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A Middle Pueblo II Production Zone for Shivwits Ware Ceramics: Implications for Understanding Settlement Patterns and Socio-Environmental Responses on the Shivwits Plateau

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A MIDDLE PUEBLO II PRODUCTION ZONE FOR SHIVWITS WARE CERAMICS: IMPLICATIONS FOR UNDERSTANDING SETTLEMENT PATTERNS AND SOCIO-ENVIRONMENTAL RESPONSES ON THE SHIVWITS PLATEAU

By

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ABSTRACT

The distribution of ceramics from upland regions in Northern Arizona into Southern Nevada is one of the many curiosities concerning the Virgin Branch Puebloan culture. From the Shivwits Plateau, it is more than 100 kilometers to the Moapa Valley, yet Shivwits Wares make up a sizeable proportion of sherds found at many lowland sites. These networks appear to reach their height in the Middle Pueblo II period and then collapse sometime around AD 1150. The reason for this is not yet fully understood; however, research performed on the southern end of the Shivwits Plateau concerning landscape usage and settlement placement suggests that the collapse of the distribution networks is coincident with possible changes in subsistence strategies. These changes coincide with climate anomalies that occur prior to the secession of Puebloan culture traits in the region.
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CHAPTER 1 INTRODUCTION

Where people choose to settle can be thought of in part, as a behavioral response to the ecological constraints placed on a society’s ability to meet its needs through interacting with its environment. While humans are indeed not always completely rational actors, their endeavors require either basic raw materials or particular environmental conditions, that when absent, either force them to seek out other regions for exploitation or to adapt to a new set of conditions. Because of this, archaeologists have long been interested in the human response to the environment, particularly in areas of elevated risk where slight increments of environmental variability can have dramatic impacts on ways of life. This research addresses Virgin Branch Puebloan settlement patterns though time as a response to socio-environmental stress on the Shivwits Plateau. This will be accomplished with ceramic seriations that correspond to specific time spans throughout the Virgin Branch culture area, known changes in social structure linkages between cultural subgroups, assumed variations in climate for the region, and spatial modeling in a GIS data driven environment. Additionally, this research provides evidence of a core production area for Shivwits Ware ceramics, which were an important ceramic ware for the distribution networks in the region up until the late Pueblo II period.

Background

The Virgin Branch Puebloan (VBP) people occupied what is now northwestern Arizona, southwestern Utah, and southern Nevada between at least AD. 1 and 1200 AD (Lyneis 1995). They share characteristics with other Puebloan groups found throughout the Greater Southwest,
including a dependence on maize agriculture, the production of ceramics, and architectural forms that include pit houses during the Basketmaker phases and pueblos during the Puebloan phases.

Within the Virgin Branch culture, there are two major subgroups, lowland and upland. The lowland group lived in southern Nevada along the Virgin and Muddy Rivers and the upland group lived along the plateaus and basins of northern Arizona and southern Utah stretching as far as the Escalante River (Figure 1-1). While research into the Virgin Branch culture has been going on since the 1930s, considerably more is known about the lowland groups of southern Nevada than the upland groups. These lowland groups practiced relatively intensive agriculture using the floodplains of these rivers to water their crops, and lived in settlements atop the ridges and mesas throughout the Moapa and Virgin Valleys (Lyneis 1995). In the uplands however, considerably less work has been done, and on the Shivwits Plateau itself, only a handful of investigations were performed from the mid-1940s until the early 1990s (Wells 1990). Modern academic work started in the region in 2006 when both Brigham Young University (BYU) and the University of Nevada Las Vegas (UNLV) initiated separate field projects in the area (Friess 2010). Since then much of what we know about the Shivwits group of the Virgin Branch Puebloan culture has come from work conducted by UNLV with support being drawn from grey literature created through resource management projects and facilitated by the National Park Service out of Boulder City.

Much of the previous research on the Virgin Branch culture has focused on trade and land use patterns in the region, (see, Harry 2005; Harry, et al. 2013; Jensen 2002; Lyneis 2005; Osborne
Two findings from these studies are particularly relevant to the research being conducted here, and suggest that the VBP people living on the Shivwits Plateau were exposed to socio-

Environmental stresses during the late Pueblo II and early Pueblo III periods. The first of these is the identification of a ceramic distribution network that involved the movement of ceramics produced on the Shivwits Plateau to the Moapa Valley (Lyneis 2005). This distribution network was at its peak during the middle Pueblo II period but lasted only about 50 years and had collapsed by the late Pueblo II period, likely triggering socioeconomic stresses and possibly adaptive changes designed to manage these stresses. The second relevant finding concerns

Figure 1-1 The Virgin Branch Culture Area
changing climatic and subsistence patterns on the Shivwits Plateau. Excavation data suggest that between the Pueblo II and early Pueblo III periods, the inhabitants of the Shivwits Plateau may have experienced a decreased reliance on agriculture and an increased emphasis on the use of wild plant resources (Harry personal communication 2018); and climatic studies from other areas of the Colorado Plateau raise the possibility that these subsistence changes may have been triggered by climatic change. The present study examines whether temporal shifts in settlement patterns can be observed on the southern end of the Shivwits Plateau and, if so, whether they correlate with and can be explained by the two stressors (i.e., the collapse of the distributional networks and climatic changes) discussed here.
CHAPTER 2 THE ENVIRONMENT

The role that the environment plays in shaping human adaptation is an important consideration in any analysis concerning human behavior as a response to risk. This section covers the key environmental variables that are considered in this thesis as being critical to understanding Virgin Branch Puebloan lifeways on the Shivwits Plateau.

Geographic Setting

The Shivwits Plateau is one of the numerous upland areas in the Colorado Plateau physiographic region accounting for approximately 1,875 square miles in total area (Hamblin 1986), see Figure 2-1. Of this area, the National Park Service administers approximately 130 square miles of the plateau at its southern end starting around Mount Dellenbaugh and extending south to the terminuses of Kelly Point and its eastern neighbor Twin Point. At its rim, the Shivwits Plateau rises to an altitude of approximately 6,000 feet with its highest point, Mount Dellenbaugh, reaching 7,072 feet in elevation. Below the southern rim of the Plateau, the Sanup Plateau stretches out southwards towards the rim of the Grand Canyon at 4,400 feet, with the Colorado River below it at 1,200 feet. At the far Western edge of the Plateau are the Grand Wash Cliffs, and to the east are the Hurricane Cliffs. Further to the east lie the Uinkaret and Kanab Plateaus. The landscape is by all practical standards moderately inhospitable in the sense that there are limited water resources.
Geology

The unique geology of the Grand Canyon region is one of the prime factors to consider concerning the environment of the Shivwits Plateau. In this section, the major geological variables considered in this research are discussed along with their implications for constraining human activities.

Lithology

The predominate rock type across the project area on the Shivwits Plateau is Late Miocene to Pliocene basalt and alkaline basalt (USGS Mineral Resources 2005). This layer forms the uppermost cap of the plateau that sit on Permian age Limestone. On the eastern rim of Kelly
Point, overlooking Andrus Canyon, a small band of Middle Triassic mudstone slopes relatively gently away from the rim, transitioning into Pennsylvanian to Permian age sandstone that continues down into the canyon. To the West of Kelly Point, both Suicide Point and Twin Point have a surface lithology that is predominately Permian age Limestone. This geologic layer is also seen at the surface on the southern end of Kelly Point. Small pockets of Pennsylvanian to Permian age sandstones can be found inside the National Park boundary and on the slopes of the canyon walls off Twin point and to an even lesser extent, Kelly Pont.

\[Figure\ 2-2\ Lithology\]

From a human behavioral standpoint, the lithology of the region has major implications on where certain activities, namely agriculture, could take place. As noted in Harry (2015), two geological
substrates make up the primary lithology of the Shivwits Plateau – limestone and basalt. Areas where limestone is the primary substrate tend to have poorer soils, particularly in areas of low organic input. The basaltic substrates typically however have much richer soils and with heavy clay contents. As such, they often have superior water retention capabilities than does limestone. In contrast, areas off the highland areas of the plateau, such as the Sanap and Espalande, are predominately of sandstone substrate which contain poor soils with poor water retention capabilities. As such these areas are particularly unsuitable for agriculture when compared to the upland regions, see Figure 2-2 Lithology.

Soils

A variety of soils are present within the study area, some of which are suitable for limited agriculture. For the purposes of this study, the dominant soil orders are defined and spatially examined to better understand habitation site distribution through time as it relates to subsistence strategies. There are six soil orders with the National Park Service administered areas of the Shivwits Plateau and their distributions can be found in Figure 2-3.

Alfisols

In general, this order is noted to have “naturally fertile soils with high base saturation and a clay-enriched subsoil horizon” (Soil Survey Staff 2015:[4-7]). This high base saturation slows the rate that they become acidic and increases the rate in which they return to lower levels of acidity. Water tension at 1500kPa is held for at least 3 months out of the year coincident with its regions growing season making them suitable for agriculture. (Soil Survey Staff 1999). Alfisols form on stable landforms typically in forested to semi forested regions.
**Aridisols**

As their name implies, aridisols are best characterized by their lack of available moisture to such an extent that there is no consecutive 90 day period in which there is moisture that is continuously available for plant growth (Soil Survey Staff 1999). These soils can often contain high levels of salt. This combined with their lack of moisture greatly limits the amount of vegetation that can grow in these soils. Irrigation can be used in some cases to provide adequate moisture for crop production, however it is highly unlikely that the Virgin Branch people utilized these soils for farming in the area. Most Aridisols can be found below the elevation at which this study is conducted, however they play an important role in the regional ecology. Since much of the soil at the lower elevations are Aridisols, moving fields to lower elevations during cold periods was likely not an option.

**Entisols**

This soil order is characterized as having very limited to no soil horizons and being found on steep slopes, the regional environments of flood plains, and sand dunes. They form in regions where erosional processes are taking place and a greater rate than depositional ones (Soil Survey Staff 2015:[4-150]). They tend to be rich in minerals such as quartz which also has the effect of minimalizing the formation of soil horizons. These conditions, particularly the high rates of erosion, make entisols unlikely candidates for agriculture.

**Inceptisols**

Inceptisols are a diverse order of soils that all share a weak development profile. Thus, they can be found in an extensive variety of environments that have high degrees of erosion and deposition rates. These include slopes, river valleys, and flood plains. Their high iron rich content
can cause significant hardening after repeated wet dry cycles (Soil Survey Staff 2015:[4-246]). They can also contain elevated levels of sodium and other soluble salts making them potentially problematic for agricultural production. No inceptisols are found within the immediate area of the study.

**Mollisols**

These soils are characterized as having an organic rich surface and as being extremely fertile. They form in conditions that result in deep inputs of organic material and nutrients, typically in grassland or steppe environments that foster considerable amounts of belowground bio-mass. This bio-mass effectively cycles the nutrients in the soil (Soil Survey Staff 2015:[4-290]). Animal and microorganism activity also aides in the distribution of nutrients and adds to the overall fertility of the soil. These soils are suitable for agriculture when the necessary amount of moisture is present (Soil Survey Staff 1999).

**Vertisols**

This soil order is easily identified by its high clay content and the presence of large cracks on the surface caused by the expansion and retraction of soil during periods of high and low moisture. These soils can become particularly sticky and plastic when wet, while very firm and hard while dry (Soil Survey Staff 2015:[4-457]). Because of this, these soils are difficult to work with and require excessive amounts of energy to manipulate even with modern tools and techniques (Soil Survey Staff 1999). Because of these characteristics, it is likely the Virgin Branch would have preferred other soils for agriculture.
Available Water Storage

Available water storage is the difference between the maximum capacity of water that can be held by the soil and the permanent wilting point (Birkeland 1984:18). Thus, it is the volume of water required to go from the wilting point to field capacity. The wilting point in a soil is where the forces of attraction between the soil structure and the water molecules are such that plants can no longer draw moisture through their roots. The amount of water available in the soil is chiefly then a function of the surface area of soil particles and the degree of porosity occurring in the soil structure. Various degrees of available water storage can be found across the study area and can be seen in Figure 2-4.
For this analysis the degree of run off is simply ranked as found in the Natural Resources Conservation Service’s Soil Survey Geographic Database (SURRGO) dataset. Areas that have high degree of run off consequently have high degrees of erosion and are thus less suitable for agriculture. As run off can carry away sediment from soils, it fundamentally changes the soil structure in terms of sediment inclusions in clay bodies. A map of the areas ranked by their degree of run off can be found in Figure 2-5.

Figure 2-4 Available Water Storage

Degree of Run Off
The landforms on the Shivwits Plateau can be classified into six basic typologies. As human habitation and agricultural production requires relatively flat areas upon the landscape, these landforms may be useful in understanding Virgin Branch settlement patterns over time. In terms of agriculture, areas that are along valley flats likely represent the best locations, given all other requirements being present, for placing agriculture fields as they would be the locations that would have water drain into them with a minimal amount of erosion. The distribution of landforms and their types can be found in Figure 2-6.
Hydrology

Permanent water sources are scarce within the region. Apart from the Colorado River, no permanent rivers or steams are in the vicinity. In the immediate area of the study, there are few known springs and a handful of water pockets that store rainwater for at least some portion of the year, see Figure 2-7. Within the study area itself, Green Springs is the only relatively substantial water source having a flow rate of approximately one gallon every minute (Arizona Department of Water Resources Staff 2009). However, the collection pools for Green Springs are precariously below the rim of the Canyon and relatively difficult to access. South of Green Springs,
Ambush Pocket sits at the head of a side canyon and when visited in both 2015 and 2016 contained several pools of stagnant water. In addition to these water sources, the study area contains numerous seasonal stream channels and washes that become active during periods of liquid precipitation. Several of these drain substantial areas of upslope terrain across relatively flat areas making them suitable collection areas for rain water during the wet seasons.

*Figure 2-7 Springs and Seeps*

**Ecology**

The varied ecology of the study area provides numerous vegetation and animal habitats that could have been exploited by the Virgin Branch. While some alterations to the environment have
occurred in the historic period, these have been generally limited to logging, animal grazing, homesteading, and burning. Thus, historic impacts to the environment have most likely not radically altered the vegetation communities in the region except for possibly reducing the expanse and numbers of Ponderosa trees. Chaining has not been reported to have taken place in the study area.

_Eco-divisions_

While classifications for different eco-regions and divisions vary broadly from agency to agency, data produced for resource management practices on the Arizona Strip define three broad eco-divisions on National Park Service lands. These are the Ponderosa Pine Forest, Mohave-Great Basin Transition, and Great Basin. The Ponderosa is dominated by Ponderosa Pine Forests intermixed with Pinyon Juniper Woodlands. The great basin ecology is primarily Pinyon Juniper Woodlands. The vegetation community for the Mohave-Great Basin Transition is dominated by scrublands and badlands see, Figure 2-8.
Vegetation cover was sourced from the Southwest Regional Gap Analysis Project (SWReGAP) and grouped based on ecological similarity based on (Osborne 2008). Within the National Park Service administered lands, there are five distinct varieties of vegetation, see Figure 2-9. However, only three of these are found on the basaltic cap of the plateau and thus in the study area. These are the pinyon-juniper woodland, ponderosa forest, and steppe and grassland. A description of these three ecologies can be found below.
Pinyon-Juniper Woodlands

Often found in the higher elevations of the Arizona Strip, this vegetation formation is predominately made up of juniper and pinyon trees (Alschul and Fairley 1989:34). On the basaltic cap of the plateau it makes up the primary vegetation cover within the study area. Juniper has historically been used for food, fuel, and medicine by various Native American groups including the Paiute and Shoshone (Janetski 1999). Pinyon produces edible pine nuts which appear in abundance roughly every 2-5 years depending on the species and are historically extremely valuable as a food source. Within the understory, a variety of other plants can be found including several edible or useful cacti such as prickly pears, chollas, and hedgehogs (Alschul and Fairley 1989:34).

Ponderosa Pine Forest

As the name suggests the dominate species of tree in this vegetation formation is the Ponderosa Pine. Additionally, this ecological community often contains species of Gamble Oak which produce edible acorns. Based on accounts of 19th witnesses, these forests were at one time considerably different than what is seen in the modern times (Brown and Smith 2000). These pre-eneuromerican settlement forests were characterized by “well-spaced” stands of ponderosa with younger trees interspersed and maintained a “vigorous and abundant” amount of herbaceous flora. The effects of fire, windfall, insects, and tree mortality create openings in the forest that would become meadow areas, hence sometimes giving the name to these forests Ponderosa grasslands, see (Biswell 1973). Light surface fires helped maintained the meadow like environments of the Ponderosa stand ecologies by reducing the annual pine needle litter on the ground. While it is difficult based on available data to say for certain the extent and nature of the
ponderosa ecology within the study area at the time of the Puebloan occupational sequence, first 
hand observations made during this study on the nature of recently burned areas of forest 
confirm the presence of a strong herbaceous understory. Some of the species of plants that could 
be potentially found in abundance within the ponderosa ecology are listed below. While many of 
these can be found in the other ecologies of the study area, based on the qualities of this 
vegetation structure discussed here, the ponderosa community represents an area of high 
potential for their acquisition. Some of the economically important species of plants that can be 
found in this environment are discussed at length below as the ponderosa ecology represents 
one of the best catchment areas for wild plant extraction. A photograph of a typical ponderosa 
meadow on the Shivwits Plateau can be found in Figure 2-10.

Cheno-Ams

There are multiple varieties of wild goosefoot, all if which are annuals that germinate after the 
summer monsoons (Dunmire and Tierney 1995:171). Preferring disturbed soils these plants 
would have grown perfectly near homesteads, pueblos, and agricultural fields. They are excellent 
sources of protein and calories. Both the seeds and leaves of these plants can be used.

Amaranths are also an annual plant that prefers disturbed or cultivated soils and tend to appear 
by midsummer (Dunmire and Tierney 1995:173). They can be classified into two types, grain 
amaranths and vegetable amaranths. Grain amaranths however may not have made it into the 
Southwest from Mesoamerica until after historic times. Vegetable amaranth seeds are highly 
nutritious, and their greens are high in vitamin A.
Amaranthus (Amaranth, Pigweed).

Pigweed, also called redroot amaranth, blooms in early spring though late summer and can be found in waste areas and disturbed soils such as in gardens (Tilford 1997:14). The leaves can be eaten raw or cooked and are better if from younger plants. The seeds from pigweed can be also eaten and are high in protein.

Atriplex (Saltbush).

Saltbush is a dioecious plant that can be found in washes, mesa tops, and hillsides (Dunmire and Tierney 1995:129). It is also able to grow in highly alkaline soils. Seeds could be ground up and cooked into a cereal and the leaves can be cooked or eaten raw (Ibid.:130). The ashes from the burned plant can be used to make lye and to bring out the niacin content of corn (through the adding of lye to soften the hulls of corn). This has the effect of increasing the availability of amino acids in the proteins of the corn.

Chenopodium (Goosefoot, Lamb's Quarters).

Members of the goosefoot family germinate with the summer rains throughout the southwest and can be found growing in waste regions by late July (Dunmire and Tierney 1995:171). They produce highly nutritious seeds of about the same caloric value as Indian Ricegrass. The greens of the plant can also be used boiled or fried.
*Suaeda* (Seepweed).

Seepweed, also known as desert blight, is also a member of the goosefoot family and can be found in soils that are high in alkaline and saline (Kirk 1975:62). These succulents’ seeds may be consumed either raw or parched, and young plants have edible greens that have a salty flavor (Ibid.). Groups such as the Pima paired this plant as a spice when cooking cactus fruits (Moerman 1998:546). When the stems and leaves are soaked in water, a black dye can be produced that is useful for coloring woven objects such as mats.

*Mentzelia* (Blazing star, Stickleaf)

Blazing Star or Stickleaf (*Mentzelia albicaulis*) is known by some Paiute groups as the Gravy plant and has red seeds that thicken when added to hot water (Murphy 1959:27). Parched seeds can be made into a meal (Kirk 1975:32). It can be found from February to August in arid and sandy soils, and along washes at elevations up to 7000 ft. (Kearney and Peebles 1960:566).

*Plantago* (Plaintain, Indian Wheat)

Plantago can be found in moist ground throughout the American West. They are annual to perennial and produce small flowers on leafless stems (Kirk 1975:65). They are known for their use as potherbs or as salad greens, and their seeds can be parched and ground into meal. The coating on these seeds are mucilaginous and when soaked in water or eaten raw can have a laxative effect.

*Poaceae* (Grass Family)

This family of grasses are known to be viable sources of food during the cooler seasons in the American Southwest, and are reliant on winter and spring moisture for their growth and
development (Bohrer 1975; Ebeling 1986:464). Species that belong this family include bentgrass (Agrostis), wild rye (Elymus), wheat grass (Agropyron), and Indian ricegrass (Oryzopsis hymenoides). Their seeds can be eaten raw or parched. When ground into flour they can be used to make breads and mushes. Their leaves can be used as greens.

Indian Ricegrass (Oryzopsis hymenoides)

The perennial ricegrass plant is often referred to as a cool season grass that produces seeds in the spring and early summer (Dunmire and Tierney 1995:155). It grows in dry, sandy soils, and can be found in the pinyon juniper ecozone and below. It was a highly important plant to Native Americans living in the southwest namely for it being available for early season harvest, typically by mid-June (Ibid:157). Seeds could be parched, combined with cornmeal, or used in times of food shortages and were highly nutritious.

Quercus gambelii (Gambel’s oak)

Gambel’s oak can be found at elevations between 5,000 and 8,000 feet where it often forms thickets of vegetation amongst pinyon and juniper woodlands (Dunmire and Tierney 1995:114; Kearney and Peebles 1960:219). The tree produces acorns that can be gathered in the fall and are high in lysine, which incidentally is an essential amino acid not found in corn (Dunmire and Tierney 1995:115). These acorns would have been processed to remove their tannin and then ground into a meal or simply boiled and eaten (Moerman 1998:461). Potential medicinal applications of the plant include being used as an emetic, a reproductive aid, and as a pediatric oral aid.
Grasslands

Grasslands represent the smallest map unit of vegetative land cover within the study area. While such environments would clearly have the same vegetative potential as discussed above in terms of many of the economic plant species, the presence of these grasslands occur in the vicinities of historic landscapes and may coincide with alterations made during the historic era of occupation.

*Figure 2-9 Landcover*
Climate

The Shivwits Plateau represents a semiarid environment with bimodal moisture patterns. Rainfall on the southern end of the plateau ranges between 400 – 500 mm of liquid precipitation per year and growing seasons range from approximately 126-153 days, Figure 2-11 (Soil Survey Staff 2014). While these conditions are adequate for growing maize, the high elevations of the region would have forced planting to occur no earlier than late May to avoid early frosts (Harry 2015). As the period between late May and early June is the driest period of the year, moisture for germination would have had to come from Spring snowmelt.
Modern Precipitation

The closest weather stations with operational history near the project area are at Mt. Trumbull, Arizona (025744), and Tuweep, Arizona (028895). The Mount Trumbull station is approximately 15-30 miles to the North Northeast of project area and at 5600 feet in elevation. The Tuweep station is approximately 15-30 miles to the East-Northeast of the project area and at 4780 feet in elevation. The Western Regional Climate Center reports that for the station at Mt Trumbull recorded climate date between 10/1/1919 and 12/31/1977. The percent of possible observations for the period of record are 3.7% for maximum temperature, 3.7% for minimum temperature, 90.8% for precipitation, 89% for snowfall, and 82.6% for snow depth. Monthly averages for the reporting period can be found summarized in Table 2-1. For the Tuweep station, the period of record is between 06/01/1941 and 03/12/2006. During this period, the percent of possible observations reported were 87.6% for maximum temperature, 87.6% for minimum temperature, 96.2% for precipitation, 95.6% for snowfall, and 93.4% for snow depth. Monthly averages for the reporting period can be found summarized in Table 2-1. For the US Department of Agriculture precipitation estimates across the study area, see Figure 2-12.
Figure 2-11 Frost Free Days

Table 2-1 Tuweep Station Climate Data

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<th>Feb</th>
<th>Mar</th>
<th>Apr</th>
<th>May</th>
<th>Jun</th>
<th>Jul</th>
<th>Aug</th>
<th>Sep</th>
<th>Oct</th>
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<td>Insufficient Data</td>
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<tr>
<td>Average Min. Temperature (F)</td>
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<td>Insufficient Data</td>
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<td></td>
</tr>
<tr>
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<td>0.96</td>
<td>0.88</td>
<td>0.69</td>
<td>0.54</td>
<td>0.41</td>
<td>1.73</td>
<td>2.05</td>
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<td>0.98</td>
<td>0.63</td>
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<th>Mar</th>
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<tr>
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<td>1.25</td>
<td>0.62</td>
<td>0.49</td>
<td>0.41</td>
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<td>0.83</td>
<td>0.89</td>
<td>0.91</td>
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<td>0.60</td>
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</table>

Figure 2-12 Average Liquid Precipitation

Past Climate Variation

Little research is currently available on the paleoclimatic condition of the western proportion of the Colorado Plateau. Reconstructions have been made however by Salzer and Kipfmueller for the eastern portion. These patterns as inferred by Salzer and Kipfmueller (2005) reveal several
periods of climatic stress. The first of which that we are interested in is the period at or around the
time that it appears the Shivwits Plateau was first populated by Puebloan groups. Here we see between the years of A.D. 975 - A.D. 984 and A.D. 991 and A.D. 1005 periods of significant
drought. During these periods, the Colorado Plateau was between -0.8 and -0.64 standard
deviations below normal in terms of rainfall than average. Between these two dry periods, a
highly unusual but brief period of heavy moisture occurred from A.D. 985 to A.D. 989 (z = 2.15).
This period of moisture was coincident with a period of extreme cold (z = -1).

The next major period of climatic instability comes during the Middle Pueblo II phase. Starting at
A.D. 1033 and lasting until A.D. 1046, drought conditions persisted on average at -0.46 standard
deviations below normal. This period gives way to much wetter conditions between A.D. 1049 –
A.D. 1056 and again at A.D. 1060 through A.D. 1066. Incidentally it was around this time that it is thought that the distribution networks between the uplands and lowlands were at their height.
A period of unusual warmness also occurs between the dates of A.D. 1046 – A.D. 1055.

Precipitation for the Colorado Plateau appears stable then until A.D. 1090 when another drought
occurs lasting until A.D. 1101. During the period between A.D. 1067 – A.D. 1091 however,
conditions on the Plateau were unusually warm (z = 0.81). This period represents the longest
uninterrupted climate period in the Virgin Branch occupational sequence that would have been optimal for agricultural production. It ends in the above-mentioned drought and an unusual cold period that begins in A.D. 1094 and lasts until A.D. 1120 (z = -0.98). Considering the short growing season and high elevation of the Shivwits Plateau, these cold and dry conditions could have had profound consequences on groups subsisting off agriculture.
CHAPTER 3 RESEARCH DESIGN

Research Issues

There are several important research issues that make up the components of the research design used in this study. These components mainly have to do with the mitigation of subsistence risk in semi-marginal environments that have medium to low levels of predictability. Here I will outline the implications of these components considering what is known so far about subsistence strategies and trajectories in the region for the Puebloan period.

Socio-Environmental Stressors, Adaptation, and Environmental Variability in Marginal Environments

In general, effective human adaptation to the environment requires a degree of flexibility in order to respond to the “perturbations” that naturally arise out of the natural variability in ecological systems, see (Slobodkin and Rapoport 1978:198). Thus, concerning human adaptation to the environment Minnis (1985:19) writes that, “the magnitude of [behavioral] responses should match the severity of the perturbation. To do otherwise creates situations where adaptive flexibility is lost, with the result that other perturbations may not be addressed effectively.”. While climate variations do occur over the span of the occupational sequence for the Virgin Branch Culture as discussed above, their long term trajectory is relatively stable suggesting that the ecological perturbations experienced on the Shivwits Plateau constitute what Butzer (1982:28) refers to as “first and second order” changes in ecosystems. These changes amount to yearly fluctuations in the forms of anomalies or cyclical events that cause variations in biomass, landscape productivity, and available water, and do not last for more than a few decades. As Butzer points out, these levels of environmental changes have the greatest impact in ecological
contexts that have low levels of predictability (Ibid.). Given that the environment of the Shivwits Plateau is at the margins of suitability for agriculture in terms of climate, I would argue that the margin then for error in predicting patterns in the environment may have been razor thin.

Based upon data produced by Salzer and Kipfmueller (2005), a high degree of climatic variability existed on the eastern side of the Colorado Plateau between the years AD 1060 – 1120. While we do not have climate data specific to the Shivwits Plateau, this period of variability appears to coincide with the breakdown of the distribution networks between the upland groups and the lowland groups living in the Moapa Valley. Of particular note, during this time span is a period of significant cold lasting from about AD 1094 until AD 1120. As the growing seasons in the upland regions were undoubtedly shorter than those in lowland areas, it is likely that such a period would have produced a noticeable amount of stress on the inhabitants of the Shivwits Plateau. If this is so, then it is likely that such stress is observable in the archaeological record, manifesting itself in observable changes in adaptations to the environment.

*Virgin Branch Agriculture on the Shivwits Plateau*

Considerable debate still exists concerning how dependent the Lowland VBP were on cultivated resources. While Dalley and McFadden (1988) and Martin (1999) have argued that the Virgin Branch People were primarily farmers who supplemented their diets with wild resources, Larson and Michaelsen (1990) have suggested they were horticulturalists who relied more on hunter-gather diets until major socio-ecological pressures forced them into agriculture when wild resources became more risky to rely on. Whatever the degree of agricultural dependency occurred in the lowland areas, upland groups likely did not share the same subsistence patterns
of the lowland groups if we consider the differences in the environmental settings alone (Harry 2015).

While sufficient evidence of agricultural activity has been documented on the Shivwits Plateau in the form of both agricultural terraces (MacWilliams, et al. 2006; Wells 1991) and corn pollen recovered from excavations by Harry (2015), agricultural activity would have involved significant risks and unlike the lowlands, irrigation on the Shivwits Plateau would not have been possible. Thus, upland groups would have been dependent on dry farming techniques. Varieties of maize are most productive in dry farming regions where there are at least 150 mm of annual precipitation but preferably 250mm (Shaw 1988). Of that precipitation, at least 100 mm needs to fall within the summer growing season (Muenchrath and Salvador 1995). Additionally, maize agriculture requires no less than 115 frost free days (Benson, et al. 2007). While the southern end of the Shivwits Plateau does receive between 400 – 500 mm of liquid precipitation a year (Soil Survey Soil Survey Staff 2016), little of this moisture falls during the germination period for maize (Harry 2015). Frost free days on the Shivwits Plateau range from approximately 126-153 days making for considerably shorter growing seasons than found in the Virgin Branch lowlands (Soil Survey Soil Survey Staff 2016). While again adequate for growing maize, the high elevations of the region would have forced planting to occur no earlier than late May to avoid early frosts (Harry 2015). As the period between late May and early June is the driest period of the year, moisture for germination would have had to come from spring snowmelt. Considering this, agricultural practices on the Shivwits Plateau may have been such to optimize productivity by using the very best available land to ensure that maize would grow and mature within the limited window of opportunity the environment affords. Land that has a high available water storage,
nutrient rich soils, low run off, and is situated in the valley floors where moisture from precipitation would collect, would likely have been highly sought after.

_Agricultural Dependence through Time on the Shivwits Plateau_

Based upon limited excavation data, agricultural dependence on the southern end of the Shivwits Plateau may have waned toward the end of the VBP occupational sequence. Both the ubiquity and proportions of domesticated resources appear to decline overtime with the latest site dated so far on the Plateau having only 0.3% maize out of all charred non-woody plant remains recovered (Harry 2015). This trend is coincident with both declines in the largest rooms sizes overtime and the decline in jar to bowl ratios, which suggests a decline in the reliance of stored food overtime. However, excavations on the Shivwits Plateau only began in the mid-2000s and very limited amounts of excavated data have been dated past the Late Pueblo II period. Nevertheless, the potential decline in agricultural dependence coinciding with the breakdown of the distribution networks in the region point to a possible shift in Virgin Branch lifeways during the latter half of their occupational sequence on the Shivwits Plateau.

_Ceramic Distribution Network_

Margaret Lyneis was the first to identify a ceramic distribution network that originated from the Shivwits Plateau and that moved ceramic vessels to the Moapa Valley (Lyneis 2005). These ceramics, known as Shivwits Wares, were first defined in 1988 by Lyneis who proposed they were produced on the southern end of the Shivwits Plateau. Lyneis’ reasoning for this was because these wares were made from clays that were high in iron content, and they were tempered with Moapa Grayware sherds, which are found in high abundance on the southern end of the Shivwits Plateau. Compositional studies confirm that these Shivwits wares were not produced in the
Moapa Valley and supported Lyneis’ (1988) belief that they were made on the southern end of the plateau (Harry, et al. 2013). Jensen (2002) attempted to locate this production zone, however; her study focused on finding Middle Pueblo II sites that had high proportions of Shivwits Ware on the central to southern end of the plateau. None of the sites in her analysis met those criteria which led her to suspect that the production zone was further south.

The distribution networks between the lowland and upland groups of Virgin Branch Puebloans were likely based on a decentralized network of production clusters, which produced Shivwits Ware or Moapa Gray Ware ceramics (Harry, et al. 2013). While Shivwits Wares are common at sites located in the Moapa Valley, sourcing studies utilizing neutron activation analysis have demonstrated that they were not made of local clays, and it has been suggested that they were produced on the Shivwits Plateau around the area of Mount Dellenbaugh (Ibid.). Compositional studies suggest that Moapa Gray Wares were produced around the Mount Trumbull area of the Uinkaret Plateau, where the olivine that is used as their temper is found (Sakai 2007, 2009, 2014). These distribution networks represent travel distances approaching nearly 100 miles by foot through relatively difficult topography. The locations for the Moapa Valley, Uinkaret Plateau, and Shivwits Plateau can be seen in Figure 1-1.

In general, the utility wares that are found in the northern Southwest are assumed to have been produced by individual households for local consumption. A noteworthy exception to this can be found in the manufacture of wares in the Chuska Mountains that were used by those at Chaco Canyon, see (Toll 1997:91). However, the scale of complexity surrounding the cultural processes at Chaco appear far greater than what is seen in the far western reaches of the Puebloan world
in Southern Nevada. It is important to point out though that other non-utilitarian wares such as painted olivine tempered ceramics, and red and orange wares from the eastern regions are also seen in the Moapa Lowlands of Southern Nevada. Finally, although not seriously considered in this thesis, we must acknowledge that our conception of utility wares may not match with the way Ancestral Puebloan populations understood the properties of objects.

Based upon studies conducted at lowland sites, it appears that households in the lowlands would have likely received somewhere between 3-5 Shivwits and Moapa ware vessels each year (Allison 2000:129.212-215). While Lyneis had suggested that the mechanism for distribution from the uplands to the lowlands was through “down-the-line exchange”, (Lyneis 1992), Allison (2000) has suggested that they are the result of direct distribution from those in the uplands coming to the lowlands to participate in harvest festivals, like that of the Havasupai. Proportions of non-local wares at lowland sites are significant in number. For example, at the sites at Yamashita on the eastern margins of the Lower Moapa Valley, approximately 13,100 utilitarian body sherds were found. From this assemblage, 24% were olivine-tempered Moapa wares, and 11% were Shivwits ware (Lyneis 2005). North Creek Gray of various tempers made up the remaining bulk of the assemblage. Additionally, at the site of Main Ridge in the Moapa Valley, olivine-tempered ceramics make up roughly 40% of the painted ceramics (Lyneis 1992). Allison (2000:123) notes it is highly difficult to calculate the precise volume of distribution of non-local wares into southern Nevada, however; he estimated that total imports into the Moapa Valley likely amounted to a household importing no more than 3-5 vessels per year.
In general, the upland ceramic distribution appears to be unidirectional, originating in the highlands of the Plateaus and moving into the lowlands to the west. In the case of Shivwits Wares, large jars were the principal vessel form produced and distributed; the size and shape of these vessels would have made it difficult or impossible to carry more than one at a time (Lyneis 2005). The frequency of trips to lowlands, assuming direct distribution and the volume of importation, was likely relatively low compared to some of the other exchange networks in the Southwest. However, the sheer level of effort involved in these exchanges would have been quite significant (Harry, et al. 2013). Thus, this exchange pattern is noteworthy for a few important reasons: (1) it indicates there were contacts, and thus relations, between groups living in the upland regions and the lowland regions and (2) it indicates that these relations were strong enough to facilitate exchange despite the difficulty such processes must have invoked.

It has yet to be illustrated what factors drove the strength of these relations. Exploratory ethnographic models comparing the exchange between upland and lowland groups and modern analogs seem to indicate that agricultural marginality for the upland groups does not sufficiently explain the existence of the exchange network (Harry 2005). It is important to point out however that the fuel resources for manufacturing ceramics are much more abundant on the Shivwits Plateau than they would have been in the Moapa Valley, which is situated in the Mojave Desert. According to Lyneis (2005), this may be one of the driving factors in the distribution of pots from the upland regions into the lowlands. The lowland region is predominantly Mojavian in its ecology and the predominant wooded species in the region are cottonwood, mesquite, and willow. These species would have been greatly limited in their range to areas around the terraces and floodplains along the Muddy River and they would have appeared in limited abundance. Allison
suggested that the jars were in fact vessels that contained some other item of exchange and that the jars themselves were simply a byproduct of that exchange.

Nevertheless, it is highly unlikely that the ceramics produced on the Shivwits Plateau were exchanged for food in the lowlands that was directly carried back to the uplands in order to mitigate ongoing subsistence stress. Lightfoot (1979) has calculated that for most food sources utilized by Puebloan groups, 20 to 50 km is the maximum range for efficient food distribution in terms of the caloric costs of transport and the caloric value of the foodstuff. Based on Lightfoot’s calculations, a 24-kilogram burden of milled corn yields 88,290 calories. With such a load over uneven terrain, a moderate pace of 5.76 kilometers per hour for 100 kilometers would burn 17,674 calories. While creating an optimal model of caloric efficiency for subsistence activities is beyond the scope of this research, it is unlikely that other subsistence activities on the Shivwits Plateau would have exceeded the caloric investment required to transport food from the lowlands in transportation costs alone, to say nothing about the investment in ceramic manufacture and opportunity costs involved in the production of those ceramics. That is not to say that food may not have been exchanged, simply that it seems unlikely that such a system’s primary function was to mitigate risks quid pro-quo. However, it is highly conceivable that the movement of people into the lowlands on a seasonal basis to help with harvesting could have indeed been a subsistence strategy by upland groups (Allison 2000).

A permanent disruption of the exchange networks between the uplands and the lowlands appears to have occurred sometime after AD 1150, see (Allison 2000:113). This is about the same time that corrugated design styles become more prominent in the archaeological record in the
uplands. While a firm explanation for the cessation of these networks has not been fully explored, changes in the territorial expanse of other regional groups such as the Patayan may have played some part. The most direct route for these networks would have been through what is now the Gold Butte area where non-local ceramic wares make up nearly 30% of the ceramic assemblages at sites. Here, Paiute brown wares and Patayan pottery are nearly as abundant as Puebloan pottery (McGuire, et al. 2010:77-78). The time period associated with the collapse of the distribution networks also coincides with a period of environmental unpredictability throughout the Puebloan world (Benson, et al. 2007; Larson and Michaelsen 1990). While it is difficult to directly show that environmental factors drove the collapse of these exchange networks, a better understanding of changes in settlement patterns in the uplands may give us deeper insight in how people responded to the socio-environmental stresses that occurred as the socio-ecological landscape changed.

**Research Questions**

Given the nature of the covarying patterns discussed above, this research has focused on two primary questions to better understand the variation of Virgin Branch lifeways over time on the southern portion of the Shivwits Plateau. The first question relates to the distribution of habitation sites on the Shivwits Plateau and whether we can identify a correlation between their locations and other socio-environmental variables. The second question relates to identifying a production zone for Shivwits Ware ceramics that dates to the height of the distribution networks discussed above.
Questions

1) Is there a spatial-temporal pattern to settlement distributions on the Shivwits Plateau? 

And if so, do the observed settlement shifts correlate with/reflect responses to socio-environmental stresses

The question of spatial temporal sequencing for habitation sites is answered through acquired corrugated ceramic proportions from archaeological contexts located in the different sub regions of the plateau. With these data, spatial statistics were used to assess if the distributions of sites from certain time-periods clustered significantly. When clusters were present, then environmental variables were investigated to see whether they covary with the settlement patterns.

The premise of this approach was that if there are spatial-temporal patterns to settlement distributions, we should expect that given the nature of elevated risk of the Shivwits Plateau, these settlement patterns would reflect a response to environmental conditions. Indicators of such responses would be shifts in how settlements are positioned across the landscape that coincide with other changes in either the prehistoric climate and/or changes in cultural processes such as exchange. Additionally, adaptive responses to changing environmental conditions could include changes in settlement sizes overtime.
2) Can we identify the production area on the Shivwits Plateau for Shivwits Ware ceramics?

If there is a core production area for the distribution of Shivwits Ware ceramics, then we should expect to see regions where sites dating before the collapse of the exchange networks have a higher than average abundance of Shivwits Ware sherds by proportion. These sites should cluster significantly.

*Previous Related Research and Pilot Studies used in this Thesis*

Prior to the research conducted for this thesis two other projects and a series of excavations were instrumental in the formulation of both the research questions and design now undertaken. The first of these projects was datamining the vast amounts of archaeological information that has been collected over the years by the National Park Service while administering their portion of the Grand Parashant National Monument. The second project was an extension of the ongoing Shivwits Research Project being conducted by the University of Nevada, Las Vegas Department of Anthropology. These two endeavors are briefly discussed below along with a summary of findings from excavations undertaken in the area.

*Previous Excavations*

Archaeological excavation on the Shivwits Plateau has been ongoing over the past decade. In all 10 sites have had some level of subsurface investigation performed at them which has allowed us to give them temporal designations. These sites include 1 field house, 2 hamlets, 5 continuous pueblos, 1 discontinuous pueblo, and 1 roasting pit (Willis and Harry 2017). The site typologies and their corresponding temporal designation can be found in Table 3-1. The spatial distribution
of these sites can be found in Figure 3-1. As can be noted, only one habitation site dates to the period associated with the height of the distribution networks.

*Table 3-1 Previously Excavated Sites*

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</tr>
<tr>
<td>12-034</td>
<td>Hamlet</td>
<td>Puebloan, multicomponent</td>
</tr>
<tr>
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<td>Hamlet</td>
<td>Puebloan, multicomponent</td>
</tr>
<tr>
<td>AZ A:14:046 (ASM)</td>
<td>Field house</td>
<td>Middle Pueblo II</td>
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<td>Pueblo (continuous)</td>
<td>Late Pueblo II</td>
</tr>
<tr>
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</tr>
<tr>
<td>AZ A:15:056 (ASM)</td>
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</tr>
</tbody>
</table>
Location and Time Period of Excavated Sites

National Park Service Data

An abundance of data for the National Park Service administered portion of the Shivwits Plateau can be accessed with permission from the park service. This data consists of mostly site assessment observations and infield typological analysis of artifacts. Using site data from the National Park Service, a geospatial database was created in 2015. This database includes ceramic counts sampled from observation units from many of the habitation sites on the Shivwits Plateau and surrounding National Park Service land. The sample sizes for these data however were in nearly all cases too small for robust analysis. Despite this, ceramic data collected by the National
Park Service was used to map the concentration of all corrugated ceramics and of the proportions of Shivwits Ware. Tentatively, this data lent support for the hypothesis that the Shivwits ware ceramics were produced on the southern portion of the Plateau in and around the Ambush Pocket area. Based on ceramic gravity theory; see (Orton, et al. 1993; Rice 1997) and based on these data, it was believed that the region directly to the southeast of Ambush Pocket is a production zone for Shivwits ware ceramics being traded to the Moapa Valley. Additionally, these sites appeared to date to the Middle Pueblo II period, when the distribution network was at its peak. However, the National Park Service data was insufficient for reliable results and field work was needed to further investigate this.

In addition to those preliminary results on the distribution of ceramic wares, the analysis of resource processing locations through space suggested that resource processing activities were mapped onto certain ecological conditions. As can be seen in Figure 3-2, grinding sites on the Shivwits Plateau appear almost entirely within the ponderosa ecology suggesting that the milling activities at these sites are directly related to resources from the ponderosa meadows. While we currently have no way of dating these sites and thus assigning a cultural affiliation to them, their patterning is convincing evidence that certain subsistence activities were concentrated within particular ecologies.
Research conducted as part of the UNLV Shivwits Research Project over the summer of 2015 in the Ambush Pocket area documented the abundance of ceramic ware types from habitation sites using observed surface data (Harry, et al. 2015). The main goal of this project was to date the sites based on the proportion of corrugated ceramics at each location visited. It has been noted that Puebloan sites in the lowlands that have no corrugated ceramics date to the Pueblo I or early Pueblo II periods. In the Middle Pueblo II period, sites have between 1 and 10 percent corrugated ceramics and those of the Late Pueblo II have between 11-39 percent. Those having 40 percent
or more can be assigned to the Pueblo III period (Allison 2005; Harry, et al. 2013). We are assuming that this pattern persists in the uplands as well. Secondary goals were to document the proportion of Shivwits, Moapa gray wares and Virgin wares at each site. Ten sites were visited during this project whose data are used in this thesis.
CHAPTER 4 METHODS

Site Typologies

Site typologies for habitation sites were derived from the UNLV/NPS Shivwits Archaeological Overview and Assessment Database (SAOAD). The habitation site typologies that currently reside in this database include pueblos, discontinuous pueblos, hamlets, and fieldhouses. Pueblos are habitation sites that have room blocks that clearly define courtyards or plazas and these room blocks are arranged in a continuous or nearly continuous manner. Discontinuous pueblos are those that contain multiple structures that do not form continuous room blocks but are constructed in such a way that they delineate some degree of shared space, typically they are c-shaped. Hamlets are habitation sites that contain multiple structures but do not have clearly defined shared spaces. Hamlets normally have their structures dispersed across the site and each structure typically has only a single habitation room and may or may not have associated storage rooms attached. Field houses are habitation sites that have typically only a single structure or a couple of widely dispersed structures. These structures do not make up room blocks and if separate storage structures are attached, they are not clearly definable as separate rooms. The term field house is what is used by the National Park Service to describe these sites, however; the variation in these sites and the large archaeological surface deposits sometimes associated with them make the term as it is traditionally used a likely misnomer. For the purposes of this research the term is kept but it is believed that at least some of these sites represent small single-family settlements as opposed to hamlets and pueblos that may represent extended or multifamily settlements.
Ceramics

While multiple ware types are associated with the Virgin Branch Puebloan world, the three most common ware types were of specific interest in this study. These were Shivwits Ware, Tusayan Ware - Virgin Series (Virgin Ware), and Tusayan Ware - Moapa Series (Moapa Ware). In addition to these wares, redwares and orange wares were also noted although they were lumped into the general category of redware for analysis. Several types of brown ware are also commonly found on the Shivwits plateau, however the variation in these wares make them difficult to type without a comparative collection and a good deal of experience. These wares were recorded as unidentified with their attributes recorded. The descriptions of the three primary ware types are discussed below and are taken from (Allison 2000; Colton 1952; Lyneis 1988, 2005, 2008).

1. **Shivwits Ware**: These wares are identified by their dark paste ranging from dark reddish brown, to dark gray to black. They are sherd tempered and often Moapa Wares were the sherds used, although occasionally Virgin Wares were used instead. As such, Shivwits Ware often contains traces of olivine or sometimes sand as well. It is believed that these ceramics were produced on the southern end of the Shivwits Plateau where the clay mineralogy best matches the ceramic paste (Harry, et al. 2013; Jensen 2002; Lyneis 1988). Archaeologically these ceramics appear by at least the middle Pueblo II period on through the Pueblo III when the region is abandoned.

2. **Virgin Ware**: These wares are identified by their gray to white pastes and have quartz or sand tempers. They are believed to have been produced throughout the western region of the Virgin Branch culture area, but it is assumed that they were not produced on the
southern end of the Shivwits Plateau because the color of the paste does not match the mineralogy of the clays in that area. These ceramics were manufactured throughout the Virgin Branch ceramic sequence from Basketmaker III to the Pueblo III period.

3. **Moapa Ware**: These wares are also identified by their gray to white pastes, however; they are distinguished from Virgin Wares by the presence of olivine as a temper. Sourcing studies of this ceramic type have determined that this ware is produced in the Mt. Trumbull region (Sakai 2009, 2014). They are seen in the Virgin Branch region from Basketmaker III on into the Pueblo III period.

**Temporal Placement**

Site chronologies were created through the proportion of corrugated ceramics found within the observation units used at each site. While the relationship between time and the proportion of corrugated ceramics on the Shivwits Plateau has not been fully vetted, it is assumed that in general the pattern of increasing corrugation through time holds. Site chronology was thus assigned according to Table 4-1.

*Table 4-1 Time Period by Corrugation*

<table>
<thead>
<tr>
<th>Pecos Period</th>
<th>Proportion of Corrugated Ceramics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pueblo I or early Pueblo II</td>
<td>0%</td>
</tr>
<tr>
<td>Middle Pueblo II</td>
<td>1-10%</td>
</tr>
<tr>
<td>Late Pueblo II</td>
<td>11-39%</td>
</tr>
<tr>
<td>Pueblo III</td>
<td>40% and over</td>
</tr>
</tbody>
</table>
Site Selection

Selecting sites for investigation was handled by using SAOAD. While this database was insufficient for addressing all the research questions of this study, it was sufficient for the preplanning and reconnaissance required to maximize the effectiveness of time spent in the field collecting data. Information such as site type, location, and observations on the abundance and condition of cultural resources were the primary attributes used to determine which sites were visited. Sites that were selected for data collection met a series of criteria. They must have contained a habitation feature, had abundant archaeological resources suitable for high sample sizes, had been relatively undisturbed either by natural and cultural transformation such as looting or collecting by other archaeologists, and must have been accessible in such a way that visiting the site does not decrease the overall effectiveness of the study. Habitation features included pueblos, hamlets, and field houses. The abundance of artifacts at a site was accessed through previous documentation that was been provided by the National Park Service. Sample sizes of 100 or more were considered optimal for analysis; however, this was not always feasible, particularly at smaller sites such as field houses. Sites forms that specifically noted a relative lack of ceramic artifacts were generally avoided when planning; however, in cases where sites were visited that had unexpectedly low ceramic counts, samples were taken that appeared to best represent the overall assemblage of the site.

Field Work

The principal concern in this study was to compile data that accurately represented the sites being investigated in terms of surface deposits and cover enough spatial area to provide a
meaningful sample for the variety of habitation sites through space. The primary data of interest were ceramics, however; all artifact types that appeared in the observation units used in this analysis were recorded and documented. Furthermore, in cases where new sites were discovered, site maps were generated to aid future research in the region.

*In field Analysis from 2015 – 2016 Field Seasons*

Selected sites were assessed for their proportion of ceramic wares with rectangular systematic spatial units. These units were placed within areas of high ceramic concentrations and were large enough to obtain, if possible, a minimum of 100 ceramics measuring larger than 1 cm². These spatial units were plotted onto the preexisting survey site maps using a hand-held GPS unit and whenever possible were tied to the site datum or identifiable feature with a surveying compass and tape. Often however, it was impractical to get reliable measurements using the later method as underbrush and obstacles often made running tape from the datum difficult.

All ceramics meeting the size criterion were collected and analyzed on-site according to the attribute analysis methods shown in the appendix section, and then returned to the spatial unit from which they were collected. No artifacts were removed from the site. In order to return the sherds to the same area of the site from which they were recovered, no systematical spatial units measured larger than 3 m in length. If a larger size was needed to obtain an adequate sample, then additional units were used. The size of the spatial units was measured so that ceramic density could be calculated. In many cases it was not possible to hit a 100-ceramic sample based on the total abundance of ceramics at a site. For these sites the samples taken are relative to the overall total abundance of surface deposits at the site.
**Analytical Methods**

Data collected during fieldwork were entered into Microsoft Excel, which was then joined to the spatial locations of the related habitation sites in ArcMap. Spatial statistics were used to test for meaningful patterns in the spatial distribution of sites based upon ware types and the proportion of corrugated wares. This was done through the use of the Getis-Ord Gi* statistic which calculates whether the clustering of spatial locations weighted by some class of event data is due to random chance (ESRI 2016). It is essentially a z-score statistic and is calculated by the following equations:

$$G_i^* = \frac{\sum_{j=1}^{n} w_{ij} x_j - \bar{X} \sum_{j=1}^{n} w_{ij}}{s}$$

Where:

- $x_j$ is the event value for the spatial feature
- $w_{ij}$ is the spatially determined weight between feature $i$ and $j$
- $n$ is the total number of features

and:

$$\bar{X} = \frac{\sum_{j=1}^{n} x_j}{n}$$

$$S = \sqrt{\frac{\sum_{j=1}^{n} x_j^2}{n} - (\bar{X})^2}$$
As the Getis-Ord Gi* statistic is a z-score, the corresponding p-value relates to the area under the curve of a randomly dispersed distribution of theoretical spatial data and allows for the creation of confidence levels for both hot and cold spots in the event data being used to weight the spatial features. The event data are the ceramic proportions.

**Detecting a Production Zone**

Detecting the core production zone for Shivwits Ware ceramics was done by applying the gravity model discussed by (Orton, et al. 1993; Rice 1997). This model holds that a production zone should have the largest proportion of sites containing a particular ware type, and the largest proportion of that ware type at those sites. As discussed above it is likely that all households produced their own pottery at some level of intensity, however; sites that produced surplus ceramics to be distributed elsewhere should have values over the mean proportion across all sites in the study area.

**Analysis Expectations**

If there are in fact spatial – temporal patterns on the Shivwits plateau in terms of the distribution of habitation sites, then we should expect to see the spatial clustering of certain proportions of corrugated ceramics return a significant result in our statistical analysis. If there is a non-significant pattern in terms of habitation site clusters based upon corrugated ceramics, then we will not be able to reject the hypothesis that the distribution of habitation sites through time is based upon the vagaries of Virgin Branch Puebloan site preferences or our spatial sampling. Similarly, if there are significant spatial clusters in terms of the different ceramic wares through both time and or space, then it can be determined that spatial location is at least in part a function
of the passage of time. Assuming a significant result to the Getis-Ord Gi statistic on corrugated wares, we might expect that settlement patterns reflect adaptive fluctuations in the environment. As noted by (Osborne 2008), some of the factors that drive settlement distributions are access to water, vegetation, and arable land. The exploration of the environment against the spatial-temporal array of settlement patterns may then reveal differences in land use practices over time as a response to diachronic changes in the socio-environmental context.

**Environmental Analysis**

To identify the regions of the study area that were most well suited for agricultural production, several environmental layers were combined into a composite layer in ArcMap. These layers included the dominate soil order, geographic landforms, and degree of run off. Based on the information discussed above, two soil orders were determined to be optimal for agriculture. These were the Molisols and the Alfisols. From the landform layer, valley flats and nearly level plateau and terraces were selected to be the optimal settings for agricultural fields. Finally, from the run off layer, areas that had minimal to no run off were selected. The relevant map units from each of these layers were exported into new shape files and then used to form a composite map of agriculturally suitable lands.
CHAPTER 5 RESULTS

Infield Results

A full documentation of data collected and/or utilized from the 2015 and 2016 field seasons can be found in (Harry, et al. 2015; Willis and Van Alstyne 2017). Pertinent data used specifically in the following analyses can be found in Table 5-1. In all 39 sites were visited or located that had usable data. These included 21 field houses, 15 hamlets, 2 continuous pueblos, and 1 discontinuous pueblo. Two sites were previously undocumented with the National Park Service.

Spatial-Temporal Analysis of Sites

The spatial distribution of corrugated wares by proportion can be found in Figure 5-1. Based on the Getis-Ord Gi analysis, the southernmost region of the study area appears to have a spatially significant cold spot in terms of corrugated ceramics, see Figure 5-2. This suggests that early sites are clustered together though space in this region. However, early sites also appear to be ubiquitous across the entire project area. Pecos phase designations can be found in Figure 5-3 and show that no PIII sites can be found in the southernmost region of the study area. A graduated representation by natural breaks of the proportion of corrugated ceramics at sites through space can be found in Figure 5-4 further illustrating the concentration of earlier sites.
### Table 5-1 Summary of Data from 2015 -2016 Field Seasons

<table>
<thead>
<tr>
<th>Site Number</th>
<th>Total Ceramics</th>
<th>Percent Shivwits Ware</th>
<th>Percent Corrugated</th>
</tr>
</thead>
<tbody>
<tr>
<td>13-019</td>
<td>91</td>
<td>43%</td>
<td>1%</td>
</tr>
<tr>
<td>13-026</td>
<td>73</td>
<td>88%</td>
<td>85%</td>
</tr>
<tr>
<td>13-029</td>
<td>151</td>
<td>76%</td>
<td>18%</td>
</tr>
<tr>
<td>13-039</td>
<td>80</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>13-040</td>
<td>119</td>
<td>18%</td>
<td>25%</td>
</tr>
<tr>
<td>AZ A:15:052 (ASM)</td>
<td>148</td>
<td>25%</td>
<td>3%</td>
</tr>
<tr>
<td>AZ A:15:074 (ASM)</td>
<td>89</td>
<td>60%</td>
<td>39%</td>
</tr>
<tr>
<td>AZ A:15:076 (ASM)</td>
<td>97</td>
<td>37%</td>
<td>1%</td>
</tr>
<tr>
<td>AZ A:15:079 (ASM)</td>
<td>178</td>
<td>15%</td>
<td>44%</td>
</tr>
<tr>
<td>AZ A:15:104 (ASM)</td>
<td>88</td>
<td>19%</td>
<td>7%</td>
</tr>
<tr>
<td>AZ A:15:108 (ASM)</td>
<td>116</td>
<td>97%</td>
<td>12%</td>
</tr>
<tr>
<td>AZ A:15:123 (ASM)</td>
<td>203</td>
<td>67%</td>
<td>40%</td>
</tr>
<tr>
<td>AZ A:15:151 (ASM)</td>
<td>210</td>
<td>48%</td>
<td>34%</td>
</tr>
<tr>
<td>AZ A:15:248 (ASM)</td>
<td>92</td>
<td>18%</td>
<td>0%</td>
</tr>
<tr>
<td>AZ A:15:282 (ASM)</td>
<td>139</td>
<td>78%</td>
<td>20%</td>
</tr>
<tr>
<td>AZ A:15:293 (ASM)</td>
<td>279</td>
<td>84%</td>
<td>27%</td>
</tr>
<tr>
<td>AZ A:15:296 (ASM)</td>
<td>41</td>
<td>41%</td>
<td>0%</td>
</tr>
<tr>
<td>AZ A:15:307 (ASM)</td>
<td>47</td>
<td>83%</td>
<td>19%</td>
</tr>
<tr>
<td>AZ A:15:311 (ASM)</td>
<td>99</td>
<td>93%</td>
<td>26%</td>
</tr>
<tr>
<td>AZ A:15:315 (ASM)</td>
<td>119</td>
<td>17%</td>
<td>1%</td>
</tr>
<tr>
<td>AZ A:15:321 (ASM)</td>
<td>84</td>
<td>87%</td>
<td>12%</td>
</tr>
<tr>
<td>AZ A:15:326 (ASM)</td>
<td>62</td>
<td>74%</td>
<td>10%</td>
</tr>
<tr>
<td>AZ A:15:327 (ASM)</td>
<td>94</td>
<td>81%</td>
<td>20%</td>
</tr>
<tr>
<td>AZ A:15:329 (ASM)</td>
<td>112</td>
<td>80%</td>
<td>28%</td>
</tr>
<tr>
<td>AZ A:15:332 (ASM)</td>
<td>62</td>
<td>69%</td>
<td>5%</td>
</tr>
<tr>
<td>AZ A:15:335 (ASM)</td>
<td>155</td>
<td>30%</td>
<td>1%</td>
</tr>
<tr>
<td>AZ A:15:340 (ASM)</td>
<td>75</td>
<td>28%</td>
<td>15%</td>
</tr>
<tr>
<td>AZ A:15:345 (ASM)</td>
<td>102</td>
<td>60%</td>
<td>0%</td>
</tr>
<tr>
<td>AZ A:15:352 (ASM)</td>
<td>51</td>
<td>45%</td>
<td>14%</td>
</tr>
<tr>
<td>AZ A:15:357 (ASM)</td>
<td>46</td>
<td>91%</td>
<td>7%</td>
</tr>
<tr>
<td>AZ A:15:360 (ASM)</td>
<td>169</td>
<td>89%</td>
<td>14%</td>
</tr>
<tr>
<td>AZ A:15:362 (ASM)</td>
<td>93</td>
<td>80%</td>
<td>32%</td>
</tr>
<tr>
<td>AZ A:15:366 (ASM)</td>
<td>111</td>
<td>63%</td>
<td>0%</td>
</tr>
<tr>
<td>AZ A:15:370 (ASM)</td>
<td>331</td>
<td>71%</td>
<td>5%</td>
</tr>
<tr>
<td>AZ A:15:371 (ASM)</td>
<td>78</td>
<td>82%</td>
<td>4%</td>
</tr>
<tr>
<td>AZ A:15:386 (ASM)</td>
<td>156</td>
<td>79%</td>
<td>8%</td>
</tr>
<tr>
<td>AZ A:15:394 (ASM)</td>
<td>21</td>
<td>48%</td>
<td>5%</td>
</tr>
<tr>
<td>SRP 16-001</td>
<td>109</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>SRP 16-002</td>
<td>31</td>
<td>26%</td>
<td>0%</td>
</tr>
</tbody>
</table>
Figure 5.1 Percent Corrugated Wares
Figure 5-2 Corrugated Ware Hot Spots
Figure 5-3 Sites by Time Period
Spatial Analysis of Habitation Sites and Shivwits Ware

The spatial distribution of Shivwits Wares can be seen in Figure 5-5 showing a concentration of sites in the southern area that have high proportions of this ware. The results of the Getis-Ord Gi analysis show that there is a significant hot spot for Shivwits Ware in the southernmost part of the study area, see Figure 5-6. When comparing these results with that of the proportion of corrugated ceramics, we see that there is considerable overlap between the cluster of sites with low proportion of corrugated wares with the sites that have a high proportion of Shivwits Ware.
Figure 5-5 Percent Shivwits Ware
Settlement Size/Site Typology over Time

To test for whether habitation site typology and thus settlement size was a function of time, a Mann-Whitney U-test was performed by lumping the pueblo and hamlets together as one group and the field houses as another. Based on the results of this test, it was found that site typology and thus the abundance of rooms at a site was very unlikely a function of time as expressed in the proportion of corrugated ceramics ($U_1 = 191.5$, $U_2 = 186.5$, $Z = -0.05637$, $p = 0.95216$).
Optimal Lands for Agriculture and Settlement Patterns

The results of the environmental analysis for optimal agricultural lands can be seen in Figure 5-7 along with the distribution of habitation sites which were investigated in this study by Pecos Phase. While agriculturally suitable lands are found throughout the study area, the area that contains both agriculturally suitable land and low levels of run-off is found in the southern region of the project area where the significant cluster of earlier sites that also significantly clustered in terms of their proportion of Shivwits Ware are located.

Figure 5-7 Optimal Agricultural Land
**Ponderosa Ecology and Settlements Patterns**

When plotting habitation sites through space against the ponderosa ecology of the region, all late sites appear in the Ponderosa eco-division and near extant stands of ponderosa trees, see Figure 5-8. This suggests that this ecological region could have been favored by the Virgin Branch over others during the later phase of the region’s occupational sequence.

*Figure 5-8 Site Chronology and Ponderosa Ecology*
CHAPTER 6 SYNTHESIS AND CONCLUSIONS

Synthesis of Results and Findings

The spatial-temporal placement of habitation sites investigated in this study revealed that in the southernmost portion of the study area, all sites could be assigned temporal designations that were coincident with the time periods in which the distribution networks with the lowlands were operating or beginning to fail. None of the sites in this part of the study area were found to post-date the Late Pueblo II. In contrast, while several sites in the northern part of the study area were found to date to the Late Pueblo II and earlier, three sites were dated to the Pueblo III period. Adding in the previously excavated sites, this brings a total six Pueblo III sites in the northern region of the study area and zero Pueblo III sites in the dense cluster of habitation sites documented during this project to the south, see Figure 6-1. When considered against the environmental variables discussed above, there appears to be two major patterns regarding site locations and the landscape.

The first of these patterns warranting discussion is that the concentration of early sites in the study area are located near what was determined to be the best agricultural land in the immediate area. In Chapter 3 of this thesis I suggested that the most productive lands would have been greatly sought after by those that were practicing agriculture on the Shivwits Plateau. These lands were determined to be in the southern portion of the study area below Ambush Pocket. The second of these patterns is that all the Pueblo III sites in the region exist in or very near to the ponderosa meadow ecology. As discussed in the chapters above, this ecological region is extremely productive in terms of grassland resources due to the nature of its fire adapted
ecology. These resources would have also been a boon to wild game that may have been hunted in the region as well, making the area doubly attractive to the Virgin Branch Puebloan people. While the pinyon ecology undoubtably also produced high quality wild resources such as pinyon nuts and juniper berries, pinyon’s productivity is highly variable from year to year in any given location. As it is believed that the region’s ecology has remained relatively stable over the past 700-1000 years and considering that milling sites appear to be concentrated within the modern ponderosa ecology, it is highly likely that these ecologies were distributed in mostly the same manner as they are today, albeit with some reduction in extant ponderosa stands from logging activity. For the distribution of both excavated sites and those analyzed in this study in relation to the ecological variations seen on the landscape, see Figure 6-1.

Returning then to the first of the research questions;

Is there a spatial-temporal pattern to settlement distributions on the Shivwits Plateau? And if so, do the observed settlement shifts correlate with/reflect responses to socio-environmental stresses?

There is indeed a spatial-temporal pattern to the distribution of sites investigated thus far in the study area. Thus, the task comes to seeing whether these patterns correlate with suspected and known socio-environmental stresses throughout the region.

The first of these potential indices of stress is the breakdown of the distribution networks that occurs prior to the Pueblo III period. While it cannot be understood at this point what caused this breakdown, the result is almost certainly the cessation or reduction of whatever reciprocity was
occurring between upland and lowland groups. Whether the prime causes for these networks failing were due to issues experienced in the uplands, lowlands, and/or in the intermediate area where people traveled to and from is beyond the scope of this investigation. However, the collapse of these networks appears to be coincident with a shift in settlement patterns into the ponderosa ecology on the southern end of the Shivwits Plateau.

The second of these potential indices of stress is in the climatic patterns that were occurring in the region at the time. As discussed in the environment chapter, the Colorado Plateau underwent a considerable amount of climate variation during the later portion of the Pueblo II period from about A.D. 1090 until A.D. 1120. Most significant for the area was the period of cold between A.D. 1094 until A.D. 1120. The average temperatures during this later period were nearly a full standard deviation colder than normal average temperature and would have surely shortened growing seasons and resulted in some level of subsistence stress. While later Pueblo II sites appear to be ubiquitous throughout the study area, sites dating after this time appear only in the ponderosa ecology marking a shift in settlement patterns that are at least concurrent with the regional climate instability. Other factors of course could be at work, such as the over exploitation of the landscape and soils from previous occupations in the south. It should also be noted that pockets of Pueblo III sites may still exist on areas of the Shivwits Plateau that have yet to be surveyed.

None of these suspected stressors appear to drive any change in settlement size within the study area, suggesting that site aggregation was not a means of coping with stress. Small settlements and large settlements are equally ubiquitous throughout the area overtime. However, there
appear to be many more Pueblo II period settlements than Pueblo III. This is not at all surprising given that it is believed that the region is abandoned at some point in the Pueblo III period.

The second question on whether we can identify the production area on the Shivwits Plateau for Shivwits Ware ceramics has a mostly straightforward answer. Based on the proportion of Shivwits Ware ceramics through space, I have identified a region in the southernmost part of the project area that significantly clusters spatially in terms of having a higher than average proportion of Shivwits Ware. This area also overlaps with the region that significantly clustered in terms of having a lower than average amount of corrugated ceramics. No site in this area postdates the believed collapse of the distribution networks to the Moapa lowlands. This evidence agrees with what we would expect to see for a production zone for ceramics being distributed during the distribution network with the lowlands.

**Broader Implications**

As discussed elsewhere in this thesis, the degree to which the upland Virgin Branch people were dependent on agriculture is a topic that has never been fully resolved, however given the data presented in this thesis, I would argue that utilizing wild resources played a key role in upland Virgin Branch subsistence patterns and that this reliance may have actually increased during the end of their occupational sequence. This assertion needs further testing but a few additional suspected factors lead me to this hypothesis. The first is that it does not appear that populations on the Shivwits Plateau were ever high enough to, in of themselves, cause subsistence stress. It is generally believed that sites on the plateau were occupied for no longer than a generation and there simply are not enough rooms or enough sites to
warrant the belief that there was ever a substantial population in the region. This is not to say that there were not enough people on the plateau to place stress on resources in a particular area, but that once such stresses begin to have an impact on the productivity of the land, people would have simply been able to move. Naturally, more research into estimating populations and the carrying capacity of the landscape is needed to further investigate these assumptions. The second is that, the Virgin Branch people never appear to buy into the socio-religious phenomena that comes to dominate the rest of the Puebloan world. Kivas are noticeably absent from nearly all Virgin Branch sites, and at locations where they are suspected, more research is needed to
confirm their presence. Regardless, there are no kivas, suspected or otherwise, documented on the Shivwits Plateau, and given their associations with religious ceremonies related to agricultural practices in the modern Puebloan world, their absence suggests a perhaps lesser degree of dependence on cultivated food. Maize was obviously important, but if the Virgin Branch groups in the uplands were also adept at utilizing wild resources, then a bad year for maize or even several may not have been catastrophic. More work is needed in the region in understanding diachronic trends related to subsistence practices and such work can only come from excavation and the collection and analysis of botanical remains.

Assuming a shift to a greater reliance on wild resources toward the end of the occupational sequence on the Shivwits Plateau, the question then becomes is there a relationship between such a shift and the breakdown of the distribution networks into the southern lowlands. If Allison (2000) is correct that the distribution of ceramic wares into the lowlands represents the movement of people coming in to participate in the harvest along the flood plains of the Virgin and Muddy Rivers, then a shift to harvesting wild foods and hunting in the fall could represent a conflict in the scheduling of activities and thus the decision to no longer make the journey into the lowlands during harvest time. In such a scenario, the perceived risk to reward ratio for foraging in the fall would have been lower than that of participating in the harvests in the lowlands. Even if the movement of ceramic wares has nothing to do at all with participating in the fall harvests in the lowlands, it stands to reason that whatever the utility these networks had for upland groups, such utility waned by the end of the Middle Pueblo period. What activity took its place?
Conclusions

In this thesis, I have presented evidence that there are spatial-temporal patterns to habitation sites on the Shivwits Plateau and that these patterns may reflect responses to changing subsistence risks. While the settlement patterns are clear, more research is needed to test the hypothesis that they truly represent responses to socio-environmental stress. Thus, the potential implications discussed in this thesis should be seen as new ground being broken to further investigate subsistence practices over time rather than a straight conclusion on lifeway changes for the Virgin Branch people. Additionally, this research has found evidence of a core production zone for Shivwits Ware ceramics that appears to date to the time which the distribution networks to the lowlands in southern Nevada were at their peak. However, the extent of our knowledge of the lifeways and archaeological patterns on the Shivwits Plateau is still greatly limited. Vast amounts of the Plateau remain unsurveyed, and many of the known sites still await further investigation. Continued and focused work on the Shivwits Plateau is needed to both confirm or reject the patterns discussed here in, and to untangle the many questions remaining concerning the lifeways of the ancients that called the plateau home.
APPENDIX

In-Field Ceramic Coding System

Column 1. Ware

Gray and White Wares
1. Logandale (limestone-tempered)
2. Tusayan Gray Ware, Virgin Series (sand-tempered)
3. Tusayan Gray Ware, Moapa Series (olivine-tempered)
4. Tusayan White Ware, Kayenta series (sand-tempered but very white)
5. Tusayan White Ware, Little Colorado series (tempered with white sherds)
6. Shivwits (can be plain or corrugated; dark gray to dark brown, with crushed sherd/olivine temper)
7. Shinarump (can be plain or black-and-white)
8. White or Gray ware, other series
9. White or gray ware, but undetermined what series

Red Wares
10. Tsegi Orange Ware (white sherd temper with subangular to well-rounded quartz grains)
11. San Juan Red Ware (crushed andesite temper)
12. Sand-tempered Red Ware
13. Red ware, but undetermined what type

Brown Wares
14. Paiute

Buff Wares
15. Buff ware, not further specified

Other
98. Other (explain in comments column)

Indeterminate
99. Indeterminate
### Column 2. Decoration

1. Plain
2. Corrugated
   - 2.1. Corrugated
   - 2.2. Corrugated and slipped
   - 2.3. Corrugated and painted
   - 2.4. Corrugated, slipped, and painted
3. Incised
4. White slipped
   - 4.1. White slipped and painted
5. Red
6. Painted

### Column 3. Part

1. Rim
2. Body
3. Neck
4. Other (*please explain in comments*)
99. Indeterminate

### Column 4. Artifact Form

1. Jars
2. Bowls
3. Other (*please explain in comments*)
99. Indeterminate

### Column 5. Design Style (Painted only)

#### Unpainted Wares

99. Not applicable (the sherd is unpainted)

#### Painted White and Gray Wares

1. Lino
2. Kana-a
3. Black Mesa
4. Sosi
5. Broad line (i.e., either Black Mesa or Sosi, but you can’t tell which)
6. Dogoszhi
7. Flagstaff
8. Other (recognizably not one of the above)
9. Indeterminate (the sherd has paint but not enough to tell what style)

*Painted Red Wares (if you know it)*

10. Deadman’s/Medicine
11. Tusayan (Dogoszhi)
12. Polychrome
13. Other (recognizably not one of the above)
14. Indeterminate (the sherd has paint but not enough to tell what style)

**Column 8. Rim diameter** (Rom sherds only;
to nearest cm; measured for rim sherds only which have >5% arc present; use code 98 = not a rim sherd; 99= rim sherd but not enough present to determine diameter)

**Column 9. Count.**

**Column 10. Comments** (note mend hole, residue present, use-wear such as striations or soot, etc)
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2014- Present   PhD Program
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College of Science and Technology
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2010   Associate of Arts and Sciences
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Field Archaeology Experience:

2016   Shivwits Research Project Geospatial Study of Habitation Sites, Parashant National Monument, Arizona
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National Park Research Permit Number: PARA-2016-SCI-0001
2016 NPS IAR Report Number: 152916
2015  Shivwits Research Project: University of Nevada, Las Vegas  
   Crew Chief  
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Field Survey of Whitney Mesa Nature Preserve, Las Vegas, Nevada  
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2014  Shivwits Research Project: University of Nevada, Las Vegas  
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2013  Investigation of Civil War Forts near Radford, Virginia  
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   Archaeological Survey at the Radford Arsenal, Virginia  
   Field School Student  
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   Carter Robinson Mound Site Excavations in Lee County, Virginia  
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   Principal Investigator: Maureen Meyers  

2012  Midsouth Cultural Resource Consultants  
   Contracted Field Investigator  
   - Phase I Survey of Proposed Cell Tower Site, Honaker, Virginia  
   - Phase I Survey of Proposed Cell Tower Site, Southern Gap, Virginia  
   Principal Investigator: Scott Jones  

Radford University Forensic Science Institute  
   Radford, VA Phase I Archaeological Survey: Crew Chief / Report Co-Author  
   - Oversee field techs during Phase I survey  
   - Provide training to students taking a field methods class  
   - Co-author a report deliverable to the City of Radford, Virginia  
   Principal Investigator: C. Clifford Boyd  

2011  Radford University Forensic Science Institute  
   Smithfield Plantation Phase II Archaeological Survey Field Tech/ Report Co-Author  
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GPR Survey at Mountain View Cemetery, Radford, Virginia
Field Tech
Principal Investigator: C. Clifford Boyd

GPR Survey of Family Cemetery in Galax, Virginia
Field Tech
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Archaeological Survey of CCC Camp Rattlesnake in Deerfield, Virginia
Volunteer Field Tech
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Archaeological Survey at the Radford Arsenal, Virginia
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Archaeological Survey at the Flannery Site in Dungannon, Virginia
Field School Student
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GPR Survey of African American Cemetery at the Reynolds Plantation, Stuart, Virginia
Field School Student
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GPR Survey of Potential Civil War Mass Burial in Wytheville, Virginia
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Cold Case Field Search in Conjunction with Smith County, Virginia
Homicide Investigation
Line Search and Recovery Volunteer
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GPR Survey of Family Cemetery in Newport, Virginia
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2010  
**Phase I Archaeological Survey near Wytheville, Virginia**  
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**Isabella Heth Family Cemetery Restoration Project, Radford Virginia**  
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**Teaching Experience:**

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*University of Nevada, Las Vegas*  
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Department of Anthropology  
- ANTH 105 Introduction to Archaeology and World Prehistory (Spring 2018)  
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*University of Nevada, Las Vegas*  
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- Statistical analysis of survey data collected during National Institute of Justice funded law enforcement training sessions
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• Mentor anthropology students preparing research for presentation at a national conference
• Train others on the use of portable XRF
• Train others in the use of multivariate statistics in SPSS
• Conduct field work and remote sensing surveys of Civil War sites in the Radford, VA area
• Collect and evaluate geochemical data from archaeological assemblages using pXRF and multivariate statistics
• Conduct geophysical surveys of cemeteries in the local area
• Participate with local law enforcement agents in search and recovery operations

Thesis, Reports, and Proceedings Papers

2018 (Anticipated) Harry, Karen and William Willis
Archaeological Overview and Assessment of the Shivwits Plateau
Anticipated Submission for review by July 1, 2018

2017 Willis, William
On File: Lake Mead National Recreation Area Headquarters, Boulder City, NV

Annotated Bibliography of Resources Related to the Archaeology of the Lake Mead National Recreation Area-Parashant National Monument
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On File: Lake Mead National Recreation Area Headquarters, Boulder City, NV
2015  Harry, Karen G., William Willis and Shannon Horton
Preliminary Report of the Shivwits Research Project 2015 Field Season
On File: Lake Mead National Recreation Area Headquarters, Boulder City, NV

2012  Willis, William
X-Ray Fluorescence Analysis of Lithic Artifacts from 44Pu0072, Southwest Virginia, with a Portable XRF Device.
Upland Archaeology in the East Series XI

Presented Papers

William Willis
- Three Corners Conference, Las Vegas, NV (2017)

2018  A Middle Pueblo II Production Zone for Shivwits Ware Ceramics: Implications for Understanding Settlement Patterns and Socio-Environmental Response on the Shivwits Plateau.
William Willis
- The Nevada Archaeological Association, Reno, Nevada
- College of Southern Nevada/Archaeo-Nevada Society Conference, Las Vegas, Nevada

2015  An Experimental Approach to Understanding Limestone-Tempered Ceramic Production
William Willis
Three Corners Conference, Las Vegas, NV

2015  The Potential Role of Water Salinity in Limestone Tempered Logandale Gray Ware Ceramic Production in the Moapa Valley, Nevada: An Experimental Approach
William Willis and Karen Harry
- Society for American Archaeology, San Francisco, CA
- UNLV Graduate Student Research Forum, Las Vegas, NV

2014  Using Portable XRF and Discriminant Analysis for making Geochemical Comparisons between Lithic Assemblages
William Willis
• Mid Atlantic Archaeology Conference, Langhorne PA

2012
X-Ray Fluorescence Analysis of Lithic Artifacts from 44Pu0072, Southwest Virginia, with a Portable XRF Device.
William Willis
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Presented Posters

2017
Spatial -Temporal Patterns in Habitation Site Distributions and Ceramic Ware Typologies on the Shivwits Plateau
William Willis
• Society for American Archaeology, Vancouver, BC
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2016
Virgin Branch Puebloan Sandstone Artifact Distribution on the Southern Shivwits Plateau
William Willis
• Society for American Archaeology, Orlando, FL

2013
Geochemical Comparison of Lithic Assemblages from Different Geographic Localities in Virginia
William Willis
• Society for American Archaeology, Honolulu, HI
• Radford University Student Undergraduate Forum, Radford, VA

2012
X-Ray Fluorescence Analysis of Lithic Artifacts from 44PU72, Southwest Virginia
Willis, William and Dr. Cliff Boyd
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• Radford University Student Undergraduate Forum, Radford, VA

Heth Cemetery Restoration Project, Radford, Virginia
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• Mid Atlantic Archaeology Conference, Virginia Beach, VA
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Participation in Organized Sessions and Symposiums

2018
New Findings from the Far Western Puebloan Region: Papers in Honor of Margaret Lyneis
Society for American Archaeology, Washington D.C.
Presenter
2016  Archaeology of the Virgin Branch Puebloan Culture  
Society for American Archaeology, Orlando, FL  
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Awards and Honors and Scholarships

2017  UNLV Graduate Student Research Forum  
Second Place (Poster Session)

2016  Angela Peterson Memorial Scholarship  
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2012  Radford University College of Science and Technology Dean’s Scholar for Anthropological Sciences

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Second Place (Paper Session)

1997  Boy Scouts of America  
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Professional Affiliations

2018  Archaeo-Nevada Society  
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2017-Present  UNLV Lambda Alpha  
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2015  UNLV Anthropology Society  
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