6-15-2024

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Document Type

Masters Thesis

Degree Name

M.A. in Anthropology

First Advisor

Nicole Herzog

Keywords

Archaic, Behavioral ecology, Drought, Great Basin, Sage Hen Springs, Survivance

Subject Categories

Anthropology | Archaeological Anthropology | Behavior and Ethology | Ecology and Evolutionary Biology | Geography | Human Geography | Social and Behavioral Sciences

Publication Statement

Evidence of Climatic Influence on Subsistence Strategies at Sage Hen Springs, Nevada

A Thesis

Presented to

the Faculty of the College of Arts, Humanities and Social Sciences

University of Denver

In Partial Fulfillment

of the Requirements for the Degree

Master of Arts

by

Andrew Rogers

June 2024

Advisor: Nicole Herzog

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Title: Evidence of Climatic Influence on Subsistence Strategies at Sage Hen Springs, Nevada
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Acknowledgements

I would like to thank numerous people and organizations for their assistance with this project. First and foremost, thank you to Nicole Herzog for her help in the field, her advice and guidance, and her patience. Thank you to Jen Rovanpera of the BLM for including me in the work at Sage Hen Springs, and for arranging and supplying the expedition. Thank you to Elisa Correa, Roland Brady, and Genevieve Frissell for their help in the field, and again to Genevieve for her hard work in the lab. Thank you to Richard Hughes for the XRF analysis and Tom Origer and Associates for the obsidian hydration analysis.

Thank you very much to the Nevada Archaeological Association/Am-Arcs, the Colorado Archaeological Society, and the University of Denver Department of Anthropology for funding this research, and thank you to the NAA for providing funds for me to present my findings at their annual meeting.

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Chapter 1: Introduction

The Sage Hen Springs site (26WA6916), located in northwest Nevada, is rich with lithic data related to hunter-gatherer lifeways in the Great Basin. The site contains multiple rock features, rock art, and a substantial lithic scatter that dates from the Post-Mazama period to the Late Archaic. This temporally broad record, combined with the site's location near an upland water source, suggests a varied pattern of intensive occupation and site use throughout the Archaic. Using lithic analysis and toolstone conveyance data, I explore how the use and occupation of Sage Hen Springs changed throughout the Archaic, primarily in response to climate change. I develop my hypotheses from other research in the northwest Great Basin that shows residential mobility decreased as an adaptation to periods of drought in the Mid-Late Archaic. The data at Sage Hen Springs supports my hypotheses and thus the broader research in the region.

Organization of Thesis

In this chapter, I briefly discuss the context of Sage Hen Springs within the northwestern Great Basin, outline the research goals in studying Sage Hen Springs, describe the methods I used and data I collected, and summarize the results and conclusions. In Chapter 2, I discuss the environmental context and management history of Sage Hen and relevant previous research done in the Great Basin. In Chapter 3 I detail the theoretical basis for the thesis, namely the Behavioral Ecology paradigm and Optimal Foraging Theory. Chapter 4 elaborates on the field and lab methods I used to investigate Sage Hen. I present the results of these investigations in Chapter 5, and discuss those results in Chapter 6. Finally, Chapter 7 summarizes conclusions from the investigation and offers suggestions for future research.

Sage Hen Springs Within the Northwestern Great Basin

Sage Hen Springs lies to the north of the Massacre Lake Basin (see Leach 1988) in the higher-elevation tablelands of northwestern Nevada. The area that spans northwest Nevada, northeast California, and southwest Oregon is defined as the northwestern Great Basin and is often considered separately from the rest of the Great Basin due to its specific ecological factors; the topographic trend in this region is generally small basins bounded by mountain ranges, which results in many and closely-spaced ecozones. Also, the region lies far enough north that periods of drought have generally impacted the region less than they have areas further south (Thomas et al. 2023). The undulating landscape of the northwestern Great Basin is host to a wide range of habitats in close proximity to one another (O’Connell 1975); still, broadly, the area is dominated by sagebrush and grass steppe with juniper and conifer woodlands extending into higher montane environments (Leach 1988). The arid lowlands are punctuated by marshy areas near playa lake beds (many of which are typically dry, sometimes filling after summer rain or snowmelt) and bounded by upland spring sites, and wetter montane woodland areas. Today, the vegetation of the region is affected by grazing animals and modern land management practices, which notably suppress fire; burning would have very likely been utilized by prehistoric inhabitants to manage the landscape (Leach 1988).

Climate fluctuations throughout the Holocene caused multiple shifts in precipitation patterns and floral and faunal distributions (Leach 1988:9–11). During periods of drought, the basin lakes and associated marshlands would have receded, and upland spring sites would have become increasingly important in subsistence strategies. Sage Hen Springs would have thus played a prominent role in Mid-Late Archaic utilization of the Massacre Lake Basin. This is evidenced by the rich and extensive archaeological record extant at the site.

Documenting the Sage Hen Springs Site

Previous efforts to catalog the Sage Hen Springs site recorded roughly a dozen rock rings, 100 rock art panels, and a 60-acre lithic scatter sometimes exceeding 30 artifacts per square meter, estimated to contain 50,000 artifacts (Carambelas 2014). The site appears to be divided into two main activity areas. The northwest activity area contains the rock rings with a relatively minimal associated lithic scatter. The southwest activity area closer to the springs themselves is characterized by a denser lithic scatter and no associated rock rings. There are also some artifacts proximal to the spring and outside the bounds of the other activity areas, which perhaps constitute a third activity area (discussed further in later chapters).

The Bureau of Land Management (BLM) conducted Phase II testing at Sage Hen in July 2023 as part of a range management project. They intended to construct a spring box outside the boundary of the site, fed by a subterranean pipeline from the springs, as well as a cattle exclosure around the site. I was invited to design a testing plan that included more of the site than the proposed project area. As such, we excavated test units in the northwest and southeast activity areas and collected all artifacts recovered from test units. Further, we collected tools from each of the material classes present at the site through opportunistic surface collection. We also employed a transect-based spatial sampling method to characterize lithic distribution across the site. After transporting the collected artifacts to the University of Denver, I identified diagnostic projectile points and identified formal tools. I then sent a sample of artifacts to independent geochemical labs. The first used X-Ray Fluorescence (XRF) to source the toolstone to known quarries in the area, and the second used obsidian hydration dating to provide date ranges for the obsidian artifact sample (see Chapter 4). Using the spatial and temporal data, I then developed statistical tests to investigate the research questions discussed above (see Chapter 5).

Present Research: Goals, Ethics, and Findings

Intensive analysis of the Sage Hen Springs site offers an opportunity to investigate and test models for northwestern Great Basin lifeways at the small scale. By considering the archaeological record at one site, I aim to develop a postulate as to how that specific site was used throughout the Archaic. I can then compare this postulate to larger-scale northwestern Great Basin research to see if Sage Hen Springs fits into those models or if it represents a novel site type or use. My research questions are detailed in Chapter 2, but in brief, I investigate whether there is an intensification in site use during the Mid-Late Archaic as a response to drought conditions. I hypothesize that the intensification in this period is represented by a decrease in residential mobility and decrease in logistic mobility as an adaptation to changing food availability. Lastly, I test whether the Sage Hen Springs data indicates an increase in population during the Middle Archaic, as has been suggested by other research (Hildebrandt et al. 2016; LaValley 2013; Leach 1988).

This work is aligned with the Society for American Archaeology (SAA) Principles of Archaeological Ethics (https://www.saa.org/career-practice/ethics-in-archaeology). The first principle, stewardship, is concerned with "collaborative management of the archaeological record for the benefit of all people." This work aims to investigate the Sage Hen Springs site to contribute to archaeological scholarship, and assists the Bureau of Land Management in preserving the site and managing the land on which it is located. The BLM project aims to inventory the cultural resource ahead of the installation of an exclosure to prevent trampling by local cattle and wild horse populations, thus preserving the site into the future.

This thesis also aligns with principles five and six regarding preserving and reporting on the archaeological record. The work here avoids publishing sensitive location info but provides material culture data and analysis to the general public. Further, this thesis as well as the rest of the data and location information are held by the BLM, and the BLM archaeologist in charge of the site actively pursues consultation with concerned parties.

Results of my analysis suggest that use of the site does indeed intensify in the Mid-Late Archaic, and peaks during periods of drought. Further, use of the site during this period shifts towards residential use, with evidence of residential structures dating to this period. Lastly, population at the site, indicated by artifact counts and size of residential structures, seems to increase in the Mid-Late Archaic (3,800-600 BP).

Chapter 2: Background

Defining the Great Basin

The Great Basin, a 200,000-square mile region covering most of Nevada and parts of Utah, California, Oregon, Idaho, and Wyoming, is known by its arid valleys, alkali flats, and towering mountain ranges. The boundaries of the Great Basin are defined differently by various scientific approaches. Most common across academia is the hydrographic definition; all water in the Great Basin drains not to an ocean, but internally (Fiero 2009; Grayson 2011). Water drains into streams, marches, and “fetid salt lakes” (Frémont 1845:209 via Grayson 2011), many of the latter having dried out to form playas. By this definition, the Basin is bounded by the Walker and Carson Rivers to the West, the Humboldt, Truckee, and Quinn Rivers to the north, the many feeders of Utah’s Great Salt Lake to the East, and the Amargosa, Mojave, and Owens Rivers to the south (Grayson 2011).

The unique hydrography of the Great Basin is caused by its unique physiography. The Basin is bounded by mountain ranges that divert water towards the center of the region. Physiographers also focus on the unique basin-and-range topography of the region; valleys and flats transition abruptly to imposing mountain peaks. Ranges predominantly run north to south, and the fifteen ranges in Nevada average a width of 70 miles each (Grayson 2011). The basin and range topography extends beyond the borders of the Great Basin, but the Great Basin within this definition is bounded by the Sierra Nevada in the West, the Wasatch Range in the East, the Columbia Plateau in the north, and the Mojave River in the south (Grayson 2011).

The unique physio- and hydrographic nature of the Great Basin has caused similarly unique populations and distributions of flora. These distributions constitute the third scholarly definition of the Great Basin. Botanists rarely agree on the exact boundary line of the floristic Great Basin, but the most forgiving definition stipulates saltbush and sagebrush in the lower elevations of the region, and pinyon-juniper woodland in the montane regions (Cronquist et al. 1972 via Grayson 2011). The floristic boundaries typically include more territory to the north and less to the south than the hydrographic definition, but prioritizes the unique biological characteristics of the Great Basin over the geologic.

The fourth and final definition of the Great Basin discussed here, and perhaps the most relevant for this thesis, is the ethnographic definition. Unique cultural adaptations to the geographic and floristic conditions of the Great Basin are the indicators used by ethnographers and anthropologists to determine cultural clusters. These clusters are said to identify culture groups that are more similar to each other than they are to cultures not included in the cluster, in terms of behavior and material culture (Grayson 2011). The Great Basin culture cluster is approximated by language groups. Often language is not a very good proxy for culture, but in the Great Basin, anthropologists point to Uto-Aztecan – more specifically, Numic – language groups as the constituents of the Great Basin culture cluster (Grayson 2011). Grouping and clustering cultures in this fashion is more often than not overly reductive and is couched in antiquated anthropological theory that has since been reformed to highlight the diversity of culture instead. This concept is discussed further later in this chapter. For now, the ethnographic Great Basin, while potentially problematic, serves to point out that the anthropology of the Great Basin is suitably unique to justify a subdiscipline within archaeology that focuses solely on human behavior in the Great Basin across prehistory. The development of this subfield of archaeology is what I discuss in this chapter. Following this discussion, I describe how the history of Great Basin archaeology informs the research goals of this thesis.

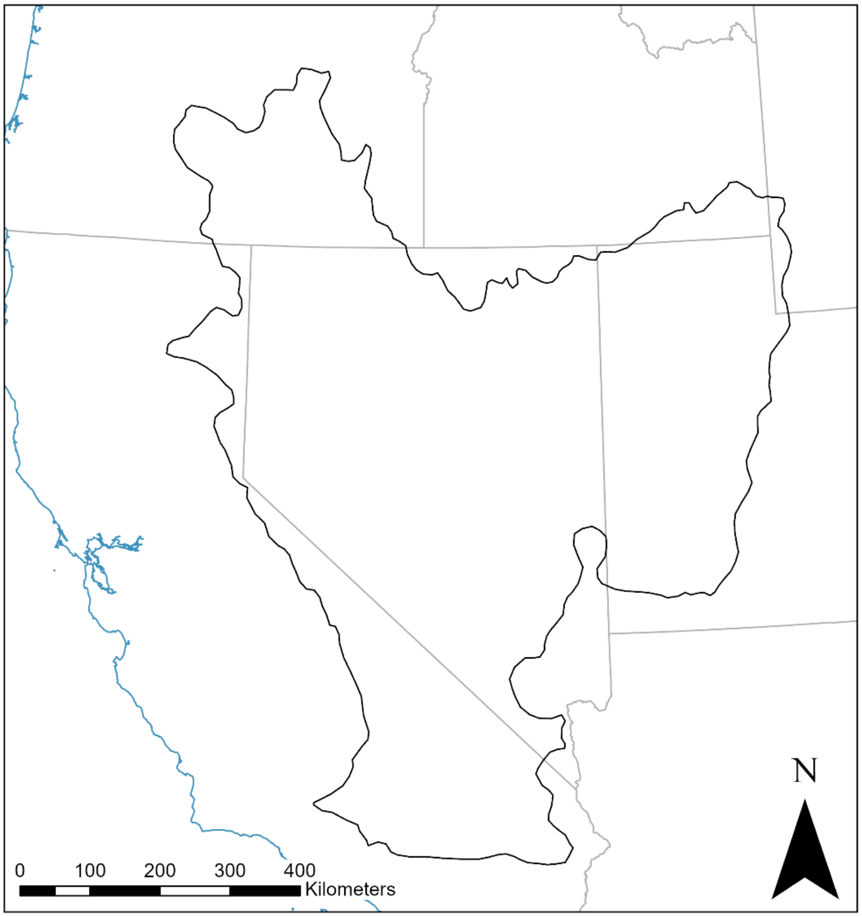

Figure 2.1: The Hydrographic Great Basin (after Grayson 2011).

The History of Archaeology in the Great Basin

Early Anthropologists

As early as 1776, Euro-American explorers documented their observations of Great Basin cultures, notably the Escalante expedition's account of the Ute group near Utah Lake, and Lewis and Clark's notes on their interactions with the northern Shoshone (Fowler 1980). Later researchers traveled to the Great Basin with the express goal of conducting ethnographic research. Among the first of them were John Wesley Powell in the 1870s, who recorded aspects of the subsistence, social organization, and religion of multiple Numic-speaking groups; Alfred Kroeber in 1900, who "did some brief ethnographic work with the northern Ute…" (Fowler 1980:9); Edward Sapir in 1910, who focused on recording the language of the southern Paiute and Ute peoples (Fowler 1980); and Isabel Kelly in 1930, who compiled an extensive ethnography of the Surprise Valley Paiute (Kelly 1932).

Most of these early ethnographers' work was devoted to cataloging the cultural elements of the people they worked with, without attempting to explain distributions or developments of Great Basin cultures. In the 1930s, new expeditions sought to construct lists of cultural element distributions, noting the location of every cultural component they observed across a wide area, with the goal of understanding culture history (Fowler 1980; Voegelin 1942). Julian Steward was one of the two anthropologists (the other being Omer Stewart) that conducted most of these cultural element surveys (Fowler 1980). Steward's work led to his publishing an extensive analysis of Great Basin sociopolitical organization (Fowler 1980; Steward 1938). Steward's landmark study proposed that the

Great Basin as a whole should be perceived as simply a peripheral extension of the group Steward called the San Juan Anasazi, rather than a unique cultural area of its own (Fowler 1980; Jennings and Norbeck 1955; Steward 1938). The term ‘Anasazi’ is no longer used for peoples of the southwest, as it is an offensive term to modern Indigenous people. Steward claimed that the Shoshonean (Numic) culture was a result of adaptation to the Great Basin’s relatively unproductive environment, developing an early ecological-cultural model (Steward 1938, 1955; Wilde 1994). Steward's model was extended across the Great Basin and into deep prehistory (Thomas 1973; Wilmsen 1970). This served to collapse any spatial and temporal variation in Great Basin culture, a trend that was furthered by the next major archaeological paradigm in the region: Jesse Jennings’ Desert Archaic model.

Jesse Jennings and the Desert Archaic

Jennings’ novel cultural model was based on his archaeological investigations at Danger Cave, located on the eastern edge of Utah and the Great Salt Lake desert. In his work, Jennings proposes the Desert culture model, which posits that Great Basin culture was broadly unchanging for that whole span of time (Jennings 1957; Wilde 1994). Jennings based his model off of Steward’s Shoshonean ecological model, claiming that cultural adaptations were constricted by the unproductive environment of the Great Basin (Jennings 1957; Wilde 1994). Jennings posited that subsistence strategies remained similar across 10,000 years and were based on the non-specific exploitation of any and all available food sources (Wilde 1994). The Desert culture model also claims that subsistence strategies remained consistent across hypothesized climatic events, such as

Antev’s Altithermal (Antevs 1948; discussed further below). Jennings’ study was quickly adopted by the discipline and hailed as “a classic” (Heizer 1958).

The Desert Archaic model, or the idea that early cultures persisted relatively unmodified for 10,000 years, sunk its teeth into Great Basin archaeology for decades, before scholars shifted to a more systemic approach to prehistoric cultures (Wilde 1994). The problems with the Desert Archaic model are, first and foremost, that it ignores any spatiotemporal variation in culture, and especially those brought on by climatic events; second, that it assumes ethnographic studies are valid indicators of behavior in deep prehistory; and third, that it perpetuates Steward’s collapsing of a 200,000-square mile area into a monolithic peripheral region of the southwest. Later archaeologists sought models more specific to time periods and regions, and focused more on the link between climate and cultural adaptations. The discipline of Great Basin archaeology still reckons with Jennings’ model today, and scholars still publish research pushing back against the Desert Archaic paradigm. This cognitive shift resulted in the reclassification of Great Basin prehistory with novel chronologies.

Redefining Great Basin Chronologies

There are nearly as many chronologies for Great Basin prehistory as there are researchers. Research questions typically shape how an archaeologist might define and bound temporal periods. Commonly, these boundaries are defined by projectile point typologies (O’Connell and Inoway 1994), separating time periods by the primary point type, i.e., the northern Side Notched period early on and the Rosegate period later. Other researchers attempt to define cultural periods, similar to the Pueblo and Basketmaker chronologies of the American southwest. In the northeastern Great Basin, these chronologies include, for example, the Fremont period starting around 1600 BP and continuing to about 600 BP (Hester 1973; Jepsen 2021). Other chronologies are based on the inferred occupation dates of rock shelters, i.e., defining the Danger or Hogup periods by the earliest and latest dates recorded in each respective cave (Hester 1973).

These chronologies are useful in discussing prehistory within the context of a specific region, or in reference to specific cultural elements. However, to facilitate comparisons of cultural adaptation between regions, a more generalized chronology is useful. The chronology used in this thesis, adapted from Hildebrandt et al.'s (2016), consists of the Terminal Pleistocene/Early Holocene (TP/EH) period as the earliest temporal unit (ca. 16,000 to 7,800 BP). This is followed by the Early (7,800 to 3,800 BP), Middle (3,800 to 1,300 BP), and then Late Archaic (1,300 to 600 BP). Last, the Terminal Prehistoric (TPH) period is the final temporal unit (600 BP to Euro-American contact).

In the northwest Great Basin, the stratigraphic lens of the Mt. Mazama eruption is a useful temporal indicator. Around 7,600 BP (the exact date is unknown, but estimates put the date between 7,580 and 7,680), Mt. Mazama in southern Oregon erupted, depositing a lens of ash and tephra across the northernmost extent of the Great Basin and up into Canada (Egan et al. 2015). The tephra lens can be reliably geochemically identified, and thus provides an isochronous indicator across the region in which the ash was deposited. Thus, Post-Mazama is a common chronologic label by northwestern Great Basin researchers.

The Terminal Pleistocene/Early Holocene (TP/EH)

The TP/EH is defined by the earliest known period of human occupation of the Great Basin and extends up until the eruption of Mt. Mazama (ca. 16,000 BP to 7,800 BP; Beck and Jones 1997; LaValley 2013; Smith and Barker 2017). The Great Basin archaeological record for this period is, for the most part, limited to lithic scatters near or on the surface, and deposits in rock shelters or caves. Sites with a buried TP/EH component are rare and are typically only identified by diagnostic projectile points (Beck and Jones 1997).

Climate was significantly variable over the 4,000-plus years of the TP/EH. Beck and Jones (1997), state that the Great Basin was cooler and moister during the 12,000 - 9,500 BP period than it is today. From 9,500 onward, climate became drier, resulting in wetlands reducing in size and productivity (Jones et al. 2003). Smith and Barker (2017), report on higher-resolution climatic data 20 years later; according to them, TP/EH summers were warmer and winters were colder than in earlier and later periods. Lake fill records indicate variability in lake stands, but lakes were more often full to the point of overflowing than dry. Regarding fauna, artiodactyls have been found with high frequency at multiple sites dating to the TP/EH, but remains of megafauna are rare. Lagomorphs are common in the record; in fact a decrease in the quantity of pygmy rabbits in the record in the following eras may indicate a decrease in sagebrush and thus hint at lower precipitation amounts in those eras (Smith and Barker 2017). Locations of TP/EH sites near marshlands, as well as dietary evidence from coprolites and dental analysis in caves suggest the importance of marsh resources, including small fish and roots and grasses, as well as other foods processed with milling stones (Smith and Barker 2017).

Lithic data suggest TP/EH people were highly mobile. Many of the early point types (Great Basin Fluted and Great Basin Stemmed) are found very close to the obsidian sources that they were made from (Smith and Barker 2017), suggesting that people made, used, and discarded tools near these sources before moving on to another area, and that they did not bring toolstone back to a central residential base for use there. Further, Jones et al. present a study of toolstone sources and lithic conveyance for the TP/EH, in which they suggested that early Great Basin inhabitants traveled in large seasonal rounds of over 400 km, targeting wetland subsistence areas. In the Early Holocene, past 9,500 BP, wetlands became less productive as a product of climate change, and this resulted in a change in mobility patterns to focus on longer stays at residential sites, evidenced by a change in how far artifacts are found from their respective toolstone source; artifacts found at greater distances from the toolstone source suggests people were bringing material to a home base for use there (Jones et al. 2003).

The Archaic

The Archaic period in the Great Basin extends from the end of the TP/EH through the beginning of the Terminal Prehistoric period. Exact dates for the Archaic vary by region and by researcher, but for this thesis, I use a chronology developed by Hildebrandt et al. (2016) for northwestern Nevada. In this chronology, the Early Archaic spans from 7,800 to 3,800 BP, the Middle Archaic from 3,800 to 1,300 BP, and the Late Archaic from 1,300 to 600 BP.

In 1948, Ernst Antevs published a model for Holocene climates that quickly became the prevailing climatic model for the Great Basin. Antevs based his model on data from lake height records and the geomorphology of arroyos in the Great Basin (1948). The model consisted of the Anathermal from 10,000 to 7,000 BP, which was a period of cooler, wetter temperatures than today. Following this was the Altithermal from 7,500 to 4,500 BP, a period of hotter and drier climate than today. Finally, the Medithermal lasted from 4,500 BP to today, with a similar climate to today. Antev's model predated reliable carbon dating and has been replaced with higher-resolution and more accurate models since its publication.

Contemporary paleoclimatologists generally recognize three main periods of drying in the Holocene. The first drying period, known as the Mid-Holocene Drought, mostly aligns with Antev's Altithermal; from ca. 7,500 to 5,000 BP (the start date varies by geographic location), a drying trend is supported by lake and river deposit histories, botanical distributions constructed from pollen records, and inferred distributions of wetlands (Hildebrandt et al. 2016; McAfee et al. 2023). During this time, distributions of food sources, particularly wetland resources and large mammals would have shifted or reduced in quantity. These changing distributions would have challenged Great Basin inhabitants to restructure their subsistence strategies to cope with varying and reduced food availability (Leach 1988). The second drying period, referred to as the Late Holocene Dry Period (LHDP), extended from 3,100 to 1,800 BP (McAfee et al. 2023; Mensing et al. 2023, 2013; Thomas et al. 2023). There was a brief wet period from 2,200 to 2,000 BP before the most extreme drought period of the LHDP from 2,000 to 1,800 BP (Thomas et al. 2023). Climatological evidence suggests that the aridification of the LHDP was primarily localized to areas south of 40° N latitude, with climates in areas north of 42° N remaining mesic (Thomas et al. 2023). The final drying period of the Holocene was the Medieval Climatic Anomaly (MCA) from 1,000 to 600 BP (Jones et al. 1999; McAfee et al. 2023; Reinemann et al. 2014; Thomas et al. 2023). These shifts in prevailing climatic conditions are primary factors in cultural adaptations during the Holocene. Some of these adaptations are detailed below.

As mentioned above, diet was quite variable in the TP/EH period, with Great Basin peoples pursuing big and small game, fish and waterfowl, marsh plants, seeds and roots, and insects (Beck and Jones 1997; LaValley 2013). As the climate became drier in the Early Archaic, rivers and lakes receded, sagebrush and pine habitats diminished, and wetlands and their associated resources became far less plentiful (Hildebrandt et al. 2016). Resource scarcity and different distributions of species resulting from climate change forced Great Basin inhabitants to pursue new strategies to procure sufficient quantities of food. An intensification in seed processing technology, including baskets and grinding stones, is observed at Danger Cave prior to the start of the Early Archaic, and this trend is observed at other sites across the Great Basin by the height of the period (LaValley 2013; Rhode et al. 2006).

Developments in projectile point technology towards smaller and more effective points (northern Side Notched, Humboldt, and Gatecliff series, the latter two persisting into the Middle Archaic), alongside the development of the atl-atl in the Early Archaic (Grayson 2011; LaValley 2013) likely indicates an increase in hunting activity, or at least a concerted effort to increase the caloric returns of hunting activities. Elston and Zeanah suggest Early Archaic resource scarcity resulted in a sexual division of labor, with men focusing on logistic hunting trips, and women primarily pursuing plant resources that could be found more reliably (Elston and Zeanah 2002; LaValley 2013). Jones and Beck also note a shift from a toolstone industry focused on large bifaces to one more reliant on expedient flake tools, indicating the development of a more portable toolkit (Jones and Beck 2012).

Climate at the start of the Middle Archaic returned to the more mesic conditions of the Pre-Holocene, resulting in an increase in shrubland and wetland resources, and higher numbers of artiodactyls (Hildebrandt and McGuire 2002; LaValley 2013). The archaeological record from this period suggests Great Basin residents pursued fairly broad diets; seed processing continued alongside a concomitant increase in big-game hunting (LaValley 2013; Leach 1988). Elko, Gatecliff, and Humboldt points are predominant in the record (LaValley 2013). Population likely increased in number and density as a result of increased resource availability (LaValley 2013; Leach 1988; Louderback et al. 2011), and is probably the reason why diet remained quite broad – despite increases in resource abundance, a higher population increased subsistence quotas and drove diet breadth. McGuire and Hildebrandt suggest that hunting increased in the Middle Archaic as men sought to gain prestige by procuring big game (2005), but Zeanah claims that it was in fact women's plant-gathering activities that provided most of the calories (2004). Pinyon nut processing also developed in the Middle Archaic, but was not pursued in areas lacking pinyon pine, such as the northwestern Great Basin, the study area for this thesis (LaValley 2013).

The LHDP in the latter half of the Middle Archaic resulted in a decrease in available food resources and shifting distributions of what remained. This, coupled with the increased population brought on by the Early-Middle Archaic resource density, induced considerable pressure on Great Basin residents, and it appears that most sites south of 40° N, where the greatest drying occurred, were abandoned (Thomas et al. 2023). However, some groups shifted their strategies to include more intensive occupation of upland areas, especially spring sites (Thomas et al. 2023), and increased diet breadth and intensification of exploitation of upland resources (Leach 1988).

Pinyon nut processing intensified in areas with endemic pinyon populations, a structured settlement structure developed in the Owens Valley, the Utah Fremont pursued maize agriculture, and new wetland strategies were developed by peoples of the Great Salt Lake area. These developments are not seen in the northwestern Great Basin; the greatest subsistence development in the region was the shift to bow-and-arrow technology, with a rise in the predominance of arrow points, including Rosegate, Cottonwood, and Desert Side Notched (the latter of which become more common in the Terminal Prehistoric). Halfway through the Late Archaic, the Medieval Climatic Anomaly (MCA) heralded returns to xeric conditions across the Great Basin. Around this time as well, it is generally accepted that a culture group termed the Numic peoples, spread from the southeast Great Basin throughout the region, either displacing or mixing with existing groups (Bettinger and Baumhoff 1982; Hildebrandt et al. 2016; Magargal et al. 2017). Basketry changes significantly during this period, potentially a signal of Numic arrival, and the introduction of Desert series points may also indicate Numic presence (Hildebrandt et al. 2016). McGuire and Hildebrandt suggest that Numic peoples focused less on big-game prestige hunting and more on processing lower-ranked food items (2005), which would have increased their ability to survive in the Great Basin, and ultimately led to their displacing pre-Numic peoples. This demographic shift makes it difficult to apply ethnographic data to periods earlier than the Late Archaic, as adaptations and subsistence strategies were significantly different between the Numic peoples that ethnographers worked with, and the pre-Numic residents of the Great Basin.

As subsistence strategies varied across the Archaic, so too did mobility regimes. The two are invariably linked, but they warrant separate discussions, given the goals of this research as discussed below. The very high residential mobility of the TP/EH gave way to a significantly less residentially mobile regime in the Early Archaic, evidenced by the appearance of more robust residential structures and storage pits in the record of this period (LaValley 2013; O'Connell 1975). Logistic trips likely concomitantly increased as residents of residential sites forayed out for resources (Grayson 2011; O'Connell 1975). It is likely that people constructed residential bases near reliable water, and shorter-term logistic bases across the landscape, especially higher-elevation areas for hunting (LaValley 2013) as an adaptation to xeric conditions. Middle Archaic mobility regimes followed similar patterns to those of the Early Archaic, with residential bases and logistic camps dominating the record, and toolstone conveyance indicating similar distances traveled (LaValley 2013). It appears that Late Archaic residential patterns reflect an intensification of the trend seen in earlier periods, with further decreased residential mobility reflected at both rock shelter and open-air sites (Hildebrandt et al. 2016; Leach 1988).

The Terminal Prehistoric (TPH)

The anthropological record of the Terminal Prehistoric period (600 BP through Euro-American contact) is extensive. Given the prolific data for this period, I limit the discussion of the TPH geographically to just the record for the northwestern Great Basin, where this study is situated. As discussed above, Numic adaptive strategies in the TPH deviated from pre-Numic behavior in the Archaic. Climate was more mesic than the drought of the preceding Medieval Climatic Anomaly (MCA). Settlement became more dispersed and residential group size decreased during the TPH, with many sites being used much less intensively than they had been in the Archaic, suggesting a more mobile strategy (Hildebrandt et al. 2016; O'Connell 1975; O'Connell and Inoway 1994). Overall regional population appears to decrease, attributed to the effects of the MCA (Hildebrandt et al. 2016). Groundstone increases in quantity in the archaeological record, alongside an increase in diet breadth related to plant foods (Hildebrandt et al. 2016). Projectile points and flaked stone in general appear to decline in importance during this period, and toolstone is procured from farther away than in previous periods (Hildebrandt et al. 2016). The increased mobility inferred from the TPH record is likely due in part to the introduction of horses to the region by Euro-Americans near the end of the period.

Isabel Kelly's ethnography of the Surprise Valley Paiute offers further information about the Numic cultures in the northwest Great Basin. Kelly relates that the northern Paiute foraged constantly and for diverse resources, often facing starvation in the winter (1932). One person reported that the Surprise Valley Paiute focused on gathering seeds and roots in the summer and cached them for the winter; when winter supplies ran out, they'd move somewhere else. Further, the group hunted every day, year round, targeting crickets, both upland birds and waterfowl, lagomorphs, large rodents, artiodactyls, and wildcats, when each were seasonally available (Kelly 1932). Kelly noted a sexual division of labor that likely appeared in the Archaic, with men focused on hunting and women on gathering, both of plant foods and of insects. Winter houses were conical grass mat-covered structures roughly twelve feet in diameter, while summer residential structures were limited to shade structures or brush windbreaks (Kelly 1932). While this information should not be applied beyond the TPH, it provides useful insight into what materials to expect from more recent habitation at Sage Hen Springs.

Moreover, historic-period and modern Northern Paiute bands frequently name themselves after culturally important foods. For example, the Gidutikad (groundhog eaters; here diacritics are not included in accordance with how the word is spelled on the Fort Bidwell community website: gidutikadpaiute.com; Kelly 1932) Kamödökadö (jack-rabbit eaters; Stewart 1939), and Wadadökadö (wada-seed eaters; Stewart 1939) represent just a few. These names indicate a fairly broad diet (i.e. they are mostly low-return foods, thus necessarily indicating a broad diet) pursued by the Numic groups, as well as an intense focus on regionally important foods.

The Black Rock Desert and the Massacre Lake Basin

The Sage Hen Springs site lies within the Massacre Lake Basin of northwestern Nevada, which itself lies in the Black Rock Desert, also termed "High Rock Country." The Black Rock Desert is a volcanic plateau, featuring extensive surface deposits of basalt and rhyolite (Hildebrandt et al. 2016). Tablelands interspersed with rimrocks are the predominant landform, and ash flows typically underlay much of the basalt outcrops in the further northwestern extent of the region (Hildebrandt et al. 2016). At the northeastern extent of the Black Rock Desert lies the Massacre Lake Basin. The Massacre Lake/Guano Valley obsidian source, as well as nearby Coyote Spring and Nut Mountain sources are "Tertiary-age extrusions that have been widely dispersed as lag cobbles and gravels over millennia of uplift and erosion” (Hildebrandt et al. 2016:21). Northwest of the lake itself is Massacre Rim, made up of basalt caps on faulted blocks (Hildebrandt et al. 2016); Sage Hen Springs lies on the Massacre Rim. The modern environment of Sage Hen Springs consists primarily of sagebrush, juniper, and grasses (Carambelas 2014), with marshy zones in the lowland basin.

The culture history of the Massacre Lake Basin follows the general trend laid out above. Leach’s dissertation work in the region found evidence of intensification of resource use at, and habitation of, upland sites in the Middle Archaic and increased intensification in the Late Archaic (Hildebrandt et al. 2016; Leach 1988). Leach also notes a decline in residential mobility, an increase in diet breadth, and an increase in population during the later Archaic periods (1988). LaValley’s work in the Black Rock Desert indicates that obsidian procurement patterns remained unchanged through the Middle and Late Archaic, but residential mobility increased in the Late Archaic (2013).

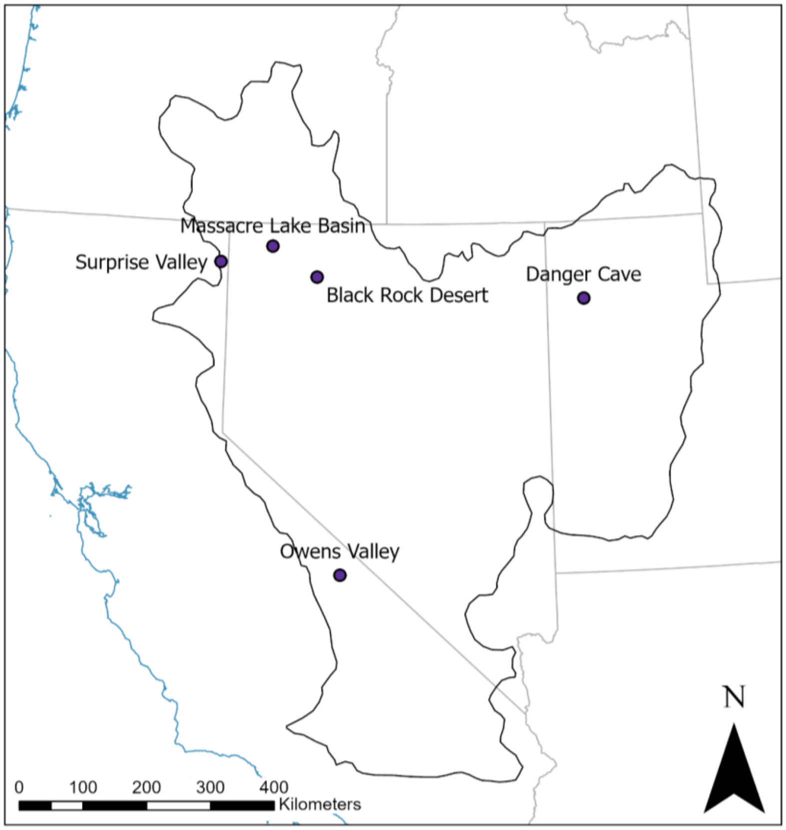

Figure 2.2: The Massacre Lake Basin and Black Rock Desert in relation to other culturally significant locations (adapted from Leach 1988: 186).

Sage Hen Springs

As mentioned above, Sage Hen Springs (Smithsonian number 26WA6916) is located on the Massacre Rim above the Massacre Lake Basin. The site was first recorded by the Bureau of Land Management (BLM) in 1977 and revisited in 1996, 2000, and 2013 (Carambelas 2014). As of the 2013 revisit, the cultural resource inventory consisted of "99 rock art panels, five rock alignments, eight rock rings, one rock concentration, two modern hunting blinds, one modern rock stack, 40 tools, and at least 50,000 pieces of lithic debitage spread over a 60-acre area" (Carambelas 2014:1). Deposits have been recorded dating to the Post-Mazama through the Late Archaic periods (Carambelas 2014). Intrusion by modern cattle and wild horse populations are known impacts to the site. Concerns regarding trampling were the impetus for the proposal of the construction of a cattle exclosure around the site and a springbox to provide water for cattle at some distance from the site. The proposal of ground disturbance on federal land triggered a Section 106 compliance survey and Phase II testing, which was the basis for field work and data collection for this thesis (detailed in Chapter 4). The 2013 site survey classified Sage Hen Springs simply as “a habitation site with rock features and rock art” (Carambelas 2014:2). Interpretation of the site by surveyors was limited, leaving room for this thesis to provide context for the site and infer site use.

The rock art mentioned above is extensive both within the modern boundaries of the site, and in multiple directions beyond the boundary; the 99 panels recorded by the BLM and noted above are likely a significant underestimate of the total number of panels in and near the site, since full documentation has been beyond the scope of recent efforts. Most of the rimrock in the surrounding area is covered with rock art panels of varying design and type (Figure 2.3). These include panels of stipple pecked, solid pecked, and scratched designs, typically interpreted as abstract shapes or geometric designs, but occasionally a human, animal, or naturalistic figure is salient (Carambelas 2014). Dating the panels is difficult, but repatination on many of the panels suggests they date to at least the Late Archaic, and more extensive patination may suggest older age (Hildebrandt et al. 2016; Carambelas 2014).

Figure 2.3: Rock art panels in and near Sage Hen Springs

Research Goals

In this thesis, I seek to understand developments in subsistence strategies and mobility patterns reflected in the archaeological record at Sage Hen Springs, and contextualize inferred developments in adaptive strategies in the culture history of the northwest Basin. Based on the information outlined in this chapter, I seek to answer three primary research questions:

1) Does the archaeological record at Sage Hen Springs reflect an intensification in residential use and an increase in diet breadth during the Middle and Late Archaic, as would be expected given patterns of site use in the broader northwest Great Basin?
2) What are the patterns of toolstone procurement at Sage Hen Springs, and do these patterns indicate a decrease in residential mobility concomitant with an increase in logistic mobility during the Middle and Late Archaic?
3) Is there an indication of increased population during the Middle Archaic, as has been indicated in other areas of the northwest Great Basin, particularly in the Massacre Lake Basin (Leach 1988)?

Chapter 3: Theory

This thesis is grounded in the behavioral ecology approach. To deconstruct the term, "behavioral ecology" aims to understand human behavior through a dualistic evolutionary and ecological lens (Smith and Winterhalder 1992). Behavioral ecologists use the principles of natural selection to understand why certain behaviors are beneficial, and an ecological perspective to investigate how variations in the environment affect behavior by changing selective pressures. Each of these terms require and deserve in-depth discussion, which I offer in this chapter.

To adequately contextualize behavioral ecology and how it is applied in archaeological investigations, I begin with evolutionary theory, then move into the development of the culture history approach in American archaeology. I then investigate how culture history gave way to the processualist perspectives of the American "New Archaeology," before moving into a detailed discussion of behavioral ecology. Lastly, I discuss applications of behavioral ecology in Great Basin research.

Evolutionary Theory: Darwin and Selection Theory

Charles Darwin's radical publication, *On the Origin of Species* (Darwin 1859) offered an alternative to the prevailing theory of his time that all life on Earth was divinely created. By synthesizing a lifetime of naturalist research, Darwin developed a unified theory for speciation and change in species over time. This theory centered the idea that certain adaptations, derived from stochastic genetic mutations, provided a benefit to organisms within their environmental niche. This benefit increases the chance that the organism survives to reproductive age and successfully mates, thus passing on its genes and with them, the beneficial trait. The ratio of organisms possessing the trait within a population may increase over time, thereby making that trait a characteristic of the species. These genes are thus selected for and are amplified in the population over time. This process is often simplified as “survival of the fittest,” although this exact phrase has been co-opted for numerous insidious causes since Darwin’s publication.

“Survival of the fittest” was erroneously applied by Social Darwinists like Herbert Spencer to the human condition to claim that differentiation between human races were the result of natural selection and therefore certain races were inherently more or less “fit.” This racist ideology has mostly fallen out of favor, but certain libertarian thinkers have promoted similar ideas in more recent times (i.e., Ayn Rand’s objectivism) (Moberg 2019). There is a critical distinction however between “survival of the fittest,” and natural selection; this being that natural selection is not concerned with survival but rather with reproduction, and thus the passing down of advantageous phenotypes. Behavioral ecology crucially evaluates behavior using this framework, rather than the fallacious survival metric.

Beginnings of Archaeological Theory in America and the Great Basin

Evolutionary theory, or at least the facile reduction of it into the generic statement that “species change over time” was the basis for archaeology’s arguably first rigorous theoretical framework: culture history. The culture history paradigm supplanted the predominant antiquarian practice and supplied a novel way of conceptualizing culture and the way that it is manifested. This conceptualization of culture became known as the normative model, which posits that culture is a collection of norms, or shared ideas, which are manifested and detectable in the material remains of a group that shares these norms (Johnson 2010).

Operating under this model of culture, the culture history approach is concerned with determining the stages of development of a certain cultural group as perceived in the material record and the movement and transmission of this group and its culture, respectively (Lyman et al. 1997). This theory developed first in continental Europe and was then introduced to British and American archaeologists by the likes of V. Gordon Childe (Trigger 1994). The culture-history approach claims that cultural groups are distinct and that they can be identified through their unique material records. This approach relies on categorization and sequencing of artifacts, and prioritizes as its end goal a sequential timeline of cultural development, diffusion (movement of ideas), and migration (movement of people) (Trigger 2006:200). The link between evolutionary theory and culture-history theory is thin, but it is apparent that culture-historians base their theory of development on the foundation of “change over time.” However, the culture history approach fails to account for the development of unique cultural expressions, instead flattening variation into the linear development model.

By the 1950s, Julian Steward made this link stronger by incorporating ecological theory into culture-history approaches. Steward was interested in exploring how the environment affected culture development. He was also interested in constructing a theory that was more nomothetic than the highly specific culture-histories that his contemporaries were producing. Steward synthesized a new framework that became known as “cultural ecology.”

Steward is considered to be one of the first anthropologists to adequately resolve the issue of how the physical environment was related to culture (Moberg 2019:74). His theory of cultural ecology was revolutionary in its time as a way to situate environment in discussions of cultural development. Steward’s specific flavor of environmental anthropology was based on a theory of “multilinear evolution” (Moberg 2019:17), unlike the unilineal culture history approach. This refers to the idea that evolution does not progress in one direction, with each step being “better” than the last, but rather that adaptation is specific to the environment and adaptations suit the present environment; there is no assumption that any one adaptation is “better” than another. This approach explicitly rejects the idea that culture progresses down a single linear path regardless of location or environment. Steward also disagreed with environmental determinism as such, instead arguing that environment does not necessarily directly determine culture. Rather, culture is generally shaped by environment and environmental pressures result in the development of cultural elements.

Steward developed as part of his theory the idea of the *cultural core,* which he defined as “the constellation of features which are most closely related to subsistence activities and economic arrangements.” Further, “The core includes such social, political, and religious patterns as are empirically determined to be closely connected with these arrangements” (Steward 1955:37). In other words, the *cultural core* includes elements of culture that can be directly tied to subsistence strategies. Steward’s theory of a *cultural* *core* built on work by his predecessors, Wissler and Kroeber, who began developing the idea of culture areas, i.e. geographical zones that had similar environments, and thus cultures within the zone would be expected to have similar subsistence strategies, and thus also have similar *cultural cores* (Moberg 2019:288).

The value of Steward's work lies in 1) its ability to explain relationships between environment and culture, which theretofore had not been adequately explored, 2) its ability to produce testable hypotheses in the exploration of environment-culture relationships, and 3) its departure from the ideas of Franz Boas, i.e. that cultural development was "the result of historical accident," which is not very helpful in developing new research questions (Moberg 2019:288–292; Smith and Winterhalder 1992:20–21).

Despite its usefulness at the time, Steward's theory has plenty of shortcomings. First, as Moberg points out, Steward focused heavily on hunting and men's roles in hunting, which skewed Steward's interpretations toward male-biased explanations (2019:292; Slocum 1975). Further, cultural ecology suffers from the same shortcomings as Steward's predecessors' theories, in that they are all quite reductive and essentializing. Steward collapsed all cultural development to material determinants and reduced large numbers of unique cultures across the Western Hemisphere to a few subsistence areas.

The Processualist Revolution

As a further departure from culture history and even from cultural ecology, the "New Archaeology" of the 1960s was developed by American archaeologists and championed primarily by Lewis Binford. Binford propelled a radical paradigm shift in

North American archaeology. Binford argued that rather than focusing on constructing histories of culture change, archaeology should be a tool for conducting anthropological research on past cultures, seeking universal laws of human behavior (Yu et al. 2015). Further, a scientific approach to archaeology would be able to test hypotheses and assumptions about the past, which Binford termed Middle Range Theory – an investigation of the ways that archaeologists test what they know or infer (Yu et al. 2015). Binford's framework utilizes a different basic definition of culture, which – rather than the normative view which identifies culture as a set of shared ideas – claims that culture is a set of shared behavioral *processes*. Processualists claim that adaptations to the environment are core elements of culture development, which is a clear link to Steward's earlier work. Processualists also hold true that adaptations develop within a set framework, and by understanding this framework culture change can be predicted (Trigger 2006). In seeking to understand this framework, processualists endorsed a scientific, hypothetico-deductive theory, in contrast to the earlier inductive approach of the culture-historians.

As an example, Binford writes about how a smudge pit was identified at an archaeological site through analogy (i.e. comparison with other known features elsewhere and with ethnographic research). After the feature was identified, the analogy-derived postulate – that the ethnographic unit was used in the same way as the archaeological unit – was used to come up with new hypotheses about relationships between archaeological features that hadn't been compared before This is done in the interest of finding "generalizations regarding the operation of cultural systems and their evolution." (Binford 1967:10). Following his work with the Nunamiut of northern Alaska, Binford also developed some critical archaeological concepts, such as foragers versus collectors (those that spend most of their time looking for food, versus those that spend most of their time processing food), curated versus expedient technologies (bifaces versus expedient flake tools), and residential versus logistic mobility (moving the primary living location between foraging locales versus maintaining a base and traveling outward for resource collection)(Binford 1983; Yu et al. 2015).

Another prominent processualist, Michael Schiffer, makes apparent the link between Processualism and evolutionary theory in his article about depositional processes (1972). He explains artifact deposition in a similar way to how evolutionary theorists describe the "life history" of an organism, which highlights the important events in an organism's life related to reproduction, like birth, puberty, age at first child, senescence, death, etc. (Ahlström 2011). Schiffer's model considers the "procurement, manufacture, use, maintenance, and discard" (Schiffer 1972:156) of artifacts, and develops a life history, or in his words, systemic context of artifacts which helps to understand the processes of the culture that produced that artifact.

Foundations of Behavioral Ecology and Ecological Theory

Behavioral Ecology began in fields outside of archaeology. Early forays into this theoretical perspective began with scholars of biology who co-opted principles from economics (primarily optimality logic – maximizing gain while minimizing loss) to better understand decision-making in non-human organisms (Charnov 1976a, 1976b; MacArthur and Pianka 1966). These models offered mathematical explanations and hypotheses for how organisms move through ecozones and exploit food resources in their environment based on minimizing caloric and time expenditure and maximizing caloric intake. These models are built on the theory that all organisms have developed over time through natural selection and thus survive and reproduce more frequently depending on how well adapted they are to their environment. In evolutionary ecology models, this adaptation is usually quantified using caloric variables. Researchers assume that an organism that is best able to maximize caloric intake while minimizing caloric expenditure is most likely to survive and reproduce.

This theoretical framework became appealing to archaeologists because it offered several new postulates from which testable hypotheses could be developed. Behavioral ecologists within the field of archaeology therefore build models that focus on human activities using caloric analogs for reproductive fitness. Individuals should opt for activities that decrease expended calories and maximize calories consumed in this framework. These models are used to understand how people would have most likely behaved, assuming optimized behavior.

Within the paradigm of Behavioral Ecology, archaeologists have often focused on Optimal Foraging Theory (OFT), a set of models used to predict how organisms will forage for food (Herzog and Goodale 2019). One commonly applied OFT-based model is the diet breadth or prey choice model developed by evolutionary biologists, which predicts what foods a forager will include in their diet given environmental constraints (Charnov 1976a; Herzog and Goodale 2019). In the model, food sources are quantified by their assumed caloric return, i.e., how many kcals a forager can expect to gain from a food after the effort expended in locating (search time) and processing (approximated by time spent pursuing, capturing, and preparing a food) is deducted from the outright caloric value of the food. The yes/no decision to include any given food item in a forager’s diet is based on the return expected for that item vs. the forager’s overall returns. If one can expect that a food item will have a higher caloric return than the overall return rate then that food should be harvested; otherwise, the forager should opt to bypass the item and continue searching for a different item with higher expected returns (Herzog and Goodale 2019). MacArthur and Pianka built on the diet breadth model by accounting for the clustering of resources into patches, i.e., that foods are more likely to be found near to one another rather than dispersed (1966). The choice by a forager to enter a patch or bypass it for another are the important decisions in this model. The inclusion of a resource in a forager’s diet under this model depends on the profitability of all patches in the environment (Herzog and Goodale 2019).

When to leave a patch depends on the Marginal Value Theorem (MVT), because the longer a forager harvests food in a patch, the less there is to harvest. At some point, returns in a given patch will diminish below returns that could be expected in an unharvested patch, prompting the forager to depart (Charnov 1976b; Herzog and Goodale 2019). This concept led to the development of Central Place Foraging Theory, which takes a residential base as a patch, and seeks to determine the extent to which a forager will process a resource in the field before bringing it back to the residential base (Metcalfe and Barlow 1992). This model assumes that most resources are collected as “packages,” with a useful or edible portion and an unusable part (shellfish within a shell, a biface within a cobble), and that processing is required to separate the usable from unusable portions (Metcalfe and Barlow 1992). Further, the model assumes that processing is essentially free back at camp, as there are other people or better tools at the base camp to help in the process, so processing costs are only considered for processing afield. Thus, it is expected that a forager will process a resource in the field if the processing results in more calories saved during the trip back to basecamp than expended in processing (Metcalfe and Barlow 1992). Caloric returns are thus dependent on distance traveled and on weight of the resource before and after processing. This shapes the decision of when, where, and to what extent processing will take place.

Behavioral Ecology: Approaches in the Great Basin

Archaeology in the Great Basin became a testing ground of sorts for Behavioral Ecologists' models. Processualists in the Great Basin took to foraging models due to the latter's ability to generate hypotheses that could be tested using the lithic data that is so widely available in the region. Working with the Prey Choice Model, Elston and Zeanah claimed that diet breadth increased after the TP/EH in the Great Basin as a reaction to resource scarcity, and subsequently resulted in a sexual division of labor, with men focusing on big game hunting, and women on seed processing (Elston and Zeanah 2002; LaValley 2013). McGuire and Hildebrandt discuss how big game is included in Middle Archaic diet in greater frequencies than would be expected by OFT, and thus predict that the prestige gained from procuring big game provided a reproductive fitness benefit beyond caloric returns (2005). Hawkes and O'Connell (1992) discuss the tradeoffs between searching for a food item and handling that item, versus doing so for a different, "lower-ranked" (i.e. less calorie-dense or more labor-intensive) food. Importantly for my research, they determine that as more low-ranked foods are included in the diet, search time decreases and processing time increases. Thus, foraging radii should be expected to decrease as diet includes more lower-ranked foods. Accordingly, group mobility is expected to decline as the breadth of the diet increases.

Predictions derived from Central Place Foraging (CPF) models are tested in the article, “Rocks are heavy: transport costs and Paleoarchaic quarry behavior in the Great Basin,” by Charlotte Beck and her graduate students (2002). The authors investigate the degree of processing of lithic source material in relation to travel time and distance from home base. Beck et al. hypothesize that, in accordance with Central Place Foraging models, quarries that are farther from the residential site will contain evidence of more advanced stages of biface reduction than quarries that are closer. When people have to carry toolstone over a greater distance, CPF models predict that they will discard more of the package. In the case of lithics, this means that more of the cobble will be discarded as quarry distance increases, thus greater biface reduction will occur at the quarry rather than at the central place. Beck et al. include a hypothesis based on ethnographic data that posits 10 km as the critical distance at which lithic reduction begins to occur. They examine lithic assemblages gathered from two quarries and a residential site associated with each, both in Nevada; one pair is 9 km separated, the other 60 km. Using a biface stage scheme and the Johnson Thinning Index, the authors assert that their data supports the hypothesis, with the further quarry having evidence of greater reduction work than the closer quarry.

This is a crucial postulate for developing hypotheses with the lithic materials from Sage Hen Springs, as it allows for correlation between quarry distance and expected lithic patterns. I expect that toolstone from further away shows up at greater reduction stages, and that quality of toolstone should increase as distance from Sage Hen increases.

Furthermore, Melinda Leach's dissertation in the Massacre Lake Basin is heavily couched in behavioral ecology and the diet-breadth model. Leach argues that Archaic groups adapted to climate changes through a broadening of their diets to include lower-ranked (less calorically dense/harder-to-process) foods. As climatic pressure and increased population density resulted in diminished food availability, groups had to adjust the breadth of their diet to meet subsistence needs. As higher-return foods became less available, the increased search time to find remaining patches of those foods reduced caloric returns. Accordingly, people spent more time and energy processing lower-ranked foods, and the diet became broader, with more foods pursued overall. This came with an associated lack in mobility and thus longer-term residence in specific areas, as movement associated with searching for food decreased, and more time was spent processing items closer to home (Hawkes and O'Connell 1992).

For Sage Hen Springs, Behavioral Ecology models suggest that people pursued a broader diet in the Mid-Late Archaic when droughts and increased population decreased the availability of high-ranked foods. Accordingly, I should expect that residential mobility decreases to support increased processing efforts, while logistic mobility increases as people continue searching for the high-ranked foods. Furthermore, Beck et al.'s lithic CPF model predicts that toolstone at Sage Hen Springs sourced from more distant quarries should be more substantially reduced than toolstone from closer to the site.

Chapter 4: Methods

On-Site Work

Work onsite at Sage Hen Springs occurred between July 10 and July 13, 2023. The expedition was planned and led by Jen Rovenpera of the BLM Applegate Field Office, Cedarville, CA. The BLM were primarily interested in conducting Phase II testing for a Section 106 compliance investigation prior to the installation of a spring box and piping to direct water from the spring to a cattle trough outside a proposed cattle and wild horse exclosure. This project was intended to compromise between the needs of cattle ranchers and the protection of the cultural area. The BLM plan for the Sec. 106 testing included four 50x50 cm units along the proposed buried pipe transect. Each test unit was dug in 10-cm levels following the surface contour, and pits were closed once two subsequent sterile levels were encountered.

The BLM plan also included surface survey to reidentify rock rings identified during previous site visits (Carambelas 2014) and to map surface artifacts, focusing on bifaces and groundstone (artifact density was far too high to flag every artifact). This survey and previous identification of apparently discrete activity areas (Carambelas 2014) informed the placement of a 2x2 surface scrape unit within the activity area closest to the spring. This unit was located approximately 100 m away from the test units and was excavated to a depth of 10 cm following the ground contour.

While BLM employees worked on these units, my advisor, Nicole Herzog, and I excavated two further units. The first was a 1x1 m located on the interior of one of the rock rings. Unlike the BLM test units, this unit was excavated in 5 cm levels, to record stratigraphy in more detail. We intended to excavate until two sterile levels were encountered, but by level four, there were still a few artifacts, but too few to use our limited time in continuing the excavation. We picked the ring we did based on perceived integrity of the alignment, the predicted sediment depth, and, partially, the level of shade on the area for our own comfort. The location of the pit slightly intruded on the ring so as to sample both the interior of the ring and the area under the ring itself. I hoped that materials from inside the ring might help to date its construction and use, and sampling the ring itself would provide a *terminus post quem*, as materials under the rocks themselves would predate its construction. We also excavated a second 2x2 m surface scrape down to 10 cm approximately 30 m away from the first unit and near another rock circle. We screened all fill from all units through a ¼-inch screen. We collected any and all artifacts discovered in situ or in the screened fill. See Figure 4.1 below for a map of each excavation unit by type.

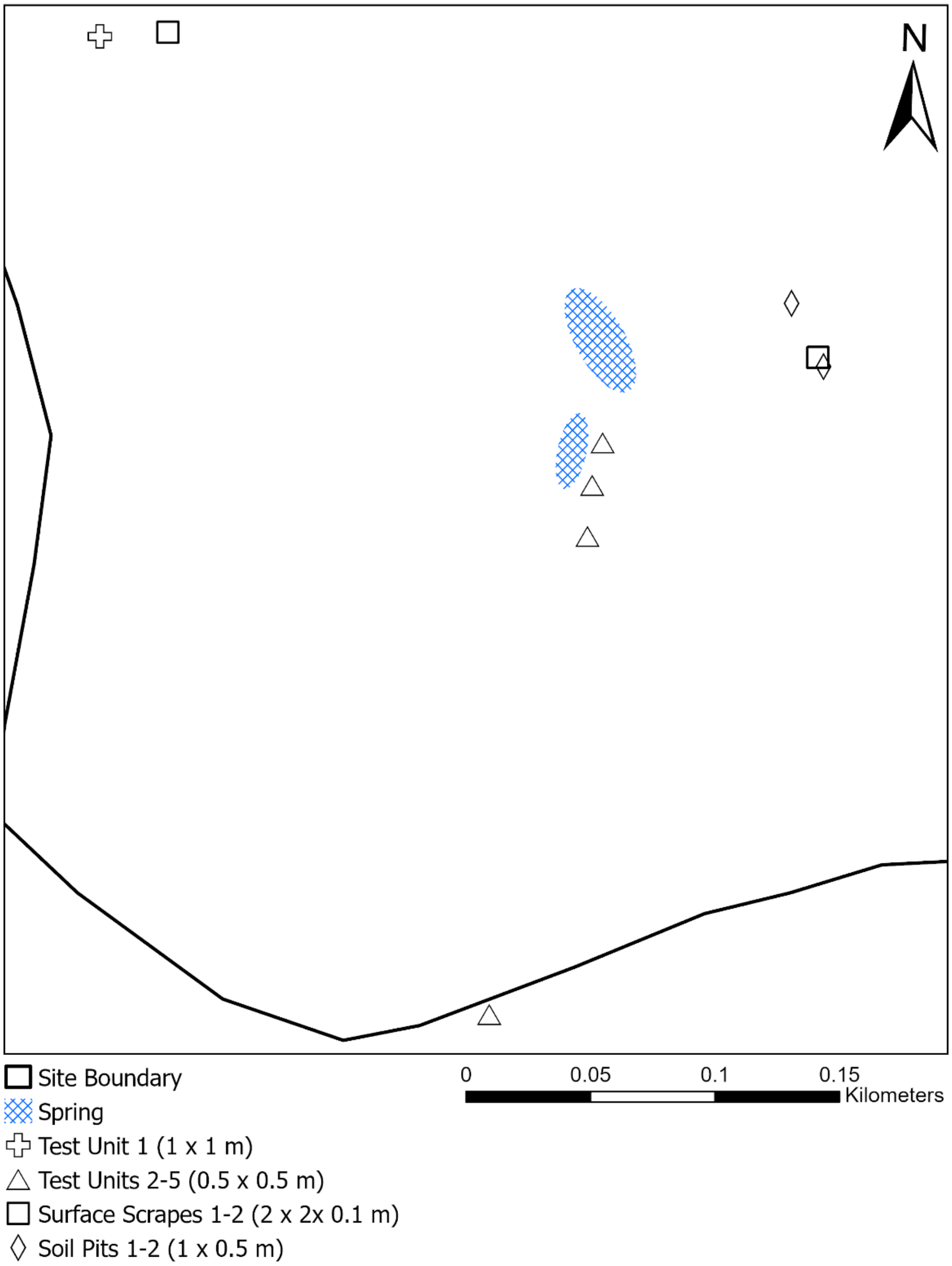

Figure 4.1: Map of Excavation Units by Type.

A professional geologist, Roland Brady, accompanied us on the expedition, and conducted two soil test pits near the first surface scrape in the southeast area of the site.

These were dug as 50 x 25 cm trenches to expose the stratigraphy. Artifacts were a secondary concern for these investigations, but we screened all fill and collected all artifacts akin to the archaeological units.

To understand artifact dispersal patterns and test our preconceived activity area boundaries, we conducted a transect survey, sampling every 50 m. The transect extended from one side of the site boundary to the other, and transect angle was determined by the intercept of the two surface scrape units. Every 50 m, I drove a pin into the ground, and moved a 25-cm string attached to the pin around in a circle. We collected all surface artifacts within the 25-cm radius circle. Altogether, we surveyed 14 circles, plus the two surface scrapes along the transect.

On the final day, I selected a sample of artifacts flagged during survey for collection. The size of this sample was determined by the BLM collection plan. My intended sample contained each material type represented at the site. This included samples of various colors of crypto-crystalline silicate stone (CCS); each unique type of obsidian, assessed in the field by candling (looking through the piece at the sun to assess color and transparency); each type of fine-grained volcanic determined by texture, and each tool type. We also collected every piece of transportable groundstone.

Lab Procedures

Once safely back at the field office, we cleaned the collected artifacts (save for bone and groundstone) and cataloged them. Maintaining provenience, we rinsed and scrubbed the lithics with a soft toothbrush before setting them out to dry. Once dry, we sorted artifacts by material type (obsidian, fine-grained volcanic, CCS, or welded tuff), then by functional type. We separated tools, both formal and expedient, from debitage and gave each one a unique catalog number. We cataloged the debitage of each material from each level of each unit together under one catalog number after counting.

Once cleaned, sorted, and numbered, we measured each tool dimensionally (length, width, maximum and minimum thickness), weighed them, and sealed them in an archival bag with an artifact tag. We also determined subtype (projectile point type, stage of biface, etc.) and condition (complete vs. incomplete) for each artifact. I determined projectile point type using a guide provided by the BLM (Hockett and Spidell 2022), and determined biface stage and debitage type using lab manuals published by Far Western and ASM, respectively (copies available c/o Jen Rovanpera, BLM Applegate Field Office). Once this was completed for the entire collection, I transported the collection back to the University of Denver for further analysis. There I quantified retouch on projectile points using the Andrefsky Retouch Index (Andrefsky 2006). This involved laying the point on a piece of paper and dividing the part above the hafting element into 8 sections (divided once perpendicular to the horizontal axis, and thrice to the vertical axis). Then, each section is evaluated for how many flake scars extend from the edge to the center of the point. If none extend to the center, i.e., the section is completely retouched, the section is scored as a 1. Conversely, if all scars extend to the center, i.e., the section is not at all retouched, the section is scored a 0. If a section is mixed, it is scored 0.5. This is done on both faces of the point to evaluate a total of 16 sections (if the point is incomplete, the total sections is reduced). Then the scores of each section are summed and divided by the total section count to obtain an average retouch score. Higher scores indicate more retouch, and thus a longer period of reuse of the tool. According to

Beck et al.'s model (2002), higher quality toolstone procured from further from home should have more retouch.

X-Ray Fluorescence (XRF) Analysis

To investigate how far residents of Sage Hen Springs traveled to obtain toolstone, Sage Hen artifacts were attributed to known quarries using X-Ray Fluorescence analysis. XRF is a method involving bombarding (typically) volcanic stone with X-Ray radiation. This causes electrons in the atoms of the material to become excited and emit radiation as well. This emitted radiation is detected and quantified. Different elements emit slightly different wavelengths of radiation, so the quantity of each wavelength indicates the relative quantities of each element in the material. The elemental ratios can be compared between artifacts and reference samples from various quarries; matching ratios indicate the artifact was derived from the matching quarry (Hughes 1986).

I selected a sample of artifacts from the whole collection to be sent to Richard Hughes' laboratory for XRF analysis (see Appendix A for Hughes' report). This sample contained 186 artifacts, which was the quantity that the BLM had budgeted for testing. To produce the sample, I used the ratio of obsidian and fine-grained volcanic artifacts from each provenience to the total number of artifacts of those materials to determine how many of the 186 samples should come from each provenience. For many of the proveniences, the ratio indicated I should include fewer than one sample; in these cases I included just one sample, and included one fewer from the highest-sampled provenience. While this skewed the sample away from the most productive provenience, it ensured adequate spatial coverage of the whole site.

Once I received results from Hughes, I added them to my working ArcGIS (Esri Inc. 2023) file for the Sage Hen data. This file included the locational data for all surface artifacts (both collected and not), excavations, transect circles, rock rings, and activity areas, and the site boundary. I obtained a shapefile of source locations from Hughes' website (https://obsidianlab.com/resources/) and added it to the GIS project. I then copied all records matching the results I received from the Hughes shapefile to a new layer. I then used the "Generate Near Table" analysis tool within ArcGIS Pro (Esri Inc. 2023) to determine the distance between the obsidian source and a point approximately in the middle of the Sage Hen boundary. I then added these distances to my working Excel file for each sourced artifact.

Obsidian Hydration Dating (OHD)

The most appropriate option for dating artifacts from Sage Hen Springs is Obsidian Hydration Dating (OHD). During fieldwork, we did not obtain organic samples suitable for radiometric carbon dating, nor did we have any wood samples suitable for dendrochronological dating. I generated dates for diagnostic projectile points using Hockett and Spidel's typology (2022) and Smith et al.'s chronology (2013), discussed in further detail in a later chapter. However, OHD allows for dating of non-diagnostic artifacts, and it can provide a tighter date range for each artifact. (Rogers and Stevenson 2022)

OHD is based on water diffusing into obsidian specimens at a roughly constant rate. Water is absorbed into obsidian at a rate determined by the chemical makeup of the obsidian, as well as temperature of the local environment. It is therefore crucial to know the source of the obsidian prior to calculating the age of the artifact based on hydration. Thus, the Sage Hen artifacts were subjected to XRF analysis before going to Tom Origer's lab to be dated. In his lab, Origer sliced into the edge of each obsidian artifact and then took a thin section from the slice (see Appendix B for Origer's report). Under a microscope, the depth of water penetration (a.k.a. the thickness of the hydration rim) is measured in microns.

Once I received the hydration rim measurements, I then applied a formula (typically years BP = cx^2, where c = a source-specific coefficient and x = rim thickness) to the thickness to return years before present at which point the face of the obsidian was exposed to the environment. This formula varies by quarry location, and most of the formulae used here were obtained from Hildebrandt et al. 2016. The published formulae offer precise and trustworthy dates. However, published formulae were only available for a few of the quarries identified by the XRF analysis. For locations where the exact formula was not available, I applied the average coefficient across all published formulae (see Chapter 5 for more detail).

Starch Granule Analysis

Lastly, we investigated collected groundstone artifacts through starch granule analysis (Herzog and Rogers 2024). This procedure results in the recovery of starch granules from the surface of groundstone artifacts, which can typically be identified to the genus level (Torrence and Barton 2016). This type of analysis indicates what plant foods were processed on the surface of the groundstone, thus providing information on diet. During this process, we ultrasonicate the artifact in a water bath to extract all materials from the surface of the artifact. We then process the collected liquid with a density-based fractionation procedure to separate the starch granules from the rest of the solution. We then examine extracted starch granules under a visible light microscope and use unique characteristics of the starch granules to identify from which genus (and hopefully species) they came. This usually results in ascertaining whether seeds and/or geophytes were processed on the groundstone.

Chapter 5: Results

Artifact Collection

Table 5.1 below lists the quantities of all artifact types collected during the 2023 field work at Sage Hen Springs. The predominant type of artifact we recovered was debitage, which we classified as non-utilized cortical, interior, thinning, or pressure flakes, or shatter. We also collected debitage of obsidian, fine-grained volcanic, crypto-crystalline silicate (CCS), and welded tuff. We found these both on the surface and in test units. Bifaces were the second most common artifact type collected; bifaces were classified as two-sided artifacts with bifacial modification; flakes on a biface extend to the longitudinal center of the tool. Flake tools were the next most common item, classified as an utilized flake with working on one or two faces; flakes on at least one side do not extend to the center of the tool, unlike bifaces. Following flake tools, projectile points were the next most common artifact type we collected; these are classified as bifaces with a clear hafting element and/or a shape matching a type listed on the point identification guide (Hockett and Spidel 2022).

Next most common were cores, defined as a lithic artifact with working on more than two sides, and includes tested cobbles – cores with only one or a few flakes removed – and multidirectional cores – cores with flakes removed from a multitude of striking faces. We did not identify any platform cores – cores with flakes removed from a single striking face. We collected groundstone in the next highest quantity, which is identified by smooth areas or concavities on the surface of course volcanic stone. We only collected portable groundstone, which included both handstones (n=4) and small metates (n=2). We collected core tools next most frequently, which are classified as multi-facial artifacts with a defined worked edge, indicative of choppers. Next most common were drills, identified as bifaces that have been retouched to create a point, but does not have a hafting element like a projectile point.

We also collected four soil samples from the test unit that we placed inside the rock ring. Next most common across the site were small bones, likely from rodents or lagomorphs (extensive faunal analysis was not pursued – identification is inconclusive). Next, we collected two manuports, which were both spherical pieces of stone recovered from Nut Mountain, about 20 km southeast of Sage Hen Springs). We can only speculate on the purpose of these objects; it is possible these manuports were used as projectiles for a sling, or were brought from the Nut Mountain rhyodacite quarry as a non-functional keepsake. Lastly, we collected the one intact seed that was recovered *in situ*, and a small piece of what is probably ceramic (identification is inconclusive).

Table 5.1: Counts of all artifact types collected across the site

Type	**Count**		**Type (cont.)**	**Count**
Debitage	4870		Drill	4
Biface	78		Soil sample	4
Flake Tool	30		Faunal	3

Proj Point	25		Manuport	2
Core	7		Botanical	1
Groundstone	6		Ceramic	1
Core Tool	4			

Activity Areas

During the surface survey, we flagged all visible bifaces and groundstone. We mapped the location of 216 artifacts, of which we collected 62. After mapping the surface artifacts, we noticed that artifacts seemed to cluster into two separate areas. Figure 5.1 below shows this apparent distribution in relation to the spring and the site boundary.

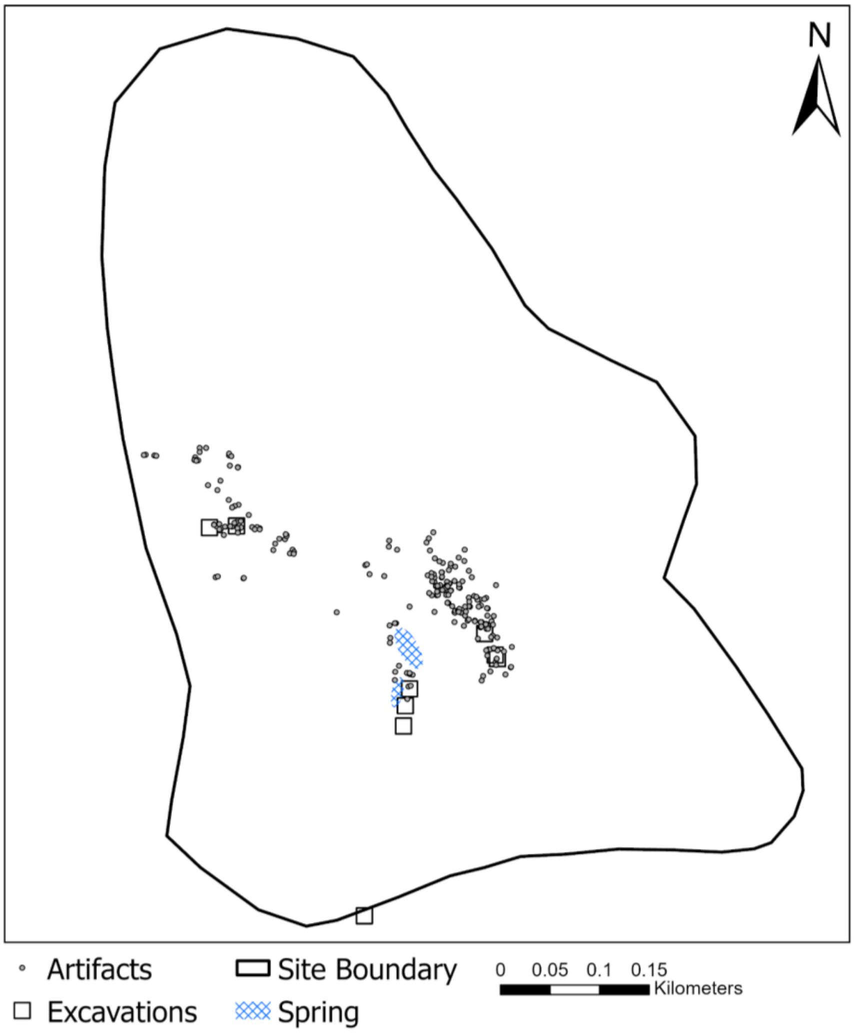

Figure 5.1: Distribution of artifacts in relation to the spring and excavation units.

I confirmed the observed clustering of flagged artifacts with a Kernel Density (KD) analysis conducted in ArcGIS Pro (ESRI). This tool calculates the probability that an artifact will occur at a point, based on the point's proximity to all other artifact occurrences using a sum of Gaussian kernels intersecting the point. This analysis approximates the density of artifacts and indicates where artifacts cluster. The KD map is shown below, with the activity area boundaries hypothesized by the BLM shown with a dashed line.

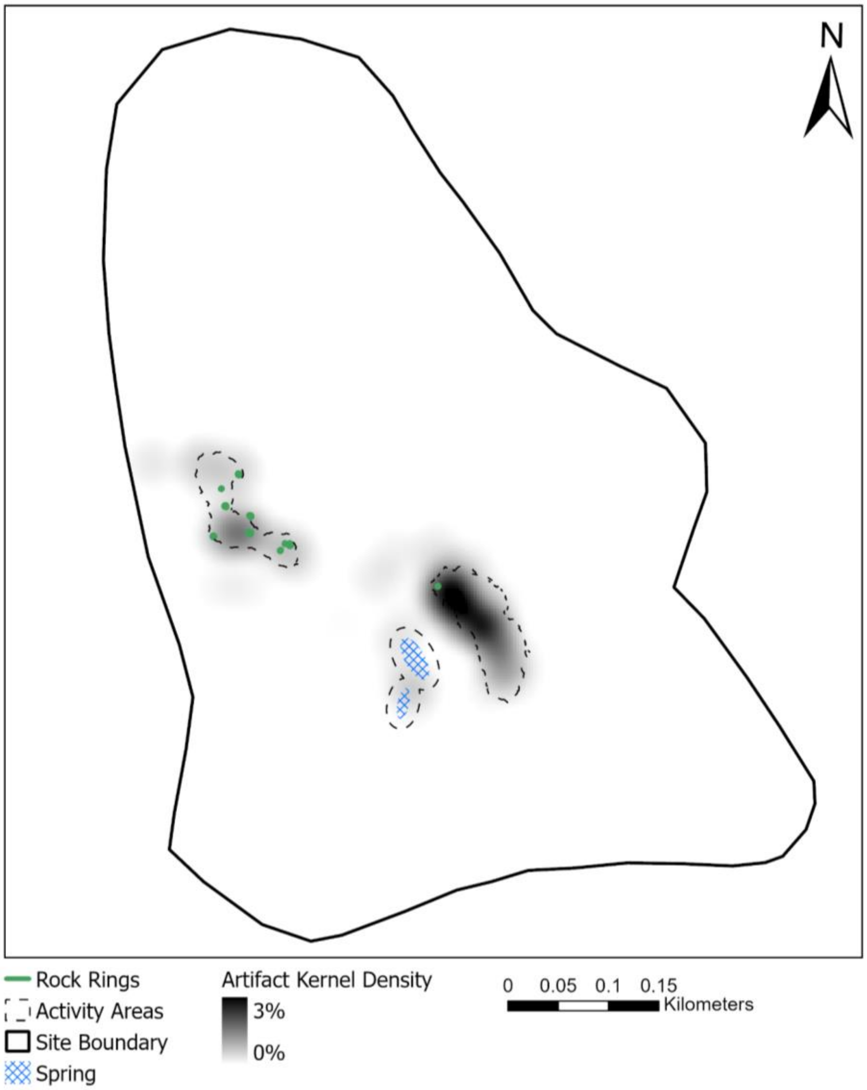

Figure 5.2: Kernel Density analysis of artifact distribution and hypothesized artifact clusters shown in relation to the spring and rock rings.

After completing this analysis, it appeared that the artifact clusters, as defined ad hoc during site recording, were relatively accurate. However, they did not perfectly align with the densest areas of artifacts as identified via the KDE analysis. Thus, I created contour isopleth lines from the KDE raster to show the boundaries of the clusters determined by the KDE analysis. The result is shown in Figure 5.3 below, in which the outer line represents all cells with a 0.25% chance that an artifact would be found in that cell. The inner line represents all cells with a 0.5% (higher) chance of an artifact occurring in that cell. The 0.25% contour appears to be a better approximation of the activity areas, as it joins the two areas in the northwest part of the site and includes the areas around the spring rather than just the middle of the spring. Further, the lower probability contour includes more of the artifacts, which is desirable for such a small sample size. Thus, I use the 0.25% contour as the boundary of the activity areas going forward.

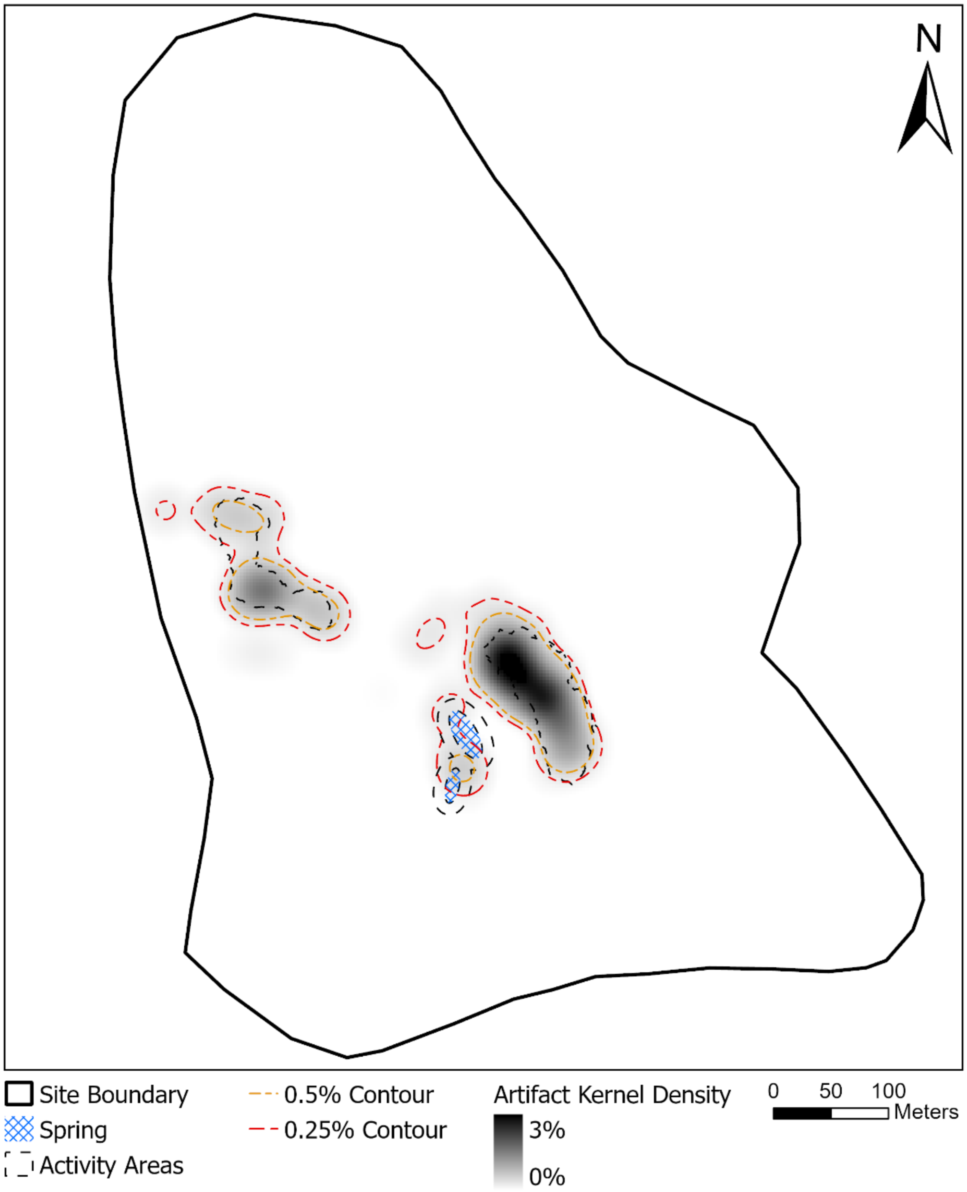

Figure 5.3: Contour Isopleths from Artifact Presence KDE.

While at the site, we were interested in testing whether the artifacts were in fact localized to the two areas outlined above, or if our survey was biased. To test this, we walked a transect survey from one side of the site to the other across a line that intersected the two surface scrape units. Every 50 meters, we collected all artifacts in a

25-cm circle. The only circles that contained artifacts were localized to either of the two clusters. Thus, both the random onsite sampling, the fixed transect, and kernel density mapping confirm the presence of two artifact clusters. Table 5.2 lists the quantities of artifacts found in each circle that were positive for artifacts, and Figure 5.4 shows the transect line and sample circles. As the northwest cluster contains all but one rock ring, and the southwest cluster is much closer to the spring, we hypothesized that each cluster indicated areas intended for different uses, or perhaps used at different times by different groups. While test units near the spring were sterile, surface artifacts within 10 m of the spring are analyzed as a separate group later in this discussion.

Table 5.2: Count of artifacts collected from transect circles

Transect Circle #	**Activity Area**	**Count of Artifacts**
1	Southeast	2
5	Northwest	15
6	Northwest	3

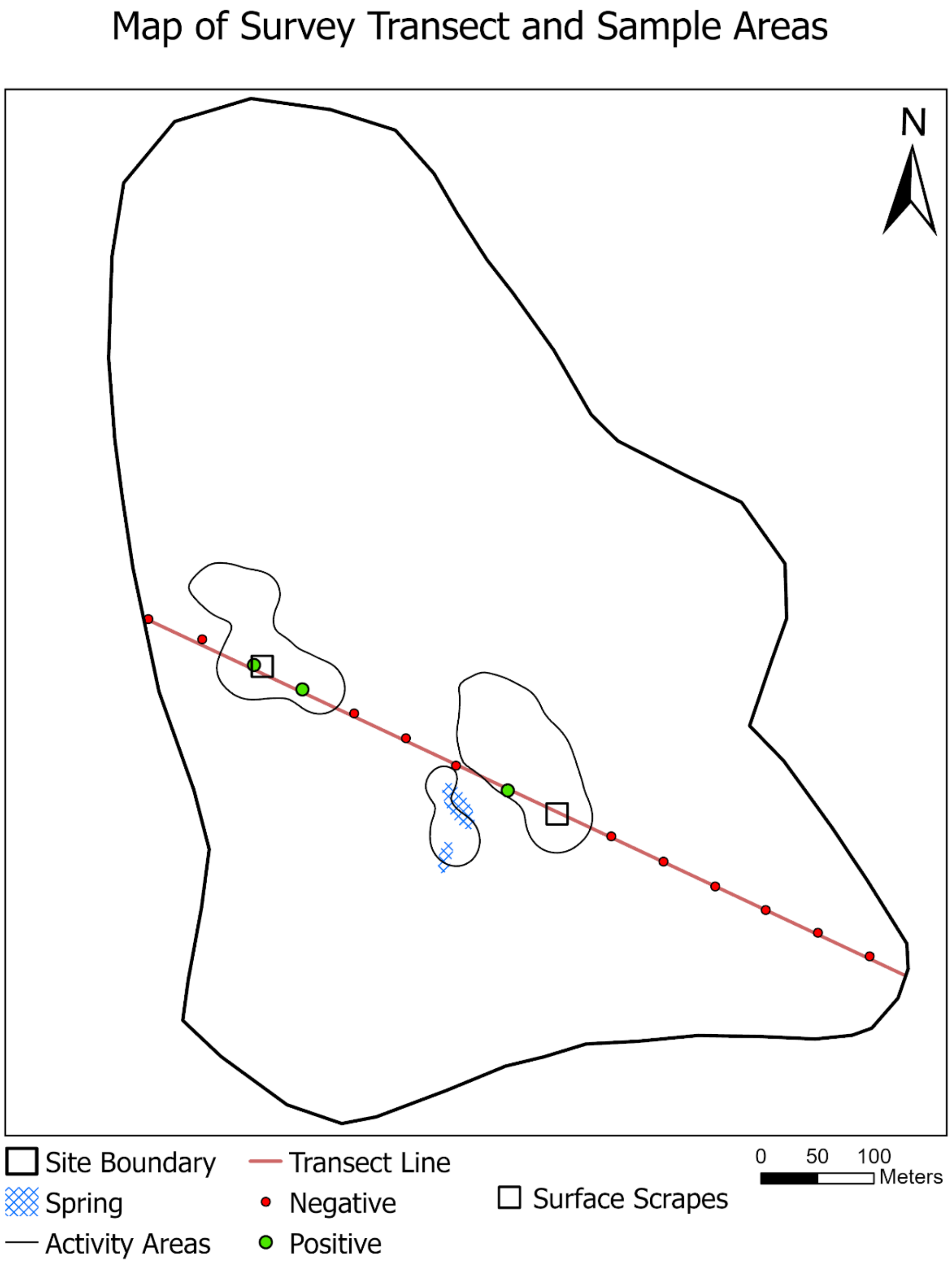

Figure 5.4: Transect line and sample circles shown in relation to the spring, excavation units, and hypothesized activity areas.

Once I had verified that the boundaries of the activity areas were supported by the distribution of artifacts, I then analyzed the density of artifacts in each area to determine their likely use and timespan of use. Table 5.3 below lists the count of artifacts in each unit, and sums up the counts for each activity area. Density is normalized to a 1x1 m area and a 10-cm depth for each unit. For each unit, the total artifacts found across all levels are reported, but the density is reported for just the levels within 10 cm.

Table 5.3: Count of artifacts collected from each provenience, showing activity area and artifact density*

Provenience	**Size of Unit**	**Activity Area**	**Count of tools**	**Count of debitage**	**Artifact density**†
Surface Scrape 1	2 x 2 m	Northwest	22	479	125.25
Test Unit 1	1 x 1 m	Northwest	7‡	23‡	22‡
Soil Pits 1 & 2	Two 1 x 0.5 m	Southeast	6	282	286
Surface Scrape 2	2 x 2 m	Southeast	69	4065	1033.5
Test Unit 2	0.5 x 0.5 m	Proximal to spring	0	0	0
Test Unit 3	0.5 x 0.5 m	Proximal to spring	0	0	0
Test Unit 4	0.5 x 0.5 m	Proximal to spring	0	0	0
Test Unit 5	0.5 x 0.5 m	Proximal to spring	0	0	0
Surface Collection	N/A	N/A	62	0	N/A
Activity area totals					
Northwest			29	502	73.6

Southeast		75	4347	659.8
Proximal to spring		15	0	N/A

* Transect survey results are presented in Table 5.4 below

[†] Density is calculated as all artifacts, both tools and debitage, per 1 x 1 x 0.10 m level

[‡] Artifact totals are from all four 5-cm levels, artifact density is from just the first two to match other units

The southeast activity area, that is, the one closer to the spring and containing only one rock ring, has a much higher artifact density than the northwest activity area, which contains the other nine rock rings. This finding is discussed in detail in the following chapter.

Furthermore, there is a statistically significant difference in counts of tool type between the activity areas. I ran three chi-squared tests, one to test the difference in counts between the northwest and southeast activity areas, one to test the difference between the northwest area and artifacts within 10 m of the spring, and one to test the difference between the southeast area and artifacts within 10 m of the spring. I hoped to understand if there were any activities that were specific to the spring area as opposed to further away in the identified activity areas.

A chi-squared test is ideal for comparing counts of a nominal variable across two samples (Ranganathan 2021). The null hypothesis is that the proportion of counts of each variable level (i.e., type) is the same for each sample. A chi-squared test requires that the expected count for each artifact type is at least five, as the accuracy of the test declines as the expected sample becomes lower than five (Franke et al. 2012). Therefore, artifact types with fewer than five expected occurrences were eliminated from the chi-squared test for each area.

The test between the northwest ($n = 79$) and southeast areas ($n = 234.7$) compared counts of artifacts identified as bifaces, flake tools, groundstone, projectile point, core (and core tools), and debitage. The debitage count greatly inflated the variance, as the count of debitage was 40 times larger than the count for tools. Using these numbers for the test would effectively ignore any variance in artifact types as the debitage count is so much higher than the count of any other tool type, and the difference between the debitage counts in each area was very significantly different. As such, any test including the actual debitage counts would be significant, despite the other tool types. As I was interested in understanding the variance in the other tool types, I reduced the count of debitage by a factor of 104.2. I chose this factor so the count for debitage from the northwest activity area being reduced from 521 to 5 (the minimum number of observations for test reliability), and the debitage count from the southeast activity area being reduced from 4349 to 41.7. This process allows the other artifact types to contribute to the test value. The test indicated a significant difference between artifact type counts from the two activity areas ($\chi^2 = 23$, $p < 0.001$). The main driver of the variance here was the debitage count, even after normalization. Without considering debitage, the result is still significant ($\chi^2 = 16.1$, $p = 0.01$). Flake tools and projectile points were roughly equal contributors and second-highest contributors after debitage. There were more flake tools observed than expected, and fewer projectile points in the northwest area than the southeast area, assuming equal proportions.

There was also a significant difference between type counts from the southeast area ($n = 234.7$) and artifacts 10 m away from the spring ($n = 14$), indicating some tasks were localized to the spring ($\chi^2 = 11.2$, $p = 0.03$). The largest driver of variance here was groundstone (both mobile and not), i.e., there was more groundstone near the spring than expected assuming equal proportions. Flake tools and debitage were roughly equivalent as the second-highest drivers of variance. There was not a statistically significant difference between counts of type between the northwest activity area and the artifacts near the spring ($\chi^2 = 9.69$, $p = 0.17$). These results are discussed further in the following chapter.

Geochemical Analysis – XRF

Table 5.4 lists the counts of all artifacts selected for geochemical analysis. I selected at least one artifact from each provenience. Dr. Hughes was able to determine the geochemical source of 169 of 186 artifacts (see Appendix A for his report).

Table 5.4: Count of artifacts sent for geochemical analysis, separated by material type

Obsidian	
Type	**Count**
Biface	64
Debitage	42
Projectile Point	22
Flake Tool	13
Drill	1

Fine-Grained Volcanic	
Type	**Count**
Biface	4
Debitage	17
Projectile Point	2
Flake Tool	12
Drill	3

Core Tool	1
Core	4

Core Tool	1

For the 169 sourced artifacts, Dr. Hughes identified 14 sources, ranging from 15 to 107 km away from Sage Hen Springs. I determined the distance from the approximate geospatial center of the source (i.e., the point closest to the middle of all points for each source, provided by Dr. Hughes) to the approximate center of the site (i.e., an artifact point location near the middle of the site boundary) using the Generate Near Table tool in ArcGIS Pro (ESRI). Table 5.5 lists each of the quarries that Dr. Hughes identified, the distance from the source to the site, and the counts of artifacts and percentages of all sourced artifacts for each source.

Table 5.5: Count of artifacts from each quarry

Quarry	**Distance from Site (km)***	**Count of artifacts**	**% of total**
Badger Creek	15	22	11.8%
Long Valley	17	16	8.6%
Massacre Lake/Guano Valley	18	72	38.7%
Mosquito Lake	20	15	8.1%
Nut Mountain/Coyote Spring	23	24	12.9%
Bidwell Mountain/Cowhead Lake	36	4	2.2%
Surveyor Spring	40	2	1.1%
Nellie Spring/East Creek	44	1	0.5%
Buck Mountain	51	3	1.6%

Bordwell Spring	60	1	0.5%
Craine Creek	64	3	1.6%
Beatys Butte	91	3	1.6%
Buffalo Hills	105	1	0.5%
Hawk’s Valley	107	2	1.1%
Unknown Obsidian	N/A	3	1.6%
Unknown Volcanic	N/A	14	7.5%

*Distance from center of Sage Hen Springs to geospatial center of geochemical source, rounded to nearest whole kilometer

Figure 5.5 shows the location of all the identified sources in relation to Sage Hen. Latitude lines are also included to assist in depicting the scale of the distance of the sources.

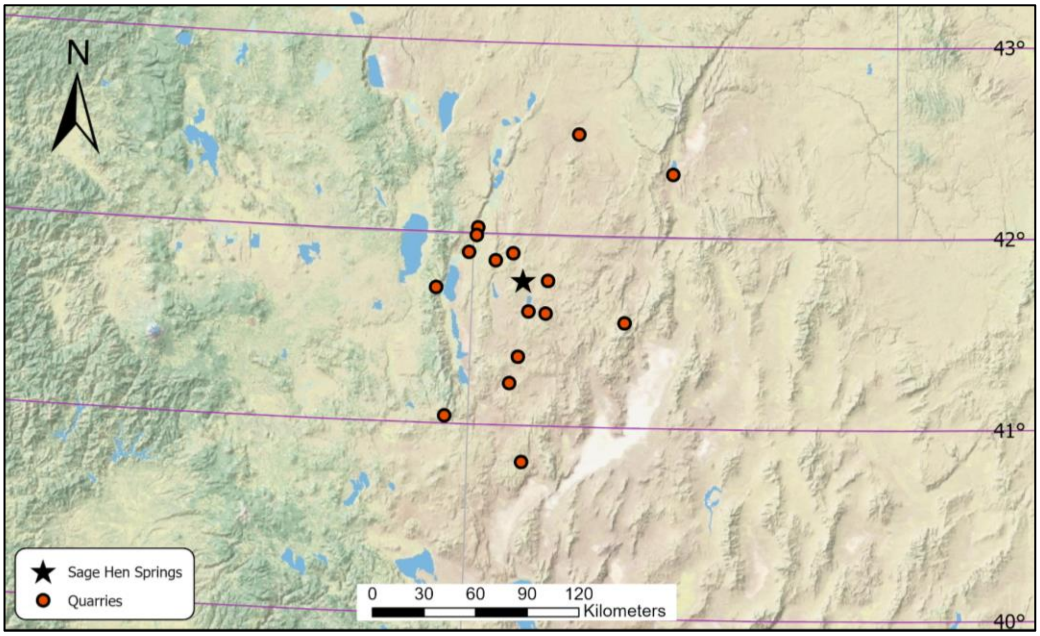

Figure 5.5: Map of toolstone sources identified from Sage Hen Springs artifacts.

Geochemical Analysis – Obsidian Hydration

Origer and Associates provided a measurement of the hydration rim for 130 of the 147 obsidian artifacts (see Appendix B for their report). Hydration rates, which are used to convert the measurement of the hydration rim to an age, were published for 98 of the 130 measured artifacts (Hildebrandt et al. 2016). The formula for these rates is cx^2, where x is the hydration rim thickness in microns, and c is a coefficient specific to the geochemical source and climate after deposition. For the remaining artifacts for which no coefficient is published, I used the mean coefficient across the other published rates. This mean coefficient was 256.86. The average rim thickness was 3.4 microns, and the published rate coefficients ranged from 72.94 to 478.96, with a median of 285.62. Thus, the extrapolated mean coefficient could result in dates that are off by up to $193.34(3.4)^2 =$ 2,235 years (193.34 is 478.96 - 256.86). However, using the median rate of 285.62, the most frequent error is likely only $28.76(3.4)^2 = 332.5$ years. Thus, the obsidian hydration dates are not precise to the year, decade, or century, but dates are precise enough for analyses on the scale of 500-1000 years. To visualize the hydration data, I plotted the counts of artifacts in a histogram with 15 bins (Figure 5.6), which accounts for the lack of precision in the dating method. For most of my charts, I used R (R Core Team 2022; RStudio Team 2022) with the ggplot 2 package (Wickham 2016). The rest were constructed in Microsoft Excel.

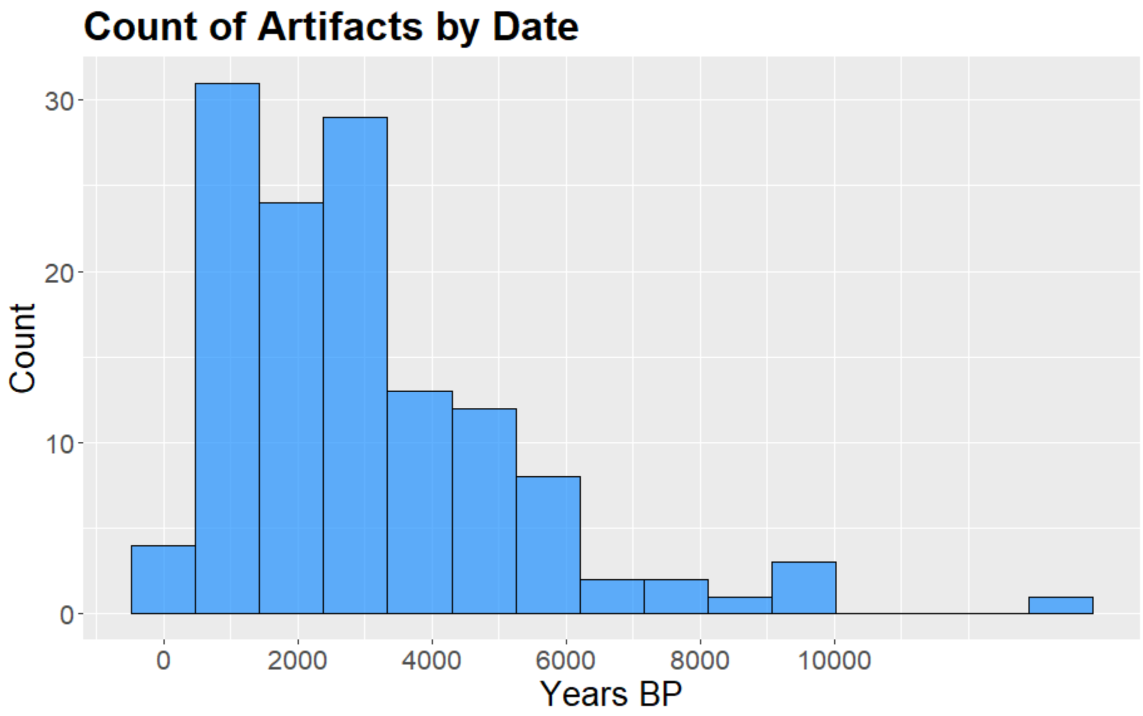

Figure 5.6: Count of OHD artifacts at Sage Hen Springs over time.

There is one outlier artifact that dates to roughly 13,000 BP. This result may be real, but it is probably a result of inexact dating. The extrapolated mean rate was used to calculate the date of this artifact, so error was introduced. Otherwise, results indicate that the site was occupied from at least 10,000 BP through 300 BP. Artifact counts increase starting 6,000 BP and reach a peak at roughly 3,500 BP. This peak declines at around 2,500 BP before increasing again by about 1,000 BP. Between 500 and 300 BP, artifact counts are minimal. This trend is supported by a chi-squared test of artifact counts prior to 4,000 BP versus counts after 4,000 BP ($\chi^2 = 34.8$, $p \approx 0$). These artifact counts likely indicate intensification of site use during the post-4,000 BP period.

I used a similar approach to identify a likely date for construction and habitation of the rock rings. Figure 5.7 is a histogram of counts of artifacts recovered from the unit inside the rock ring and the unit placed 10 m away from another rock ring. The artifacts are divided into eight bins, which makes each bin about 750 years wide to account for the imprecision in the hydration dates. From the histogram, it appears that the rock rings were inhabited predominantly from 4,000 BP onward, with the most intense occupation from roughly 1750 to 1000 BP. The post-4,000 BP finding is supported by a chi-squared test ($\chi^2 = 21.2$, $p \approx 0$), but the post-2,000 BP intensification is not statistically significant ($\chi^2 = 2$, $p = 0.3$).

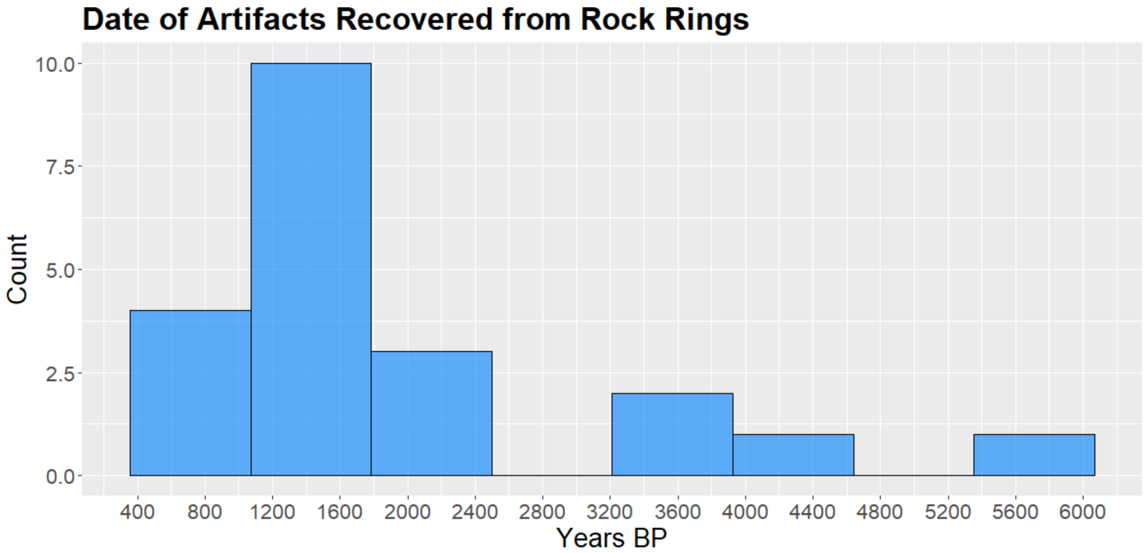

Figure 5.7: Count of OHD artifacts from the northwest activity area over time.

I also plotted the dates derived from diagnostic projectile points to determine whether the chronological trend is supported by a dating approach other than OHD. I assigned dates to each projectile point type based primarily on Smith et al. (2013), and supported by other sources (O'Connell 1975; O'Connell and Inoway 1994). I took the mean of each date range and condensed those dates into 500-year ranges both to match the OHD histogram bins and to smoothen the curve of the point chronology. The results are shown below in Figure 5.8. It appears that the diagnostic point chronology does indeed align with the OHD trend, with a distinct peak at about 2,500 BP, and higher counts in the Middle Archaic.

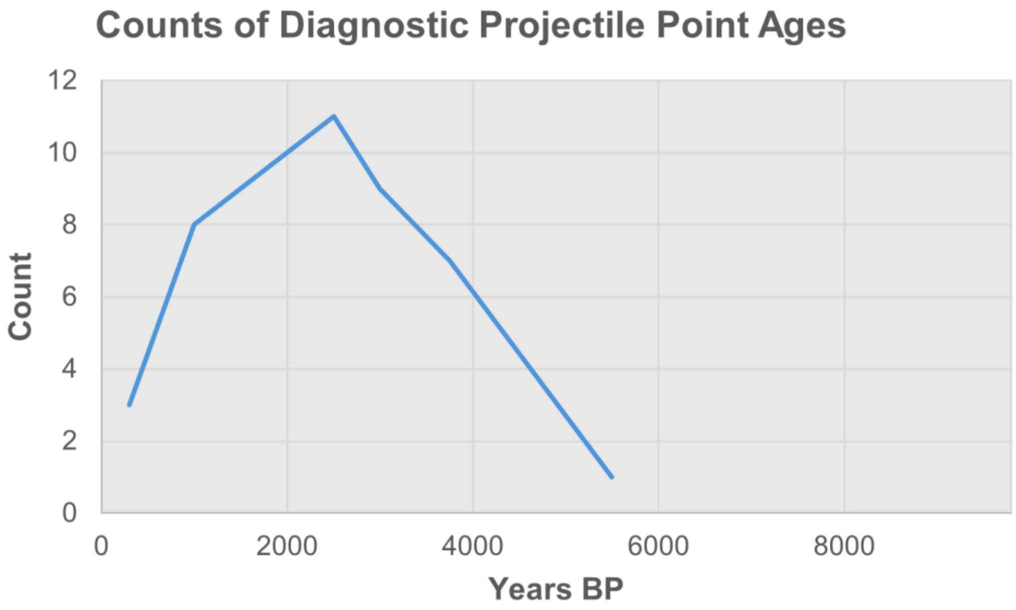

Figure 5.8: Chronological Trend Derived from Diagnostic Projectile Point Counts

Dating of Activity Areas

I also ran a statistical test to see if there was a difference in the dates of artifacts from each activity area. As discussed above, I compared the southeast activity area, the northwest activity area, and all artifacts located up to 10 m away from the spring. Because there are three samples in this test, an ANOVA test is most appropriate (Ranganathan 2021). This test compares the difference in means between three samples for a single continuous variable, in this case years BP. The ANOVA, which I ran in R (R Core Team 2022; RStudio Team 2022), indicated a statistically significant difference in mean age of artifacts recovered from at least two of the three activity areas ($F = 3.477$, p

= 0.034). Figure 5.9 below visualizes the dates of artifacts across the three areas in a box plot.

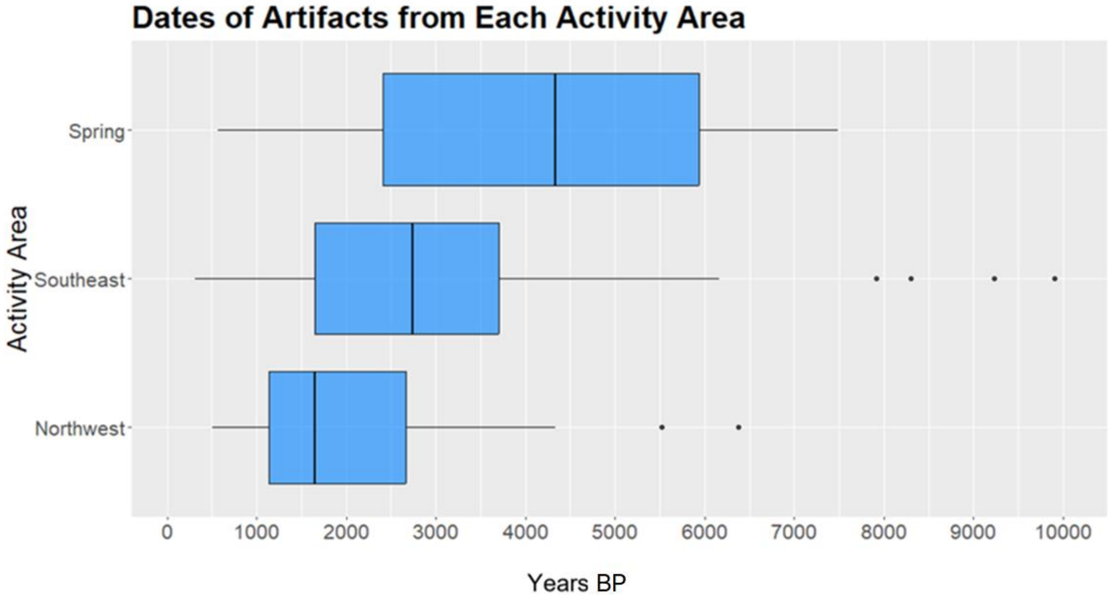

Figure 5.9: Box plot showing dates of OHD artifacts across three site areas.

The chart indicates that the activity area associated with the spring was used first in time, then the southeast activity area, then the northwest activity area most recently in time. This finding is supported further by the significant p-value from the ANOVA test. This may suggest that the spring was the primary draw for its associated subsistence resources. However, during later Mid-Late Archaic droughts, those resources may have declined in abundance, and inhabitants focused on other resources slightly more distant from the spring. Alternatively, the site was used more intensively and by larger groups of people during drought periods, thus expanding the radius of artifacts to the northern and southern activity areas.

Temporal Analysis of Toolstone Sources

Given that there appears to be an intensification of site use past 4,000 BP, I then tested whether toolstone sources are used differently prior to and after 4,000 BP As Figure 5.10 shows, more distant toolstone sources are identified at Sage Hen only after the 4,000 BP cutoff. The appearance of the more distant quarries does not represent a shift to just those, as the closer quarries used in earlier times continue to be used when the new quarries start being deposited at Sage Hen.

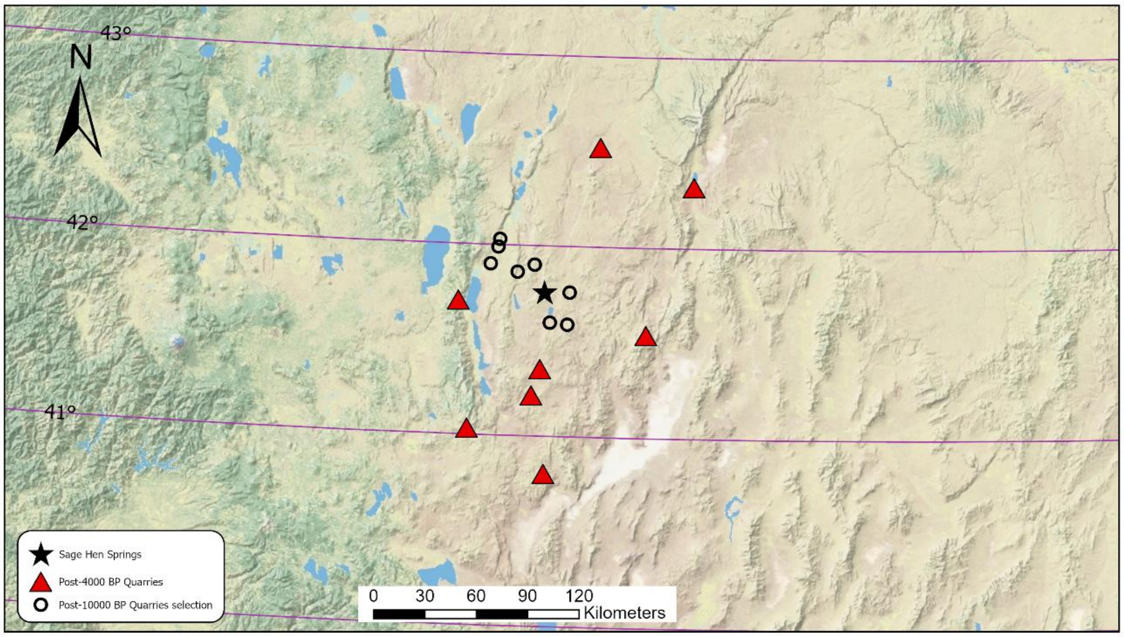

Figure 5.10: Map of toolstone sources with post-4,000 BP sources highlighted.

These quarries are all at least 40 km from Sage Hen Springs. This indicates an increased logistic range for inhabitants of Sage Hen Springs. Further, nearby quarries (<40 km) continue to be used throughout site occupation, indicating that the nearby sources produce toolstone of sufficient quality. Figure 5.11 shows the distance of each source from Sage Hen, and the length of time that the source appears in the Sage Hen record. The span is not necessarily continuous, but represents the earliest and latest date at which each source was identified.

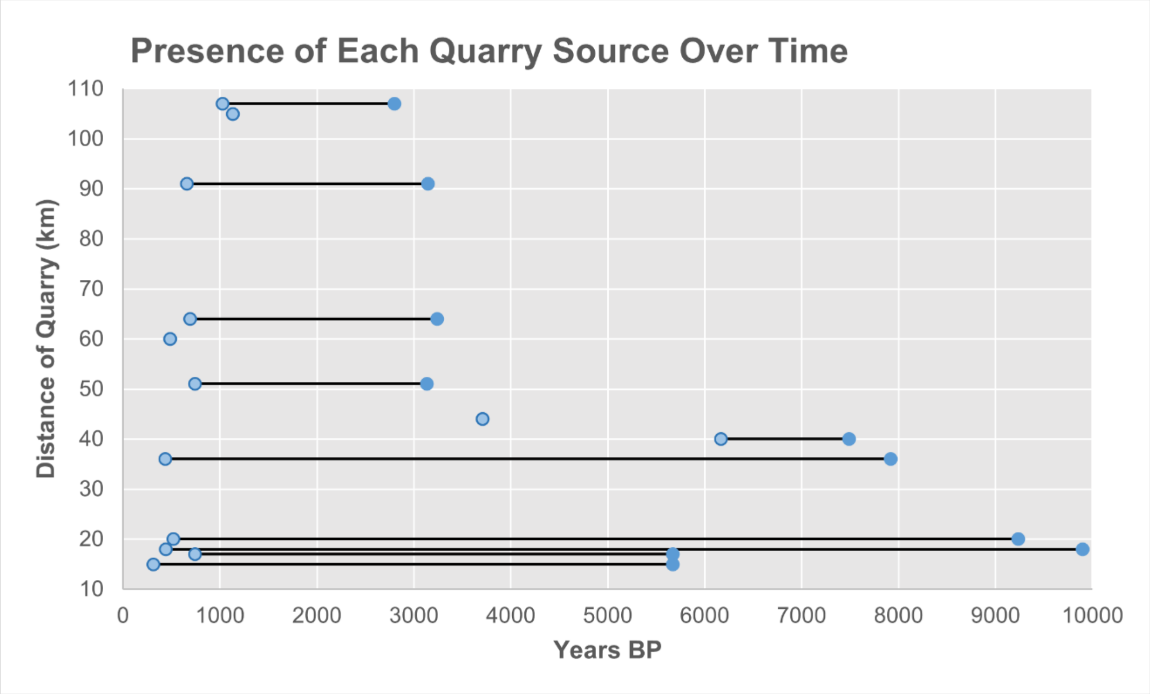

Figure 5.11: Chart showing the span of time that each toolstone source is identified in the record at Sage Hen Springs.

I then condensed the toolstone sources into local (< 40 km away from Sage Hen Springs) and non-local (> 40 km away) sources. Figure 5.12 shows this condensed classification and shows the trend in toolstone source use over time more clearly.

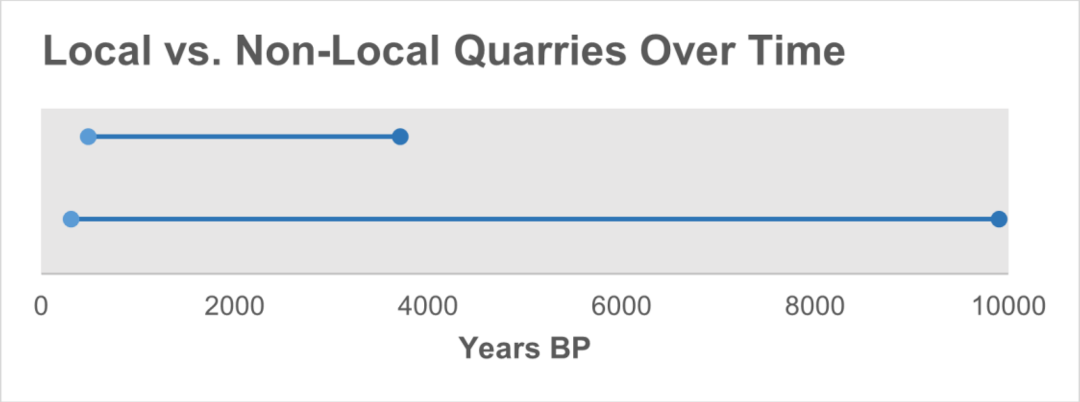

Figure 5.12: Chart showing the span of time that local quarries vs. non-local quarries appear in the Sage Hen Springs record.

This trend is qualified by a statistical test. I used Levene’s test for variance here, since the means of the distance used for each temporal span (pre-4,000 BP and post-4,000 BP) would be roughly similar, as the nearby sources continue to be used in high quantities throughout occupation. However, the variation in the distance of the sources used appears to increase as further sources are included. Levene’s test compares the variation in two samples of data, with the null hypothesis being that the variation is the same for both samples. Levene’s test is a good choice for this data since the data is non-parametric, and Levene’s test, unlike other variance tests like an F-test, can accurately test variance in non-parametric data (Hosken et al. 2018). For this test, the p–value was 0.08. Thus, the difference in variance across the time periods is not statistically significant. Because non-local sources are included in the Sage Hen record only after 4,000 BP, the non-significant result likely indicates that local sources were still preferred, despite non-local sources being exploited concomitantly. This is also demonstrated by comparing counts of artifacts from local versus non-local sources over time. Figure 5.13 shows just that and indicates that local sources continue to be the dominant sources throughout site occupation, while non-local sources are included from 4,000 BP onwards.

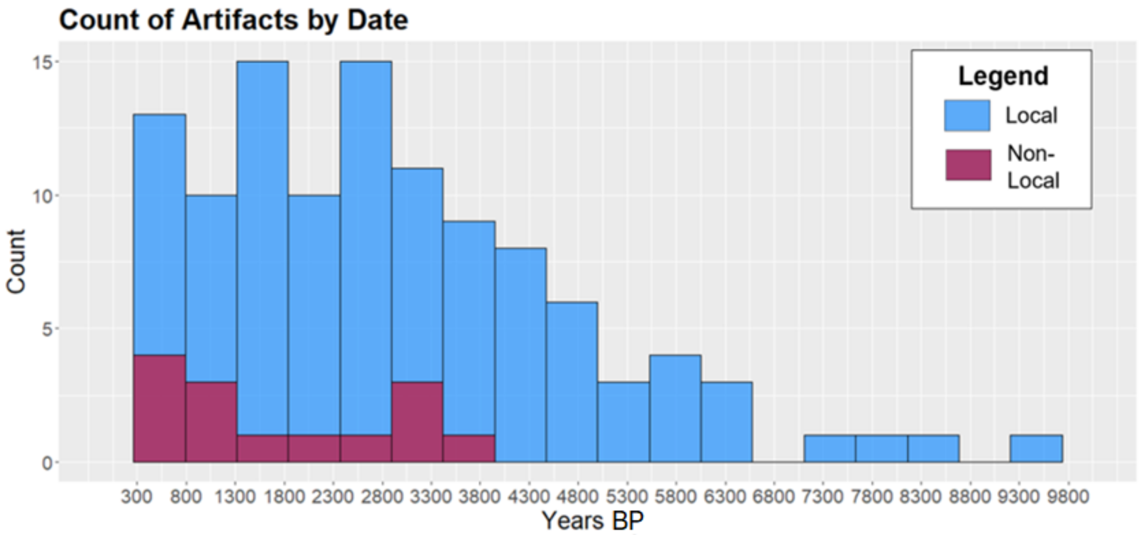

Figure 5.13: Histogram of OHD artifacts shown by date, separated by local and non-local sources.

Lastly, the results of the biface reduction and projectile point retouch analyses were inconclusive. I hypothesized that, according to Beck et al.’s model (2002), people should venture to distant quarries solely to procure higher quality toolstone than what is locally available, as it is costly to transport toolstone, and there should be a benefit to doing so in the form of better tools. Accordingly, toolstone from further away should be more reduced than close sources according to Central Place Foraging theory, and they should have more retouch, as people would attempt to reuse higher quality toolstone rather than returning to a distant quarry to procure more material. However, the reduction stage and retouch index across all quarries did not exhibit any apparent trend. I plotted the distance to source against the retouch index, and the linear regression returned an R-squared value of 0.005 and a p-value of 0.68, indicating no statistically significant relationship between retouch and quarry distance. Further, an ANOVA test revealed the mean distance to quarry for each reduction stage was not significantly different from any other (F = 1.44, p = 0.23). These results are probably due to significant trampling at the site causing false indications of reduction and retouch, but I discuss this in more detail in the following chapter.

Chapter 6: Discussion

To summarize the Sage Hen Springs data, my analyses indicate that the site was used residentially and for subsistence-based tasks. The rock rings are probable residential structures, which suggests intensive residential use, while the presence of both groundstone and projectile points suggests the site was used for both hunting and plant-food processing. Further, artifacts date from circa 10,000 BP through 300 BP, indicating a long and fairly consistent use of the site. Despite this consistent use, I hypothesized that site use would be at its most intensive in the Middle Archaic, when population was highest in the region (Hildebrandt et al. 2016; LaValley 2013; Leach 1988; Louderback et al. 2011; see Chapter 2). Accordingly, I expected to find that the residential structures were primarily used during this time. Further, existing models built on Optimal Foraging Theory say that diet breadth and residential sedentism should increase in the Mid-Late Archaic, as a response to resource scarcity brought on by simultaneous drought conditions and high population (Hawkes and O'Connell 1992; Herzog et al. n.d.; Hildebrandt et al. 2016; LaValley 2013; Leach 1988; see Chapter 3).

I sought to understand patterns of site use at Sage Hen Springs to test these hypotheses and to address the following questions: 1) did people intensify their residential use of the site and increase their diet breadth during the Middle and Late Archaic? 2) do toolstone procurement patterns indicate a decrease in residential mobility with a concomitant increase in logistic mobility during the Middle and Late Archaic? and 3) did the population increase during the Middle Archaic?

Spatial and Temporal Variations in Site Use

Surface artifact distribution, the location of rock ring features, and differing artifact type proportions between artifact clusters all suggest the organization of the site into multiple activity areas. One activity area, to the southeast of the other, contains only one rock ring in the furthest northwestern corner, and a very high artifact density (660 artifacts per 1 x 1 m level). The other, to the northwest of the first, contains nine extant rock ring features and a much lower artifact density (64 artifacts per 1 x 1 m level). Dated artifacts from the northwest activity area (n = 32) had a mean date that was nearly 800 years later than those from the southeast activity area (n=86). The mean date of artifacts within 10 m of the spring (n=6) was roughly 1300 years earlier than the southeast activity area. These dates (shown in figure 5.3) indicate that the spring was utilized earliest in time, followed by the southeast activity area, and finally the northwest activity area.

Furthermore, significant differences in tool type proportions between the activity areas suggest differing uses of the activity areas. The artifacts proximal to the spring include groundstone in significantly higher proportion than the southeast activity area. This suggests that people primarily focused on grinding foodstuffs very close to the spring, while the southeast activity area was used for more general purposes and perhaps for tool manufacture given the high quantity of debitage recovered from the activity area.

The shift in subsistence strategy away from hunting and towards plant processing, as indicated by the expedient tool assemblage and the prevalent groundstone, indicates that women and their subsistence activities became more important to the overall diet. As discussed previously, gendered division of labor likely began in the Early Archaic, with women pursuing plant processing and men focusing more on big game hunting (Zeanah 2004). This trend is also supported by ethnographic evidence (Kelly 1932). Thus, women's strategies seem to be more advantageous in times of drought, likely because plant processing skills can be applied to a broad range of foods, whereas big game hunting is heavily dependent on artiodactyl distributions. The latter of which, as discussed earlier, shifted significantly because of drought, and thus big-game hunting likely declined in productivity during droughts.

Researchers tend to concur that investment in groundstone began in the Early Archaic but intensified in the Middle Archaic (Herzog et al. n.d.; Hildebrandt et al. 2016; LaValley 2013). Hildebrandt et al. suggest that at least in Nevada's northern tier, the Middle Archaic saw a simultaneous increase in both flaked stone technology and groundstone technology, indicating a need to procure higher quantities of food than in previous eras due to climatic and population pressures (2016). Thus, while the groundstone at Sage Hen Springs cannot be directly dated, it seems likely that most of the groundstone at the site dates to the Middle Archaic, with portions of the assemblage dating to other eras of the Holocene.

Thirteen pieces of groundstone were identified in the southeast activity area, demonstrating that people also processed plant foods in that location. However, the variety in artifact type within the southeast activity area suggests that tasks conducted there were highly varied compared with activities proximal to the spring. Artifacts in the northwest activity area were also recovered in different proportions than those from the southeast activity area. The quantity of debitage in particular was less than in the southeast activity area, and flake tools were found in higher proportion. This may suggest that people used expedient tools at a higher rate in the northwest activity area than in the southeast activity area. The manufacture of flake tools produces smaller quantities of debitage than the production of formal bifaces, thus the decreased quantity of debitage in the northwest activity area corroborates the increased quantity of flake (expedient) tools.

The shift from bifaces being the predominant tool type to a more expedient technology likely occurred during the TP/EH-Early Archaic transition, as suggested by Beck and Jones (2012). They claim that this shift indicates a desire for more mobile toolkits. Thus, the flake tools in the northwestern activity area may indicate that people using that area were more highly mobile than people centered in the other activity areas. An alternate explanation for the lower quantity of debitage is that people were bringing more fully formed tools to the northwestern activity area, and thus produced less debitage by making tools at the site. According to Beck et al. (2002), this would predict that tools are being brought from further away, as transporting a later-reduction-stage tool is beneficial when traveling a long distance from the quarry. Because the northwest activity area was used later in time, people at Sage Hen Springs later in the Archaic may have been traveling further distances to the site, indicating that the site increased in regional importance during that time. We can surmise that the increase in regional importance of this upland spring is related to the onset of the LHDP, which caused lowland lakes to dry up while upland springs stayed productive.

The most obvious difference between the activity areas is the presence of the nine rock rings in the northwest activity area. Rock rings are not associated with residential structures in the region ethnographically (Kelly 1932; Strong 1969; Voegelin 1942). However, Ruby interprets larger rings as remains of dwellings, and smaller rings as caches (Hildebrandt et al. 2016). Ruby does not define "larger" and "smaller," but Kelly's ethnography of the Paiute describes their largest dwellings as being able to hold eight people (1932:104), and Strong notes that Klamath winter dwellings were up to 10 feet (3 m) in diameter and held about eight people (1969:144,5). Thus, assuming the rock rings represent residential structures, all ten of them around 10 feet in diameter, I may use the Klamath ethnographic analogy to approximate population density. Accordingly, the rock rings structures could have accommodated roughly 80 people during the height of occupation.

The date range of artifacts collected from the northwest activity area suggests the area, and particularly the rock rings, were used predominantly from roughly 4,000 BP to 1,500 BP. This date aligns with the scholarly consensus that residential mobility decreased in the Early and Middle Archaic, then increased in the Late Archaic (Hildebrandt et al. 2016; LaValley 2013; McGuire and Hildebrandt 2005; Smith 2011). However, models for the northwestern Great Basin suggest that people living in the valleys transitioned from large and substantial residential structures to more ephemeral brush structures by the end of the Early Archaic (Leach 1988; O'Connell 1975). While the dates of the Sage Hen Springs rock rings run counter to this, suggesting more substantial residential structures in the Mid-Late Archaic, this may align with the idea that people moved to upland areas and largely abandoned formal settlements in the valleys during the Middle Archaic (Leach 1988; O’Connell 1975). This pattern could be the result of lowland lake and marsh resources becoming less productive during periods of drought causing people to shift their residential and resource procurement activities to upland areas where water and food resources were more abundant.

While the Sage Hen data seems to support this hypothesis, without accurate and precise temporal controls for the rock rings themselves (thermoluminescence or radiocarbon dating), the timing of the construction of the rock rings is difficult to pinpoint. The rock rings may have been built during the Early Archaic, and then not used during later periods while the surrounding activity area was used. However, the dated artifacts from the unit placed inside the rock ring tentatively date to later than 1,500 BP with obsidian hydration dating, suggesting the rock rings were indeed used during a later era.

Intensification During Drought

The apparent intensification in the use of the Sage Hen Springs site during the Middle Archaic is likely explained by the consistent water source available at the springs during periods of drought. Regular use of the Sage Hen Springs area appears to start around the time of the Mid-Holocene Drought (7,500 to 5,000 BP). Site use then increases during the Late Holocene Dry Period (LHDP), which spanned from 3100-2200 BP and 2000-1800 BP in the Great Basin, with an intervening wetter period from 2200-1800 BP (Mensing et al. 2023; Thomas et al. 2023).

Arid conditions during the Late Holocene droughts were geographically specific. During the earlier period, areas south of 42° N latitude experienced an increase in aridity.

The later, more intense period was localized to areas south of 41° N (Mensing et al. 2023). Sage Hen is located at 41° 45’ N, and thus would have become more arid during the earlier period of the LHDP, but would have stayed fairly stable through the later period. Further, glacier-fed upland springs such as Sage Hen would have been highly attractive areas as lowlands became increasingly arid (Thomas et al. 2023). Use of the northwest activity area, and the residential structures there align with the Middle Archaic and the severe droughts at the end of that period as well as the Late Archaic. Therefore, it appears that residential mobility decreased during the drought periods, with people maintaining a residential base near the dependable water source.

Further, the site saw little use prior to 6,000 BP, suggesting that it was not an important part of TP/EH subsistence strategies. This aligns with the model that TP/EH foragers focused on a highly mobile scheme, targeting highly productive wetland resources (Beck and Jones 1997; LaValley 2013). Indeed, receding lakes and diminishing wetlands in the Early Archaic as a result of the Mid-Holocene Drought drove the shift to less mobile strategies, and intensification at upland resource areas (Grayson 2011; Hildebrandt et al. 2016; LaValley 2013; see Chapter 3).

Exploitation of a range of subsistence resources is indicated by the breadth of tool type identified at the site. At the very least, seed and tuber processing – indicated by the presence of groundstone and the starch granules identified thereon – and hunting – indicated by projectile points and other flaked stone tools (Hildebrandt et al. 2016) – occurred at the site. Contemporaneity is difficult to determine, as the groundstone could not be directly dated, but, as discussed above, researchers suggest that seed and geophyte processing continued in the Middle Archaic while big game hunting increased in importance (Hildebrandt and McGuire 2002; LaValley 2013). The increase in big game hunting may be supported by the Sage Hen record. Of just the hydration-dated projectile points, only one dated to prior to 5000, but there was no significant difference in count between the Early to Middle Archaic (5000-1300 BP) and Late Archaic (1300-600 BP). However, when all the diagnostic projectile points identified at the site (n = 39) are considered, the dominant type was Humboldt (n = 11), followed by Elko (n=7) and Pinto (n = 7). Only one Northern Side Notched was identified. The predominance of Middle Archaic points suggests big game hunting may have been most important to subsistence strategies of that period. Furthermore, Leach suggests that diet breadth increased in later periods as a way to provide enough calories for larger populations in a less productive landscape (1988). The presence of tool types other than projectile points in large numbers further supports a broad diet. These other types are not unique to specific resource types as projectile points are specific to hunting, so subsistence strategies remain ambiguous according to the Sage Hen record. A detailed use-wear analysis of some collected tools may hint at specific tasks, but this was not part of the research plan for this thesis. Ultimately, diet breadth cannot be quantified, but it appears that Sage Hen Springs provided several high-quality foods for Archaic inhabitants.

The harvesting and processing of plant foods at Sage Hen Springs is undeniable. We conducted starch granule analysis on four pieces of groundstone from the site. From the residues we extracted from the surface of the groundstone, we identified *Leymus/Elymus* spp., a high-caloric-return grass seed (Herzog et al. n.d.; Herzog and Lawlor 2016; Herzog and Rogers 2024) . Further, we identified starch granules attributed to Apiaceae and *Fritillaria* spp. or *Calochortus* spp., which are plants harvested for their edible subterranean parts, referred to as geophytes (Herzog and Rogers 2024). Geophytes are typically harvested in spring, while grass seeds would have been available in late summer (Herzog et al. n.d.). Thus, it is possible that people would have lived at Sage Hen Springs in spring and summer. Alternatively, Sage Hen Springs could have been a fall or winter village, where people processed cached plant foods during the colder months. More extensive excavations would be helpful in disambiguating this, as the presence or absence of caches at the site would provide conclusive data.

Toolstone Conveyance

While the residential area at Sage Hen Springs indicates a decrease in residential mobility during the Middle Holocene, the toolstone sources represented at the site indicate a concomitant increase in logistic mobility. Before 4000 BP, the only toolstone brought to Sage Hen Springs came from quarries no further than 40 km distant. The Massacre Lake/Guano Valley (ML/GV) source is very close to the site (~18 km) and provides good-quality obsidian. Accordingly, we would assume that ML/GV obsidian should be the most prevalent source at Sage Hen Springs. This hypothesis is based on Beck et al.'s postulate that more distant toolstone is carried back to a site only when it is of superior quality, according to central place models (2002). It is calorically expensive to move toolstone, even when at an advanced reduction stage. Therefore, it is not beneficial to carry large quantities of toolstone back to a residential base like Sage Hen Springs unless it is of superior quality to toolstone that can be found locally. Since residents of Sage Hen can procure good quality toolstone close to home, there is not an energetically favorable reason to carry more distant obsidian back with them, nor travel long distances for the sole purpose of obtaining obsidian. Indeed, ML/GV is most prevalent at the site (38.7%), and it is used for the longest period (~10,000-500 BP).

After 4,000 BP, more distant sources – up to 107 km – appear in the Sage Hen record. As discussed above, it is unlikely that people traveled to these sources with the sole intention of collecting toolstone. Toolstone collection likely occurred when the opportunity arose on the way to other resource patches, or if a tool was needed for harvesting at the distant patch. Thus, the presence of distant quarries indicates a larger logistic range during the Middle Archaic. This trend is also reflected in the wider record of the northwestern Great Basin, according to Leach (1988) and LaValley (2013). During the dry periods of the Middle and Late Archaic, artiodactyl populations probably declined due to reduced ranges of forage plants (Byers and Broughton 2004), and high-ranked plant foods may have become more scarce as the environment became more arid. Thus, foragers may have traveled farther to target more dispersed resources.

The Sage Hen Springs data, indicating a shift towards decreased residential mobility and increased logistic mobility, concurs with Smith's local/non-local toolstone ratio study (2011). Smith suggests that local quarries are those within 20 km of a site, as a 40-km round trip is the limit of a day's travel. Smith also points out that an arbitrary cutoff distance is not useful in most cases, as travel distance and days per foray are variable. Indeed, the data at Sage Hen seems to suggest that 40 km is a critical distance and may be the cutoff between local and non-local for residents of the site. Further, the 4,000-BP date at which more distant quarries begin to be represented at Sage Hen might be taken to be the critical moment at which mobility strategies shift. Distant quarries are first represented in the Middle Archaic in relatively small quantities of toolstone at the site. This seems to conflict with proposed regional trends, i.e., that the Middle Archaic sees the smallest amount of quarry diversity in northwestern Nevada due to low logistic mobility (Hildebrandt et al. 2016). However, the presence of distant toolstone during the Late Archaic and Terminal Prehistoric does align with data from the region at large (Hildebrandt et al. 2016; Smith 2010), which suggests that these later eras are when toolstone distance increases. The Middle Archaic discrepancy is rather tricky to parse. It is possible that the obsidian hydration dating introduced enough error to produce a false positive for distant sources during the Middle Archaic. However, signals of distant toolstone appear from 3,800 BP onward in the obsidian hydration data. Thus, the Middle Archaic discrepancy may instead indicate an alternate explanation for the procurement of distant toolstone, other than logistic mobility on the part of the primary residents of Sage Hen.

Alternate explanations for the increase in toolstone procurement distance include people traveling to Sage Hen Springs from further away, and/or people engaging in trade in greater amounts. Regarding the latter, Hildebrandt and colleagues have suggested that a significant driver of toolstone conveyance in the Great Basin is intergroup exchange (Gilreath and Hildebrandt 2012; Hildebrandt et al. 2016; Hildebrandt and McGuire 2002). It is possible that distant toolstone ended up at Sage Hen through trade, which would suggest that logistic ranges for Sage Hen residents were less than the 107 km of the most distant source represented in the Sage Hen record.

Another potential explanation is that people traveled from 100 km away to visit Sage Hen Springs. During the Late Holocene droughts, people were forced to adapt to new climatic conditions and resource distributions. As Jones et al. suggest, this adaptation may have resulted in aggressive migration (Jones et al. 1999). People may have moved to more productive areas that were already occupied. In response to resource scarcity, existing residents of productive areas would have been driven to defend productive areas, and interpersonal violence may have been the result (Cashdan 1992; Jones et al. 1999). Encroaching foragers may have brought toolstone with them and ultimately deposited it at Sage Hen. This explanation seems unlikely however, as all of the toolstone quarries represented at Sage Hen (and Sage Hen itself) are above 40° N, which is the cutoff line between extreme aridity and mesic conditions during the Late Holocene Dry Period (Thomas et al. 2023). While people at Sage Hen likely did not suffer from the extreme aridity of areas further south, it is possible that they still expanded their foraging range to include more sites to the north; along the way, they may have procured or traded for toolstone from distant sources. Alternatively, people living near the toolstone sources may have moved to the Sage Hen area, but again, the drive for this movement would have been minimal given the sustained mesic conditions in the area. A detailed typological analysis of projectile points may possibly identify cultural differences in design, pointing to encroachment by outside groups, but this would be exceedingly difficult to recognize within such a small region (i.e., a 100-km radius circle expanding from Sage Hen).

Thomas et al. provide an alternate explanation for intensification during drought periods. The concept of survivance privileges the cultural importance of places of spiritual power. During drought, sacred sites grow in importance and significance. Thomas discusses how foragers forced from their homeland by drought-induced resource scarcity would have faced the difficult decision to leave their sacred places (Thomas et al.

2023). However, interacting with places of power during times of uncertainty may also explain the intensification patterns at Sage Hen. The extensive assemblage of rock art – not just within the recorded Sage Hen Springs site boundary but extending beyond the boundary on the volcanic rim rock of Massacre Rim – indicates that the site was one of spiritual and/or cultural significance.

Kelley Hays-Gilpin discusses how rock art was important to people as landscape markers, directing foragers towards important places both for subsistence and for spiritual use (2004). Gilpin points out how, particularly for Numic peoples, the rock surface might be conceived of as an interface between the profane and the spiritual (2004). Thus, the extensive rock art assemblage at and near Sage Hen Springs indicates its importance within the landscape. According to the survivance model, the site may have increased in importance in this way under the duress caused by drought conditions. Further analysis of the Sage Hen rock art, alongside collaboration with Indigenous communities to record and analyze oral histories, may elucidate the spiritual and/or cultural significance of the site.

Indeed, the survivance model may be a more apt framework for Sage Hen Springs than Beck et al.'s "Rocks are Heavy" central place model (2002). My analysis of the Sage Hen Springs artifacts along the lines of Beck et al., quantifying lithic reduction and retouch, was inconclusive. Inconclusive results may have arisen because 1) trampling at the site made retouch analysis unreliable, as trample can appear very similar to retouch, and 2) all the obsidian sources near Sage Hen Springs provide decent toolstone. Thus, forays to lithic sources to collect superior toolstone to that that can be acquired nearby is unnecessary, and the appearance of one source over another at the site is not predicted by the source’s quality. Therefore, it may be more fruitful to conceive of Sage Hen Springs as a site drawing people from further away during drought due to the subsistence and spiritual/cultural importance of the area, rather than attempting to establish mobility patterns based on optimal foraging models.

Overall, the archaeological record at Sage Hen Springs illustrates a multi-faceted adaptation to resource scarcity. During the Middle and Late Archaic, people intensified the residential use of the upland spring site, focusing on the collection and processing of plant foods near the consistent water source. However, this was not enough to feed the growing population, so logistic mobility increased to augment encounter rates, evidenced by the inclusion of distant toolstone sources during these periods. Further research identifying tool use, culture group migration, or higher-precision dates may disagree with this interpretation, but it is consistent with existing models of the northwestern Great Basin.

Chapter 7: Conclusion

Summary of Findings

Results from the Sage Hen Springs site indicate that inhabitants of the site pursued intensification of site use, in the form of increased logistic mobility and decreased residential mobility. Dating of the likely residential rock ring structures in the northwest activity area of the site indicates that the residential structures were constructed and used during the Mid-Late Archaic (later than 4,000 BP). This reflects a decrease in residential mobility, with intensification at the upland spring site to focus on processing food resources like seeds and geophytes. Concomitantly, an increase in logistic mobility is indicated by the inclusion of more distant toolstone quarries during the Middle and Late Archaic. This was likely a strategy to augment diet with higher-ranked foods through an increase in encounter rates achieved by higher logistic mobility.

The change in diet and subsistence strategies was most likely driven by resource scarcity during periods of drought and increasing population during the Middle Archaic. Site use, indicated by counts of lithic artifacts, peaked during the Late Holocene Dry Period. Further, population at the site, also indicated by counts of lithic artifacts, appears to be largest during the later Middle Archaic. Drought and increased population would have decreased the availability of high-ranked food sources, driving an increase in time spent on both processing of and searching for food.

Groundstone starch analysis indicates Sage Hen Springs residents were processing both seeds and geophytes at the site, while a predominance of Middle Archaic projectile points indicates hunting was pursued at a higher rate during this period. While the breadth of the diet cannot be directly measured, it appears that the most intensive subsistence strategies were pursued during the Mid-Late Archaic. Further, toolstone sources further than 40 km from Sage Hen Springs are only included in the Sage Hen record after 4,000 BP, suggesting a significant shift in mobility strategies during the Mid-Late Archaic. Likely, people exploited more distant food sources as a response to decreased resource density, and collected toolstone near where they were collecting food.

Scope of Work

This analysis is limited to one site, and thus cannot speak to regional trends in isolation. However, the temporal trends in subsistence and mobility strategies are similar to those suggested in other research in the region (Hildebrandt et al. 2016; LaValley 2013; Leach 1988). The in-depth analysis of the lithic assemblage at Sage Hen Springs should thus be considered a data point in support of these other models. Furthermore, the data we collected from the site was limited. The BLM only pursued Phase II testing, so only a small portion of the site was excavated. Also, we collected only a sample of surface artifacts, and dated and sourced only a sample of the collection. Therefore, the results presented here should not be considered a comprehensive study of the Sage Hen Springs. The site still has significant potential to contribute data to research in the region, and more detailed and comprehensive studies could result in the refutation of my analysis.

Further Research Directions

As mentioned, there is still a lot of data to be collected from the Sage Hen Springs site. More detailed field work there will help flesh out the data I have presented here. Further, a detailed rock art analysis and oral history analysis conducted in collaboration with Northern Paiute community members may elucidate alternate cultural explanations for the importance of Sage Hen Springs. Additionally, use wear analysis of lithic artifacts may help to determine the nature of the diet across time at the site, and effectively quantify the diet breadth, hopefully lending credence to my claim that diet breadth increased in the Mid-Late Archaic. More precise dating techniques will also help to temporally place changes in adaptive strategy at Sage Hen Springs.

The Value of University-Agency Collaboration

The work at Sage Hen Springs is an example of the kind of fruitful research that can emerge when students, academics, and agency archaeologists work collaboratively to research and preserve sites. Without the resources, knowledge, and interest of the BLM, not to mention their adherence to the legal and regulatory guidelines that guide Section 106 work, I would not have had a chance to go to Nevada and work on this site. Likewise, without the additional field support and in-depth post-fieldwork analysis generated as part of this thesis, the rich and detailed description of site use over time may not have been possible.

The outcomes of this project and the cooperative effort involved both support the mission of the BLM in their goal of ethical stewardship of public lands and exemplifies several of the nine Principles of Archaeological Ethics adopted by the Society for American Archaeology (SAA) on March 7, 2024. This research contributes to the scholarly literature around temporal and spatial trends in land use regionally, but it also holds implications for proactive cultural heritage management in accordance with the SAA principles of Stewardship, Responsibility, and Preservation of the Archaeological Record. This work also supports the SAA principles of Training and Resources, Public Outreach, and Reporting as it prompted me to train and develop new methods with a diverse group of anthropologists, design and execute a research program, present my research at an academic conference and to avocational groups, and interact with local community members, all of whom have a vested interest in the research.

As well as expanding regional understanding of landscape use, my analysis of the surface artifact distribution found that the boundaries for the activity areas include a larger area of the site, thus calling for focused protection of more of the site. Further, areas with prolific rock art, associated with ecological features that may have served as places of survivance, should be treated as part of a larger cultural landscape. Hopefully future work will aim to establish even larger protections related to regional patterns of landscape use. I also demonstrated which quarries show up in the site record; this information may prove useful in making a case to protect those quarries, both as culturally significant sites speaking to landscape use and as sources of archaeological data. Doing archaeology ethically and in a way that benefits people, not just laws, is critical to good heritage management. I strongly believe that collaboration between communities, academics, and agency archaeologists can facilitate this kind of scholarly, ethically, and legally responsible management.

Overall, the site-level findings I present here support regional models of adaptive strategies as a response to climate change. This work is clearly important not only to the academic pursuit of archaeological knowledge, but also to the goals of the National Historic Preservation Act and of ethical archaeology as laid out by the SAA. Now, with a cattle exclosure built around Sage Hen Springs and the site’s data potential firmly established, the site will be better documented, better understood, and will ultimately be better protected for the descendants of its inhabitants and others who study lifeways in the Great Basin.

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Appendix A: Hughes XRF Report

Geochemical Research Laboratory Letter Report 2023-27

Energy Dispersive X-ray Fluorescence Analysis of Obsidian from 26WA6919, Located Within the Sage Hen Spring Riparian Restoration Project, Washoe County, Nevada

January 22, 2024

Ms. Jennifer Rovanpera, Archaeologist
BLM Surprise Valley Field Station
P.O. Box 60
602 Cressler Street
Cedarville, CA 96104

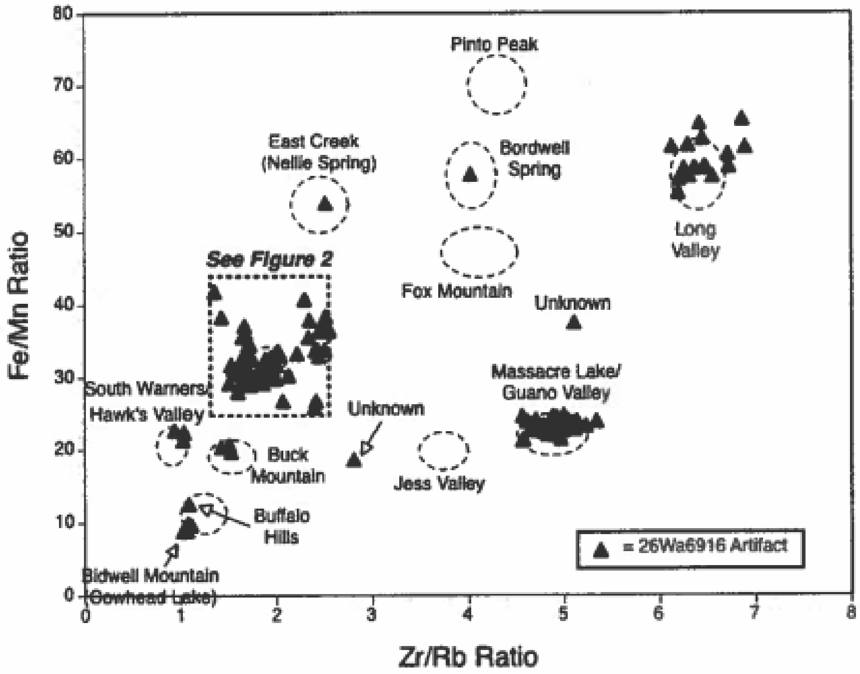
Dear Jen:

This letter report contains tables and figures presenting energy dispersive x-ray fluorescence (edxrf) data generated from the analysis of 186 artifacts from archaeological sites 26WA6916, located within the BLM's Sage Hen Spring Riparian Restoration Project in Washoe County, Nevada. This research was conducted pursuant to your letter request of November 9, 2023.

Laboratory analysis conditions, artifact-to-source (geochemical type) attribution procedures, element-specific measurement resolution, and literature references applicable to these specimens (except as added) follow those I reported for artifacts from sites in the Home Camp Riparian Project (Hughes 2022).

Figure 1

Fe/Mn vs. Zr/Rb Composition of Obsidian Artifacts from 26WA6916



Dashed lines represent range of variation measured in archaeologically significant geological obsidian source samples. Symbols plot data from Tables 1 and 2. *Note*: non-obsidian artifacts not plotted.

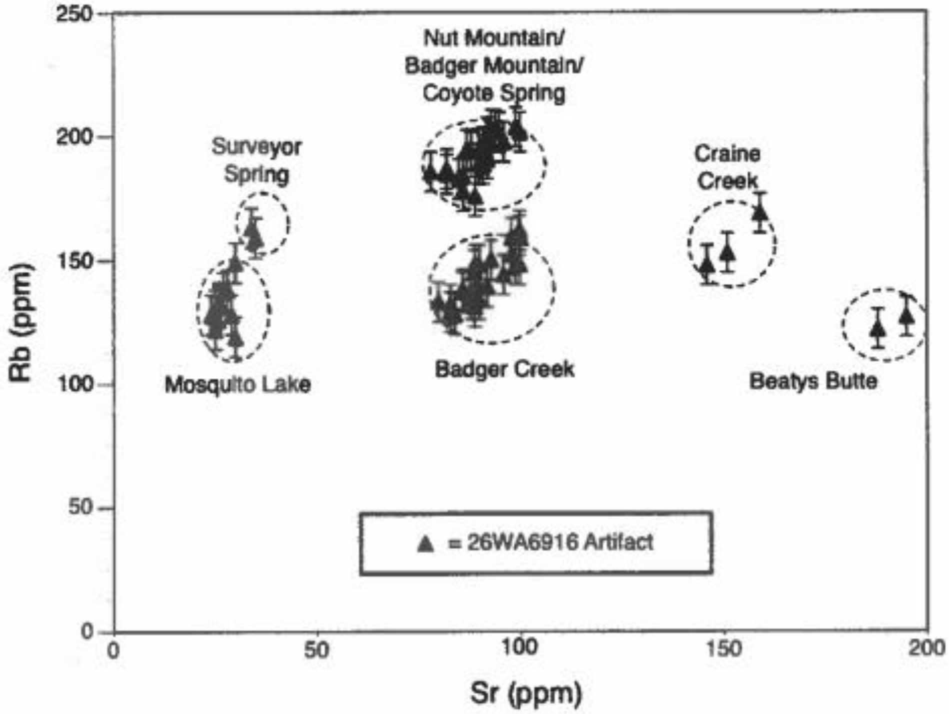
Most of the artifacts (183 of 186) you sent from this site were of adequate physical size to generate reliable quantitative composition estimates, but three others were too small and thin to generate x-ray counting statistics adequate for proper conversion from background-corrected intensities to quantitative concentration estimates (i.e., ppm) so I analyzed these three to generate integrated net count (intensity) data for the elements Rb, Sr, Y, Zr, Nb, Mn and Fe (protocol and references in Hughes 2010). Integrated net peak intensity data for these artifacts appear in Table 2, and the ratios derived are plotted in Figure 1 along with the other samples so that quantitative and integrated net peak intensity data can be compared directly (see Hughes 2022: 2).

As you'll see from Figure 1, Fe/Mn vs. Zr/Rb data effectively partition most of the Wa6916 artifacts into the correct geochemical group, with some notable exceptions. For example, Fe/Mn vs. Zr/Rb data for South Warners and Hawk's Valley obsidian are very similar, but South Warner glass contains ca. 350-400 ppm Ba, while Hawk's Valley contains < 50 ppm. Buffalo Hills and Bidwell Mountain have a similar Fe/Mn vs. Zr/Nb profile, but Buffalo Hills contains > 1000 ppm Ba, while Bidwell Mountain contains < 25.

Different combinations of trace elements were employed to identify the sources (chemical types) not successfully segregated using Fe/Mn vs. Zr/Rb data. Rb vs. Sr ppm values (see Figure 2) separated Nut Mountain (which also occurs in redeposited context at Coyote Spring and at Badger Mountain), from Badger Creek, Surveyor Spring, and Mosquito Creek. Craine Creek and Beatys Butte also were identified using Rb vs. Sr data, although other element combinations could have been used (including Ba).

Figure 2

Rb vs. Sr Composition of Obsidian Artifacts from 26WA6916



Dashed lines represent range of variation measured in archaeologically significant geological obsidian source samples. Symbols plot data from Tables 1 and 2. ***Note***: non-obsidian artifacts not plotted.

Laboratory Analysis Results for 26Wa6916

The combined results from quantitative and integrated net peak intensity data show that 72 of 186 artifacts plot within the composition range of obsidian of the Massacre Lake/Guano Valley (ML/GV) chemical type, 24 other conform to the Nut Mountain chemical profile, 22 match the chemical signature of Badger Creek obsidian, 16 conform to the Long Valley obsidian fingerprint, 15 fall within the range for obsidians of the Mosquito Lake chemical type, four were made from Bidwell Mountain (aka Cowhead Lake) volcanic glass, three specimens each match the profile of Buck Mountain and of Craine Creek, obsidian, and two specimens each were made from Beatys Butte, Hawk's Valley and from Surveyor Spring obsidian. Single artifacts match the profile of Buffalo Hills, East Creek (a.k.a. Nellie Spring), Bordwell Spring, and South Warners obsidian. Three artifacts were made from obsidians not in my current regional comparative reference collection, and 14 other specimens were manufactured from geographically-unknown varieties of basalt, andesite, and/or dacite.

I hope this information will be of assistance in your interpretation of the significance of this site. Please contact me at my laboratory ([650] 400-6815; e-mail: rehughes@silcon.com) if I can be of further assistance. As you requested, all of the artifacts have been forwarded to Tom Origer for obsidian hydration analysis.

Sincerely,
Richard Hughes
Richard E. Hughes, Ph.D., RPA
Director, Geochemical Research Laboratory

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2022 Energy Dispersive X-ray Fluorescence Analysis of Obsidian from Four Archaeological Sites Located Within the Home Camp Riparian Project, Washoe County, Nevada. Geochemical Research Laboratory Letter Report 2021-43, submitted to Jennifer Rovanpera, BLM Surprise Valley Field Station, June 12, 2022.

Table 1

Quantitative Composition Data for Large Obsidian Artifacts from 26Wa6916

			Trace and Minor Element Composition																Ratio	Obsidian Source
Site	**Cat. No.**	**Sub.**	**Rb**	**±**	**Sr**	**±**	**Y**	**±**	**Zr**	**±**	**Nb**	**±**	**Ba**	**±**	**Fe_2O_3'**	**±**	**Fe/Mn**	**(Chemical Type)**
26WA6916	001	a	192	5	1	2	89	4	546	6	29	3	nm	–	2.20	0.03	23.4	Massacre Lake/Guano Valley
26WA6916	005	a	130	4	25	3	41	3	188	4	32	3	219	19	1.39	0.02	36.7	Mosquito Lake
26WA6916	006	a	228	5	17	2	47	3	135	4	28	3	nm	–	0.95	0.02	22.5	Hawk's Valley
26WA6916	007	–	196	5	91	4	31	3	182	4	20	3	643	21	1.39	0.03	32.4	Nut Mountain
26WA6916	009	a	225	5	0	2	100	4	616	7	34	3	nm	–	nm	–	22.8	Massacre Lake/Guano Valley
26WA6916	011	–	184	5	86	4	29	3	177	4	19	2	636	21	1.24	0.02	33.0	Nut Mountain
26WA6916	012	a	229	5	1	2	100	4	620	6	34	3	nm	–	nm	–	23.0	Massacre Lake/Guano Valley
26WA6916	016	a	210	5	1	2	90	4	587	6	30	3	nm	–	2.14	0.03	22.3	Massacre Lake/Guano Valley
26WA6916	018	–	183	4	1	2	96	4	698	8	76	3	nm	–	2.51	0.03	59.0	Long Valley
26WA6916	019	–	185	4	2	2	95	4	668	7	75	3	nm	–	2.37	0.03	58.8	Long Valley
26WA6916	020	–	246	5	3	3	106	4	647	8	35	3	nm	–	nm	–	24.1	Massacre Lake/Guano Valley
26WA6916	021	–	209	4	2	2	92	4	578	6	30	3	nm	–	2.17	0.03	22.9	Massacre Lake/Guano Valley
26WA6916	022	a	232	5	2	2	104	4	633	7	34	3	nm	–	nm	–	23.0	Massacre Lake/Guano Valley
26WA6916	022	b	210	5	1	2	94	4	582	6	32	3	nm	–	2.46	0.03	23.2	Massacre Lake/Guano Valley
26WA6916	023	a	190	5	90	4	34	3	171	4	20	3	605	21	1.42	0.02	31.2	Nut Mountain
26WA6916	025	a	232	5	1	2	98	4	628	7	33	3	nm	–	nm	–	23.2	Massacre Lake/Guano Valley
26WA6916	026	a	190	5	92	4	32	3	172	5	19	2	625	25	1.49	0.03	29.6	Nut Mountain
26WA6916	027	–	148	4	146	4	20	3	143	3	14	2	1206	23	1.55	0.02	34.5	Craine Creek
26WA6916	028	–	208	5	1	2	109	4	724	7	81	4	nm	–	nm	–	61.7	Long Valley
26WA6916	029	a	133	4	80	3	18	2	135	4	10	2	1016	25	0.94	0.02	30.3	Badger Creek
26WA6916	029	b	220	5	2	2	102	4	620	7	31	3	nm	–	nm	–	23.5	Massacre Lake/Guano Valley
26WA6916	030	a	190	5	90	4	33	3	181	4	17	2	626	21	1.32	0.03	32.0	Nut Mountain
26WA6916	033	a	160	4	100	4	21	3	156	4	12	2	1023	24	1.14	0.02	29.0	Badger Creek
26WA6916	034	a	191	5	92	4	33	3	186	4	17	2	642	21	1.31	0.03	30.9	Nut Mountain
26WA6916	037	a	230	5	2	2	99	4	625	7	33	3	nm	–	2.52	0.03	22.5	Massacre Lake/Guano Valley
26WA6916	041	a	227	4	2	2	99	4	627	7	34	3	nm	–	nm	–	23.1	Massacre Lake/Guano Valley
26WA6916	042	–	131	4	26	3	40	3	187	4	32	3	208	19	1.55	0.03	38.4	Mosquito Lake
26WA6916	043	–	235	5	2	2	100	4	627	7	35	3	nm	–	nm	–	23.8	Massacre Lake/Guano Valley
26WA6916	044	–	240	5	1	2	105	4	639	7	35	3	nm	–	nm	–	22.7	Massacre Lake/Guano Valley
26WA6916	045	–	227	5	1	2	101	4	621	7	31	3	nm	–	nm	–	22.2	Massacre Lake/Guano Valley
26WA6916	046	–	235	5	1	2	102	4	906	6	32	3	nm	–	2.37	0.03	21.3	Massacre Lake/Guano Valley
26WA6916	047	–	157	4	4	2	66	3	457	5	51	3	nm	–	2.19	0.03	35.2	Unknown
26WA6916	048	–	218	4	1	2	100	4	616	6	34	3	nm	–	nm	–	23.2	Massacre Lake/Guano Valley
26WA6916	049	–	209	4	2	2	95	4	589	6	33	3	nm	–	2.27	0.03	21.5	Massacre Lake/Guano Valley

Table 1

Quantitative Composition Data for Large Obsidian Artifacts from 26Wa6916

			Trace and Minor Element Composition														Ratio	Obsidian Source
Site	**Cat. No.**	**Sub.**	**Rb**	**±**	**Sr**	**±**	**Y**	**±**	**Zr**	**±**	**Nb**	**±**	**Ba**	**±**	**Fe_2O_3'**	**±**	**Fe/Mn**	**(Chemical Type)**
26WA6916	050	–	117	4	6	2	34	3	73	3	17	2	nm		0.83	0.02	9.8	Bidwell Mountain
26WA6916	051	–	140	4	72	4	26	3	100	4	14	2	1017	23	0.82	0.02	13.1	Buffalo Hills
26WA6916	052	–	200	5	2	2	91	4	565	6	29	3	nm	–	2.32	0.03	23.4	Massacre Lake/Guano Valley
26WA6916	053	–	220	5	3	2	99	4	611	6	35	3	nm	–	2.54	0.03	23.8	Massacre Lake/Guano Valley
26WA6916	054	–	131	4	26	3	40	3	174	4	33	3	191	19	1.43	0.02	35.5	Mosquito Lake
26WA6916	055	–	177	4	2	2	93	4	691	7	72	3	nm	–	2.28	0.03	61.6	Long Valley
26WA6916	056	–	195	5	86	4	31	3	180	4	19	2	636	21	1.30	0.03	29.1	Nut Mountain
26WA6916	057	–	194	5	95	4	31	3	183	5	17	2	608	23	1.53	0.03	32.6	Nut Mountain
26WA6916	058	–	85	4	263	5	39	3	202	5	10	2	1670	28	6.50	0.04	53.8	Unknown Dacite I
26WA6916	060	–	78	3	634	6	11	2	105	4	4	2	648	27	4.52	0.04	80.8	Unknown Dacite II
26WA6916	061	–	64	3	742	7	12	2	108	4	5	2	1431	26	6.05	0.04	70.6	Unknown Dacite
26WA6916	064	a	128	4	24	3	40	3	178	4	31	3	194	18	1.30	0.02	32.9	Mosquito Lake
26WA6916	064	b	132	4	26	3	42	3	185	4	30	3	214	19	1.49	0.03	36.5	Mosquito Lake
26WA6916	064	c	170	4	2	2	88	4	633	7	72	3	nm	–	2.13	0.03	57.6	Long Valley
26WA6916	064	d	134	4	88	4	16	2	151	4	11	2	1105	24	0.98	0.02	31.9	Badger Creek
26WA6916	064	e	119	4	30	3	33	3	190	4	20	2	673	22	1.29	0.02	18.7	Unknown
26WA6916	068	–	148	4	89	4	18	2	153	4	13	2	973	24	1.09	0.02	29.7	Badger Creek
26WA6916	069	–	152	4	98	4	19	2	168	4	10	2	1010	25	1.19	0.02	32.8	Badger Creek
26WA6916	070	–	225	5	2	2	97	4	627	7	32	3	nm	–	2.70	0.03	24.1	Massacre Lake/Guano Valley
26WA6916	071	–	208	5	3	3	98	4	597	6	33	3	nm	–	2.50	0.03	24.2	Massacre Lake/Guano Valley
26WA6916	072	–	232	5	0	2	99	4	634	7	34	3	nm	–	2.57	0.03	23.0	Massacre Lake/Guano Valley
26WA6916	073	–	205	5	0	2	93	4	584	6	31	3	nm	–	2.36	0.03	23.1	Massacre Lake/Guano Valley
26WA6916	074	–	178	5	2	2	96	4	682	7	75	3	nm	–	2.33	0.03	60.7	Long Valley
26WA6916	075	–	219	5	1	2	97	4	609	7	33	3	nm	–	2.42	0.03	23.5	Massacre Lake/Guano Valley
26WA6916	076	–	195	4	1	2	91	5	563	6	32	3	nm	–	2.17	0.03	23.0	Massacre Lake/Guano Valley
26WA6916	077	–	200	5	1	2	90	4	569	6	31	3	nm	–	2.29	0.03	22.1	Massacre Lake/Guano Valley
26WA6916	078	–	202	5	2	2	93	4	584	6	32	3	nm	–	2.35	0.03	23.7	Massacre Lake/Guano Valley
26WA6916	079	–	146	4	89	4	19	2	145	4	11	2	1078	23	1.06	0.02	29.2	Badger Creek
26WA6916	080	–	204	5	2	2	95	4	585	6	30	3	nm	–	2.31	0.03	23.4	Massacre Lake/Guano Valley
26WA6916	081	–	163	4	34	3	28	3	126	4	15	2	285	19	1.28	0.02	41.8	Surveyor Spring
26WA6916	082	–	244	5	1	2	102	4	646	7	35	3	nm	–	nm	–	23.0	Massacre Lake/Guano Valley
26WA6916	083	–	228	5	2	2	98	4	611	6	31	3	nm	–	nm	–	22.7	Massacre Lake/Guano Valley
26WA6916	084	–	128	4	25	3	38	3	179	4	31	3	244	19	1.40	0.02	36.6	Mosquito Lake
26WA6916	085	–	211	5	1	2	100	4	617	6	34	3	nm	–	nm	–	24.0	Massacre Lake/Guano Valley
26WA6916	086	–	164	4	14	3	71	3	235	5	17	2	96	18	2.01	0.03	54.0	Nellie Spring/East Creek

Table 1

Quantitative Composition Data for Large Obsidian Artifacts from 26Wa6916

			Trace and Minor Element Composition														Ratio	Obsidian Source
Site	**Cat. No.**	**Sub.**	**Rb**	**±**	**Sr**	**±**	**Y**	**±**	**Zr**	**±**	**Nb**	**±**	**Ba**	**±**	**Fe_2O_3'**	**±**	**Fe/Mn**	**(Chemical Type)**
26WA6916	087	–	171	4	71	3	18	2	91	4	13	2	372	20	nm	–	22.8	South Warners
26WA6916	088	–	223	5	0	2	98	4	611	6	32	3	nm	–	2.52	0.03	22.4	Massacre Lake/Guano Valley
26WA6916	089	–	148	4	90	4	20	3	156	4	11	2	1049	24	1.28	0.02	30.6	Badger Creek
26WA6916	090	–	223	5	2	2	100	4	619	6	35	3	0	19	2.53	0.03	24.7	Massacre Lake/Guano Valley
26WA6916	091	–	169	4	168	4	22	3	161	4	13	2	1248	29	2.15	0.03	37.1	Craine Creek
26WA6916	092	–	215	5	1	2	95	4	593	6	32	3	nm	–	2.25	0.03	22.9	Massacre Lake/Guano Valley
26WA6916	093	–	117	4	7	2	33	3	72	3	16	2	nm	–	0.87	0.02	10.0	Bidwell Mountain
26WA6916	094	–	122	4	188	5	15	2	121	4	9	2	1082	22	1.30	0.02	32.5	Beatys Butte
26WA6916	095	–	127	4	190	5	13	2	151	4	11	2	1078	23	nm	–	33.3	Beatys Butte
26WA6916	096	–	234	5	19	2	48	3	136	4	28	3	25	20	1.05	0.02	21.4	Hawk's Valley
26WA6916	098	–	186	5	2	2	101	4	704	9	75	4	nm	–	nm	–	65.5	Long Valley
26WA6916	099	–	217	5	2	2	96	4	607	7	33	3	nm	–	2.48	0.03	22.5	Massacre Lake/Guano Valley
26WA6916	100	–	139	4	90	4	18	2	158	4	11	2	1128	24	nm	–	31.7	Badger Creek
26WA6916	101	–	192	4	1	2	98	4	686	7	75	3	nm	–	nm	–	57.6	Long Valley
26WA6916	102	–	159	4	92	4	20	2	157	4	12	2	1095	23	nm	–	29.3	Badger Creek
26WA6916	103	–	133	4	82	3	19	2	137	4	11	2	1122	23	0.92	0.02	31.2	Badger Creek
26WA6916	104	–	206	5	1	2	90	4	580	6	31	3	nm	–	2.27	0.03	23.9	Massacre Lake/Guano Valley
26WA6916	105	–	205	5	1	2	95	4	592	6	32	3	nm	–	2.40	0.03	23.4	Massacre Lake/Guano Valley
26WA6916	106	–	150	4	93	4	17	2	158	4	10	2	1008	28	1.23	0.02	31.3	Badger Creek
26WA6916	107	–	148	4	85	4	20	2	170	4	12	2	1124	23	1.33	0.03	33.7	Badger Creek
26WA6916	108	–	193	5	2	2	87	4	549	6	31	3	nm	–	2.29	0.03	24.5	Massacre Lake/Guano Valley
26WA6916	109	–	227	5	2	2	97	4	626	7	33	3	nm	–	2.26	0.04	23.2	Massacre Lake/Guano Valley
26WA6916	110	–	138	4	28	3	41	3	188	4	33	3	224	20	nm	–	36.8	Mosquito Lake
26WA6916	111	–	197	5	2	2	87	4	560	6	32	3	nm	–	2.22	0.03	23.6	Massacre Lake/Guano Valley
26WA6916	112	–	176	4	1	2	91	4	649	7	72	4	nm	–	2.34	0.03	59.0	Long Valley
26WA6916	113	–	203	4	2	2	93	4	568	6	31	3	nm	–	2.43	0.03	24.5	Massacre Lake/Guano Valley
26WA6916	114	–	198	5	1	2	89	4	555	6	29	3	nm	–	2.22	0.03	23.0	Massacre Lake/Guano Valley
26WA6916	115	–	134	4	90	4	17	2	192	4	11	2	1153	25	1.00	0.02	30.3	Badger Creek
26WA6916	116	–	199	5	1	2	89	4	559	6	31	3	nm	–	2.27	0.03	23.8	Massacre Lake/Guano Valley
26WA6916	117	–	189	4	2	2	90	4	548	6	31	3	nm	–	2.21	0.03	23.8	Massacre Lake/Guano Valley
26WA6916	118	–	130	4	26	3	41	3	179	4	31	3	254	21	1.48	0.02	35.9	Mosquito Lake
26WA6916	119	–	148	4	2	2	56	3	336	5	18	2	nm	–	2.11	0.02	57.8	Bordwell Spring
26WA6916	120	–	187	5	82	4	32	3	169	4	19	2	545	20	1.23	0.02	30.6	Nut Mountain
26WA6916	121	–	189	5	90	4	32	3	177	4	19	2	560	20	1.31	0.02	32.5	Nut Mountain
26WA6916	122	–	183	4	85	4	32	3	172	4	19	2	562	20	1.24	0.02	30.2	Nut Mountain

Table 1

Quantitative Composition Data for Large Obsidian Artifacts from 26Wa6916

			Trace and Minor Element Composition														Ratio	Obsidian Source
Site	**Cat. No.**	**Sub.**	**Rb**	**±**	**Sr**	**±**	**Y**	**±**	**Zr**	**±**	**Nb**	**±**	**Ba**	**±**	**Fe_2O_3'**	**±**	**Fe/Mn**	**(Chemical Type)**
26WA6916	123	–	194	5	88	4	34	3	177	4	20	2	558	20	1.32	0.02	30.6	Nut Mountain
26WA6916	124	–	178	4	86	4	30	3	170	4	17	2	633	21	1.29	0.02	36.1	Nut Mountain
26WA6916	125	–	53	3	444	5	27	3	247	5	10	2	1316	25	5.52	0.04	57.3	Unknown Dacite
26WA6916	131	a	131	4	89	4	18	2	152	4	11	2	1048	22	nm	–	33.0	Badger Creek
26WA6916	131	b	137	4	86	4	18	2	145	4	10	2	1072	23	0.95	0.02	29.2	Badger Creek
26WA6916	131	c	228	5	2	2	103	4	627	7	32	2	nm	–	nm	–	23.6	Massacre Lake/Guano Valley
26WA6916	131	d	125	4	81	4	18	2	141	4	12	2	1122	22	nm	–	29.1	Badger Creek
26WA6916	131	e	230	5	2	2	100	4	621	7	35	3	nm	–	nm	–	22.8	Massacre Lake/Guano Valley
26WA6916	131	f	128	4	84	4	17	2	145	4	11	2	1062	23	0.92	0.02	30.0	Badger Creek
26WA6916	131	g	137	4	27	3	41	3	183	4	32	2	193	22	nm	–	38.7	Mosquito Lake
26WA6916	131	h	228	5	0	2	99	4	619	7	32	3	nm	–	nm	–	23.3	Massacre Lake/Guano Valley
26WA6916	131	i	138	4	86	4	18	2	143	4	10	2	1092	24	0.99	0.02	30.8	Badger Creek
26WA6916	131	j	148	4	90	4	20	3	165	4	12	2	1070	22	nm	–	29.8	Badger Creek
26WA6916	131	k	129	4	83	4	17	2	138	4	10	2	1055	25	nm	–	31.6	Badger Creek
26WA6916	131	l	232	5	1	2	102	4	628	7	33	2	nm	–	nm	–	22.9	Massacre Lake/Guano Valley
26WA6916	131	m	190	5	1	2	98	4	695	8	78	3	nm	–	nm	–	58.7	Long Valley
26WA6916	131	n	208	5	2	2	94	4	593	6	32	3	nm	–	nm	–	23.6	Massacre Lake/Guano Valley
26WA6916	131	o	183	4	3	2	97	4	655	7	72	3	nm	–	nm	–	61.9	Long Valley
26WA6916	131	p	208	5	1	2	94	4	591	6	30	3	nm	–	2.44	0.03	24.1	Massacre Lake/Guano Valley
26WA6916	131	q	226	5	2	2	98	4	627	6	34	2	0	17	2.49	0.03	23.2	Massacre Lake/Guano Valley
26WA6916	131	r	139	4	88	4	18	2	163	4	10	2	1111	24	1.20	0.02	26.9	Badger Creek
26WA6916	131	s	209	5	3	2	94	4	587	6	31	3	nm	–	2.16	0.03	23.0	Massacre Lake/Guano Valley
26WA6916	131	t	207	5	2	2	95	4	587	6	31	3	nm	–	2.40	0.03	23.0	Massacre Lake/Guano Valley
26WA6916	131	u	216	5	5	2	97	4	608	7	31	3	nm	–	nm	–	23.8	Massacre Lake/Guano Valley
26WA6916	131	v	186	4	1	2	84	4	559	6	29	3	nm	–	nm	–	22.9	Massacre Lake/Guano Valley
26WA6916	132	a	32	3	635	7	70	3	269	5	21	3	2031	31	13.67	0.08	56.7	Unknown Basalt
26WA6916	132	b	74	3	685	7	18	2	198	5	9	2	1345	25	6.44	0.05	79.3	Unknown Dacite
26WA6916	132	c	189	5	88	4	29	3	178	4	17	2	631	22	1.28	0.02	29.7	Nut Mountain
26WA6916	132	d	186	4	78	3	33	3	165	4	19	2	545	20	1.30	0.02	30.4	Nut Mountain
26WA6916	132	e	190	5	86	4	33	3	182	4	19	2	614	21	nm	–	29.7	Nut Mountain
26WA6916	132	f	190	5	87	4	32	3	180	4	18	2	589	23	nm	–	32.3	Nut Mountain
26WA6916	132	h	65	3	675	8	18	2	162	4	9	2	1275	25	6.58	0.04	68.5	Unknown Dacite
26WA6916	132	i	98	4	25	3	40	3	486	6	24	3	472	21	3.79	0.04	131.2	Unknown Dacite?
26WA6916	132	j	185	4	85	4	32	3	179	4	17	2	636	24	nm	–	30.2	Nut Mountain
26WA6916	141	–	235	5	0	2	101	4	629	6	33	3	nm	–	nm	–	24.2	Massacre Lake/Guano Valley

Table 1

Quantitative Composition Data for Large Obsidian Artifacts from 26Wa6916

			Trace and Minor Element Composition														Ratio	Obsidian Source
Site	**Cat. No.**	**Sub.**	**Rb**	**±**	**Sr**	**±**	**Y**	**±**	**Zr**	**±**	**Nb**	**±**	**Ba**	**±**	**Fe_2O_3'**	**±**	**Fe/Mn**	**(Chemical Type)**
26WA6916	142	–	201	5	1	2	92	4	587	6	32	3	nm	–	2.29	0.03	24.0	Massacre Lake/Guano Valley
26WA6916	143	–	229	5	1	2	96	4	596	6	33	3	nm	–	2.16	0.03	21.5	Massacre Lake/Guano Valley
26WA6916	144	–	233	5	2	2	99	4	619	7	34	3	nm	–	nm	–	22.7	Massacre Lake/Guano Valley
26WA6916	145	–	145	4	4	2	63	3	414	5	49	3	nm	–	1.98	0.02	36.4	Unknown
26WA6916	146	–	210	5	3	2	96	4	591	6	29	3	nm	–	2.45	0.03	23.4	Massacre Lake/Guano Valley
26WA6916	147	–	153	4	151	4	19	2	149	4	14	2	1350	25	1.64	0.02	34.5	Craine Creek
26WA6916	148	–	105	4	70	3	19	2	91	4	12	2	700	21	0.89	0.02	19.8	Buck Mountain
26WA6916	149	–	226	5	2	2	99	4	616	7	34	3	nm	–	nm	–	23.4	Massacre Lake/Guano Valley
26WA6916	150	–	190	5	2	2	94	4	575	6	32	3	nm	–	2.42	0.03	24.0	Massacre Lake/Guano Valley
26WA6916	151	–	210	5	0	2	92	4	586	6	30	3	nm	–	2.25	0.03	23.1	Massacre Lake/Guano Valley
26WA6916	152	–	133	4	26	3	41	3	188	4	32	3	209	19	1.55	0.02	36.3	Mosquito Lake
26WA6916	153	–	208	5	2	2	93	4	585	6	32	3	nm	–	2.42	0.03	23.3	Massacre Lake/Guano Valley
26WA6916	154	–	208	5	1	2	102	4	618	7	32	3	nm	–	nm	–	23.3	Massacre Lake/Guano Valley
26WA6916	155	–	128	4	29	3	40	3	183	4	31	3	204	19	1.39	0.02	33.8	Mosquito Lake
26WA6916	156	–	186	4	1	2	93	4	652	7	72	3	nm	–	2.50	0.03	55.4	Long Valley
26WA6916	157	–	183	4	1	2	95	4	672	7	73	3	nm	–	2.34	0.03	58.8	Long Valley
26WA6916	158	–	180	4	1	2	99	4	655	7	75	3	nm	–	2.08	0.03	64.9	Long Valley
26WA6916	159	–	159	4	35	3	27	3	129	4	14	2	293	20	1.17	0.02	38.3	Surveyor Spring
26WA6916	160	–	170	4	72	3	16	2	92	4	10	2	704	22	0.86	0.02	20.7	Buck Mountain
26WA6916	161	–	122	4	25	3	36	3	174	4	29	3	220	20	1.35	0.02	36.3	Mosquito Lake
26WA6916	162	–	116	4	4	2	32	3	68	3	15	2	15	17	0.82	0.02	8.9	Bidwell Mountain
26WA6916	163	–	119	4	75	3	19	2	94	4	14	2	714	22	nm	–	20.5	Buck Mountain
26WA6916	164	–	132	4	26	3	39	3	181	4	31	3	220	20	nm	–	33.7	Mosquito Lake
26WA6916	165	–	200	5	1	2	90	4	564	6	33	3	nm	–	2.29	0.03	23.2	Massacre Lake/Guano Valley
26WA6916	166	–	115	4	4	2	30	3	68	3	16	2	nm	–	0.80	0.02	9.0	Bidwell Mountain
26WA6916	167	–	178	4	2	2	94	4	650	7	74	3	nm	–	2.31	0.03	62.8	Long Valley
26WA6916	168	–	206	5	2	2	92	4	580	6	32	3	nm	–	2.14	0.03	22.7	Massacre Lake/Guano Valley
26WA6916	169	–	204	5	2	2	90	4	577	6	30	3	nm	–	2.27	0.03	22.7	Massacre Lake/Guano Valley
26WA6916	170	–	201	5	0	2	89	4	582	6	30	3	nm	–	2.21	0.03	22.9	Massacre Lake/Guano Valley
26WA6916	171	–	202	5	0	2	90	4	566	7	32	3	nm	–	2.60	0.03	22.9	Massacre Lake/Guano Valley
26WA6916	172	–	183	4	0	2	95	4	643	7	75	3	nm	–	2.13	0.03	57.3	Long Valley
26WA6916	173	–	141	4	91	4	17	2	152	4	11	2	1072	24	1.17	0.02	32.6	Badger Creek
26WA6916	174	–	133	4	26	3	40	3	185	4	32	3	237	20	nm	–	33.9	Mosquito Lake
26WA6916	175	–	185	5	82	4	32	3	167	4	18	2	566	21	nm	–	28.0	Nut Mountain
26WA6916	176	–	190	5	85	4	32	3	181	4	20	2	589	20	nm	–	31.9	Nut Mountain

Table 1

Quantitative Composition Data for Large Obsidian Artifacts from 26Wa6916

			Trace and Minor Element Composition														Ratio	Obsidian Source
Site	**Cat. No.**	**Sub.**	**Rb**	**±**	**Sr**	**±**	**Y**	**±**	**Zr**	**±**	**Nb**	**±**	**Ba**	**±**	**Fe_2O_3'**	**±**	**Fe/Mn**	**(Chemical Type)**
26WA6916	177	–	62	3	400	5	34	3	240	5	13	3	1143	25	7.52	0.05	55.1	Unknown Dacite II
26WA6916	178	–	185	4	86	4	33	3	183	4	18	2	692	26	nm	–	31.1	Nut Mountain
26WA6916	179	–	79	3	389	5	36	3	201	4	13	2	1200	26	7.44	0.05	54.9	Unknown Dacite II
26WA6916	180	–	431	5	8	2	187	4	1086	10	87	4	48	19	2.98	0.03	58.2	Unknown Rhyolite
26WA6916	181	–	69	3	695	8	19	2	203	5	12	2	1334	26	6.47	0.05	74.9	Unknown Dacite
26WA6916	182	–	188	4	86	4	31	3	180	5	16	2	606	22	1.32	0.02	31.1	Nut Mountain
26WA6916	183	–	185	5	90	4	31	3	190	5	20	2	634	21	nm	–	35.6	Nut Mountain
26WA6916	184	–	55	3	601	7	41	3	144	4	9	2	2103	29	13.44	0.07	66.5	Unknown Basalt
26WA6916	186	–	72	3	232	5	20	3	63	3	9	2	258	20	7.52	0.05	60.8	Unknown Dacite
U.S. Geological Survey Reference Standard																		
RGM-1 (measured)			152	4	112	3	24	3	222	4	9	3	816	22	1.85	0.02	63.0	Glass Mountain
RGM-1 (recommended)[a]			149		108		25		219		9		807		1.86		n.r.	Glass Mountain

Values in parts per million (ppm) except total iron [in weight %] and Fe/Mn intensity ratios; ± = 2 σ expression of x-ray counting uncertainty and regression fitting error at 120-360 seconds livetime. nm= not measured., n.r.= not reported [a], (Govindaraju 1994).

Table 2

Integrated Net Peak Intensity Data for Small/Thin Artifacts from 26Wa6916

		Element Intensities							Element Ratios						Source
Site	**Cat. no.**	**Rb**	**Sr**	**Zr**	**Σ Rb,Sr,Zr**	**Rb%**	**Sr%**	**Zr%**	**Fe/Mn**	**Rb/Sr**	**Zr/Y**	**Y/Nb**	**Zr/Nb**	**Sr/Y**	**(Chemical Type)**
26WA6916	010	288	65	662	1015	0.284	0.064	0.652	40.8	4.4	5.7	1.0	5.6	0.6	Mosquito Lake
26WA6916	038a	370	11	1689	1770	0.209	0.006	0.785	24.7	33.6	10.5	1.4	15.1	0.1	ML/GV
26WA6916	065a	471	251	722	1444	0.326	0.174	0.500	31.7	1.9	7.4	1.5	10.9	2.6	Nut Mountain

Elemental intensities (peak counts/second above background) generated at 40-60 seconds livetime.

Appendix B: Origer OHD Report

ORIGER'S OBSIDIAN LABORATORY
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February 27, 2024

Jen Rovanpera
BLM Applegate Field Office
708 W. 12th Street
Alturas, CA 96101

Dear Ms. Rovanpera:

I write to report the results of obsidian hydration band analysis of 172 specimen submitted from site 26WA6916 within the BLM's Sage Hen Spring Riparian Restoration Project in Nevada. This work was completed following source determination by Richard Hughes, Geochemical Research Laboratory, who forwarded the specimens to us on your behalf.

Procedures typically used by our lab for preparation of thin sections and measurement of hydration bands are described here. Specimens are examined to find two or more surfaces that will yield edges that will be perpendicular to the microslides when preparation of each thin section is done. Generally, two parallel cuts are made at an appropriate location along the edge of each specimen with a four-inch diameter circular saw blade mounted on a lapidary trimsaw. The cuts result in the isolation of small samples with a thickness of about one millimeter. The samples are removed from the specimens and mounted with Lakeside Cement onto etched glass micro-slides.

The thickness of the sample was reduced by manual grinding with a slurry of #600 silicon carbide abrasive on plate glass. Grinding was completed in two steps. The first grinding is stopped when the samples thickness is reduced by approximately one-half. This eliminates micro-flake scars created by the saw blade during the cutting process. The slide is then reheated, which liquefies the Lakeside Cement, and the sample is inverted. The newly exposed surfaces are then ground until proper thickness is attained.

Correct thin section thickness is determined by the "touch" technique. A finger is rubbed across the slide, onto the sample, and the difference (sample thickness) is "felt." The second technique used to arrive at proper thin section thickness is the "transparency" test where the micro-slide is held up to a strong source of light and the translucency of each sample is observed. The sample is reduced enough when it readily allows the passage of light. A cover glass is affixed over the sample when grinding is completed. The slide and paperwork are on file at the offices of Origer's Obsidian Laboratory under File No. OOL-1386.

The hydration bands were measured with a strainfree 60-power objective and a Bausch and Lomb 12.5-power filar micrometer eyepiece mounted on a Nikon Labophot-Pol polarizing microscope. Hydration band measurements have a range of ± 0.1 microns due to normal equipment limitations. Six measurements are taken at several locations along the edge of the thin section, and the mean of the measurements are calculated and listed on the enclosed data pages.

Forty-two specimens failed to yield useful hydration measurements. Twenty-eight specimens had no visible hydration band. Eight specimens exhibited a hydration band too diffuse to make a reliable reading and had weathered surfaces. Six specimens exhibited a hydration band with variable width and had weathered surfaces.

Four specimens had multiple hydration bands. Multiple hydration bands could be the result of reworking of the specimens or the occurrence of damage. "Band 1" on multiple band specimens is the thinner band while "Band 2" is the thicker band. For two of these specimens, a crack yielded measurable hydration noted as Band 2.

Multiple hydration bands, no visible hydration, and weathered surfaces could all be the result of prehistoric and historic trampling and/or fire which could also leave specimens marked by no visible hydration band, especially if a fire was relatively recent.

Special Analysis

Six specimens were selected for detailed analysis to examine the history of alteration/damage they sustained. Pertinent information is summarized in the table below.

Specimen ID	Description	Alteration/damage
2023-020	Biface tip	Laterally broken
2023-141	Projectile point	Tip and base damaged Shallow concavity at most damaged end
2023-143	Projectile point	Tip, base, and barbs broken
2023-147	Projectile point with concave base	Laterally broken
2023-151	Projectile point	Tip damaged and barbs removed
2023-152	Projectile point base	Laterally broken

Procedures

Specimens 2023-020 was analyzed by removing a single sample that included both faces and the broken surface.

Specimen 20-23-141 was analyzed by removal of two samples: one sample included both faces and the broken edge and the second sample included both faces at the concavity.

Specimen 2023-143 was analyzed by removal of two samples: one that included both faces and the broken edge at the distal end; and one sample that included both faces and the broken edge at the proximal end.

Specimen 2023-147 was analyzed by removing a single sample that included both faces and the broken surface.

Specimen 20-23-151 was analyzed by removal of two samples: one sample included both faces and the broken edge at the tip; and one sample included both faces and the broken edge of a missing barb.

Specimen 2023-152 was analyzed was analyzed by removing a single sample that included both faces and the broken surface.

Results

Specimen 2023-020 is marked by faces with hydration that measures 7.1 microns and a broken surface with hydration that measures 6.6 microns. The tip broke off after initial manufacture.

Specimen 2023-141 is marked by a complex history of damage/alteration. Face “A” is weathered and suggests original manufacture at approximately 3.5 microns. Side “B” is weathered and has 3.2 microns of hydration. Weathering on sides A and B may account for different hydration band thicknesses.
The edge damage resulting in the longitudinal scar took place at 2.8 microns.

Specimen 2023-141’s concavity is also complex. It’s “A” face has two flake scars. The older marked by 3.4 microns and the younger (nearer the edge) by 2.4 microns. The damaged (flake removed) “B” face is marked by hydration that measures 3.4 microns. The “working” edge of the concavity shows several cracks and step-fractures with hydration that measures 2.5 microns.

Specimen 2023-143 is marked by both faces, whether at the proximal or distal end, having hydration that measures 4.7 microns. The distal break surface has hydration that is the same thickness as the faces. The proximal (base) break shows no hydration. The base was broken off recently.

Specimen 2023-147 is marked by hydration that measures 1.2 microns on both faces and the broken surface.

Specimen 2023-151's tip has hydration that measures 1.2 microns on its "A" surface and its broken surface. The "B" surface has hydration that measures 3.4 microns. The barb location has hydration that measures 3.4 microns on the "A", "B", and broken surfaces.

Specimen 2023-152 is marked by hydration that measures 3.7 microns on both faces and the broken surface.

The remaining 120 specimens yielded normal hydration band measurements.

Please contact me with any questions.

Sincerely,

Thomas M. Origer
Director

Catalog#	Remarks	Measurements	Mean
26WA6916-2023-001-A			NVB
26WA6916-2023-005-A		1.3 1.3 1.3 1.4 1.5 1.5	1.4
26WA6916-2023-006-A		2.0 2.0 2.0 2.0 2.1 2.1	2.0
26WA6916-2023-007			NVB
26WA6916-2023-009-A		2.4 2.5 2.5 2.5 2.5 2.6	2.5
26WA6916-2023-010		2.5 2.5 2.5 2.5 2.6 2.6	2.5
26WA6916-2023-011			NVB
26WA6916-2023-012-A		4.0 4.1 4.2 4.2 4.3 4.3	4.2
26WA6916-2023-016-A		3.4 3.4 3.4 3.5 3.6 3.7	3.5
26WA6916-2023-018		2.0 2.0 2.0 2.0 2.0 2.0	2.0
26WA6916-2023-019		2.5 2.5 2.5 2.5 2.6 2.6	2.5
26WA6916-2023-020	Cut at break; Band 1; both sides	6.9 7.0 7.0 7.1 7.1 7.2	7.1
26WA6916-2023-020	Cut at break; Band 2; break	6.6 6.6 6.6 6.6 6.7 6.7	6.6
26WA6916-2023-021		3.1 3.1 3.2 3.3 3.3 3.3	3.2
26WA6916-2023-022-A		3.3 3.4 3.4 3.4 3.5 3.6	3.4
26WA6916-2023-022-B		4.9 4.9 5.0 5.1 5.1 5.2	5.0
26WA6916-2023-023-A			NVB
26WA6916-2023-025-A		3.8 3.8 3.8 3.9 4.0 4.0	3.9
26WA6916-2023-026-A			NVB
26WA6916-2023-027		2.5 2.5 2.5 2.5 2.6 2.7	2.6
26WA6916-2023-028		3.1 3.2 3.2 3.3 3.3 3.3	3.2
26WA6916-2023-029-A		2.9 2.9 2.9 3.0 3.0 3.0	3.0
26WA6916-2023-029-B		2.5 2.5 2.5 2.5 2.6 2.6	2.5
26WA6916-2023-030-A			NVB
26WA6916-2023-033-A		1.1 1.1 1.1 1.1 1.1 1.1	1. 1
26WA6916-2023-034-A			NVB
26WA6916-2023-037-A		3.4 3.5 3.6 3.6 3.6 3.7	3.6
26WA6916-2023-038-A			NVB
26WA6916-2023-041-A		2.8 2.8 2.9 3.0 3.0 3.0	2.9
26WA6916-2023-042		2.2 2.3 2.3 2.3 2.4 2.4	2.3
26WA6916-2023-043	Band 1		VW
26WA6916-2023-043	Band 2; crack	2.7 2.7 2.8 2.8 2.8 2.8	2.8
26WA6916-2023-044		2.1 2.1 2.1 2.1 2.1 2.2	2.1
26WA6916-2023-045	Band 1	2.3 2.4 2.4 2.4 2.5 2.5	2.4
26WA6916-2023-045	Band 2	6.6 6.6 6.7 6.7 6.8 6.9	6.7
26WA6916-2023-046		5.1 5.2 5.2 5.3 5.4 5.4	5.3
26WA6916-2023-047		3.8 3.8 3.8 3.8 3.9 4.1	3.9
26WA6916-2023-048		4.7 4.7 4.7 4.7 4.8 4.8	4.7
26WA6916-2023-049		3.0 3.0 3.1 3.1 3.1 3.2	3.1

26WA6916-2023-050		3.2 3.3 3.3 3.3 3.4 3.5	3.3
26WA6916-2023-051		2.0 2.0 2.0 2.0 2.1 2.1	2.1
26WA6916-2023-052		2.8 2.8 2.9 2.9 3.0 3.0	2.9
26WA6916-2023-053		2.7 2.8 2.9 2.9 2.9 2.9	2.9
26WA6916-2023-054		3.0 3.0 3.0 3.0 3.1 3.1	3.0
26WA6916-2023-055	Weathered	1.6 1.6 1.6 1.7 1.7 1.8	1.7
26WA6916-2023-056			NVB
26WA6916-2023-057			NVB
26WA6916-2023-064-A		2.8 2.8 2.8 2.8 2.9 2.9	2.8
26WA6916-2023-064-B		2.0 2.2 2.2 2.2 2.2 2.3	2.2
26WA6916-2023-064-C	Weathered		VW
26WA6916-2023-064-D		2.0 2.0 2.0 2.1 2.1 2.2	2.1
26WA6916-2023-064-E		2.1 2.2 2.2 2.2 2.3 2.3	2.2
26WA6916-2023-065-A			NVB
26WA6916-2023-068		1.1 1.1 1.2 1.2 1.3 1.3	1.2
26WA6916-2023-069		1.5 1.5 1.6 1.6 1.6 .16	1.6
26WA6916-2023-070		2.5 2.5 2.5 2.6 2.6 2.6	2.6
26WA6916-2023-071		2.5 2.5 2.5 2.5 2.5 2.5	2.5
26WA6916-2023-072		3.0 3.0 3.0 3.0 3.1 3.1	3.0
26WA6916-2023-073		2.8 2.9 2.9 2.9 3.0 3.0	2.9
26WA6916-2023-074		4.6 4.7 4.7 4.7 4.8 4.9	4.7
26WA6916-2023-075		2.0 2.0 2.0 2.0 2.1 2.1	2.0
26WA6916-2023-076		3.7 3.8 3.8 3.8 3.8 3.9	3.8
26WA6916-2023-077		3.0 3.0 3.0 3.0 3.0 3.1	3.0
26WA6916-2023-078		3.6 3.6 3.6 3.7 3.8 3.8	3.7
26WA6916-2023-079		3.5 3.5 3.6 3.7 3.7 3.7	3.6
26WA6916-2023-080		3.8 3.8 3.9 3.9 4.0 4.1	3.9
26WA6916-2023-081		4.8 4.8 4.9 4.9 5.0 5.1	4.9
26WA6916-2023-082		3.9 3.9 4.0 4.1 4.1 4.1	4.0
26WA6916-2023-083		4.4 4.4 4.5 4.6 4.6 4.8	4.6
26WA6916-2023-084	Band 1; weathered		DH
26WA6916-2023-084	Band 2; crack	4.4 4.4 4.5 4.5 4.5 4.6	4.5
26WA6916-2023-085	Weathered	3.4 3.4 3.4 3.5 3.6 3.6	3.5
26WA6916-2023-086		3.7 3.8 3.8 3.8 3.8 3.8	3.8
26WA6916-2023-087		3.9 3.9 3.9 4.0 4.0 4.1	4.0
26WA6916-2023-088		4.3 4.4 4.4 4.4 4.5 4.5	4.4
26WA6916-2023-089	Weathered	2.0 2.0 2.0 2.0 2.1 2.1	2.0
26WA6916-2023-090	Weathered	4.0 4.0 4.1 4.2 4.2 4.2	4.1
26WA6916-2023-091		1.6 1.6 1.6 1.6 1.7 1.8	1.7
26WA6916-2023-092		4.8 4.8 4.9 4.9 5.0 5.1	4.9

26WA6916-2023-093		4.6 4.7 4.7 4.7 4.8 4.8	4.7
26WA6916-2023-094		1.5 1.5 1.5 1.6 1.6 1.6	1.6
26WA6916-2023-095		3.4 3.4 3.4 3.5 3.6 3.7	3.5
26WA6916-2023-096		3.2 3.3 3.3 3.3 3.3 3.3	3.3
26WA6916-2023-098	Weathered	4.6 4.6 4.6 4.7 4.7 4.9	4.7
26WA6916-2023-099		4.8 4.8 4.9 5.0 5.0 5.0	4.9
26WA6916-2023-100		3.2 3.2 3.3 3.3 3.3 3.4	3.3
26WA6916-2023-101		3.3 3.3 3.4 3.4 3.4 3.5	3.4
26WA6916-2023-102		3.7 3.8 3.8 3.8 3.8 3.9	3.8
26WA6916-2023-103		1.6 1.6 1.6 1.6 1.6 1.7	1.6
26WA6916-2023-104		2.3 2.4 2.4 2.4 2.5 2.5	2.4
26WA6916-2023-105		4.7 4.8 4.8 4.8 4.9 4.9	4.8
26WA6916-2023-106		3.0 3.0 3.0 3.0 3.1 3.2	3.1
26WA6916-2023-107		7.1 7.1 7.2 7.3 7.4 7.4	7.3
26WA6916-2023-108		4.1 4.1 4.2 4.2 4.3 4.4	4.2
26WA6916-2023-109	Weathered		VW
26WA6916-2023-110	Weathered		NVB
26WA6916-2023-111		4.2 4.2 4.3 4.4 4.4 4.4	4.3
26WA6916-2023-112		3.1 3.2 3.2 3.3 3.3 3.3	3.2
26WA6916-2023-113		3.4 3.4 3.5 3.5 3.6 3.6	3.5
26WA6916-2023-114		3.9 3.9 4.0 4.1 4.1 4.1	4.0
26WA6916-2023-115			DH
26WA6916-2023-116		2.5 2.6 2.6 2.6 2.7 2.7	2.6
26WA6916-2023-117		5.2 5.2 5.3 5.4 5.4 5.5	5.3
26WA6916-2023-118	Weathered	1.6 1.6 1.6 1.7 1.7 1.7	1.7
26WA6916-2023-119		1.6 1.6 1.7 1.7 1.7 1.7	1.7
26WA6916-2023-120			NVB
26WA6916-2023-121			NVB
26WA6916-2023-122			NVB
26WA6916-2023-123			NVB
26WA6916-2023-124			NVB
26WA6916-2023-131-A	Weathered		VW
26WA6916-2023-131-B		2.6 2.7 2.7 2.7 2.8 2.8	2.7
26WA6916-2023-131-C			DH
26WA6916-2023-131-D		2.8 2.8 2.9 2.9 3.0 3.0	2.9
26WA6916-2023-131-E	Weathered		VW
26WA6916-2023-131-F	Weathered		VW
26WA6916-2023-131-G		3.9 4.0 4.0 4.0 4.0 4.1	4.0
26WA6916-2023-131-H		4.6 4.6 4.7 4.7 4.7 4.7	4.7
26WA6916-2023-131-I		3.4 3.5 3.5 3.6 3.6 3.6	3.5

26WA6916-2023-131-J		3.6 3.6 3.7 3.7 3.7 3.8	3.7
26WA6916-2023-131-K	Weathered		DH
26WA6916-2023-131-L			DH
26WA6916-2023-131-M		3.9 3.9 4.0 4.1 4.2 4.2	4.1
26WA6916-2023-131-N		4.8 4.8 4.8 4.9 4.9 5.1	4.9
26WA6916-2023-131-O			DH
26WA6916-2023-131-P	Weathered		DH
26WA6916-2023-131-Q		3.3 3.3 3.3 3.4 3.4 3.5	3.4
26WA6916-2023-131-R	Weathered		VW
26WA6916-2023-131-S		4.5 4.6 4.7 4.7 4.7 4.7	4.7
26WA6916-2023-131-T	Weathered		DH
26WA6916-2023-131-U		3.9 3.9 4.0 4.1 4.1 4.2	4.0
26WA6916-2023-131-V	Weathered	3.5 3.5 3.6 3.6 3.6 3.7	3.6
26WA6916-2023-132-C			NVB
26WA6916-2023-132-D			NVB
26WA6916-2023-132-E			NVB
26WA6916-2023-132-F			NVB
26WA6916-2023-132-G			NVB
26WA6916-2023-141	Cut A at edge damage; band 1; side A; weathered	3.4 3.5 3.5 3.6 3.6 3.6	3.5
26WA6916-2023-141	Cut A at edge damage; band 2; burin-like scar	2.7 2.7 2.8 2.8 2.8 2.9	2.8
26WA6916-2023-141	Cut A at edge damage; band 3; side B; weathered	3.1 3.1 3.2 3.2 3.2 3.2	3.2
26WA6916-2023-141	Cut B at concavity; band 1; side A	3.3 3.3 3.3 3.4 3.4 3.5	3.4
26WA6916-2023-141	Cut B at concavity; band 2; side A	2.3 2.3 2.4 2.4 2.4 2.5	2.4
26WA6916-2023-141	Cut B at concavity; band 3; side B	3.3 3.4 3.4 3.4 3.5 3.5	3.4
26WA6916-2023-141	Cut B at concavity; band 4; step fracture (edge)	2.4 2.4 2.4 2.5 2.5 2.5	2.5
26WA6916-2023-142		3.8 3.9 3.9 3.9 3.9 4.0	3.9
26WA6916-2023-143	Cut A at tip; both sides and break the same	4.6 4.6 4.7 4.7 4.8 4.9	4.7
26WA6916-2023-143	Cut B at base; both sides the same	4.6 4.7 4.7 4.8 4.8 4.8	4.7
26WA6916-2023-143	Cut B at base; break		NVB
26WA6916-2023-144		1.6 1.6 1.6 1.6 1.6 1.7	1.6
26WA6916-2023-145			NVB
26WA6916-2023-146		5.6 5.6 5.7 5.7 5.8 5.9	5.7

26WA6916-2023-147	Cut at break; both sides and break the same; weathered	1.1 1.2 1.2 1.2 1.3 1.3	1.2
	VOID		
26WA6916-2023-148		4.6 4.6 4.7 4.8 4.8 4.8	4.7
26WA6916-2023-149		7.0 7.0 7.1 7.2 7.2 7.3	7.1
26WA6916-2023-150		6.4 6.5 6.5 6.6 6.6 6.6	6.5
26WA6916-2023-151	Cut A at tip; side A and break the same	1.1 1.1 1.1 1.2 1.2 1.2	1.2
26WA6916-2023-151	Cut A at tip; side B	3.3 3.3 3.4 3.4 3.5 3.5	3.4
26WA6916-2023-151	Cut B at barb; both sides and break the same	3.3 3.3 3.3 3.4 3.5 3.5	3.4
26WA6916-2023-152	Cut at break; both sides and break the same	3.5 3.5 3.6 3.7 3.8 3.8	3.7
	VOID		
26WA6916-2023-153		1.4 1.4 1.4 1.5 1.6 1.6	1.5
26WA6916-2023-154		5.4 5.5 5.5 5.5 5.5 5.6	5.5
26WA6916-2023-155		2.5 2.5 2.5 2.5 2.5 2.5	2.5
26WA6916-2023-156	Weathered	3.0 3.0 3.0 3.0 3.1 3.2	3.1
26WA6916-2023-157		2.3 2.3 2.4 2.4 2.5 2.5	2.4
26WA6916-2023-158			DH
26WA6916-2023-159		5.3 5.4 5.4 5.4 5.5 5.6	5.4
26WA6916-2023-160		2.5 2.6 2.6 2.6 2.6 2.8	2.6
26WA6916-2023-161		3.4 3.4 3.5 3.6 3.6 3.6	3.5
26WA6916-2023-162		1.1 1.2 1.2 1.2 1.2 1.2	1.2
26WA6916-2023-163		3.0 3.0 3.0 3.1 3.1 3.1	3.1
26WA6916-2023-164		5.7 5.9 5.9 5.9 6.0 6.0	5.9
26WA6916-2023-165		4.6 4.7 4.7 4.7 4.8 4.9	4.7
26WA6916-2023-166		1.0 1.1 1.1 1.1 1.1 1.1	1.1
26WA6916-2023-167	Band 1	1.8 1.8 1.8 1.9 1.9 2.0	1.9
26WA6916-2023-167	Band 2	4.3 4.3 4.3 4.4 4.5 4.5	4.4
26WA6916-2023-168		3.6 3.6 3.6 3.7 3.7 3.7	3.7
26WA6916-2023-169		1.6 1.6 1.7 1.7 1.7 1.8	1.7
26WA6916-2023-170		4.3 4.3 4.3 4.4 4.5 4.6	4.4
26WA6916-2023-171		5.6 5.7 5.7 5.7 5.8 5.9	5.7
26WA6916-2023-172		2.5 2.5 2.6 2.6 2.7 2.8	2.6
26WA6916-2023-173		4.7 4.7 4.7 4.7 4.8 4.8	4.7
26WA6916-2023-174		2.7 2.7 2.8 2.9 2.9 3.0	2.8
26WA6916-2023-175			NVB
26WA6916-2023-176			NVB
26WA6916-2023-178			NVB

26WA6916-2023-182			NVB
26WA6916-2023-183			NVB

Appendix C: Catalog of Collected Artifacts

Catalog #	Source	Activity Area	Type	Sub-type	Material	Count	Weight (g)	Length (mm)	Width (mm)	Max Thickness (mm)	Min Thickness (mm)
26WA6916-2023-001	TU1	Northwest	Debitage	N/A	Obsidian	9	12	N/A	N/A	N/A	N/A
26WA6916-2023-002	TU1	Northwest	Debitage	N/A	CCS	2	0.23	N/A	N/A	N/A	N/A
26WA6916-2023-003	TU1	Northwest	Faunal	Unknown	Bone	1	0.34	18.7	10.3	1.2	1.6
26WA6916-2023-004	TU1	Northwest	Botanical	Unknown	Seed	1	0.19	8.3	6	N/A	N/A
26WA6916-2023-005	TU1	Northwest	Debitage	N/A	Obsidian	5	6.6	N/A	N/A	N/A	N/A
26WA6916-2023-006	TU1	Northwest	Debitage	N/A	Obsidian	2	1	N/A	N/A	N/A	N/A
26WA6916-2023-007	TU1	Northwest	Debitage	N/A	FGV	1	1.3	N/A	N/A	N/A	N/A
26WA6916-2023-008	TU1	Northwest	Debitage	N/A	Welded Tuff	3	2.6	N/A	N/A	N/A	N/A
26WA6916-2023-009	TU1	Northwest	Debitage	N/A	Obsidian	2	3.2	N/A	N/A	N/A	N/A
26WA6916-2023-010	TC1	Southeast	Debitage	N/A	Obsidian	1	0.12	N/A	N/A	N/A	N/A
26WA6916-2023-011	TC1	Southeast	Debitage	N/A	FGV	1	0.86	N/A	N/A	N/A	N/A
26WA6916-2023-012	TC5	Northwest	Debitage	N/A	Obsidian	12	7.5	N/A	N/A	N/A	N/A
26WA6916-2023-013	TC5	Northwest	Debitage	N/A	Quartz	1	4.6	N/A	N/A	N/A	N/A
26WA6916-2023-014	TC5	Northwest	Debitage	N/A	FGV	1	0.07	N/A	N/A	N/A	N/A
26WA6916-2023-015	TC5	Northwest	Debitage	N/A	Welded Tuff	1	1.1	N/A	N/A	N/A	N/A
26WA6916-2023-016	TC6	Northwest	Debitage	N/A	Obsidian	2	2.4	N/A	N/A	N/A	N/A
26WA6916-2023-017	TC6	Northwest	Debitage	N/A	FGV	1	0.27	N/A	N/A	N/A	N/A
26WA6916-2023-018	SP1	Southeast	Biface	Early stage	Obsidian	1	8.3	27	32.8	7.8	0.4
26WA6916-2023-019	SP1	Southeast	Biface	Early stage	Obsidian	1	1.5	19.1	17	4	1.6
26WA6916-2023-020	SP1	Southeast	Biface	Late stage	Obsidian	1	0.53	16.5	12.3	2.5	1
26WA6916-2023-021	SP1	Southeast	Biface	Late stage	Obsidian	1	0.7	25.8	8.3	2.7	0.3
26WA6916-2023-022	SP1	Southeast	Debitage	N/A	Obsidian	84	60	N/A	N/A	N/A	N/A
26WA6916-2023-023	SP1	Southeast	Debitage	N/A	FGV	20	16	N/A	N/A	N/A	N/A
26WA6916-2023-024	SP1	Southeast	Debitage	N/A	Welded Tuff	8	20	N/A	N/A	N/A	N/A
26WA6916-2023-025	SP1	Southeast	Debitage	N/A	Obsidian	13	6	N/A	N/A	N/A	N/A
26WA6916-2023-026	SP1	Southeast	Debitage	N/A	FGV	3	0.66	N/A	N/A	N/A	N/A
26WA6916-2023-027	SP2	Southeast	Biface	N/A	Obsidian	1	3.6	28.1	23.8	5.5	1.5
26WA6916-2023-028	SP2	Southeast	Biface	Late stage	Obsidian	1	0.99	21.3	15.6	3.1	0.5
26WA6916-2023-029	SP2	Southeast	Debitage	N/A	Obsidian	71	40	N/A	N/A	N/A	N/A
26WA6916-2023-030	SP2	Southeast	Debitage	N/A	FGV	16	16	N/A	N/A	N/A	N/A

26WA6916-2023-031	SP2	Southeast	Debitage	N/A	Welded Tuff	3	4	N/A	N/A	N/A	N/A
26WA6916-2023-032	SP2	Southeast	Debitage	N/A	CCS	1	0.21	N/A	N/A	N/A	N/A
26WA6916-2023-033	SP2	Southeast	Debitage	N/A	Obsidian	18	12	N/A	N/A	N/A	N/A
26WA6916-2023-034	SP2	Southeast	Debitage	N/A	FGV	6	6	N/A	N/A	N/A	N/A
26WA6916-2023-035	SP2	Southeast	Debitage	N/A	Welded Tuff	1	0.56	N/A	N/A	N/A	N/A
26WA6916-2023-036	SP2	Southeast	Debitage	N/A	CCS	1	0.14	N/A	N/A	N/A	N/A
26WA6916-2023-037	SP2	Southeast	Debitage	N/A	Obsidian	21	14	N/A	N/A	N/A	N/A
26WA6916-2023-038	SP2	Southeast	Debitage	N/A	FGV	6	4	N/A	N/A	N/A	N/A
26WA6916-2023-039	SP2	Southeast	Debitage	N/A	Welded Tuff	1	0.3	N/A	N/A	N/A	N/A
26WA6916-2023-040	SP2	Southeast	Debitage	N/A	CCS	1	0.54	N/A	N/A	N/A	N/A
26WA6916-2023-041	SP2	Southeast	Debitage	N/A	Obsidian	8	6	N/A	N/A	N/A	N/A
26WA6916-2023-042	SS1	Northwest	Proj Point	Arrow	Obsidian	1	0.97	22.3	10.6	3.9	0.7
26WA6916-2023-043	SS1	Northwest	Biface	Late stage	Obsidian	1	2.2	23.3	19.2	5.8	1.3
26WA6916-2023-044	SS1	Northwest	Biface	Late stage	Obsidian	1	2	20.1	23.8	2.5	0.4
26WA6916-2023-045	SS1	Northwest	Biface	Early stage	Obsidian	1	5.6	29.4	21.3	13.4	1.5
26WA6916-2023-046	SS1	Northwest	Biface	Midsection	Obsidian	1	2	10.5	24.5	5.3	1.5
26WA6916-2023-047	SS1	Northwest	Biface	Late stage	Obsidian	1	2.3	30.4	17	3.7	1.5
26WA6916-2023-048	SS1	Northwest	Biface	Late stage	Obsidian	1	0.65	19.5	8.5	4.1	1.8
26WA6916-2023-049	SS1	Northwest	Biface	Late stage	Obsidian	1	1.2	12.6	13.4	5.4	1.4
26WA6916-2023-050	SS1	Northwest	Biface	Midsection	Obsidian	1	1.6	10.3	15.1	7.2	1.5
26WA6916-2023-051	SS1	Northwest	Biface	Late stage	Obsidian	1	0.87	13.5	12.2	4.8	0.6
26WA6916-2023-052	SS1	Northwest	Biface	Midstage	Obsidian	1	3.1	19.8	17.9	6.8	1.7
26WA6916-2023-053	SS1	Northwest	Biface	Late stage	Obsidian	1	0.3	15.5	9.1	2.1	1
26WA6916-2023-054	SS1	Northwest	Biface	Midstage	Obsidian	1	3.2	27.1	17	7.5	1.4
26WA6916-2023-055	SS1	Northwest	Biface	Midstage	Obsidian	1	0.59	18.4	8.2	4.5	0.4
26WA6916-2023-056	SS1	Northwest	Biface	Midsection	FGV	1	1.1	11.9	16.4	4.9	2
26WA6916-2023-057	SS1	Northwest	Biface	Early stage	FGV	1	0.56	19.2	8.8	3.3	1
26WA6916-2023-058	SS1	Northwest	Biface	Late stage	FGV	1	1.5	34.5	12.1	4	1.7
26WA6916-2023-059	SS1	Northwest	Biface	Late stage	Welded Tuff	1	1.3	23.2	16.1	3.7	1.1
26WA6916-2023-060	SS1	Northwest	Flake Tool	Formed	FGV	1	15.7	43.8	30.2	11	1.7
26WA6916-2023-061	SS1	Northwest	Flake Tool	Simple	FGV	1	3.8	31.3	23.3	5.4	0.2
26WA6916-2023-062	SS1	Northwest	Flake Tool	Simple	Welded Tuff	1	3.9	33.5	20.7	4.9	0.8
26WA6916-2023-063	SS1	Northwest	Flake Tool	Simple	CCS	1	0.77	36.4	6	3.1	1

26WA6916-2023-064	SS1	Northwest	Debitage	N/A	Obsidian	329	240	N/A	N/A	N/A	N/A
26WA6916-2023-065	SS1	Northwest	Debitage	N/A	FGV	65	108	N/A	N/A	N/A	N/A
26WA6916-2023-066	SS1	Northwest	Debitage	N/A	Welded Tuff	71	86	N/A	N/A	N/A	N/A
26WA6916-2023-067	SS1	Northwest	Debitage	N/A	CCS	14	22	N/A	N/A	N/A	N/A
26WA6916-2023-068	SS2	Southeast	Proj Point	Rose Spring	Obsidian	1	0.68	31.5	11.1	3.1	1.2
26WA6916-2023-069	SS2	Southeast	Proj Point	Desert Side Notched	Obsidian	1	0.4	18.7	12.5	2.7	1
26WA6916-2023-070	SS2	Southeast	Proj Point	Humboldt	Obsidian	1	0.52	9.3	14.7	3.8	1
26WA6916-2023-071	SS2	Southeast	Proj Point	Arrow	Obsidian	1	1.2	15.8	20.3	3.7	0.5
26WA6916-2023-072	SS2	Southeast	Proj Point	Arrow	Obsidian	1	0.57	7.8	20	3.4	1.3
26WA6916-2023-073	SS2	Southeast	Biface	Midsection	Obsidian	1	5.4	19.2	30.7	7.8	0.9
26WA6916-2023-074	SS2	Southeast	Biface	Late stage	Obsidian	1	3.3	21.8	25.5	4.3	1
26WA6916-2023-075	SS2	Southeast	Biface	Midsection	Obsidian	1	1.8	16.4	13.7	4	1.7
26WA6916-2023-076	SS2	Southeast	Biface	Late stage	Obsidian	1	2.3	22.4	22.8	3.8	0.8
26WA6916-2023-077	SS2	Southeast	Biface	Midstage	Obsidian	1	8	34.2	24.3	8	1.6
26WA6916-2023-078	SS2	Southeast	Biface	Late stage	Obsidian	1	1.5	28.8	15.7	3.7	0.8
26WA6916-2023-079	SS2	Southeast	Biface	Midsection	Obsidian	1	1.2	18.7	14	3.6	1
26WA6916-2023-080	SS2	Southeast	Biface	Midsection	Obsidian	1	1.3	22.1	13.2	4	1.3
26WA6916-2023-081	SS2	Southeast	Biface	Midsection	Obsidian	1	0.62	15.8	12	3.4	0.8
26WA6916-2023-082	SS2	Southeast	Biface	Late stage	Obsidian	1	0.56	18.2	13	3.3	0.9
26WA6916-2023-083	SS2	Southeast	Biface	Late stage	Obsidian	1	0.38	18.4	9.1	3.9	1
26WA6916-2023-084	SS2	Southeast	Biface	Midsection	Obsidian	1	10.9	25.4	36.4	9	1.1
26WA6916-2023-085	SS2	Southeast	Biface	Late stage	Obsidian	1	0.8	12.4	12.6	5.5	0.9
26WA6916-2023-086	SS2	Southeast	Biface	Midstage	Obsidian	1	2.2	18.1	20.9	4.6	1
26WA6916-2023-087	SS2	Southeast	Biface	Midsection	Obsidian	1	1	18.1	12.1	3.8	0.9
26WA6916-2023-088	SS2	Southeast	Biface	Midsection	Obsidian	1	0.56	14.2	10.8	3.1	1
26WA6916-2023-089	SS2	Southeast	Proj Point	Arrow	Obsidian	1	0.61	15.2	11.8	3.2	1
26WA6916-2023-090	SS2	Southeast	Proj Point	Elko	Obsidian	1	0.7	15.6	13.5	2.6	0.6
26WA6916-2023-091	SS2	Southeast	Proj Point	Arrow	Obsidian	1	0.67	17	14.5	2.5	0.6
26WA6916-2023-092	SS2	Southeast	Biface	Midstage	Obsidian	1	3.9	37.1	21.8	3.8	1.1
26WA6916-2023-093	SS2	Southeast	Biface	Midstage	Obsidian	1	5.1	34.8	22.1	7.1	0.6
26WA6916-2023-094	SS2	Southeast	Biface	Late stage	Obsidian	1	0.63	12.9	14.3	4.1	1.3
26WA6916-2023-095	SS2	Southeast	Biface	Late stage	Obsidian	1	1.3	16	19.3	3.7	0.6

26WA6916-2023-096	SS2	Southeast	Biface	Late stage	Obsidian	1	0.37	18.2	9.1	2.3	0.7
26WA6916-2023-097	SS2	Southeast	Biface	Stage 5	Obsidian	1	0.35	20.2	6.7	2.6	0.5
26WA6916-2023-098	SS2	Southeast	Biface	Late stage	Obsidian	1	2.7	33.4	11.6	9	0.9
26WA6916-2023-099	SS2	Southeast	Biface	Late stage	Obsidian	1	1.2	19.5	14.2	4	0.9
26WA6916-2023-100	SS2	Southeast	Biface	Midstage	Obsidian	1	12.3	36.9	27.8	12.3	0.6
26WA6916-2023-101	SS2	Southeast	Biface	Late stage	Obsidian	1	5.4	39.2	20.9	6.6	0.4
26WA6916-2023-102	SS2	Southeast	Biface	Late stage	Obsidian	1	2.9	28.7	15.1	6.2	0.9
26WA6916-2023-103	SS2	Southeast	Biface	Late stage	Obsidian	1	1.4	21	15.9	5	1
26WA6916-2023-104	SS2	Southeast	Biface	Late stage	Obsidian	1	3.2	27.3	17.2	7.4	0.8
26WA6916-2023-105	SS2	Southeast	Biface	Early stage	Obsidian	1	0.83	11.5	17.5	4.2	0.9
26WA6916-2023-106	SS2	Southeast	Biface	Late stage	Obsidian	1	0.29	11.4	9.1	2.5	0.9
26WA6916-2023-107	SS2	Southeast	Biface	Midsection	Obsidian	1	1.3	11.7	16.3	6.7	0.9
26WA6916-2023-108	SS2	Southeast	Biface	Early stage	Obsidian	1	3.6	2.06	22.2	7.7	0.5
26WA6916-2023-109	SS2	Southeast	Biface	Midstage	Obsidian	1	4	23.9	21.8	9.6	0.8
26WA6916-2023-110	SS2	Southeast	Biface	Midsection	Obsidian	1	0.43	11	10.6	3.3	0.5
26WA6916-2023-111	SS2	Southeast	Flake Tool	Formed	Obsidian	1	2.2	31.4	17.9	3.9	0.5
26WA6916-2023-112	SS2	Southeast	Flake Tool	Formed	Obsidian	1	7.2	37.4	28	7.1	0.8
26WA6916-2023-113	SS2	Southeast	Flake Tool	Simple	Obsidian	1	1.3	24.1	13.3	5	0.7
26WA6916-2023-114	SS2	Southeast	Flake Tool	Formed	Obsidian	1	7.1	32.1	25.3	9	1.2
26WA6916-2023-115	SS2	Southeast	Flake Tool	Formed	Obsidian	1	7.1	31.3	21.5	11	1.3
26WA6916-2023-116	SS2	Southeast	Flake Tool	Formed	Obsidian	1	8.4	36	24.7	8.4	1.1
26WA6916-2023-117	SS2	Southeast	Core	Multidirectional	Obsidian	1	22.4	46.8	28.4	17.1	2.5
26WA6916-2023-118	SS2	Southeast	Core	Multidirectional	Obsidian	1	34.9	47.4	33.3	24.1	1.3
26WA6916-2023-119	SS2	Southeast	Core	Tested Cobble	Obsidian	1	34	41.8	30.3	25.2	8.3
26WA6916-2023-120	SS2	Southeast	Proj Point	Cottonwood leaf	FGV	1	1.3	31.7	14.8	3.5	0.9
26WA6916-2023-121	SS2	Southeast	Flake Tool	Formed	FGV	1	1.1	22.6	14.7	3.7	0.8
26WA6916-2023-122	SS2	Southeast	Flake Tool	Simple	FGV	1	1.7	27.2	18.1	3.1	0.9
26WA6916-2023-123	SS2	Southeast	Flake Tool	Simple	FGV	1	1.96	29.4	22.9	2.8	0.6
26WA6916-2023-124	SS2	Southeast	Flake Tool	Formed	FGV	1	2.7	20.3	22.9	5.1	0.4
26WA6916-2023-125	SS2	Southeast	Flake Tool	Formed	FGV	1	5.9	43.2	25	5.8	0.6
26WA6916-2023-126	SS2	Southeast	Biface	Late stage	Welded Tuff	1	0.63	20	9.3	3.8	1
26WA6916-2023-127	SS2	Southeast	Biface	Midsection	CCS	1	1.2	18	12.4	4.5	0.5

26WA6916-2023-128	SS2	Southeast	Biface	Midsection	CCS	1	0.73	12.4	13.6	5.4	0.6
26WA6916-2023-129	SS2	Southeast	Biface	Late stage	CCS	1	0.49	10.8	15.1	3.4	0.8
26WA6916-2023-130	SS2	Southeast	Biface	Late stage	CCS	1	0.27	13.5	6	3.4	1
26WA6916-2023-131	SS2	Southeast	Debitage	N/A	Obsidian	3112	1680	N/A	N/A	N/A	N/A
26WA6916-2023-132	SS2	Southeast	Debitage	N/A	FGV	645	528	N/A	N/A	N/A	N/A
26WA6916-2023-133	SS2	Southeast	Debitage	N/A	Welded Tuff	184	174	N/A	N/A	N/A	N/A
26WA6916-2023-134	SS2	Southeast	Debitage	N/A	CCS	124	116	N/A	N/A	N/A	N/A
26WA6916-2023-135	SS2	Southeast	Groundstone	Metate	FGV	1	598	105.5	115.8	36.5	18.9
26WA6916-2023-136	SS2	Southeast	Groundstone	Handstone	FGV	1	66	73	35.5	18.8	11.3
26WA6916-2023-137	SS2	Southeast	Ceramic	N/A	Ceramic	1	0.29	12.5	6.5	3.5	2.6
26WA6916-2023-138	SS2	Southeast	Faunal	N/A	Bone	1	3.7	39.5	10.7	6.6	1.6
26WA6916-2023-139	SS2	Southeast	Faunal	N/A	Bone	1	0.29	12.5	7.1	3.7	2.2
26WA6916-2023-140	SS2	Southeast	Manuport	N/A	Spherulite	1	18.8	28.4	22.3	20.2	N/A
26WA6916-2023-141	S213		Proj Point	Arrow	Obsidian	1	5	39.2	19.4	6.5	0.9
26WA6916-2023-142	S109		Proj Point	Arrow	Obsidian	1	2.8	22.5	24.5	5.8	1.4
26WA6916-2023-143	S184		Proj Point	Arrow	Obsidian	1	2.8	26.5	18.7	4.3	0.6
26WA6916-2023-144	S162		Proj Point	Desert Side Notch	Obsidian	1	1.2	29.2	17.2	3	0.2
26WA6916-2023-145	S171		Proj Point	Elko	Obsidian	1	3.5	36.8	22.6	4.7	1
26WA6916-2023-146	S215		Proj Point	Elko Eared	Obsidian	1	3.6	27.2	28.9	5.3	0.8
26WA6916-2023-147	S201		Proj Point	Humboldt	Obsidian	1	2	20	15.7	6.3	1.2
26WA6916-2023-148	S202		Proj Point	Humboldt	Obsidian	1	1.3	19.4	14.8	5.1	0.8
26WA6916-2023-149	S188		Proj Point	Humboldt	Obsidian	1	4.4	38.2	18.1	6.7	1.3
26WA6916-2023-150	S99		Proj Point	Northern Side Notched	Obsidian	1	1.5	14.5	27.7	4.3	1.8
26WA6916-2023-151	S111		Proj Point	Pinto	Obsidian	1	2.1	30	18.6	5.5	0.9
26WA6916-2023-152	S115		Proj Point	Eastgate	Obsidian	1	4.7	32.7	21.6	6.6	2
26WA6916-2023-153	S200		Proj Point	Rosegate	Obsidian	1	1	35.7	13.7	2.8	1
26WA6916-2023-154	S207		Biface	Late stage	Obsidian	1	1	21.7	13.9	3.2	1
26WA6916-2023-155	S148		Biface	Late stage	Obsidian	1	1.5	17.5	16.5	4.1	0.8
26WA6916-2023-156	S154		Biface	Late stage	Obsidian	1	1.7	28.5	17.3	6.3	0.7
26WA6916-2023-157	S156		Biface	Late stage	Obsidian	1	2.4	27.1	19.6	5.7	1.1
26WA6916-2023-158	S19		Biface	Late stage	Obsidian	1	1.5	23.8	19.4	4.1	1.3

26WA6916-2023-159	S210		Biface	Midsection	Obsidian	1	11.8	34.8	22.7	10.8	4
26WA6916-2023-160	S204		Biface	Midsection	Obsidian	1	8.8	28.4	33.1	8.9	1.3
26WA6916-2023-161	S146		Biface	Midsection	Obsidian	1	9.7	30.9	28.5	8.4	1.1
26WA6916-2023-162	S163		Biface	Midsection	Obsidian	1	24.3	62.4	35.6	9.2	1.7
26WA6916-2023-163	S81		Biface	Midsection	Obsidian	1	3	18.2	21.2	6.9	1.4
26WA6916-2023-164	S92		Biface	Midsection	Obsidian	1	12.7	43	25	11.9	1.7
26WA6916-2023-165	S208		Flake Tool	Formed	Obsidian	1	12.1	40.3	28	11.7	1.1
26WA6916-2023-166	S182		Flake Tool	Formed	Obsidian	1	25.6	65.3	40.9	8.1	1.6
26WA6916-2023-167	S24		Flake Tool	Formed	Obsidian	1	10.6	51.9	23.6	6.7	4.7
26WA6916-2023-168	S39		Flake Tool	Formed	Obsidian	1	2.1	21.8	16.7	7.2	1.7
26WA6916-2023-169	S212		Flake Tool	Simple	Obsidian	1	27.4	54	44.8	15.3	2.8
26WA6916-2023-170	S147		Flake Tool	Simple	Obsidian	1	9.9	41.6	28	10.5	1.2
26WA6916-2023-171	S167		Flake Tool	Simple	Obsidian	1	12.5	34.6	39.9	8.9	4.1
26WA6916-2023-172	S98		Drill	N/A	Obsidian	1	1.7	30	13.4	4.5	2
26WA6916-2023-173	S65		Core	Multidirectional	Obsidian	1	24.5	38.4	32.3	19.3	1.4
26WA6916-2023-174	S186		Core Tool	Multidirectional	Obsidian	1	12.7	37.3	27.5	15.3	3.6
26WA6916-2023-175	S157		Proj Point	Arrow	FGV	1	2.8	29.3	15.6	5.4	1
26WA6916-2023-176	S203		Biface	Late stage	FGV	1	1.2	27.7	9.2	4	0.5
26WA6916-2023-177	S100		Flake Tool	Formed	FGV	1	10.5	51.8	27.7	8	1.5
26WA6916-2023-178	S211		Flake Tool	Simple	FGV	1	28	54.6	41.6	12.9	2.7
26WA6916-2023-179	S135		Flake Tool	Simple	FGV	1	66.3	67.5	44.8	22.6	1.1
26WA6916-2023-180	S174		Flake Tool	Simple	FGV	1	30.7	58.4	44.3	16.5	0.7
26WA6916-2023-181	S61		Flake Tool	Simple	FGV	1	47.1	58.2	41.1	20.2	1.5
26WA6916-2023-182	S214		Drill	N/A	FGV	1	7.6	32.7	34.7	8.9	5.2
26WA6916-2023-183	S117		Drill	N/A	FGV	1	4.5	35.8	23.2	5.4	1.4
26WA6916-2023-184	S160		Drill	N/A	FGV	1	6.1	44	22.1	7.1	0.8
26WA6916-2023-185	S166		Core	Multidirectional	FGV	1	802	86.8	100.2	76	N/A
26WA6916-2023-186	S87		Core Tool	Multidirectional	FGV	1	117.7	66.2	42.7	38.8	7.2
26WA6916-2023-187	Next to R8		Groundstone	Handstone	FGV	1	306	76.8	71.6	41.6	20.9
26WA6916-2023-188	S205		Groundstone	Handstone	FGV	1	52	45.5	33.9	18.8	13.9
26WA6916-2023-189	S28		Groundstone	Handstone	FGV	1	746	114.9	85	50.4	17.9
26WA6916-2023-190	S206		Groundstone	Metate	FGV	1	N/A	290	158	111	27
26WA6916-2023-191	S37		Core Tool	Multidirectional	FGV	1	604	107	106.4	48	0.8

26WA6916-2023-192	S161		Biface	Midstage	Welded Tuff	1	15.2	47.6	36.4	9.3	1.1
26WA6916-2023-193	S216		Core Tool	Multidirectional	Welded Tuff	1	312	63.4	78.7	52	3.5
26WA6916-2023-194	S136		Flake Tool	Simple	Welded Tuff	1	39.6	65.6	37.9	15.4	1.5
26WA6916-2023-195	S73		Flake Tool	Simple	Welded Tuff	1	40.9	55.5	36.4	15.5	1.4
26WA6916-2023-196	S1		Proj Point	Humboldt	CCS	1	2.7	16.5	23.5	5.7	2.1
26WA6916-2023-197	S155		Biface	Late stage	CCS	1	2.2	28.1	16.8	4.2	1.3
26WA6916-2023-198	S31		Biface	Late stage	CCS	1	2	19.4	18.5	6.6	1.9
26WA6916-2023-199	S179		Flake Tool	Formed	CCS	1	7.9	37.8	26.4	9	1
26WA6916-2023-200	S199		Core	Multidirectional	CCS	1	17.4	36	30.5	17.2	3.8
26WA6916-2023-201	S120		Core	Multidirectional	CCS	1	33.4	41.8	22.9	23	22.7
26WA6916-2023-202	S209		Manuport	N/A	Spherulite	1	12.2	22.9	23.2	19.2	N/A
26WA6916-2023-203	TU1	Northwest	Soil sample	N/A	Soil	1	250.6	N/A	N/A	N/A	N/A
26WA6916-2023-204	TU1	Northwest	Soil sample	N/A	Soil	1	197.9	N/A	N/A	N/A	N/A
26WA6916-2023-205	TU1	Northwest	Soil sample	N/A	Soil	1	294.2	N/A	N/A	N/A	N/A
26WA6916-2023-206	TU1	Northwest	Soil sample	N/A	Soil	1	302.5	N/A	N/A	N/A	N/A

Appendix D: Catalog of Artifacts with Geochemical Analysis Data

Catalog #	Source	Activity Area	Type	Subtype	Material	Quarry Distance	Hydration Rim Thickness	Rate	Date (Yrs BP)
26WA6916-2023-001-A	TU1	Northwest	Debitage	Cortical	Obsidian	18	N/A	196.4x^2	N/A
26WA6916-2023-005-A	TU1	Northwest	Debitage	Interior	Obsidian	20	1.4	265.34x^2	520
26WA6916-2023-006-A	TU1	Northwest	Debitage	Interior	Obsidian	107	2	256.86x^2	N/A
26WA6916-2023-007	TU1	Northwest	Debitage	Indeterminate	FGV	23	N/A		N/A
26WA6916-2023-009-A	TU1	Northwest	Debitage	Interior	Obsidian	18	2.5	196.4x^2	1227
26WA6916-2023-010	TC1	Northwest	Debitage	Shatter/ Indeterminate	Obsidian	20	2.5	265.34x^2	1658
26WA6916-2023-011	TC1	Southeast	Debitage	Cortical	FGV	23	N/A		N/A
26WA6916-2023-012-A	TC5	Northwest	Debitage	Interior	Obsidian	18	4.2	196.4x^2	3464
26WA6916-2023-016-A	TC6	Northwest	Debitage	Interior	Obsidian	18	3.5	196.4x^2	2405
26WA6916-2023-018	SP1	Southeast	Biface	Stage 1	Obsidian	17	2	256.86x^2	N/A
26WA6916-2023-019	SP1	Southeast	Biface	Stage 2	Obsidian	17	2.5	256.86x^2	N/A
26WA6916-2023-020	SP1	Southeast	Biface	Stage 5	Obsidian	18	7.1	196.4x^2	8555
26WA6916-2023-021	SP1	Southeast	Biface	Stage 4	Obsidian	18	3.2	196.4x^2	2011
26WA6916-2023-022-A	SP1	Southeast	Debitage	Fragment	Obsidian	18	3.4	196.4x^2	2270
26WA6916-2023-022-B	SP1	Southeast	Debitage	Cortical	Obsidian	18	5	196.4x^2	4910
26WA6916-2023-023-A	SP1	Southeast	Debitage	Cortical fragment	FGV	23	N/A		N/A
26WA6916-2023-025-A	SP1	Southeast	Debitage	Thinning	Obsidian	18	3.9	196.4x^2	2987
26WA6916-2023-026-A	SP1	Southeast	Debitage	Interior	FGV	23	N/A		N/A
26WA6916-2023-027	SP2	Southeast	Biface	Stage 5	Obsidian	64	2.6	478.96x^2	N/A
26WA6916-2023-028	SP2	Southeast	Biface	Stage 5	Obsidian	17	3.2	256.86x^2	N/A
26WA6916-2023-029-A	SP2	Southeast	Debitage	Cortical	Obsidian	15	3	256.86	N/A
26WA6916-2023-029-B	SP2	Southeast	Debitage	Interior	Obsidian	18	2.5	196.4x^2	1227
26WA6916-2023-030-A	SP2	Southeast	Debitage	Cortical	FGV	23	N/A		N/A
26WA6916-2023-033-A	SP2	Southeast	Debitage	Interior	Obsidian	15	1.1	256.86x^2	N/A

26WA6916-2023-034-A	SP2	Southeast	Debitage	Interior	FGV	23	N/A		N/A
26WA6916-2023-037-A	SP2	Southeast	Debitage	Interior	Obsidian	18	3.6	196.4x^2	2545
26WA6916-2023-038-A	SP2	Southeast	Debitage	Pressure	FGV	18	N/A	196.4x^2	N/A
26WA6916-2023-041-A	SP2	Southeast	Debitage	Cortical	Obsidian	18	2.9	196.4x^2	1652
26WA6916-2023-042	SS1	Northwest	Proj Point	Arrow	Obsidian	20	2.3	265.34x^2	1403
26WA6916-2023-043	SS1	Northwest	Biface	Stage 4	Obsidian	18	2.8	196.4x^2	1540
26WA6916-2023-044	SS1	Northwest	Biface	Stage 5	Obsidian	18	2.1	196.4x^2	866
26WA6916-2023-045	SS1	Northwest	Biface	Stage 1	Obsidian	18	2.4	196.4x^2	1131
26WA6916-2023-046	SS1	Northwest	Biface	Stage 5 midsection	Obsidian	18	5.3	196.4x^2	5517
26WA6916-2023-047	SS1	Northwest	Biface	Stage 5	Obsidian	N/A	3.9	256.86x^2	N/A
26WA6916-2023-048	SS1	Northwest	Biface	Unknown	Obsidian	18	4.7	196.4x^2	4338
26WA6916-2023-049	SS1	Northwest	Biface	Stage 3	Obsidian	18	3.1	196.4x^2	1887
26WA6916-2023-050	SS1	Northwest	Biface	Stage 2	Obsidian	36	3.3	358.56x^2	N/A
26WA6916-2023-051	SS1	Northwest	Biface	Stage 4	Obsidian	105	2.1	256.86x^2	N/A
26WA6916-2023-052	SS1	Northwest	Biface	Stage 2	Obsidian	18	2.9	196.4x^2	1652
26WA6916-2023-053	SS1	Northwest	Biface	Late stage	Obsidian	18	2.9	196.4x^2	1652
26WA6916-2023-054	SS1	Northwest	Biface	Stage 2	Obsidian	20	3	265.34x^2	2388
26WA6916-2023-055	SS1	Northwest	Biface	Unknown	Obsidian	17	1.7	256.86x^2	N/A
26WA6916-2023-056	SS1	Northwest	Biface	Stage 3 midsection	FGV	23	N/A		N/A
26WA6916-2023-057	SS1	Northwest	Biface	Stage 1	FGV	23	N/A		N/A
26WA6916-2023-058	SS1	Northwest	Biface	Stage 5	FGV	N/A	N/A		N/A
26WA6916-2023-060	SS1	Northwest	Flake Tool	Simple	FGV	N/A	N/A		N/A
26WA6916-2023-061	SS1	Northwest	Flake Tool	Simple	FGV	N/A	N/A		N/A
26WA6916-2023-064-A	SS1	Northwest	Debitage	Interior	Obsidian	20	2.8	265.34x^2	2080
26WA6916-2023-064-B	SS1	Northwest	Debitage	Interior	Obsidian	20	2.2	265.34x^2	1284
26WA6916-2023-064-C	SS1	Northwest	Debitage	Cortical	Obsidian	17	N/A	256.86x^2	N/A
26WA6916-2023-064-D	SS1	Northwest	Debitage	Cortical	Obsidian	15	2.1	256.86x^2	N/A

26WA6916-2023-064-E	SS1	Northwest	Debitage	Thinning	Obsidian	N/A	2.2	256.86x^2	N/A
26WA6916-2023-065-A	SS1	Northwest	Debitage	Thinning	FGV	23	N/A		N/A
26WA6916-2023-068	SS2	Southeast	Proj Point	Rose Spring	Obsidian	15	1.2	256.86x^2	N/A
26WA6916-2023-069	SS2	Southeast	Proj Point	Desert Side Notched	Obsidian	15	1.6	256.86x^2	N/A
26WA6916-2023-070	SS2	Southeast	Proj Point	Humboldt	Obsidian	18	2.6	196.4x^2	1327
26WA6916-2023-071	SS2	Southeast	Proj Point	Arrow	Obsidian	18	2.5	196.4x^2	1227
26WA6916-2023-072	SS2	Southeast	Proj Point	Arrow	Obsidian	18	3	196.4x^2	1768
26WA6916-2023-073	SS2	Southeast	Biface	Stage 2 midsection	Obsidian	18	2.9	196.4x^2	1652
26WA6916-2023-074	SS2	Southeast	Biface	Stage 3	Obsidian	17	4.7	256.86x^2	N/A
26WA6916-2023-075	SS2	Southeast	Biface	Stage 5 midsection	Obsidian	18	2	196.4x^2	785
26WA6916-2023-076	SS2	Southeast	Biface	Stage 5	Obsidian	18	3.8	196.4x^2	2836
26WA6916-2023-077	SS2	Southeast	Biface	Stage 3	Obsidian	18	3	196.4x^2	1767
26WA6916-2023-078	SS2	Southeast	Biface	Stage 5	Obsidian	18	3.7	196.4x^2	2689
26WA6916-2023-079	SS2	Southeast	Biface	Stage 5 midsection	Obsidian	15	3.6	256.86x^2	N/A
26WA6916-2023-080	SS2	Southeast	Biface	Stage 5 midsection	Obsidian	18	3.9	196.4x^2	2987
26WA6916-2023-081	SS2	Southeast	Biface	Stage 5 midsection	Obsidian	40	4.9	256.86x^2	N/A
26WA6916-2023-082	SS2	Southeast	Biface	Stage 5	Obsidian	18	4	196.4x^2	3142
26WA6916-2023-083	SS2	Southeast	Biface	Stage 5	Obsidian	18	4.6	196.4x^2	4156
26WA6916-2023-084	SS2	Southeast	Biface	Stage 2 midsection	Obsidian	20	4.5	265.34x^2	5373
26WA6916-2023-085	SS2	Southeast	Biface	Stage 4	Obsidian	18	3.5	196.4x^2	2406
26WA6916-2023-086	SS2	Southeast	Biface	Stage 3	Obsidian	44	3.8	256.86x^2	N/A

26WA6916-2023-087	SS2	Southeast	Biface	Stage 4 midsection	Obsidian	91	4	72.94x^2.43	N/A
26WA6916-2023-088	SS2	Southeast	Biface	Stage 5 midsection	Obsidian	18	4.4	196.4x^2	3802
26WA6916-2023-089	SS2	Southeast	Proj Point	Arrow	Obsidian	15	2	256.86x^2	N/A
26WA6916-2023-090	SS2	Southeast	Proj Point	Elko	Obsidian	18	4.1	196.4x^2	3301
26WA6916-2023-091	SS2	Southeast	Proj Point	Arrow	Obsidian	64	1.7	478.96x^2	N/A
26WA6916-2023-092	SS2	Southeast	Biface	Stage 4	Obsidian	18	4.9	196.4x^2	4715
26WA6916-2023-093	SS2	Southeast	Biface	Stage 2	Obsidian	36	4.7	358.56x^2	N/A
26WA6916-2023-094	SS2	Southeast	Biface	Stage 4	Obsidian	91	1.6	256.86x^2	N/A
26WA6916-2023-095	SS2	Southeast	Biface	Stage 4	Obsidian	91	3.5	256.86x^2	N/A
26WA6916-2023-096	SS2	Southeast	Biface	Stage 5	Obsidian	107	3.3	256.86x^2	N/A
26WA6916-2023-098	SS2	Southeast	Biface	Stage 4	Obsidian	17	4.7	256.86x^2	N/A
26WA6916-2023-099	SS2	Southeast	Biface	Stage 4	Obsidian	18	4.9	196.4x^2	4715
26WA6916-2023-100	SS2	Southeast	Biface	Stage 3	Obsidian	15	3.3	256.86x^2	N/A
26WA6916-2023-101	SS2	Southeast	Biface	Stage 3	Obsidian	17	3.4	256.86x^2	N/A
26WA6916-2023-102	SS2	Southeast	Biface	Stage 4	Obsidian	15	3.8	256.86x^2	N/A
26WA6916-2023-103	SS2	Southeast	Biface	Midstage	Obsidian	15	1.6	256.86x^2	N/A
26WA6916-2023-104	SS2	Southeast	Biface	Stage 4	Obsidian	18	2.4	196.4x^2	1131
26WA6916-2023-105	SS2	Southeast	Biface	Stage 2	Obsidian	18	4.8	196.4x^2	4525
26WA6916-2023-106	SS2	Southeast	Biface	Stage 4	Obsidian	15	3.1	256.86x^2	N/A
26WA6916-2023-107	SS2	Southeast	Biface	Midstage	Obsidian	15	7.3	256.86x^2	N/A
26WA6916-2023-108	SS2	Southeast	Biface	Early stage	Obsidian	18	4.2	196.4x^2	3464
26WA6916-2023-109	SS2	Southeast	Biface	Stage 2	Obsidian	18	N/A	196.4x^2	N/A
26WA6916-2023-110	SS2	Southeast	Biface	Unknown	Obsidian	20	N/A	265.34x^2	N/A
26WA6916-2023-111	SS2	Southeast	Flake Tool	Formed	Obsidian	18	4.3	196.4x^2	3631
26WA6916-2023-112	SS2	Southeast	Flake Tool	Formed	Obsidian	17	3.2	256.86x^2	N/A
26WA6916-2023-113	SS2	Southeast	Flake Tool	Simple	Obsidian	18	3.5	196.4x^2	2406
26WA6916-2023-114	SS2	Southeast	Flake Tool	Formed	Obsidian	18	4	196.4x^2	3142

26WA6916-2023-115	SS2	Southeast	Flake Tool	Formed	Obsidian	15	N/A	256.86x^2	N/A
26WA6916-2023-116	SS2	Southeast	Flake Tool	Formed	Obsidian	18	2.6	196.4x^2	1327
26WA6916-2023-117	SS2	Southeast	Core	Multidirectional	Obsidian	18	5.3	196.4x^2	5517
26WA6916-2023-118	SS2	Southeast	Core	Multidirectional	Obsidian	20	1.7	265.34x^2	767
26WA6916-2023-119	SS2	Southeast	Core	Tested Cobble	Obsidian	60	1.7	168.93x^2	488
26WA6916-2023-120	SS2	Southeast	Proj Point	Cottonwood leaf	FGV	23	N/A		N/A
26WA6916-2023-121	SS2	Southeast	Flake Tool	Formed	FGV	23	N/A		N/A
26WA6916-2023-122	SS2	Southeast	Flake Tool	Simple	FGV	23	N/A		N/A
26WA6916-2023-123	SS2	Southeast	Flake Tool	Simple	FGV	23	N/A		N/A
26WA6916-2023-124	SS2	Southeast	Flake Tool	Formed	FGV	23	N/A		N/A
26WA6916-2023-125	SS2	Southeast	Flake Tool	Formed	FGV	N/A	N/A		N/A
26WA6916-2023-131-A	SS2	Southeast	Debitage	Cortical	Obsidian	15	N/A	256.86x^2	N/A
26WA6916-2023-131-B	SS2	Southeast	Debitage	Interior	Obsidian	15	2.7	256.86x^2	N/A
26WA6916-2023-131-C	SS2	Southeast	Debitage	Thinning	Obsidian	18	N/A	196.4x^2	N/A
26WA6916-2023-131-D	SS2	Southeast	Debitage	Cortical	Obsidian	15	2.9	256.86x^2	N/A
26WA6916-2023-131-E	SS2	Southeast	Debitage	Thinning	Obsidian	18	N/A	196.4x^2	N/A
26WA6916-2023-131-F	SS2	Southeast	Debitage	Interior	Obsidian	15	N/A	256.86x^2	N/A
26WA6916-2023-131-G	SS2	Southeast	Debitage	Cortical	Obsidian	20	4	265.34x^2	4245
26WA6916-2023-131-H	SS2	Southeast	Debitage	Cortical	Obsidian	18	4.7	196.4x^2	4338
26WA6916-2023-131-I	SS2	Southeast	Debitage	Interior	Obsidian	15	3.5	256.86x^2	N/A
26WA6916-2023-131-J	SS2	Southeast	Debitage	Interior	Obsidian	15	3.7	256.86x^2	N/A
26WA6916-2023-131-K	SS2	Southeast	Debitage	Cortical	Obsidian	15	N/A	256.86x^2	N/A
26WA6916-2023-131-L	SS2	Southeast	Debitage	Interior	Obsidian	18	N/A	196.4x^2	N/A
26WA6916-2023-131-M	SS2	Southeast	Debitage	Cortical	Obsidian	17	4.1	256.86x^2	N/A
26WA6916-2023-131-N	SS2	Southeast	Debitage	Interior	Obsidian	18	4.9	196.4x^2	4715
26WA6916-2023-131-O	SS2	Southeast	Debitage	Thinning	Obsidian	17	N/A	256.86x^2	N/A
26WA6916-2023-131-P	SS2	Southeast	Debitage	Cortical	Obsidian	18	N/A	196.4x^2	N/A
26WA6916-2023-131-Q	SS2	Southeast	Debitage	Cortical	Obsidian	18	3.4	196.4x^2	2270
26WA6916-2023-131-R	SS2	Southeast	Debitage	Cortical	Obsidian	15	N/A	256.86x^2	N/A

26WA6916-2023-131-S	SS2	Southeast	Debitage	Thinning	Obsidian	18	4.7	196.4x^2	4338
26WA6916-2023-131-T	SS2	Southeast	Debitage	Thinning	Obsidian	18	N/A	196.4x^2	N/A
26WA6916-2023-131-U	SS2	Southeast	Debitage	Thinning	Obsidian	18	4	196.4x^2	3142
26WA6916-2023-131-V	SS2	Southeast	Debitage	Cortical	Obsidian	18	3.6	196.4x^2	2545
26WA6916-2023-132-A	SS2	Southeast	Debitage	Interior	FGV	N/A	N/A		N/A
26WA6916-2023-132-B	SS2	Southeast	Debitage	Interior	FGV	N/A	N/A		N/A
26WA6916-2023-132-C	SS2	Southeast	Debitage	Cortical	FGV	23	N/A		N/A
26WA6916-2023-132-D	SS2	Southeast	Debitage	Cortical	FGV	23	N/A		N/A
26WA6916-2023-132-E	SS2	Southeast	Debitage	Interior	FGV	23	N/A		N/A
26WA6916-2023-132-F	SS2	Southeast	Debitage	Interior	FGV	23	N/A		N/A
26WA6916-2023-132-G	SS2	Southeast	Debitage	Cortical	FGV	N/A	N/A		N/A
26WA6916-2023-132-H	SS2	Southeast	Debitage	Thinning	FGV	N/A	N/A		N/A
26WA6916-2023-132-I	SS2	Southeast	Debitage	Interior	FGV	23	N/A		N/A
26WA6916-2023-141	S213	Spring	Proj Point	Arrow	Obsidian	18	3.5	196.4x^2	2406
26WA6916-2023-142	S109	Southeast	Proj Point	Arrow	Obsidian	18	3.9	196.4x^2	2987
26WA6916-2023-143	S184	N/A	Proj Point	Arrow	Obsidian	18	4.7	196.4x^2	4338
26WA6916-2023-144	S162	Northwest	Proj Point	Desert Side Notch	Obsidian	18	1.6	196.4x^2	503
26WA6916-2023-145	S171	Northwest	Proj Point	Elko	Obsidian	N/A	N/A		N/A
26WA6916-2023-146	S215	N/A	Proj Point	Elko Eared	Obsidian	18	5.7	196.4x^2	6381
26WA6916-2023-147	S201	Southeast	Proj Point	Humboldt	Obsidian	64	1.2	478.96x^2	N/A
26WA6916-2023-148	S202	Southeast	Proj Point	Humboldt	Obsidian	51	4.7	72.94x^2.43	N/A
26WA6916-2023-149	S188	N/A	Proj Point	Humboldt	Obsidian	18	7.1	196.4x^2	9900
26WA6916-2023-150	S99	Southeast	Proj Point	Northern Side Notched	Obsidian	18	6.5	196.4x^2	8298
26WA6916-2023-151	S111	Southeast	Proj Point	Pinto	Obsidian	18	3.4	196.4x^2	2270
26WA6916-2023-152	S115	Southeast	Proj Point	Pinto	Obsidian	20	3.7	265.34x^2	3632
26WA6916-2023-153	S200	Southeast	Proj Point	Rosegate	Obsidian	18	1.5	196.4x^2	442
26WA6916-2023-154	S207	Spring	Biface	Stage 5	Obsidian	18	5.5	196.4x^2	5941

26WA6916-2023-155	S148	Northwest	Biface	Stage 4	Obsidian	20	2.5	265.34x^2	1658
26WA6916-2023-156	S154	Northwest	Biface	Stage 5	Obsidian	17	3.1	256.86x^2	N/A
26WA6916-2023-157	S156	Northwest	Biface	Stage 5	Obsidian	17	2.4	256.86x^2	N/A
26WA6916-2023-158	S19	Southeast	Biface	Stage 5	Obsidian	17	N/A	256.86x^2	N/A
26WA6916-2023-159	S210	Spring	Biface	Stage 2	Obsidian	40	5.4	256.86x^2	N/A
26WA6916-2023-160	S204	Southeast	Biface	Stage 4 midsection	Obsidian	51	2.6	72.94x^2.43	N/A
26WA6916-2023-161	S146	Northwest	Biface	Stage 2 midsection	Obsidian	20	3.5	265.34x^2	3250
26WA6916-2023-162	S163	Northwest	Biface	Stage 3 midsection	Obsidian	36	1.2	358.56x^2	N/A
26WA6916-2023-163	S81	Southeast	Biface	Stage 3 midsection	Obsidian	51	3.1	72.94x^2.43	N/A
26WA6916-2023-164	S92	Southeast	Biface	Stage 2 midsection	Obsidian	20	5.9	265.34x^2	9236
26WA6916-2023-165	S208	Spring	Flake Tool	Formed	Obsidian	18	4.7	196.4x^2	4338
26WA6916-2023-166	S182	N/A	Flake Tool	Formed	Obsidian	36	1.1	358.56x^2	N/A
26WA6916-2023-167	S24	Southeast	Flake Tool	Formed	Obsidian	17	4.4	256.86x^2	N/A
26WA6916-2023-168	S39	Southeast	Flake Tool	Formed	Obsidian	18	3.7	196.4x^2	2689
26WA6916-2023-169	S212	Spring	Flake Tool	Simple	Obsidian	18	1.7	196.4x^2	567
26WA6916-2023-170	S147	Northwest	Flake Tool	Simple	Obsidian	18	4.4	196.4x^2	3802
26WA6916-2023-171	S167	Northwest	Flake Tool	Formed	Obsidian	18	5.7	196.4x^2	6381
26WA6916-2023-172	S98	Southeast	Drill	N/A	Obsidian	17	2.6	256.86x^2	N/A
26WA6916-2023-173	S65	N/A	Core	Multidirectional	Obsidian	15	4.7	256.86x^2	N/A
26WA6916-2023-174	S186	N/A	Core Tool	Multidirectional	Obsidian	20	2.8	265.34x^2	2080
26WA6916-2023-175	S157	Northwest	Proj Point	Arrow	FGV	23	N/A		N/A
26WA6916-2023-176	S203	Southeast	Biface	Stage 3	FGV	23	N/A		N/A
26WA6916-2023-177	S100	Southeast	Flake Tool	Formed	FGV	N/A	N/A		N/A
26WA6916-2023-178	S211	Spring	Flake Tool	Simple	FGV	23	N/A		N/A

26WA6916-2023-179	S135	Northwest	Flake Tool	Simple	FGV	N/A	N/A		N/A
26WA6916-2023-180	S174	Northwest	Flake Tool	Simple	FGV	N/A	N/A		N/A
26WA6916-2023-181	S61	Southeast	Flake Tool	Simple	FGV	N/A	N/A		N/A
26WA6916-2023-182	S214	N/A	Drill	N/A	FGV	23	N/A		N/A
26WA6916-2023-183	S117	N/A	Drill	N/A	FGV	23	N/A		N/A
26WA6916-2023-184	S160	Northwest	Drill	N/A	FGV	N/A	N/A		N/A
26WA6916-2023-186	S87	Southeast	Core Tool	Multidirectional	FGV	N/A	N/A		N/A