3.7	3.7
468-0087		9	Core	4.2	3.9	4.0	4.0	4.0	4.1	4.0
468-0088		9	Core	4.4	4.3	4.4	4.2	4.3	4.2	4.3
468-0089		9	Core	4.4	4.2	4.1	4.4	4.2	4.1	4.2
468-0090		9	Biface	3.6	3.4	3.5	3.4	3.5	3.4	3.5
468-0091		10	Biface	4.9	4.5	4.7	4.7	4.7	4.7	4.7
468-0093		10	Biface	5.8	5.6	5.9	6.1	5.6	6.0	5.8
468-0094		10	Uni-B	2.4	2.4	2.4	2.2	2.4	2.2	2.3
468-0095		10	Core	5.6	5.8	5.6	5.4	5.4	5.4	5.5
468-0096		10	Biface	4.5	4.5	4.4	4.7	4.4	4.9	4.6
468-0097		10	Biface	4.9	5.3	5.1	5.1	5.3	5.1	5.1
468-0098		11	Uni-B	3.8	3.6	3.8	3.9	4.0	3.7	3.8
468-0099		11	Core	4.2	4.2	4.2	4.4	4.5	4.4	4.3
468-0100		12	Biface	6.5	6.9	6.7	6.6	6.5	6.5	6.6
468-0101		12	Core	9.8	10.0	9.6	9.6	9.6	9.8	9.7
468-0101	*	12	Core	6.9	6.4	6.5	6.5	6.7	6.5	6.6
468-0102		12	Biface	4.0	4.4	4.5	4.0	4.2	4.2	4.2
468-0103		12	Biface	3.5	3.3	3.6	3.4	3.3	3.6	3.5
468-0104		12	Uni-B	3.3	3.4	3.3	3.3	3.4	3.6	3.4
468-0105		12	Biface	4.2	4.2	4.1	4.0	4.2	4.2	4.1
468-0106		15	Biface	4.0	4.0	4.2	4.4	4.0	4.0	4.1
468-0108		16	Uni-B	2.9	2.7	3.0	2.7	2.7	2.9	2.8
468-0108	*	16	Uni-B	2.4	2.2	2.5	2.4	2.2	2.2	2.3
468-0109		16	Core	1.7	1.9	1.7	2.0	1.7	1.8	1.8
468-0111		14	Biface	4.2	4.2	4.2	4.2	4.1	4.0	4.2
468-0112		14	Biface	7.1	7.1	7.1	7.4	7.1	7.4	7.2
468-0113		14	Uniface	5.1	5.3	5.3	5.3	5.7	4.9	5.3
468-0115		17	Core	2.8	2.8	2.9	2.7	2.8	2.9	2.8
468-0116		17	Core	4.3	4.2	4.0	4.2	4.1	4.0	4.1
468-0117		17	Biface	3.6	3.8	3.6	3.5	3.6	3.6	3.6
468-0118		17	Biface	3.8	4.0	3.8	3.6	4.0	4.2	3.9
468-0119		17	Core	3.3	3.3	3.3	3.4	3.4	3.3	3.3
468-0120		17	Biface	3.8	3.5	3.5	4.0	3.8	3.6	3.7
468-0121		18	Biface	3.6	3.6	3.8	3.7	3.8	3.8	3.7

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0122		18	Biface	4.5	4.4	4.7	4.5	4.7	4.5	4.6
468-0123		20	Biface	4.0	3.8	4.2	4.0	4.2	4.0	4.0
468-0125		20	Biface	3.5	3.7	3.5	3.6	3.6	3.6	3.6
468-0126		20	Core	4.3	4.5	4.2	4.3	4.5	4.2	4.3
468-0127		20	Biface	4.0	3.6	3.8	4.0	3.8	3.8	3.8
468-0128		20	Biface	3.5	3.6	3.4	3.5	3.4	3.5	3.5
468-0129		20	Biface	4.3	4.2	4.0	3.8	3.8	4.1	4.0
468-0130		20	Core	4.5	4.5	4.5	4.6	4.7	4.5	4.5
468-0131		20	Core	5.1	5.2	5.3	5.1	5.3	5.4	5.2
468-0133		20	Core	4.4	4.3	4.4	4.3	4.4	4.2	4.3
468-0134		20	Biface	4.6	4.7	4.5	4.5	4.4	4.4	4.5
468-0135		20	Biface	4.4	4.5	4.7	4.5	4.5	4.5	4.5
468-0137		20	Core	6.7	6.9	6.9	7.1	6.9	7.3	7.0
468-0137	*	20	Core	6.0	6.1	6.2	6.2	6.2	6.3	6.2
468-0138		21	Biface	7.1	6.9	6.9	7.1	7.3	7.1	7.1
468-0139		23	Biface	4.0	4.0	3.9	3.8	4.1	3.9	4.0
468-0140		23	Biface	3.6	3.9	4.0	4.0	3.8	4.0	3.9
468-0143		22	Core	5.9	5.4	5.4	5.8	5.6	5.7	5.6
468-0144		22	Core	2.2	2.0	2.2	2.0	2.3	2.0	2.1
468-0146		23	Biface	4.7	4.5	4.7	4.9	4.7	4.7	4.7
468-0148		21	Uni-B	4.4	4.2	4.1	4.2	4.4	4.4	4.3
468-0149		21	Core	4.0	4.5	4.0	4.5	4.0	4.0	4.2
468-0150		24	Biface	3.6	3.6	3.6	3.6	3.6	3.8	3.6
468-0152		24	Biface	5.1	4.7	4.5	4.9	4.9	4.9	4.8
468-0153		24	Biface	4.5	4.4	4.4	4.4	4.4	4.4	4.4
468-0154		24	Core	8.2	8.1	7.8	8.0	8.2	8.0	8.1
468-0154	*	24	Core	4.7	5.0	4.4	4.5	4.7	4.4	4.6
468-0155		24	Biface	4.3	4.5	4.2	4.5	4.0	4.2	4.3
468-0156		24	Uni-B	4.5	4.4	4.6	4.4	4.4	4.4	4.5
468-0157		24	Core	5.3	5.4	5.3	5.1	5.5	5.4	5.3
468-0158		24	Biface	3.9	3.9	3.9	3.7	4.0	3.7	3.9
468-0159		24	Core	3.6	3.8	4.0	3.6	3.6	3.6	3.7
468-0160		24	Biface	5.4	5.3	5.4	5.6	5.8	5.4	5.5
468-0161		24	Core	4.4	4.5	4.5	4.5	4.5	4.5	4.5
468-0162		24	Biface	6.0	6.1	6.2	6.0	6.3	6.2	6.1
468-0163		24	Biface	4.2	4.2	4.0	4.0	3.8	4.2	4.1
468-0164		25	Biface	3.3	3.3	3.0	3.3	3.1	3.1	3.2
468-0168		25	Biface	4.0	3.9	3.9	3.8	4.0	3.6	3.9
468-0169		25	Biface	3.1	3.1	3.1	3.0	3.1	3.1	3.1
468-0170		25	Biface	5.4	6.0	5.6	6.2	6.3	5.8	5.9
468-0171		25	Uni-B	4.2	4.2	4.2	4.4	4.4	4.4	4.3
468-0173		27	Core	1.4	1.3	1.3	1.4	1.3	1.4	1.3
468-0174		27	Biface	5.6	5.4	5.4	5.7	5.8	5.4	5.5
468-0175		26	Core	5.3	5.1	5.4	4.9	5.2	5.4	5.2
468-0176		26	Biface	3.3	3.3	3.3	3.3	3.3	3.4	3.3
468-0177		26	Biface	5.2	5.3	5.1	5.1	5.3	5.1	5.2
468-0178		26	Core	4.5	4.5	4.7	4.5	4.4	4.5	4.5
468-0179		26	Biface	4.0	3.8	3.8	3.8	4.0	3.8	3.9
468-0181		26	Biface	4.2	4.5	4.5	4.2	4.5	4.4	4.4
468-0182		26	Biface	4.9	4.9	4.9	4.9	4.7	4.5	4.8
468-0183		26	Biface	4.4	4.4	4.2	4.4	4.2	4.4	4.3

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0184		26	Biface	4.5	4.5	4.2	4.4	4.5	4.3	4.4
468-0185		26	Core	7.3	7.2	7.2	7.1	7.3	6.9	7.2
468-0186		26	Core	4.7	4.5	4.5	4.9	4.7	4.8	4.7
468-0187		26	Uni-B	5.8	5.6	5.8	5.6	5.6	5.8	5.7
468-0189		28	Flake Tool	4.5	4.7	4.5	4.4	4.4	4.8	4.5
468-0190		28	Core	4.2	4.2	4.4	4.5	4.4	4.2	4.3
468-0191		28	Biface	5.1	5.3	5.4	5.3	5.2	5.3	5.3
468-0192		32	Biface	2.9	3.1	2.9	3.1	3.3	3.0	3.1
468-0193		32	Biface	3.3	3.3	3.2	3.3	3.3	3.2	3.3
468-0194		33	Biface	3.8	3.6	3.8	3.7	3.9	4.0	3.8
468-0195		33	Biface	4.4	4.2	4.2	4.4	4.2	4.4	4.3
468-0196		33	Biface	4.7	4.4	4.6	4.5	4.6	4.8	4.6
468-0197		33	Biface	3.6	3.5	3.6	3.5	3.8	3.5	3.6
468-0198		33	Uni-B	4.0	3.8	3.6	4.0	4.0	3.6	3.8
468-0199		33	Biface	4.0	4.3	4.3	4.0	4.3	4.1	4.2
468-0200		35	Core	4.0	3.6	3.7	4.0	3.8	3.8	3.8
468-0201		35	Biface	3.3	3.3	3.3	3.2	3.2	3.0	3.2
468-0202		39	Biface	2.7	2.7	2.7	2.9	2.7	2.8	2.7
468-0203		39	Biface	4.4	4.5	4.2	4.2	4.5	4.4	4.4
468-0204		39	Core	3.5	3.5	3.7	3.5	3.5	3.5	3.5
468-0205		39	Core	5.4	5.7	5.4	5.4	5.4	5.4	5.4
468-0206		39	Biface							
468-0207		39	Biface	5.4	5.1	5.1	5.3	5.3	4.9	5.2
468-0208		39	Biface	3.4	3.1	2.9	3.3	3.1	2.9	3.1
468-0210		39	Biface	5.4	5.8	5.6	5.8	5.6	5.4	5.6
468-0211		39	Biface	3.6	3.5	3.8	3.5	3.8	3.6	3.6
468-0212		39	Biface	4.7	4.5	4.6	4.5	4.6	4.5	4.6
468-0213		39	Biface	2.7	2.7	2.5	2.7	2.7	2.9	2.7
468-0214		39	Biface	3.6	3.6	3.9	3.6	3.9	4.0	3.8
468-0215		39	Biface	3.2	3.2	2.9	3.1	2.9	3.1	3.1
468-0216		41	Biface	3.3	3.3	3.4	3.1	3.1	3.1	3.2
468-0217		41	Core	2.4	2.2	2.4	2.4	2.1	2.3	2.3
468-0220		41	Biface	3.3	3.4	3.3	3.1	3.2	3.3	3.3
468-0221		41	Biface	4.5	4.8	4.7	5.0	4.9	4.7	4.8
468-0222		41	Biface	4.0	4.2	4.4	4.2	4.2	4.0	4.2
468-0223		40	Biface	4.0	4.0	4.0	4.0	4.2	4.1	4.0
468-0224		40	Core	4.0	3.8	4.2	4.1	3.8	3.8	4.0
468-0226		40	Biface	1.6	1.7	1.6	1.7	1.8	1.5	1.6
468-0227		42	Core	2.7	2.7	2.5	2.5	2.8	2.6	2.7
468-0228		42	Biface	3.9	3.6	3.6	3.6	3.7	3.5	3.7
468-0229		42	Biface	3.8	3.8	3.7	3.7	4.0	3.8	3.8
468-0231		42	Biface	3.6	3.5	3.8	3.6	3.5	3.8	3.6
468-0232		42	Biface	3.7	3.6	3.6	3.8	3.5	3.6	3.6
468-0234		43	Uni-B	3.6	3.6	3.9	3.6	3.9	4.0	3.8
468-0235		43	Biface	3.6	3.8	3.5	3.8	3.8	3.8	3.8
468-0236		43	Biface	3.4	3.5	3.3	3.4	3.5	3.4	3.4
468-0237		43	Core	9.1	9.1	8.9	8.9	9.1	9.1	9.0
468-0237	*	43	Core	4.6	4.8	4.7	4.7	4.5	4.5	4.6
468-0238		43	Biface	3.9	3.8	3.8	3.6	3.8	3.9	3.8
468-0239		43	Biface	3.3	3.3	3.3	3.1	3.3	3.1	3.2
468-0240		43	Biface	3.1	3.1	3.2	3.3	3.3	3.3	3.2

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0242		43	Biface	3.3	3.3	3.3	3.3	3.1	3.1	3.2
468-0243		45	Biface	4.0	3.9	3.6	3.8	3.7	3.5	3.8
468-0244		45	Biface	4.2	4.3	3.8	3.6	3.0	4.0	3.8
468-0246		45	Flake Tool	4.7	4.7	4.5	4.7	4.8	4.7	4.7
468-0248		44	Core	3.8	3.6	3.6	3.6	3.6	3.7	3.7
468-0249		44	Core	4.4	4.4	4.2	4.0	4.2	4.2	4.2
468-0250		44	Biface	4.7	4.5	4.4	4.4	4.5	4.7	4.5
468-0251		46	Core	3.8	3.8	3.8	3.8	3.8	3.8	3.8
468-0252		46	Biface	6.0	5.7	5.8	5.8	5.7	5.8	5.8
468-0253		46	Uniface	4.7	4.9	4.7	4.9	4.9	4.5	4.7
468-0254		46	Flake Tool	5.4	5.8	5.7	5.5	5.6	5.8	5.6
468-0255		46	Biface	3.5	3.5	3.6	3.3	3.5	3.4	3.5
468-0256		46	Biface	3.5	3.8	3.6	3.8	3.7	3.6	3.7
468-0257		46	Uniface	4.5	4.5	4.5	4.5	4.5	4.4	4.5
468-0258		46	Core	4.0	4.1	3.8	4.0	4.0	4.0	4.0
468-0259		46	Biface	4.8	4.5	4.5	4.4	4.2	4.2	4.5
468-0260		46	Biface	3.6	3.6	3.8	3.6	3.6	3.6	3.6
468-0261		46	Biface	3.3	3.6	3.4	3.3	3.4	3.7	3.5
468-0262		47	Flake Tool	5.4	5.4	5.4	5.4	5.6	5.6	5.5
468-0263		47	Biface	4.5	4.5	4.7	4.5	4.4	4.7	4.6
468-0264		47	Core	2.9	2.9	3.3	3.1	3.1	3.0	3.1
468-0265		47	Uniface	5.1	5.2	5.1	5.1	5.0	5.3	5.1
468-0266		47	Biface	1.4	1.5	1.4	1.3	1.4	1.3	1.4
468-0267		49	Biface	7.3	7.3	7.4	7.4	7.3	7.5	7.4
468-0268		49	Biface	4.5	4.5	4.7	4.6	4.9	4.8	4.7
468-0270		49	Biface	6.1	6.2	6.0	6.0	6.2	6.0	6.1
468-0271		49	Core	4.2	3.6	3.6	3.8	3.6	4.0	3.8
468-0272		49	Biface	4.4	4.2	4.2	4.5	4.2	4.4	4.2
468-0273		49	Core	3.1	3.3	3.3	3.1	3.3	3.3	3.2
468-0274		49	Core	4.4	4.5	4.4	4.4	4.2	4.5	4.4
468-0275		49	Biface	4.0	4.0	3.9	3.9	3.8	3.8	3.9
468-0276		49	Biface	3.8	3.6	3.8	3.8	3.8	3.6	3.7
468-0278		50	Core	2.9	2.8	3.1	2.9	2.9	2.9	2.9
468-0279		50	Biface	4.8	4.5	4.8	4.7	4.5	4.4	4.6
468-0280		50	Biface	4.0	4.0	3.8	4.0	4.4	4.2	4.1
468-0281		50	Biface	4.1	3.9	4.2	3.8	4.0	4.0	4.0
468-0282		50	Core	4.2	4.0	4.2	4.1	4.2	4.2	4.2
468-0283		50	Core	4.7	4.5	4.5	4.7	4.4	4.5	4.7
468-0285		50	Core	3.1	3.1	3.3	3.3	3.3	3.3	3.2
468-0286		50	Core	3.3	3.1	3.3	3.2	3.3	3.3	3.3
468-0287		50	Biface	3.5	4.2	4.0	3.6	4.4	3.6	3.9
468-0288		50	Biface	3.3	3.6	3.6	3.5	3.5	3.5	3.5
468-0289		50	Core	4.4	4.5	4.2	4.4	4.4	4.4	4.4
468-0290		50	Biface	3.6	3.8	3.5	3.5	3.5	3.6	3.6
468-0291		50	Core	4.2	4.2	4.2	4.4	4.1	4.3	4.2
468-0292		50	Biface	4.5	4.7	5.0	4.5	4.7	4.5	4.7
468-0293		50	Uni-B	3.5	3.5	3.5	3.6	3.5	3.5	3.5
468-0293	*	50	Uni-B	5.1	5.1	5.3	5.3	4.9	5.1	5.1
468-0294		50	Biface	4.0	4.2	4.0	4.3	4.0	4.0	4.1
468-0295		50	Biface	4.0	4.0	4.0	4.1	3.6	4.0	4.0
468-0297		51	Biface	7.3	7.4	7.3	7.4	7.3	7.3	7.3

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0299		53	Biface	5.4	5.6	5.6	5.4	5.4	5.6	5.5
468-0300		53	Biface	3.3	3.5	3.3	3.3	3.5	3.5	3.4
468-0303		52	Biface	4.2	4.5	4.5	4.3	4.5	4.3	4.4
468-0304		52	Biface	2.0	2.0	1.8	2.0	2.1	1.9	2.0
468-0305		52	Uniface	3.6	3.9	3.6	3.6	3.6	3.8	3.7
468-0306		52	Biface	4.2	4.0	3.8	4.0	4.0	4.0	4.1
468-0307		52	Flake Tool	6.0	5.8	6.1	5.8	6.0	5.8	5.9
468-0308		52	Core	6.9	7.1	6.8	6.9	7.0	7.1	7.0
468-0309		52	Core	3.9	4.0	4.0	4.0	3.6	3.5	3.8
468-0310		52	Biface	3.6	3.8	3.6	3.6	3.8	3.5	3.6
468-0312		52	Uniface	4.4	4.5	4.7	4.4	4.5	4.6	4.5
468-0313		54	Uni-B	4.5	4.7	4.5	4.5	4.4	4.5	4.5
468-0314		54	Biface	3.8	3.7	4.0	3.8	3.9	3.9	3.9
468-0317		54	Biface	4.0	3.8	4.0	3.7	3.9	3.8	3.8
468-0318		54	Biface	2.9	3.0	2.7	2.9	2.8	2.9	2.9
468-0319		54	Biface	3.8	3.8	4.0	3.9	4.1	4.2	4.0
468-0320		54	Uniface	4.4	4.4	4.4	4.2	4.5	4.2	4.4
468-0321		54	Biface	3.8	3.6	3.6	3.6	3.5	3.5	3.6
468-0322		54	Biface	4.4	4.5	4.5	4.3	4.5	4.5	4.5
468-0323		54	Biface	5.4	5.5	5.5	5.4	5.6	5.8	5.5
468-0324		54	Biface	4.2	4.2	4.2	4.2	4.2	4.2	4.2
468-0325		54	Biface	3.8	3.8	4.2	4.9	3.8	3.8	3.9
468-0328		54	Biface	4.8	4.5	4.5	4.5	4.5	4.8	4.6
468-0330		53	Biface	4.0	3.9	3.8	3.9	3.9	4.0	3.9
468-0331		53	Biface	4.3	4.2	4.2	4.2	4.2	4.0	4.2
468-0332		53	Uni-B	4.1	4.0	4.0	4.2	4.2	4.2	4.1
468-0333		53	Biface	4.4	4.2	4.3	4.4	4.4	4.0	4.3
468-0334		53	Biface	4.6	4.5	4.5	4.5	4.7	4.5	4.6
468-0335		53	Biface	4.4	4.7	4.7	4.5	4.8	4.5	4.6
468-0336		53	Biface	2.4	2.2	2.3	2.0	2.4	2.4	2.3
468-0337		53	Biface	3.5	4.0	4.1	3.6	3.8	3.5	3.7
468-0338		53	Biface	5.1	5.1	5.1	5.3	5.3	4.9	5.1
468-0339		53	Biface	5.6	5.5	5.7	5.6	5.6	5.6	5.6
468-0340		53	Biface	4.5	4.4	4.3	4.2	4.4	4.5	4.4
468-0342		57	Biface	4.2	4.2	3.9	4.0	4.2	4.4	4.3
468-0343		57	Biface	3.5	3.5	3.3	3.5	3.5	3.3	3.4
468-0344		57	Biface	3.1	3.1	2.9	3.0	3.3	3.1	3.1
468-0345		57	Biface	4.2	4.1	4.0	4.2	4.3	4.4	4.2
468-0346		57	Biface	3.1	3.2	3.2	3.3	3.3	3.1	3.2
468-0347		57	Biface	2.9	2.9	3.1	3.2	3.1	3.1	3.1
468-0349		58	Biface	4.2	4.0	4.0	4.0	4.0	4.2	4.1
468-0350		58	Uniface	4.0	3.6	3.8	3.8	3.8	4.1	3.9
468-0352		58	Biface	3.8	3.3	3.8	3.4	3.4	3.6	3.6
468-0353		58	Flake Tool	8.0	7.8	8.3	8.0	8.3	8.2	8.1
468-0354		58	Biface	3.3	3.3	3.3	3.3	3.3	3.3	3.3
468-0355		58	Biface	2.9	2.9	2.9	2.9	3.0	3.2	3.0
468-0356		58	Biface	4.2	4.4	4.2	4.4	4.1	4.2	4.3
468-0357		59	Biface	4.0	4.0	4.0	3.8	3.8	4.3	4.0
468-0358		59	Biface	3.1	2.9	3.3	3.3	3.1	2.9	3.1
468-0360		59	Core	2.0	2.4	2.2	2.4	2.4	2.0	2.2
468-0361		59	Biface	5.3	5.3	5.3	5.3	5.4	5.1	5.3

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0363		59	Biface	4.0	3.6	3.6	3.4	3.8	3.6	3.7
468-0364		59	Core	3.7	3.9	3.7	3.7	4.0	3.8	3.8
468-0365		59	Uni-B	8.4	8.5	8.7	8.4	8.4	8.4	8.5
468-0366		59	Biface	3.1	3.1	3.1	3.3	3.3	3.1	3.2
468-0367		59	Biface	3.7	3.8	3.8	3.8	4.0	4.0	3.9
468-0368		59	Biface	3.5	3.1	3.3	3.4	3.4	3.3	3.3
468-0369		59	Biface	4.0	4.0	3.8	4.2	4.1	4.2	4.1
468-0370		59	Core	7.6	8.0	7.8	8.0	7.8	8.0	7.9
468-0371		59	Core	3.2	3.2	3.1	3.1	2.9	2.9	3.1
468-0372		62	Core	5.8	6.0	5.8	5.8	6.0	5.6	5.8
468-0374		62	Biface	4.4	4.2	4.0	3.9	4.3	4.4	4.2
468-0375		60	Biface	5.4	5.5	5.6	5.8	5.8	5.3	5.6
468-0376		60	Biface	4.4	4.4	4.5	4.5	4.2	4.2	4.4
468-0377		60	Biface	4.5	4.4	4.5	4.5	4.5	4.5	4.5
468-0378		60	Biface	3.6	3.7	3.8	3.8	3.9	3.8	3.8
468-0379		60	Biface	4.5	4.6	4.4	4.5	4.6	4.5	4.5
468-0381		60	Biface	4.0	4.2	3.8	4.2	4.0	4.0	4.0
468-0382		60	Biface	4.2	4.4	4.2	4.0	3.9	3.8	4.1
468-0384		60	Biface	4.0	4.0	3.8	3.8	3.6	3.8	3.8
468-0386		60	Core	4.5	4.9	4.5	4.7	4.9	4.9	4.6
468-0387		60	Biface	6.0	5.6	5.6	5.6	6.1	6.0	5.8
468-0388		60	Biface	4.5	4.5	4.5	4.5	4.6	4.5	4.5
468-0390		60	Biface	5.1	4.9	5.3	5.2	5.1	5.3	5.1
468-0391		60	Biface	5.1	5.1	5.3	5.1	5.4	5.0	5.2
468-0392		60	Core	2.9	3.0	3.0	2.7	2.9	2.9	2.9
468-0392	*	60	Core	9.8	9.8	9.8	9.8	10.0	9.9	9.8
468-0394		60	Uni-B	5.4	5.6	4.9	5.4	5.4	5.4	5.4
468-0395		63	Biface	3.4	3.6	3.5	3.7	3.6	3.5	3.5
468-0396		63	Biface	2.7	2.5	2.7	2.7	2.9	2.7	2.7
468-0397		64	Biface	1.8	1.8	1.7	1.8	1.7	1.8	1.8
468-0398		64	Biface	3.8	3.4	3.4	3.6	3.7	3.8	3.6
468-0400		65	Biface	3.1	3.2	3.2	3.2	2.9	2.9	3.1
468-0402		65	Uni-B	6.0	6.0	6.3	6.0	6.2	6.2	6.1
468-0402	*	65	Uni-B	3.5	3.5	3.3	3.5	3.5	3.5	3.5
468-0403		63	Core	4.3	4.4	4.5	4.4	4.2	4.0	4.3
468-0404		67	Core	4.3	4.0	4.0	4.2	4.3	4.4	4.3
468-0405		67	Biface	2.7	3.3	2.8	3.1	2.9	3.1	3.0
468-0406		67	Biface	3.1	2.8	2.8	3.0	2.7	2.7	2.9
468-0407		67	Biface	4.0	4.1	4.2	4.2	4.1	3.9	4.1
468-0408		67	Biface	4.2	3.9	4.2	4.1	4.1	3.9	4.1
468-0409		67	Biface	4.4	4.2	4.4	4.5	4.4	4.0	4.3
468-0410		67	Core	4.4	4.5	4.6	4.4	4.7	4.7	4.6
468-0411		67	Biface	12.2	12.5	12.7	12.7	12.3	12.3	12.4
468-0412		67	Biface	3.1	2.9	3.1	2.9	3.1	3.1	3.0
468-0412	*	67	Biface	4.2	4.0	4.0	4.0	4.0	4.3	4.1
468-0413		67	Core	4.5	4.4	4.4	4.7	4.5	4.7	4.5
468-0418		68	Biface	3.6	4.1	3.9	3.8	4.2	3.9	3.8
468-0420		68	Biface	3.6	3.4	3.6	3.4	3.4	3.3	3.5
468-0424		68	Biface	5.6	5.5	5.6	5.6	5.5	5.5	5.6
468-0426		68	Uni-B	3.5	3.5	3.5	3.5	3.5	3.5	3.5
468-0427		68	Biface	3.6	3.5	3.5	3.6	3.6	3.6	3.6

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0431		68	Biface	3.1	2.9	2.9	2.7	2.9	3.2	3.0
468-0432		68	Biface	3.4	3.3	3.6	3.5	3.3	3.6	3.5
468-0435		69	Biface	4.2	4.2	4.2	4.5	4.2	4.2	4.2
468-0436		69	Core	4.4	4.4	4.2	4.3	4.2	4.4	4.3
468-0437		69	Biface	4.2	4.1	3.8	4.0	3.6	3.8	3.9
468-0438		69	Biface	4.2	4.0	4.4	4.0	4.0	4.4	4.2
468-0439		69	Biface	3.8	4.0	3.5	4.0	4.1	4.2	3.9
468-0440		69	Biface	2.7	2.7	2.7	2.7	2.9	2.9	2.8
468-0441		69	Biface	4.6	4.5	4.5	4.5	4.8	4.4	4.5
468-0442		69	Biface	3.8	4.1	4.0	3.8	3.8	4.1	3.9
468-0443		69	Biface	4.0	4.2	4.2	4.2	4.0	3.8	4.2
468-0444		70	Biface	4.1	4.1	4.0	4.0	3.7	3.9	4.0
468-0447		70	Core	2.4	2.7	2.5	2.4	2.7	2.7	2.6
468-0448		70	Core	4.4	4.4	4.2	4.4	4.4	4.2	4.3
468-0450		71	Uni-B	2.9	2.7	2.7	2.9	2.7	3.1	2.8
468-0451		71	Core	4.2	4.4	4.0	4.0	4.0	4.0	4.1
468-0452		72	Biface	3.6	3.4	3.4	3.6	3.4	3.6	3.5
468-0453		73	Core	3.3	2.9	3.1	2.9	3.1	2.9	3.0
468-0457		75	Core	1.6	1.5	1.5	1.5	1.5	1.6	1.5
468-0458		75	Biface	3.6	3.6	3.6	3.8	3.8	4.0	4.1
468-0460		77	Core	2.2	2.4	2.0	2.4	2.2	2.2	2.2
468-0461		77	Biface	5.8	5.6	5.4	5.6	5.4	5.8	5.6
468-0462		77	Biface	3.8	3.8	3.8	4.0	3.8	3.8	3.8
468-0464		77	Biface	4.5	4.4	4.4	4.4	4.4	4.4	4.4
468-0465		76	Flake Tool	5.8	5.8	5.8	5.7	5.8	5.5	5.7
468-0469		47	Core	4.0	4.1	4.2	4.2	4.1	3.9	4.1
468-0471	A	2	Debitage	4.1	4.0	4.4	4.1	4.0	4.2	4.1
468-0471	B	2	Debitage	3.9	3.9	3.8	3.9	3.8	3.9	3.9
468-0471	C	2	Debitage	4.2	4.2	4.4	4.2	4.0	4.0	4.2
468-0471	D	2	Debitage	3.8	3.8	3.9	4.0	3.8	4.0	3.9
468-0471	E	2	Debitage	3.8	3.9	4.0	4.0	4.2	4.0	4.0
468-0471	F	2	Debitage	3.8	3.7	3.9	3.8	4.0	4.1	3.9
468-0471	G	2	Debitage	3.9	3.6	3.9	3.7	4.0	3.7	3.8
468-0471	H	2	Debitage	3.8	3.8	3.9	3.6	3.5	3.6	3.7
468-0471	I	2	Debitage	3.8	4.0	3.9	4.0	3.9	3.8	3.9
468-0471	J	2	Debitage	2.4	2.3	2.4	2.4	2.4	2.4	2.4
468-0471	J*	2	Debitage	3.6	3.7	3.7	4.0	4.0	4.0	3.8
468-0471	K	2	Debitage	4.0	3.7	4.0	4.0	4.2	4.0	4.0
468-0471	L	2	Debitage	3.6	3.8	3.8	3.8	3.8	4.0	3.8
468-0473	A	4	Debitage	4.0	3.6	4.0	3.8	4.0	3.8	3.9
468-0479	A	10	Debitage	4.8	4.8	5.0	4.6	4.6	4.7	4.7
468-0479	B	10	Debitage	8.5	8.5	8.8	8.5	8.4	8.4	8.5
468-0479	C	10	Debitage	5.0	4.7	4.8	5.0	4.9	4.7	4.8
468-0479	D	10	Debitage	4.7	4.5	4.7	4.5	4.8	4.5	4.6
468-0479	E	10	Debitage	4.9	4.9	4.7	4.9	4.7	4.7	4.8
468-0479	F	10	Debitage	4.9	4.7	4.9	4.7	4.5	4.5	4.7
468-0485	A	16	Debitage	2.2	2.4	2.5	2.4	2.5	2.5	2.4
468-0487	A	18	Debitage	3.6	3.9	3.6	3.6	3.8	4.0	3.7
468-0487	B	18	Debitage	3.6	3.6	3.6	4.0	4.0	3.5	3.7
468-0487	C	18	Debitage	3.8	3.7	3.9	3.8	3.6	3.8	3.8
468-0487	D	18	Debitage	3.8	3.6	3.8	3.6	3.6	3.8	3.7

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0487	E	18	Debitage	3.8	3.8	3.9	3.7	4.0	3.7	3.8
468-0487	F	18	Debitage	4.1	4.0	3.8	4.0	3.9	3.6	3.9
468-0487	G	18	Debitage	3.6	3.7	3.6	3.6	3.6	3.8	3.7
468-0487	H	18	Debitage	3.6	3.8	3.9	3.6	3.8	3.8	3.8
468-0487	I	18	Debitage	4.0	3.6	4.2	4.0	3.6	4.0	3.9
468-0487	J	18	Debitage	3.6	4.2	3.6	3.8	3.8	4.0	4.0
468-0487	K	18	Debitage	3.9	4.1	4.0	4.1	3.8	4.0	4.0
468-0491	A	22	Debitage	2.2	2.2	2.2	2.4	2.4	2.5	2.3
468-0491	B	22	Debitage	2.2	2.4	2.5	2.3	2.3	2.4	2.3
468-0491	C	22	Debitage	2.4	2.4	2.2	2.4	2.4	2.0	2.3
468-0491	D	22	Debitage	2.4	2.4	2.4	2.3	2.3	2.4	2.4
468-0491	E	22	Debitage	2.4	2.4	2.4	2.3	2.5	2.4	2.4
468-0491	F	22	Debitage	2.4	2.5	2.5	2.7	2.5	2.5	2.5
468-0491	G	22	Debitage	2.3	2.3	2.3	2.4	2.5	2.2	2.3
468-0492	A	23	Debitage	3.2	3.1	3.1	3.3	3.3	3.1	3.2
468-0493	A	24	Debitage	4.6	4.7	4.5	4.9	4.5	4.7	4.7
468-0494	A	25	Debitage	3.8	3.8	4.2	4.2	4.2	3.8	4.0
468-0494	B	25	Debitage	4.0	4.0	4.1	3.9	4.0	4.0	4.0
468-0494	C	25	Debitage	4.1	3.8	3.8	4.0	3.8	3.8	3.9
468-0494	D	25	Debitage	7.3	7.2	7.3	7.1	7.2	7.7	7.3
468-0494	E	25	Debitage	3.8	4.2	3.8	4.0	4.0	3.6	3.9
468-0494	F	25	Debitage	3.8	3.6	3.9	4.0	3.6	4.0	3.8
468-0494	G	25	Debitage	3.8	3.9	3.8	4.0	4.0	4.1	3.9
468-0494	H	25	Debitage	4.0	3.6	3.6	3.6	3.8	4.2	3.8
468-0494	I	25	Debitage	3.6	4.2	3.8	3.7	3.8	4.0	3.9
468-0494	J	25	Debitage	3.8	4.2	4.0	3.8	3.9	3.6	3.9
468-0494	K	25	Debitage	4.0	4.0	4.3	3.6	3.8	4.0	3.9
468-0498	A	29	Debitage	4.7	4.7	4.7	4.9	4.9	4.9	4.8
468-0500	A	31	Debitage	4.0	3.6	3.8	4.2	4.0	3.8	3.9
468-0500	B	31	Debitage	3.6	3.4	3.8	3.5	3.8	3.5	3.6
468-0500	C	31	Debitage	5.1	4.9	5.1	5.3	5.3	5.4	5.2
468-0500	D	31	Debitage	5.1	5.2	5.1	5.1	5.4	5.3	5.2
468-0500	E	31	Debitage	4.2	4.2	4.2	4.4	4.0	4.4	4.2
468-0505	A	36	Debitage	3.1	3.3	3.3	3.3	3.3	3.3	3.3
468-0506	A	37	Debitage	3.8	3.8	3.8	3.8	3.9	3.5	3.8
468-0506	B	37	Debitage	4.0	4.0	4.0	3.8	4.2	4.2	4.0
468-0506	B*	37	Debitage	5.8	5.7	6.1	6.0	5.8	6.2	5.8
468-0506	C	37	Debitage	5.8	6.0	5.8	6.0	6.2	6.1	6.0
468-0506	D	37	Debitage	5.6	5.3	5.3	5.4	5.6	5.8	5.5
468-0506	E	37	Debitage	4.1	4.0	4.0	3.8	3.6	3.6	3.7
468-0506	F	37	Debitage	4.9	5.0	4.7	5.3	4.7	5.2	5.0
468-0506	G	37	Debitage	3.0	3.1	3.0	3.1	3.0	3.1	3.1
468-0506	H	37	Debitage	4.0	4.0	4.1	3.8	3.9	3.8	3.9
468-0506	I	37	Debitage	4.1	4.0	3.8	3.8	3.9	3.8	3.9
468-0506	J	37	Debitage	4.1	4.1	3.9	4.0	3.8	4.2	4.0
468-0506	K	37	Debitage	4.9	5.3	5.1	5.3	5.1	5.2	5.1
468-0508	A	39	Debitage	4.5	4.4	4.4	4.7	4.5	4.4	4.5
468-0509	A	40	Debitage	4.0	3.6	3.8	4.0	3.9	3.8	3.9
468-0510	A	41	Debitage	3.2	3.1	3.1	3.1	3.1	2.9	3.1
468-0510	B	41	Debitage	3.1	2.9	3.1	3.2	3.2	2.9	3.1
468-0510	C	41	Debitage	3.1	3.2	3.1	3.2	2.9	3.3	3.1

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0510	D	41	Debitage	3.0	2.9	2.9	3.1	3.1	3.3	3.1
468-0510	E	41	Debitage	3.3	3.0	2.9	2.9	3.1	2.9	3.0
468-0510	F	41	Debitage	3.2	2.9	3.2	3.1	2.9	2.9	3.0
468-0510	G	41	Debitage	3.3	3.1	3.1	3.0	3.3	3.1	3.1
468-0510	H	41	Debitage	2.9	3.1	2.9	3.1	2.9	3.1	3.0
468-0510	I	41	Debitage	3.0	3.2	2.9	3.1	3.2	2.9	3.0
468-0510	J	41	Debitage	2.3	2.4	2.3	2.4	2.4	2.3	2.4
468-0510	K	41	Debitage	2.4	2.2	2.4	2.5	2.4	2.4	2.4
468-0510	L	41	Debitage	2.8	2.7	2.8	2.9	2.9	2.9	2.8
468-0510	M	41	Debitage	2.7	3.1	2.8	2.6	2.9	2.9	2.8
468-0510	N	41	Debitage	2.0	1.9	2.1	2.9	1.8	2.2	2.0
468-0510	O	41	Debitage	2.9	2.8	3.1	3.0	2.8	3.1	3.0
468-0511	A	42	Debitage	3.4	3.5	3.5	3.4	3.5	3.6	3.5
468-0515	A	45	Debitage	1.7	1.6	1.6	1.8	1.8	1.6	1.7
468-0515	B	45	Debitage	1.8	1.8	1.6	1.8	1.8	1.6	1.7
468-0515	C	45	Debitage	2.7	2.8	2.8	2.7	2.6	2.7	2.7
468-0515	D	45	Debitage	2.5	2.6	2.6	2.5	2.6	2.7	2.6
468-0515	E	45	Debitage	2.2	2.6	2.2	2.4	2.5	2.6	2.4
468-0515	F	45	Debitage	1.5	1.6	1.6	1.5	1.4	1.5	1.5
468-0515	G	45	Debitage	2.3	2.4	2.4	2.4	2.4	2.2	2.3
468-0515	H	45	Debitage	3.2	3.1	3.2	3.1	3.1	3.0	3.1
468-0515	I	45	Debitage	6.9	6.7	7.1	6.9	7.1	6.6	6.9
468-0515	J	45	Debitage	3.3	3.1	3.1	3.1	3.1	3.3	3.2
468-0519	A	49	Debitage	4.1	4.0	3.8	3.8	3.8	3.6	3.8
468-0519	B	49	Debitage	4.2	4.5	4.4	4.1	4.2	4.2	4.3
468-0519	C	49	Debitage	2.6	2.5	2.5	2.4	2.4	2.5	2.5
468-0519	D	49	Debitage	4.3	4.2	4.4	4.0	4.0	4.4	4.2
468-0519	E	49	Debitage	1.3	1.4	1.4	1.3	1.6	1.4	1.4
468-0519	F	49	Debitage	2.8	2.4	2.7	2.9	2.9	2.7	2.7
468-0519	G	49	Debitage	2.6	2.5	2.4	2.7	2.4	2.5	2.5
468-0519	H	49	Debitage	3.1	3.1	3.0	2.7	2.9	2.9	2.9
468-0519	I	49	Debitage	5.4	5.4	5.4	5.3	5.4	5.6	5.4
468-0519	J	49	Debitage	3.9	3.8	4.0	3.7	3.6	3.8	3.8
468-0519	K	49	Debitage	4.5	4.7	4.5	4.6	4.8	4.7	4.6
468-0519	L	49	Debitage	3.8	4.0	3.6	3.6	4.0	3.8	3.8
468-0519	M	49	Debitage	4.4	4.4	4.5	4.4	4.4	4.5	4.4
468-0519	M*	49	Debitage	5.5	5.3	5.7	5.4	5.8	5.4	5.5
468-0519	N	49	Debitage	2.7	2.5	2.7	2.7	2.9	2.8	2.7
468-0519	O	49	Debitage	4.4	4.4	4.4	4.7	4.6	4.7	4.5
468-0520	A	50	Debitage	5.1	5.3	5.3	5.3	4.9	4.9	5.1
468-0528	A	58	Debitage	4.2	3.8	3.6	3.5	3.5	4.0	3.8
468-0528	B	58	Debitage	6.3	6.3	6.5	6.7	6.4	6.5	6.4
468-0528	C	58	Debitage	2.2	2.2	2.0	2.0	2.1	2.0	2.1
468-0528	D	58	Debitage	5.8	5.6	5.8	5.5	5.8	5.4	5.6
468-0528	E	58	Debitage	6.5	6.8	6.5	6.5	6.4	6.9	6.6
468-0528	F	58	Debitage	5.4	5.4	5.4	5.4	5.6	5.6	5.5
468-0528	G	58	Debitage	1.6	1.5	1.4	1.3	1.6	1.5	1.5
468-0528	H	58	Debitage	5.8	5.9	5.8	5.8	5.8	5.6	5.8
468-0528	I	58	Debitage	6.2	6.2	6.2	6.4	6.3	6.4	6.3
468-0528	J	58	Debitage	5.8	5.4	5.4	5.4	5.4	5.6	5.5
468-0528	K	58	Debitage	1.6	1.8	1.5	1.4	1.8	1.8	1.6

Cat #	Sub Cat.	Lot #	Desc.	R1	R2	R3	R4	R5	R6	Mean
468-0528	L	58	Debitage	5.4	5.6	5.4	5.4	5.4	5.4	5.4
468-0528	M	58	Debitage	5.4	5.2	5.3	5.3	5.6	5.8	5.4
468-0528	N	58	Debitage	5.4	5.3	5.3	5.1	5.0	5.1	5.2
468-0528	O	58	Debitage	7.3	7.6	7.6	7.3	7.8	7.3	7.5
468-0533	A	67	Debitage	3.6	4.0	3.8	3.9	3.6	3.8	3.8
468-0540	A	66	Debitage	2.4	2.4	2.2	2.3	2.4	2.1	2.3
468-0540	B	66	Debitage	2.0	1.8	2.1	1.9	1.8	2.0	1.9
468-0540	C	66	Debitage	2.9	2.7	2.7	2.7	3.1	2.9	2.8
468-0540	D	66	Debitage	4.2	4.0	4.4	4.3	4.0	4.2	4.2
468-0540	E	66	Debitage	3.0	3.1	2.9	2.8	2.7	2.9	2.9
468-0542	A	72	Debitage	4.8	4.7	4.5	4.4	4.7	4.4	4.6
468-0542	A*	72	Debitage	8.6	8.5	8.5	8.5	8.2	8.4	8.4
468-0545	A	75	Debitage	1.3	1.5	1.4	1.5	1.4	1.5	1.4
468-0557		52	Uniface	3.8	4.0	3.8	3.9	3.9	4.1	3.9
468-0558		51	Uniface	7.1	7.1	7.1	7.1	7.0	7.1	7.1
468-0559		43	Uniface	4.4	4.3	4.5	4.0	4.2	3.8	4.2
468-0560		43	Uniface	3.3	3.5	3.5	3.3	3.3	3.3	3.3
468-0561		58	Flake Tool	4.4	4.5	4.5	4.4	4.4	4.5	4.4
468-0562		74	Flake Tool	2.4	2.4	2.4	2.2	2.4	2.3	2.3
468-0563		47	Flake Tool	4.4	4.2	4.4	4.4	4.4	4.4	4.4
468-0564		50	Biface	3.3	3.3	3.4	3.6	3.3	3.6	3.4
468-0565		52	Core	4.0	4.4	4.4	4.4	4.0	4.0	4.2
468-0565	*	52	Core	6.6	6.5	7.0	6.7	6.5	6.5	6.6
468-0566		52	Biface	6.0	5.4	5.6	5.4	5.6	5.8	5.6
468-0567		8	Biface	6.0	5.4	5.3	5.8	5.7	5.4	5.6
468-0568		29	Core	4.9	4.9	4.7	4.9	4.7	5.1	4.9
468-0569		51	Core	3.6	3.8	3.6	3.8	3.8	3.8	3.7
468-0571		5	Uni-B	4.2	4.2	4.0	4.0	4.1	3.5	4.0
468-0576		43	Uni-B	4.0	4.0	4.2	4.2	4.1	3.9	4.1
468-0577		47	Uni-B	3.8	4.0	3.8	4.0	4.0	4.0	3.9
468-0579		51	Uni-B	1.9	1.8	1.8	1.8	1.6	1.6	1.7

APPENDIX C: SURFACE SURVEY QUADRAT GRIDS

Quadrat Number L-1 Provenience 4199500/375500

500x500 Meters (Each square = 25m)

R	R	r	r															M	m
R	R			m	m														
R	R	R	R	M	r	R									m				
R		r	r																
R					r	r													
R	r	r	r	r	R	m	m	r			m	s			s			r	m
R	r	m	m	m	m	m	m	m	s	s	s	s	s	s	m	s	s		m
m	m	m	m	m	m	m	m	s	s	S	S	m	s	m	s	s	s	s	m
M	M	R	m	m	f	m	f	f	f	m	m	m	m	m	m	m	m	m	m
R	R	r	r	r	M	m	m	f	f	f	m	m	m	m	m	m	m	m	f
R	R	r	R	R	M	M	f	f	f	f	f	m	m	m	m	m	m	m	m
M	M	M	M	m	m	m	f	m	f	f	m	m	m	m	m	m	m	m	m
M	m	m	m	m	m	M	M	M	S	s	s	m	m	m	m	m	m	m	m
M	m	M	m	m	m	m	m	m	m	f	f	f	m	m	m	m	m	m	m
m	m	m	m	m	m	m	M	m	m	f	f	f	f	f	M	m	m	f	f
M	M	M	M	M	M	M	M	M	m	r	m	m	M	S	S	S	m	m	m
M	M	M	m	M	m	m	m	m	m	m	m	m	m	m	m	m	m	m	s
m	m	M	m	M	M	m	S	m	S	m	m	m	m	m	S	m	S	m	m
M	m	M	M	M	m	M	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	M	m	f	m	M	m	m	f	f	m	m	m	m	f	f	m	m	m

Quadrat Number L-2 Provenience 4199500/376000

500x500 Meters (Each square = 25m)

r																			
	m							m	m										
	r																		
	r		r			r													
m					r								r						
s																			
m																			
m																	S		
m	m	s															S		
m	m	m														s	s	S	
m	r	r											m		s	s	s	s	
m	m	m	m										s			s			
m	m	r	s										S				s	S	s
m	m	m		r								s	S	s	s	S	s	s	s
m	m	m	s	m	m						s	s	s	s		s	s	s	
m	m	m	m	m	s														
m	m	m	m	m	m	m													
m	m	m	m	m	m	S	s	s						r					

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number L-3 Provenience 4199500/376500

500x500 Meters (Each square = 25m)

		m	m	m															
m	m	m	m				m												
	r	r	m				s	m	m										
	m						m	m	m										
	r						m	f	m										
			r	r			r	R	m	m	s								
	r		r				m	m	m	m	m								s
							m	r	m	r									
							r	r	m	r	r								
							r	r	m	m	m	r				s	s		
								r	m	m	m	r	r				s		
										m	m	m							
								m	m	m	r	r							
									r	r	r	m	r						
S	s	s							s	r	r								
S	s																		
s				r	r				r								s	r	
									s										
s					m														
								s											

Quadrat Number L-4 Provenience 4199000/374500

500x500 Meters (Each square = 25m)

F	M	m	m	m	m	f	m	m	m	m	m	m	m	m	r	r	r	r	r
M	M	m	m	m	m	m	m	M	M	m	m	m	m	m	m	m	m	m	m
M	M	M	M	M	M	M	M	M	m	M	M	m	M	M	m	M	M	M	m
F	M	f	m	m	m	m	m	m	m	m	m	f	m	m	m	m	m	m	m
m	M	M	m	■	m	m	m	m	m	m	m	m	m	■	m	r		m	m
m	M	M	m	m	m	m	m	m	m	f	m	m	m	m	m	m	m	r	r
M	M	M	M	m	M	M	M	M	m	m	M	M	M	M	M	m	m	m	m
S	m	M	M	m	m	m	m	m	m	M	M	m	m	M	m	m	m		
m	m	m	m	m			m	m	m	m	m	m	m	m	m	m	m		
m	m	m	m	m			m	m	m	m	m	m	m		m	m	m		
m	r	m	r	m	m			m	m	m	m	m	m		m	m	m	m	
s	s				m			m	m	s						m	m	m	
s	r	r	r	m	s	m	s	m	M	m	m	m	m	s	s	m	m	s	m
f	m	r	r	r	m	m	r	m	m	m	m	f	m		m	m	m	m	m
m	s	r	m	■		r		r	r	s	s	s	m	■	m	m	r	m	s
m	m	m	m	m	s	m	m	m	m	m	m	s	m	m	r	m	m		m
m	m	m			m	m	m	r	m	m	m	m	m	m	m	m	m	m	m
m	m						m	m	m	m	m	m	m	m	m	m	m	m	m
							m	m	m	m	m	m	m	m	m	m	m	m	M
								m	m	m	m	m	m	m	f	m	m	m	M

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

□ Denotes Rock Ring, Number Indicates Quantity

■ Denotes surface collection loci

Quadrat Number L-5 Provenience 4199000/375000

500x500 Meters (Each square = 25m)

s	m	m	m	m	m	m	m	m	m	m	f	m	r	m	M	M	M	m	m
s	m	m	f	m	m	m	m	m	m	m	m	m	m	m	M	M	M	M	M
	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	r	m	m	m
m	M	M	M	m	M	M	M	M	M	m	f	M	f	M	M	m	m	M	M
r	m	m	m		M	m	m	M	m	m	m	f	m		f	M	M	M	M
m	m	m	M	M	M	f	f	M	M	m	m	f	m	m	m	m	m	m	m
m	m	m	m	M	M	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	m	m	m	M	M	m	M	m	m	m	m	m	M	m	M	M	m	m
m	M	M	M	M	M	M	M	M	m	m	M	M	M	M	M	M	M	M	m
m	m	m	m	M	M	M	M	M	M	m	m	m	m	m	m	M	M	M	M
	m	m	m	M	M	M	M	M	m	m	f	m	m	m	m	m	m	m	m
r	m	m	m	m	m	m	M	M	M	m	m	m	m	m	m	m	m	m	m
m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
M	M	M	r	M	m	m	M	M	f	m	M	M	m	m	m	m	m	M	M
m	m	m	m		f	M	f	M	M	f	M	f	M		m	f	m	m	m
m	m	m	m	m	M	M	M	M	f	f	f	f	M	m	m	m	f	f	f
m	m	m	m	m	m	M	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	m	m	m	f	M	M	M	m	m	M	m	R	m	m	m	f	f	M
f	m	m	m	m	M	M	M	m	F	M	m	m	m	m	m	m	m	m	m
M	M	m	m	M	m	m	M	m	M	m	m	m	m	m	m	m	m	M	m

Quadrat Number L-6 Provenience 4199000/375500

500x500 Meters (Each square = 25m)

m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	S	s	s
M	M	M	M	M	m	M	M	m	m	m	m	m	m	m	m	m	m	m	M
m	m	m	m	m	m	m	f	f	f	m	m	m	m	m	m	f	m	m	m
f	m	f	f	f	f	m	m	f	f	m	m	f	f	f	m	f	f	f	f
m	f	m	m		m	m	f	f	r	r	m	f	f		m	r	m	m	r
m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
M	M	M	M	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	m	m	m	r	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	f	m
m	m	m	m	m	m	f	m	r	r	R	r	m	m	r	r	r	m	m	m
m	m	S	m	m	m	m	m	m	m	r	m	m	r	m	m	m	r	r	r
m	f	f	m	m	m	r	m	M	m	m	m	m	m	m	m	m	m	m	m
f	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	m	f	f	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	f
m	m	f	m		r	r	r	r	r	r	m	m	r	r	r	r	r	r	r
m	m	m	m	r	r	r	m	r	r	r	m	r		r	r	m	r	r	r
m	m	m	m	m	m	m	r	r	m	m	m	m	m	m	f	m	m	m	
m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	f	m	m		
m	m	f	M	m	M	M	M	m	m	m	m	m	m	m	m	m			
m	m	m	r	r	r	r	r	r	r	r	r	r	r	r	r	r		s	s

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number L-7 Provenience 4198500/373000

500x500 Meters (Each square = 25m)

				s	s				s										
s	s		s																
s																			
													s	s					
														s	s				
													s	s					
						s													
							s	s	s	s			s	s					
						s	s							s					
						s	s	s											
											s	s	s						
					s														
															s			s	

Quadrat Number L-8 Provenience 4198500/373500

500x500 Meters (Each square = 25m)

																	m	m	m
																s	m	m	m
																s	m	m	m
													s				r	m	m
																	m	m	m
														m	■	m	m	m	m
														m	m	m	m	r	m
												m	m	m	m	m	m	m	m
														r	m	m	m	m	m
													s	s	m	m	m	m	m
								s	s	s	s	m	m	m	m	m	m	m	m
									s	s	s	s	m	m	m	m	m	m	m
					s	s			s		s	s	s			m	m		
					■				s	s	s	s	s			s	s		
s																	s		s
											s			■		s			
										s			s	s		s	s	s	
			s	s	s	s	m			s	s	s	s	s	s	s	s	s	s
									s						s				

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

□ Denotes Rock Ring, Number Indicates Quantity

■ Denotes surface collection loci

Quadrat Number L-9 Provenience 4198500/374000

500x500 Meters (Each square = 25m)

m	m	m	m	m	m	m	m	m	m	m	m		m						
m	m	m	m	m	m	m	M	m	m	m	m		r	m	m			r	r
m	m	m	m	m	m	M	M	M	M	M	m	m	M	m				s	s
m	m	m	M	M	M	m	m	R	R	r	r	r	R	m	r	r	R	R	r
m	m	m	m		M	m	m	m	m	m	r	r	r		m	m	m	M	M
M	m	m	m	m	m	r	r	m	r	r	r	r	r	r	r	m	m	M	m
m	m	m	m	m	m	m	m	m	m	m	r	m	m	m	m	m	m	m	m
M	M	M	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m	m
m	M	R	r	m	m	m	m	m	r	m	r	M	M	M	M	m	m	m	m
m	M	r	r	M	M	m	m	m	m	m	r	M	M	M	m	m	m	m	m
m	m	m	m	m	r	m	m	m	m	m	m	m	m	m	m	m	m	m	m
				m	m	m	m	M	m	m	m	R	m	m	m	m	m	m	m
					m	M	M	M	M	M	M	m	m	m	m	m	m	m	m
	s				s	R	R	M	M	M	M	m	M	M	M	M	M	M	M
						s	s	m	M	M	M	m	m		m	m	m	m	m
							m	m	m	M	M	M	R	M	M	M	M	M	M
s			s		s	s	m	m	M	M	M	M	r	m	m	m	M	m	m
					s	s	m	m	M	m	m	m	r	m	M	m	M	M	M
						s	m	m	f	f	f	M	M	M	M	M	M	M	M
					s	s	s	m	m	m	m	m	m	r	M	M	m	M	M

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Quadrat Number L-10 Provenience 4198500/374500

500x500 Meters (Each square = 25m)

							s	m	m	m	m	m	m	m	m	m	m	m	m
s	s										s	m	s	m	m	m	m	m	m
					s		m	m	m	m	m	M	m	m	m	M	M	f	f
s					m		m	m	m	m		m	s	m	f	m	f	m	m
M		M	M		F	M	m	m	m	m	M	s	s		M	M	M	s	s
m	m	M	f	m	m	M	M	M	m	m	m	s	f	m	m	m	m	m	m
M	m	m	m	M	m	f	M	M	m	m		m	m	m	m	m	m	m	f
M	M	m	m	m	M	M	M	m	m	m	m		s	s	m	s	s		
M	f	m	m	m	M	M	M	m	m	s			sl	s		s		s	s
M	f	m	f	m	m	m	m	m	m	s	s	s	f	f	s	f	f	f	f
M	m	M	F	M	M	M	M	s						s				s	s
m	m	m	M	M	M	M	m	m	s		s	s	s	s	s	s	s	s	s
r	M	m	M	M	M	M	m	S	s	s	m	s	s		s	s	s	s	s
m	r	f	m	m	m	m	f	s	s	m	m	m	s		s		s		
M	M	M	M		M	M	F	M	s	s	M	s	s			s			
m	m	m	R	m		m	m	m	m	m	f	s	m	r	s				
m	m	m	m	m	m	m	M	m	m	m	m	m	m	R	s				
M	M	m	m	m	M	m	m	m	s	s	s	m			s				
f	f	m	m	M	M	M	m	m	M	m	m	s							
f	f	m	m	m	m	m	f	f	f	m	s			s		s			

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number L-11 Provenience 4198500/375000

500x500 Meters (Each square = 25m)

M	m	m	m	m	M	M	F	M	M	m	f	m	m	m	f	f	m	m	m
M	M	m	M	M	M	M	M	M	m	M	m	m	m	m	m	m	m	m	m
m	m	m	m	m	m	m	M	m	m	m	m	m	m	m	m	m	m	m	m
m	m	M	M	M	M	M	M	m	F	m	m	M	F	F	f	f	F	F	M
m	m	m	m	m	m	m	m	m	M	M	m	m	m	m	m	m	m	m	m
m	m	m	m	m	m	s	f	m	m	m	f	m	m	f	m	f	m	m	m
m	m	m	m	m	m	m	m	m	m	m	M	M	m	m	m	m	m	m	m
m	m	m	s	s		m	m	m	m	M	M	r	m	m	m	m	m	m	m
m		s	s	s	m	M	m	m	m	m	M	M	M	M	M	m	M	M	m
S	s	s	s	s	s	s	s	m	m	f	f	M	m	s	s	s	m	s	
s	s		s	s	s	s			m	m	m				s	s		s	
s	s		s	s							s	s			s	s	s		
												s	s	s	s	s	s	s	
						s	s		s	s	s	s		s	s	s	s		
								s	s		s					s	s		
												s				s			
															s				
						s									s		s		
										s			s		s	s	s		
						s			s									s	

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Quadrat Number L-11a Provenience 4198500/375500

500x500 Meters (Each square = 25m)

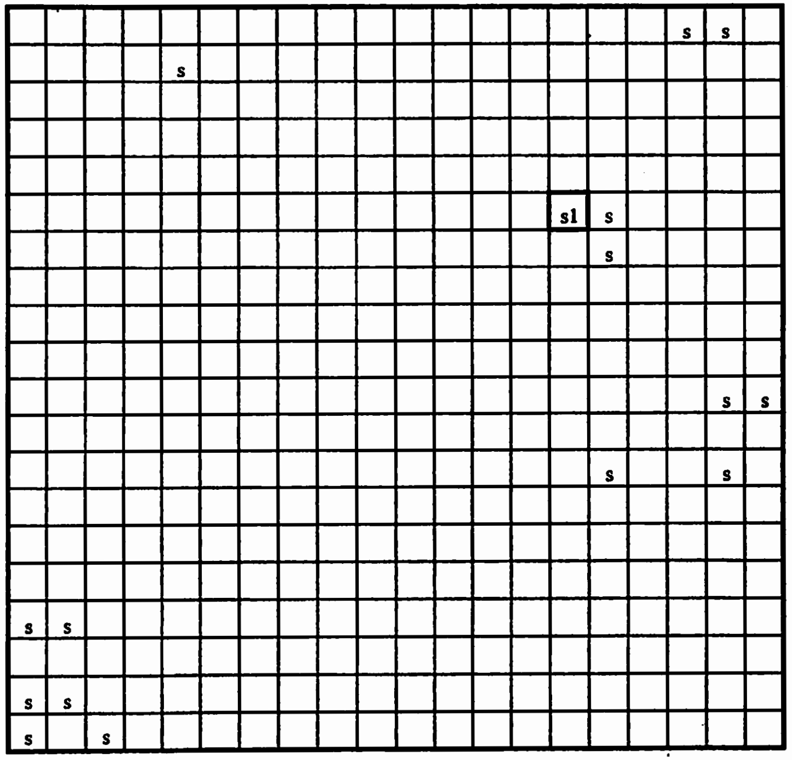
m	m	m	m	r	r	r		r	s	s	s	s	s	s	s	s	s		s
m	m		m	r	m	m	m	m	s	s	s					s			
	m	m	m	m	m	m	m		s	s	s	s		m	m				
	r		m		s	s	s	s	s									s	
S	S	s		s	s		s				s		s						
s	s	s	s	s	s	s		s	s	s	s	s	s					s	
s	s	s	s				r	s						s					
	m	s			s	m	m	m	m	m	s		s		s	f	m		m
		s	s						r							s	s	s	
s	S	S					s	s	s										
S	S	s				s			s	s								r	s
s										s	S	S	s						
					S								m		m	m			
					s									s	m				
s	S	S	s								s			s	S				
s	s	S	S	s					s		s					s	s		s
			s			s													s
		s	m		s	s										m			
																			s

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

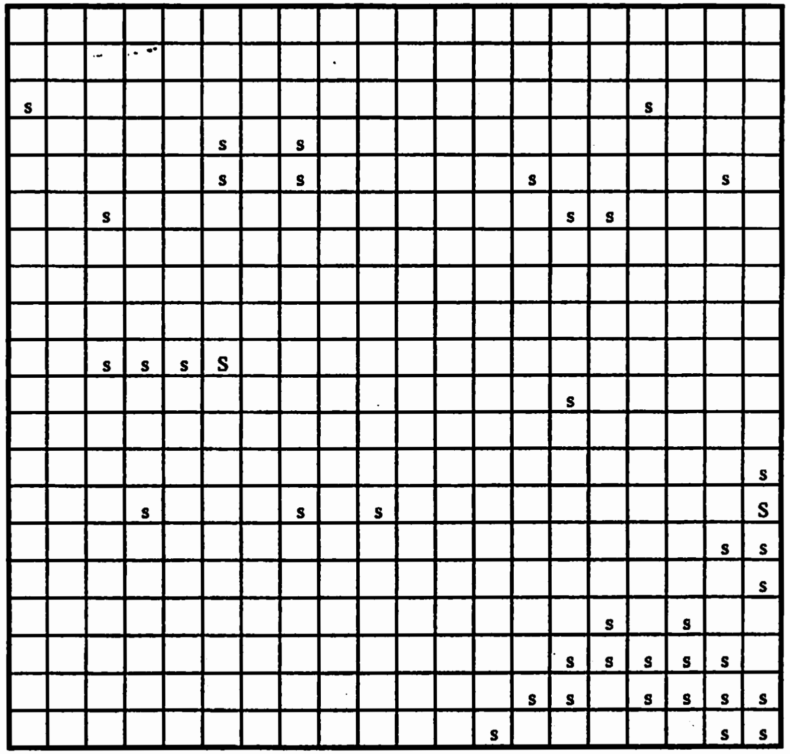
Quadrat Number L-11b Provenience 4198000/373000

500x500 Meters (Each square = 25m)



Quadrat Number L-11c Provenience 4198000/373500

500x500 Meters (Each square = 25m)



M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

☐ Denotes Rock Ring, Number Indicates Quantity

Quadrat Number L-12 Provenience 4198000/374000

500x500 Meters (Each square = 25m)

					s	m	m	m	m	m	m	m	m	m	f	m	m	m	m
				s	s	S	S	m	f	m	m	m	M	M	M	M	M	M	M
			s	s	s	m	m	m	m	m	m	m	m	m	m	m	m	m	M
		s	s	s	s	m	s	m	m	m	m	m	F	m	M	M	M	M	S
	S	S	S		■	S	f	m	m	m	m	m	f			S	m	m	M
		s	s	s	s	m	m	m	m	m	m	f	■				m	m	M
			s	f	f	m	m	M	M	m	m	m				f	m	m	m
s	s	s	s	s	r	m	m	m	m	m	m	m	r		s	s	m	m	m
s		s	S	f	f	f	f	f	f	f	m	m	m	m	m	m	m	M	M
S	s	s		S	m	m	m	m	m	m	m	m	M	m	m	M	M	m	m
		s	s			m	m	m	m	r	M	M	m	m	R	R	m	m	m
s	s	s	s	s		s	s		s	s	s	s	m	m	m	S	m	m	s
s	S	S								s		s		r	m	S			S
f	F	f	s						s	s	s								
s	s										s						s		
					■													s	
							s						s	s	■		s		
	s	s									m	m	m	m				s	s
m	m	m			s				s	M	m	M	M	M	m		r		
R			s	S	s			s	r	r	r	R	R	R	S				

Quadrat Number L-13 Provenience 4198000/374500

500x500 Meters (Each square = 25m)

M	M	m	m	m	m	m	m	r	r							s	s		
m	m	m	m	m	m	m	m	m			s					s	s		
M	M	M	M	R	m	m	m	r											
F	M	m	r	m	r									s	s				
r																			
r	m	m	m	s		s					s	s	s		s				
M	R	s		s	s	s	s												
m	r				s														
m	r	m	s			s													
m	r	s	s			s													
S	r	s				S	S		s	s					s				
r			s		s	s	s												
			s			s													
m	s	S	S	s	s														
			s																
	s			s								s							
s						s	S	s	s										
S	S	s						S	s										

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

□ Denotes Rock Ring, Number Indicates Quantity

■ Denotes surface collection loci

Quadrat Number L-14 Provenience 4197500/373000

500x500 Meters (Each square = 25m)

															■				
														s					
														s	s				s
																	s	s	s
											s	s	s	s	s	s	S		
																	m	m	
												s	m	s	s		s	r	
				■							s	s		■		r	r	r	
											s	s	s	m	s			m	
							s	s				S	S	S	r	r	r	s	
					s			s		m	r	r	r	r		m			
			s	m			s		s	r	r	r	f						
						s		s	s		r	r							

Quadrat Number L-15 Provenience 4197500/373500

500x500 Meters (Each square = 25m)

											s	s	s		s	m	m	m	
								s		s	s		r	r	r	r	r	R	r
							s	s	s	m	m	m	m	m		m	m	s	s
								s					s	s					
			s	s	s	s	r	r	r			r	r			r		r	s
		s	s	s				m	m			s			s				s
	m	m	m		m	m	m									m		m	m
	s				s	s		m											
	r						r	m		s		s							
		r						s	s										
		m	m	m	m	m	m	m	s	s	s	s	s	s				s	s
r	s	s			s	s			s										
				m	m	s	s												
					s														
s	s																		
	s	s																	
	s	s																	
																			s
										s									

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

□ Denotes Rock Ring, Number Indicates Quantity

■ Denotes surface collection loci

Quadrat Number L-16 Provenience 4197500/374000

500x500 Meters (Each square = 25m)

r	r			s						m	m	m	m		r				
m	s	m		r			m	s	s	m	m		s	s	s	s			
				r	m			s	s	s	s	s					s	s	
s	s	s		s	s	M	M	s	s	s	s	s		s		s	s		
s	s	s	s	s		m	m				m		s	s				s	s
	s		s						s	s				s		s	s		
s	s	s			s	s	s	m	s	m	m		m			r			
					s							s				s			
										s			s	s					s
s			s				s		s										s
													s		s	s	s		
											s	s	S	S		s	s		
					s														
													s	s					
											s								
											s								
										s	s								

Quadrat Number L-17 Provenience 4197000/372500

500x500 Meters (Each square = 25m)

																		s	
									s	s									
																s			
						s		s						s			s	s	s
														s			s		
																s	s	s	s
			s							s				s		s	s	m	m
					s	s			s	s	s	s	s	s	s	m	m	r	m
												r	s	S	S	r	r	s	
												s	m	m	m	m	r	m	
				s				s		s		s	s	m	m	m	m		
							s		s	s	s	s			s	m	s		
			s					s	m	s	m	m	m	m		r	m	m	
								S	S	S	S	S				R			
				s	m	m	m	m	m	m	m	s	s	r	r				
				s		s			s	m			m	m					
			s	s	s	s				s		m	m						

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number L-18 Provenience 4197000/373000

500x500 Meters (Each square = 25m)

		s	s	s	s	s	s		s		m			s	s	s			
		s	s	s	s			s	s	R	s	s	r	s	s	s		s	
			s	r	r		s	s		r									
s	s	s	f	m					m										
s	s	s	r	r		r							s	r					
s	m	m	s	s	m														
S	r	r	s	r	s			s											
r									s	s									
			s																
s						s													
		s																	
				s															
	S	S	s																

Quadrat Number L-19 Provenience 4196500/372000

500x500 Meters (Each square = 25m)

																s			
								m	m										
																			s
				s														s	s
														s	s	m	m	m	m
													s	m	m	r	m	m	m
												m	m	m			m		
									m	m	m					r	r		
										s	m	s			r			s	
			s	s	s	s	s	r	m	m	m	m							
				s	s	s	s	m	m	m									
					m	m	m	m											
r	r			m	m	m	m	r											
			s		m	m	R												
r	m	m	m	m	m	m													
s	s	m	m	m	m	r	m						s	s					
			m	m	r						s		s						
			m	m	M	r						s	s					s	
	s	s			s								m	m	s				s
s					s	m											s	s	s

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

S = Non-Quarry Archaeological Site

Lower case letters denote low densities of above categories

Denotes Rock Ring, Number Indicates Quantity

Denotes surface collection loci

Quadrat Number L-20 Provenience 4196500/372500

500x500 Meters (Each square = 25m)

m	m	m	m	s		m	s			s	r	r				s	s	s	
	s	s	s								r					s			
	s									r					s		s		
s	m	s				m	m	m											
m	m	s			s	s								s					
r		r														s			
										s									
				s															
				s					s				s	s				s	
		s																	
									m										

Quadrat Number L-21 Provenience 4196000/371500

500x500 Meters (Each square = 25m)

					s	s	s									s	s	s	s
			s	s	s													s	s
																m	m	m	
			s	r	r	r	r	r	r					m	m		m	m	s
										r							m		m
														s	s	s	s		
														s					r
m		m	m	m	m	m	m	m	m		m		m	m	r				m
	r	r	r	r				s	s										s
s	s	m	m	s	s	s	s	s	s	s	m	m	m	r	r	m	m	r	r
							s	s			s						r		
							s				s					m			
				m	m	m	m												
		s			r						m	m	m	m					
s	s	s	m				r												
s		r																	
r		r							m			r							
						m	m	m	m	m									
								m	m										
					s	r			m										s

M = Moderate Flaking Debris Relative to Cobbles < 70%

F = Flake Debris Dominant Relative to Cobbles > 70 %

A = Assaying (Cobble Breakup Dominant)

R = Raw Material Only

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Lower case letters denote low densities of above categories

☐ Denotes Rock Ring, Number Indicates Quantity