Using Ground-Penetrating Radar to Study the Bluff Great House: History and Regional Interactions from A.D. 200 to 1300

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Abstract
The Bluff Great House is a Chaco-era monumental building, located in southeastern Utah. This site was inhabited from A.D. 700 to 1300, before and after the time when Chaco Canyon was widely considered a regional "capital". To map the Bluff site's architecture throughout its' occupations, ground-penetrating radar data were collected for the site's encircling berm, plaza, terrace, and a pithouse. Excavation data were combined with ground-penetrating radar maps, which together allowed for a spatially extensive and more temporally complete understanding of the Bluff site's architecture. The findings of this research show that site had a series of long-term habitations, which provided a historical context for the great house. Also, the people living at the Bluff site were well connected to their region throughout its occupation. Altogether, there is little evidence from this research to suggest that the Bluff Great House was directly influenced by Chaco Canyon, but instead the great house architecture at Bluff may have been emulating many sites in the region in a style common to that time period.

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USING GROUND-PENETRATING RADAR TO STUDY THE BLUFF GREAT HOUSE:
HISTORY AND REGIONAL INTERACTIONS FROM A.D. 200 TO 1300

A Thesis
Presented to
the Faculty of Social Sciences
University of Denver

In Partial Fulfillment
of the Requirements for the Degree
Master of Arts

by
Sarah M. Lowry
June 2009
Advisor: Dr. Lawrence B. Conyers
The Bluff Great House is a Chaco-era monumental building, located in southeastern Utah. This site was inhabited from A.D. 700 to 1300, before and after the time when Chaco Canyon was widely considered a regional “capital”. To map the Bluff site’s architecture throughout its occupations, ground-penetrating radar data were collected for the site’s encircling berm, plaza, terrace, and a pithouse. Excavation data were combined with ground-penetrating radar maps, which together allowed for a spatially extensive and more temporally complete understanding of the Bluff site’s architecture. The findings of this research show that site had a series of long-term habitations, which provided a historical context for the great house. Also, the people living at the Bluff site were well connected to their region throughout its occupation. Altogether, there is little evidence from this research to suggest that the Bluff Great House was directly influenced by Chaco Canyon, but instead the great house architecture at Bluff may have been emulating many sites in the region in a style common to that time period.
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Chapter 1: Introduction

Chaco Canyon, located in northwestern New Mexico, is the preeminent archaeological site of the American Southwest, with extraordinary buildings dating from the tenth century (Figure 1.1). The canyon contains many large-scale multi-story buildings, is connected to other smaller sites on its periphery by elaborate road systems, and overall is evidence of an intense modification of the prehistoric landscape (Van Dyke 2007). By the eleventh century it appears that Chaco had become a major regional “capital” connecting previously disassociated pueblo communities into culturally associated networks (Lekson 2006b:12-15). Although I will attempt to re-examine the concept of the Chaco “capital” throughout this thesis, it is frequently interpreted this way in the literature and I am going to use the term capital to discuss Chaco’s role as a regional center. Those networks likely connected sites over hundreds of kilometers of the American Southwest through trade and ideology and perhaps a complex political and economic system (Kantner and Kintigh 2006). This regional system stands contrast to what was occurring prior to the unification around Chaco, where small farming-based communities were relatively isolated regionally and communicated with their neighbors only for small-scale trade (Sebastian 1992:25-28). These pre-Chaco communities, dating from about the 6th century, did not necessarily subscribe to any single religious or political ideology. After Chaco Canyon was developed, religious and political complexity appears to have increased significantly throughout the region.
Figure 1.1: Chaco Canyon contains a large number of prehistoric structures within a small area (image from Lekson 2006b:5)

The people who resided at, or at least controlled the capital at Chaco Canyon appear to have unified the region into a network of associated sites, in areas that previously had little to no affiliation to each other (Judge 1991:14-20). One of these peripheral sites, the Bluff Great House, located in southeast Utah, is the topic of this thesis. My research at that site investigates the Bluff Great House’s relationship to Chaco Canyon and the rest of this network of associated sites using ground-penetrating radar mapping of buried features integrated with excavation data.

At Chaco Canyon, between about A.D. 1050 and 1150 large numbers of people appear to have gathered periodically for ceremonial, political, and economic purposes (Judge 1989, 1991; Lekson 1991, 2006b; Neitzel 2003; Sebastian, 1992, 2006; Van Dyke 2007; Vivian ; Vivian, et al. 2006). The people who lived at sites with ties to Chaco,
apparently constructed elaborate masonry structures for such large community gatherings known as “great houses” and ceremonial, circular, semi-subterranean structures known as “great kivas”. These buildings were perhaps the location of increasingly larger ceremonial, political, and economic gatherings of people that came from great distances away from about A.D. 1050 to 1150 (Van Dyke 2007:3). The number of related communities that had social or material interactions with Chaco Canyon also increased dramatically during this period, corresponding with the larger numbers of people coming to Chaco.

Chacoan architecture was distinct within the American Southwest during the tenth and eleventh centuries. While the most impressive architecture was concentrated within the canyon itself, similar buildings, which appear to have mimicked those at Chaco, were also present throughout the Chacoan area of influence within smaller communities termed “outlier” communities. Some were as far away as 300 kilometers from the Chaco center. The “type” Chaco building defined by archaeologists is the great house (Lekson 2007). At Chaco Canyon itself these great house structures consisted of hundreds of rooms with multiple stories. The largest, Pueblo Bonito, contained over 800 rooms and was at least four stories tall (Figure 1.2).
Figure 1.2: Pueblo Bonito was the largest Chacoan great house containing over 800 rooms.

Great houses in the canyon proper, and also in the outlier communities, followed specific stylistic and architectural patterns. Common elements of these impressive structures are central plazas, core-and-veneer masonry, “blocked-in kivas” (or round rooms located within the room block), and a spatial pattern that is generally “D”-shaped (Judge 1989:27-28). Other Chacoan architectural elements that define this important period of time include “roads” or constructed linear landscape features that seem to resemble roads for the movement of people. There were also great kivas and constructed earthen features of unknown function associated with great houses, such as platforms. The general architectural styles at Chaco are often referred to as “overbuilt” because the elaborate architecture goes beyond what was structurally or functionally necessary.

While there are over 13 great houses within Chaco Canyon, outside of the canyon there are dozens of similar great house sites spread throughout the Chacoan area of influence, which I refer to as the San Juan Basin (Figure 1.3). Chacoan architectural elements in the outlier communities are often used to determine the strength of the
prehistoric connection between Chaco Canyon sites and those sites outside of the canyon (Jalbert and Cameron 2000; Judge 1991; Kantner 2004b; Kantner and Kintigh 2006; Lekson 1984, 1991, 2006a, 2007). The Chaco style is surprisingly uniform across the region, and the presence or absence of Chacoan features is used as a general indicator of “connectedness” to the center. The Bluff Great House, shares many architectural features with those at Chaco including road segments (presumably leading to roads leading to the Chaco center), earthen mounds, a plaza, and a great kiva (Figure 1.4). A study of the plaza, earthen terrace, and ancillary elements on and below these architectural elements using ground-penetrating radar (GPR) integrated with archaeological investigations is the topic of this thesis. This type of architectural feature analysis is then used to analyze the relationship between the Bluff Great House, the Chaco Canyon center, and other Chacoan outliers, particularly using temporal construction episodes to understand how closely affiliated the Bluff site was to Chaco Canyon and other Chacoan outliers over time.
Figure 1.3: Chacoan style sites are spread throughout the region around Chaco Canyon (image from Kantner and Kintigh 2006:170).
Figure 1.4: The Bluff Great House shares many architectural features with Chaco, including road segments, earthen mounds, a plaza and a great kiva (map adapted from Cameron and Geib 2007:343).

Hypotheses about relationships between the Chacoan capital and its outliers can be simplified into two basic models. One idea suggests that groups of people that occupied Chacoan outliers and those at the Chaco Canyon center were independent entities that provided mutually advantageous services to each other (Mahoney and Kantner 2000:12). For example, outlier communities may have supplied the labor to construct great houses at Chaco and people who resided at Chaco Canyon would have reciprocated by providing legitimacy to outlier leaders by recognizing their leadership. The other theory suggests that Chaco Canyon was directly in control of its outliers.
(Sebastian 1991) and would have demanded labor and other goods. In this idea, Chaco would have “run” the outlier communities as perhaps regional capitals and they would have been subservient communities supplying goods and services to the central capital. Although the relationship between Chaco and its outliers is not fully understood, the peripheral sites that appear to have emulated Chaco in some way provide an excellent way to study the interactions between Chaco Canyon and its surrounding communities over time (Jalbert and Cameron 2000). By doing so archaeologists have the ability to look at the development and organization of a complex regional system with respect to political, economic and social influences and how it might have changed over time.

However Chaco was organized or run, it rose and then fell from prominence fairly quickly, perhaps over a period of only 150-200 years. Around A.D. 1150, new construction at Chaco Canyon ceased and gradually over a period of a few years its inhabitants abandoned the canyon. The reasons for this abandonment are still unclear but it was probably a combination of factors including environmental and social dynamics (Judge and Cordell 2006:206). There appears to have been some environmental stress during the time of this abandonment in the form of a drought and there was probably some associated political and social strain as a result (Dean and Doyel 2006). Most of the population (or at least the rulers or elite) are hypothesized to have moved from Chaco to the northern San Juan River area immediately following this abandonment (Figure 1.5). Here there were more favorable conditions with reliable year-round water sources and greater precipitation for agriculture (Lekson 1999). The abandonment of Chaco Canyon did not necessarily signal the end of this regional architectural pattern, however, as
construction appears to have continued at many outlier sites after the Chaco abandonment (Cameron 2009f:297). This continuance of Chaco-like construction and the emulation of Chaco styles after the abandonment of the “center”, and even the continuation of pre-existing trade patterns suggests that people still ascribed to this cultural system. Examining the abandonment of the capital and its effect (or lack of effect) on the outliers can potentially help explain the relationship between these entities and how the central entity at Chaco developed its community using ideas regarding control or other unification techniques. For instance, it is likely that Chaco Canyon’s abandonment did not eliminate the power of this regional ideology, as it was so strong that the architectural styles continued to be used long after other social factors led to major changes in the power or control of the ruling elite.
Figure 1.5: The Bluff Great House is located about 300 kilometers from Chaco Canyon (image from Cameron 2009e:2).

One of the most distant Chacoan outliers from the Chaco center is the Bluff Great House, located in southeastern Utah (Figure 1.5). This great house community was tied in some way to Chaco, as it contains a great house, great kiva, road segments, elaborate landscape modification (an encircling berm and a terrace to the north of the room block), and numerous Chaco-style artifacts (Figure 1.4). Also it was constructed between the late eleventh and early twelfth centuries, during the period of Chaco’s greatest power in
the region. The great house architecture at Bluff appears to have been closely modeled on the typical Chaco style. Many architectural elements from the Bluff Great House also seem to closely resemble other Chacoan outlier architecture, making it possible that it was emulating more than just Chaco Canyon. Although the Bluff site is about 300 kilometers from Chaco Canyon these architectural similarities suggest there was some kind of relationship between Chaco Canyon and the Bluff Great House, but exactly what that relationship was is not known. It is possible this relationship is more cultural than direct, with Bluff being influenced by sites that were influenced by Chaco.

The Bluff Great House appears to have been a social gathering place or regional capital for people in the surrounding area. Each small-scale habitation site within the larger Bluff community contained a few small rooms and usually a small kiva (Lekson 2006a: 93-99). These sites are located within about 9 kilometers of the great house and appear to have been occupied during the same time as the great house (Cameron 2009e:7). Elsewhere at this time, many other Chacoan style great houses also acted as small capitals for their local communities, providing other central gathering places or the habitations for people that had local political power (Cameron, et al. 1997). Bluff great house architecture appears to emulate many of these other sites as well as Chaco Canyon. Architecture at Bluff was designed for community events because it contained open spaces for activities that involved large numbers of people. These large features, such as the great kiva, appear to have provided space for people from the surrounding community to gather for ritual and perhaps social activities (Adler 1989).
The Bluff Great House terrace, which is a horizontal living surface adjacent to the north wall of the great house (Figure 1.4), was constructed both before and around the same time period as the abandonment of Chaco Canyon (around A.D. 1150). This is an interesting feature, particularly because it was partially constructed after the abandonment of Chaco in the thirteenth century allowing for the study of the modification of architectural elements at Bluff after Chaco had been abandoned (Cameron 2002). Because architectural modification of this feature continued after the central capital was abandoned this suggests that the builders of this terrace were not entirely dependent on Chaco Canyon to perpetuate their architectural ideas.

The constructed terrace at Bluff is very similar to one that was found on the south rim of Chaco Canyon at Tsin Kletzin (Figure 1.6). Although the similarities between these features have been largely overlooked, the presence of a nearly identical feature in Chaco Canyon suggests that the Bluff terrace was built to mimic this Chacoan feature. The Bluff terrace was constructed both during Chaco Canyon’s period of power and after its abandonment. The timing of this mimicry in construction techniques is important because it shows that when people added onto the terrace feature at Bluff after Chaco’s abandonment they were still subscribing to the Chacoan ideas. This might suggest that the Bluff people were still connected in some way to the same influences as before. But it is possible that terraces were a common regional form and this feature indicates no direct connection between the two sites.
Excavations at Bluff have been conducted by Catherine Cameron and Stephen H. Lekson of the University of Colorado from 1995 to 2004. Their research questions for this project were directed towards trying to understand the relationship between the Bluff Great House and the Chaco Canyon center. Their excavations extensively studied the great house room block and great kiva architecture but they also mapped and interpreted other structural elements nearby including a surrounding berm, the plaza, and the terrace (Figure 1.5). The berm is an earthen feature encircling the great house, seemingly delineating the extent of the central great house. The plaza is an artificially leveled gathering place located in the center of the site, just to the south of the great house. The terrace is a feature that was built up from the ground surface and leveled, located directly
to the north of the room block. Although Cameron and Lekson identified these features, they were only partially excavated and are still not well understood within the context of the site as a whole. These excavations also did not address the pre-Chaco occupations of the Bluff Great House, meaning very little is known about the people who lived at this site before the great house was constructed. This thesis focuses on the berm, plaza, terrace, and pre-Chaco features, which remain largely buried. They are excellent features for analysis by GPR mapping methods.

Ground-penetrating radar (GPR) is a geophysical technique used to non-invasively map subsurface features (Conyers 2004a). In this method surface radar antennas send out electromagnetic pulses of energy that measure reflected energy from buried materials in the ground as they are moved in linear transects. The travel time elapsed between the sending and receiving of the energy pulses is measured to calculate depth in the ground. The strength of those reflections are measured as a way to study the chemical and physical differences of buried materials. Ground-penetrating radar data are collected in transects within a geo-referenced grid, so that all reflection data from the ground are spatially located. In the lab, these data are used to produce three-dimensional maps and two-dimensional profiles of the ground.

A study of the Bluff Great House architectural elements (the berm, plaza, and terrace) provides a way to look at how this outlier was connected to the Chacoan center, and other outliers during Chaco Canyon’s peak, and after its abandonment. Looking at the pre-Chaco occupation of the site is an important tool to understand how people lived before the great house was constructed and the historical context of the Chaco era.
occupation. Results from GPR data collection, combined with dating from excavation, determined the composition and placement of construction in these areas in relationship to the regional timeline. This understanding of site construction in relationship to regional events will answer questions about how the residents of this great house lived during these periods and how they modified their landscape to reflect any political or social changes. Because the power structure is reflected in the architectural organization of space, a change in the use of space during this period would indicate a change in the power structure and organization at the Bluff Great House.

**Research Questions**

This project addresses a number of questions about the use of space and how that changed throughout the occupation of the site from its construction to its use throughout the occupation of the Bluff Great House. What was located here prior to the building of the great house? What does that tell us about the selection of this location for the great house building? What does this location tell us about those who constructed this site? Was the landscape of the site modified prior to original building episode? Did the landscape modification style change after the abandonment of Chaco? Did the use of space change after the abandonment of Chaco? Did this site’s communal spaces (terrace and plaza) experience a change in use? These questions address landscape, its modification, the role of landscape in outlier construction, and Bluff’s connection to Chaco and the region. They will be primarily answered through comprehensively mapping the sites landscape construction and comparing those maps to excavation data (that provides dating).
**Results and Conclusions**

This research identified and mapped the terrace, the plaza, several early pit houses, and the composition of the sites berm. These features define an intense modification of the landscape with ties to Chaco and the San Juan Basin, suggesting a possible direct connection between the Bluff Great House and Chaco Canyon (Cameron 2009f). However, many of these features seemed very similar to other outlier great houses, putting this direct connection into question. The terrace was partially constructed after the abandonment of Chaco and two informal, ephemeral features were built on top of it, indicating that Bluff continued its occupation, but used space differently after the abandonment of Chaco Canyon. Complex community organization and modification of space continued at Bluff after the abandonment of Chaco Canyon. This maintenance of complexity with some modifications would suggest that the Bluff Great House inhabitants were more independent from Chaco and its abandonment affected them minimally.

The Bluff site represents an intensive modification of the landscape to create a Chacoan identity. It was located on a hill, making its Chacoan features visible to the community. Features like the plaza and terrace would have been community centers, as they were open to the outside and had highly used living surfaces. When the Bluff Great House was built and remodeled all of its architecture was monumental. The open spaces required preparation and planning. GPR surveys also found earlier habitations, beginning around about A.D. 700, below the great house that suggest a historical context for the later construction of the great house. People chose this location to reference early
ancestors and the great house was just one of the habitation episodes at this site. The site’s Chaco period construction may also not be emulating Chaco as much as it was emulating regional architectural patterns. What are considered strictly Chacoan forms, may actually be much more regional as they are seen at many different outliers. Sites like Bluff, which were tied into the regional patterns may have much more nuanced relationships with their neighbors than just Chaco Canyon alone.
Chapter 2: Geographic and Environmental Background

The Bluff Great House is located on a natural rise to the north of the San Juan River. It is positioned on an alluvial terrace and gravel capped hill and has clear visibility of the lower terraces and modern floodplain. To its’ north, dramatic cliffs composed of Jurassic age sandstone cliff create a dramatic backdrop for the site. To the south, the lower alluvial terraces form a strip of fertile farmland that prehistorically flooded annually in the spring rejuvenating the soil with silt and organic matter (Figure 2.1). The soils in the floodplain would have been fertile for prehistoric agriculture.
Figure 2.1: The Bluff Great House is located on a river terrace above the San Juan River. The blue line outlines the fertile floodplain of the San Juan River and the red dot represents the location of the Bluff Great House.

Geographically, the Bluff Great House is located in the Blanding Basin, which is a sub section of the Colorado Plateau (Stokes 1977:1). This basin consists of mesas, stripped surfaces, and shallow canyons all at a relatively low elevation. Presently, Bluff receives only about 7.55 inches of rain a year and sits at an altitude of 4320 feet above mean sea level (Davis and Westfall 2009:14). The average temperature is 54.6 degrees Fahrenheit, although it ranges from 106 degrees to -29 degrees. The average frost free growing season is 224 days, creating good conditions for agriculture. Surrounding the great house there are a series of diverse habitats including riparian, mesa top and canyon
zones. This environmental setting would have provided a rich landscape for prehistoric farming as well as hunting and gathering.

Surrounding the great house, the four most dominant landscape features are a local series of canyons (Cow, Calf and Cottonwood Canyons), the Bluff Sandstone formations to the north, the Bluff Bench and Tank Mesa extending from the cliffs to the north and northwest, and the San Juan River to the south (Figure 2.1) (Davis and Westfall 2009:15). The canyons to the north of the great house are sources of lush vegetation, seeps and intermittent water flow. Cow and Calf Canyons are short box canyons and Cottonwood Canyon is a longer canyon with its beginning in the Abajo Mountains forty miles to the north. These areas would have also been excellent for prehistoric hunting, farming, gathering. The Bluff Sandstone formations directly to the north of the great house are Jurassic Morrison formation markers. They have eroded to produce remarkable rock formations (Figure 2.2), which were probably important to the prehistoric inhabitants of the area. This particular sandstone is also a good surface for prehistoric rock art (Davis and Westfall 2009:15). The Bluff Bench and Tank Mesa lie on the east and west sides (respectively) of Cottonwood Canyon (Figure 2.1). These tableland surfaces are vegetated with grasslands and shrublands and have a large concentration of early prehistoric sites (Davis and Westfall 2009:16). The people living at these sites may have interacted with the early inhabitants of the Bluff site. The San Juan River to the south consists of several different landscapes: floodplains, terraces, and tributary drainages. In this arid environment the tributaries (such as Cow, Calf, and Cottonwood Canyons) flow intermittently following precipitation. There are a number of prehistoric
sites located on various terraces of the river, although this could be a case of selective preservation. Sites within the floodplain are more likely to have been destroyed. Prehistoric residents may have lived on the terraces and practiced horticulture within the floodplain or along tributary drainages. The river area would have been a popular place to locate sites because it was a constant water source and had good agricultural soils. Together all of these landforms compose the immediate landscape of the Bluff Great House and its’ predecessors and provide a context for a better understanding of why people chose this site.

![Image of Bluff Sandstone formations]

Figure 2.2: The Bluff Sandstone formations are to the north of the great house and were dramatic landscape features (this photo was taken from the terrace of the great house).

Geologically, the Bluff Great House is visually dominated by Jurassic Period Bluff Sandstone, which is approximately 100 feet thick and has eroded to produce the stunning formations to the north of the great house (Figure 2.2) (Stokes 1986:115). The middle San Juan is generally dominated by Jurassic Morrison exposed sedimentary beds
and Quaterny silts, sands, and gravels (Stokes 1977). Other visible bedrock units seen at Bluff are (from oldest to youngest) the Carmel formation, the Entrada sandstone, the Summerville formations, topped with Bluff sandstone (Davis and Westfall 2009:13). This Bluff sandstone is the most common source of building materials for all of the prehistoric construction. It provided easily available tabular construction materials along the talus slopes below the cliffs.

According the Soil Conservation Service (1994), the Bluff Great House soils are rocky and well drained to excessively drained in an arid climate zone. There are three dominant subsections of soils the Nakai-Limeridge-Bluechief, the Oljeto family, and the Trail fine sandy loam. The Nakai-Limeridge-Bluechief soils are well drained and located on nearly level or gentle slopes. These are the soils located on the structural benches, cuestas, and fan terraces at the location of the Bluff Great House and around it (i.e. the Bluff Bench and Tank Mesa) (Soil Conservation Service 1994:7-8). Slopes range from 1 to 12 percent and the landscape is dominated by broad structural benches dissected by narrow drainage channels (i.e. the canyons). The soils range from shallow to very deep and are moderately deep over bedrock. These soils would not have been conducive to agriculture. The Oljeto family soils are found on the stream terraces and hillsides of structural benches (Soil Conservation Service 1994:55). These soils are on 10 to 40 percent slopes and support shrubs and grasses from about 4,400 to 4,500 feet.. They would also have not been very good agricultural soils prehistorically. The Trail fine sandy loam soils are found at the riverbank and floodplain of the San Juan River. This soil type forms on slopes of zero to one percent and current populations use these soils
for irrigated alfalfa, small grain, and pasture (Soil Conservation Service 1994:84). This is
the soil type with the most prehistoric agricultural potential and was probably used to
grow food for the people living at the Bluff Great House and their predecessors.

The Bluff Great House lies within an arid climate zone and receives
approximately seven to eight inches of precipitation a year. This precipitation comes
primarily in the form of late summer monsoonal rains. The primary sources of water for
the prehistoric population would have been the San Juan River and seep springs. The San
Juan is a meandering river with a deep channel that opens up into a broad alluvial valley
at the town of Bluff (Parry 2008:96). The valley is a one-half to one mile wide at Bluff
and bordered by flat-topped mesas on both sides. The gravel capped Navajo sandstone,
Camel formation and Entrada formation terraces are about 460 feet above the river in this
valley and provide an excellent view of the entire river valley. The other prehistoric water
sour, seep springs, are formed when water is absorbed into Bluff sandstone and is forced
out at the boundary between the porous sandstone and the impervious shale of the upper
Summerville creating nearly constant small seepages of water (Davis and Westfall
2009:15). Both of these water sources would have provided ample water for the
inhabitants of this area.

The flora and fauna of the Bluff Great House are relatively diverse for the
American Southwest, which would be expected of an area with such a diversity of
landscape features and microclimates. The dominant plant community is the shadescale
zone. This consists of widely spaced, spiny, small-leaved shrubs covering ten percent of
the ground area (Cronquist, et al. 1972:115). Cottonwood trees and coyote willows are
the native species that dominate the river floodplains to the south of the great house. The animal species supported by the riparian, mesa top, and canyon ecosystems around the Bluff Great House are also diverse. In the present day, deer, shrews, mice, desert cottontail, black-tailed jackrabbit, coyotes, foxes, and raptors all habitat this area (Soil Conservation Service 1994:8). Preliminary investigations at the Bluff Great House middens outlined some of the more common animals used by the prehistoric occupants of the area (Driver 1997). Turkey was the most common bird and the most common mammals were cottontail and jackrabbit. There were also bighorn sheep, fox, bobcat, some domestic dog, gopher, packrat, and sciurids (mostly squirrel and chipmunk). Beaver and fish species were also present, most likely due to the proximity to the San Juan River.

The Bluff Great House is sited at a location with a diversity of landscapes, floral and faunal habitats, and soils. There is an alluvial valley, an arid mesa top and the verdant canyon bottoms. The great house, located at the crossroads of these features, would have been able to take advantage of this diversity to have a more reliable food supply than the rest of the San Juan Basin. A combination of subsistence patterns including, hunting, agriculture, and domestic animal harvesting (i.e. turkey) would have made this location well suited for a great house. Even though the prehistoric landscape was not identical to the landscape seen today, because this area is still verdant farmland and the rivers course has not significantly changed we can assume the landscape is not much different. Certainly alfalfa was not grown in the alluvial valley and modern irrigation was not available, but the environment probably was diverse and may have had even more
variation than it does today. This would have been an ideal environment for the series of communities that inhabited the Bluff site.
Chapter 3: Cultural Background

Paleoindian

During the Paleoindian period (from about 11,000 years ago to 7,500 years ago), the people living in the American Southwest were roving hunters and gatherers (Kantner 2004a:53). During this time, people living in the American Southwest were not necessarily culturally distinct from other groups distributed throughout the non-glaciated regions of North America (Cordell 1997:67). Subsistence patterns were mostly centered on the hunting of Pleistocene megafauna, which were distributed throughout North America (Cordell 1997:90-91). Archaeological evidence used to study this period is limited due to the ephemeral nature of campsites, but there is evidence of large game hunting from animal bones and point artifacts. People subsisted using large regions, where they moved seasonally, and populations probably grew significantly during this period (Cordell 1997:100).

Archaic

During the Archaic period, dated from B.C. 5,500 to A.D. 200 (Cordell 1997:101), environmental patterns began to resemble more modern climates. As a result of this climate change, groups of people adapted different regional responses to the many unique environments across North America (Kantner 2004a:55). Across the much of the continent, most groups were still hunters and gatherers, who left only ephemeral campsites
in the archaeological record. But these hunters and gatherers relied more heavily on locally available resources (Cordell 1997:102). In the Southwest, between about B.C. 2800 and 1000, Archaic peoples began to incorporate corn into their diets (Cordell 1997:148). By B.C. 750 to A.D. 200, corn, squash, and beans were cultivated throughout the region. These three crops eventually became the basis for the entire economy of the Southwest. With these crops, people started storing large quantities of food and developed agricultural technology. Because the region’s inhabitants grew and stored more foods, they needed to become more sedentary and larger groups would have been more advantageous because they provided a larger labor pool.

**Basketmaker**

During the Basketmaker periods people generally lived in small slightly mobile villages of foragers, who also cultivated corn (Cordell 1994:38). These periods are named after the elaborately woven baskets found at many sites during this time. The Archaic period described above used to be described as Basketmaker I, but “Archaic” is now generally used (Cordell 1994:38). Basketmaker II, dated from A.D. 200 to 500, and the Basketmaker III period lasted from A.D. 500 to 700 (Cordell 1994). The term “Basketmaker” and all of the following periods are defined using the Pecos Classification (Table 3.1). The two Basketmaker periods are distinct from each other because Basketmaker III technology was significantly more advanced than Basketmaker II technology.
Table 3.1: The Pecos Classification (Kidder 1927) groups times with common characteristics into periods.

<table>
<thead>
<tr>
<th>Dates (All A.D.)</th>
<th>Pecos Period</th>
</tr>
</thead>
<tbody>
<tr>
<td>200-500</td>
<td>Basketmaker II</td>
</tr>
<tr>
<td>500-700</td>
<td>Basketmaker III</td>
</tr>
<tr>
<td>700-900</td>
<td>Pueblo I</td>
</tr>
<tr>
<td>900-1150</td>
<td>Pueblo II</td>
</tr>
<tr>
<td>1150-1300</td>
<td>Pueblo III</td>
</tr>
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**Basketmaker II**

During the Basketmaker II period architecture primarily consisted of small circular semi-subterranean structures of about fifteen feet in diameter (Cordell 1994:38). These pithouse structures had saucer shaped floors. Walls consisted of cribbed logs or stones, and roofs were plastered in mud. Communities also used storage cists constructed much like small pithouses, which were smaller and lined with upright stone slabs (Cordell 1994:38). Preserved perishable items, such as baskets, woven items, and items made from wood suggest that there was a rich material culture during the Basketmaker II (Sebastian 1992:25). In general, architecture at this time was not very complex and was fairly uniform across the San Juan Basin.

**Basketmaker III**

During the Basketmaker III period people lived in small farmsteads often with one to four pithouses and associated storage features (Sebastian 1992:26). Although the typical village at this time was small, some larger villages were not uncommon. There were more storage features built during this period, as people were more sedentary and therefore used more stored agricultural resources to supplement hunting and gathering.
Ceramic technology was also first used during this time to prepare and store food more effectively during Basketmaker III. People in this period were more sedentary, so they used ceramics (instead of baskets) because it was easier to cook and store foods with these containers. Sedentary people did not need to move the heavier ceramics either.

This is the period when recognizable characteristics of the Pueblo culture of Chaco Canyon and the Bluff Great House probably emerged (Cordell 1994:88). These include distinctive ceramic styles and decorative patterns in addition to pithouses that resemble the later kivas. The people living during this time period were the ancestors of those who built the great houses hundreds of years later.

In Chaco Canyon, there were two large pithouse villages, Shabik’eshchee and a site designated only as 29SJ423. These and other Basketmaker III villages in the region contained thirty or more pithouses and other associated features such as storage structures and corn grinding bins (Van Dyke 2007:63). Villages often had paved walking areas and large community pit structures, which are both evidence of community gathering and cooperation. These large community pit structures may have been the precursor to the great kivas that became common in the later Pueblo I and II periods when they were associated with larger above ground pueblos. From these types of pithouse villages, it can be seen that some people in the Basketmaker III period were aggregating into much larger communities than earlier.

**Pueblo**

*Pueblo I*
The Pueblo I period, between A.D. 700 and 900, marked a major change in settlement size and layout (Rohn 1989:155). During this period, pithouse construction continued, but above-ground room blocks built with sandstone were also developed (Rohn 1989:156). During the Pueblo I period groups expanded their geographical range, became more sedentary, and depended more on stored foods (Cordell 1997:261-263) than in the earlier Basketmaker periods. The above-ground room blocks were probably built to provide increasingly needed storage space for food, and perhaps because food stored in above ground structures were less likely to be damaged by moisture or vermin (Kantner 2004a:69). In the latter part of this period, people began to spend more time in their surface structures and the use of the surface structures for storage intensified. Hearths and domestic debris indicate that some of the surface rooms were also used as living rooms (Cordell 1994:82). But even as the above ground room blocks were used for everyday activities, it appears that pithouses were still used as dwellings for sleeping because they were much more efficient at retaining heat in winter and staying cool in summer.

By the end of the Pueblo I period, about A.D. 900, single room surface structures had been expanded to blocks of several connected rooms (Sebastian 1992:27). In these connected rooms, the front room usually had the hearth and bins for grinding corn. Featureless back rooms often stood behind the front room. The outside area in front of the room block would have contained one or more pit structures. These amalgamated structures consisting of a room block and pithouse were often grouped into communities or villages (Sebastian 1992:27) that occasionally had other larger buildings that were the incipient great kivas, used presumably for community activities. The Pueblo I peoples’
subsistence was dependent on agricultural production of corns, beans, and squash. It appears that through this period, hunting and gathering for food became less common in favor of agricultural production.

**Pueblo II**

The Pueblo II period, between A.D. 900 and 1150, was defined by construction of the great houses, both inside and outside of Chaco Canyon. Great Houses were “overbuilt” community structures with specific architectural characteristics. During this period populations also grew, agricultural production increased to feed these people, architecture increased in size and formality, stratification between social classes was greater, and trade and regional interactions grew throughout the region. Site density across the San Juan Basin also increased at a remarkable rate during the Pueblo II period (Sebastian 1992:28), probably because populations were growing so significantly. Agriculture also intensified because people had to produce more crops to support the larger populations. They also needed surpluses to share, trade or save for lean years (Cordell 1997:303). Architecture changed dramatically in the Pueblo II with the construction of great houses and other large forms of public architecture (Sebastian 1992:29). At this time the loosely aggregated communities of the Basketmaker and Pueblo I periods were replaced with larger pueblos and great kivas, which were surrounded by smaller habitation sites and connected to other settlements by roadways (Cordell 1994:83).

Prior to the construction of the “classic” great houses around A.D. 900, proto-great houses or early style great houses were constructed in Chaco Canyon and
throughout the periphery of the San Juan Basin (Windes 2001). These proto-great houses vary in size and style, but all seemed to have functioned as community structures with many of the characteristics of later great houses. They often had blocked-in kivas and larger rooms. Proto-great houses appear to have been used mostly for habitation and everyday activities, but high status artifacts, such as turquoise, found at these structures suggest that they perhaps had some ritual uses (Windes 2004:85). Most importantly, there is little to suggest that the core Chaco Canyon area had more important architecture than anywhere else in the San Juan region until about A.D. 1050. Proto-great houses do not seem to have been built in any limited geographical context within the region. Therefore, the great house style actually seems to have developed in many places outside of Chaco Canyon and may not have been special in the canyon until later.

Chaco Canyon was the geographic center of the middle Pueblo II great house construction, with the most impressive, formal, and largest constructions in the San Juan region. Chaco Canyon may have had immense influence over the entire San Juan Basin and this can be seen primarily through the perpetuation of the Chacoan style of architecture throughout the region. More than 13 great houses and many other structures, such as roads, storage features, smaller residences, and one isolated great kiva, were built at Chaco Canyon during the Pueblo II (Cordell 1994:96). This construction at Chaco was a monumental task with evidence that upwards of 200,000 timbers were hauled from 65 to 80 kilometers away for building. These huge pueblos were formal, planned structures with many more rooms than previously built single-family dwellings. Rooms within them were larger and had higher ceilings than any other housing at that time. The great houses
at Chaco typically faced south, with a plaza at the front and a wall or room block enclosing the plaza. They were often “C”, “D”, or “E”-shaped in plan view and multistoried. The multiple stories were tiered with the lower stories facing the plaza (Cordell 1994:99). Walls consisted of core and veneer masonry. These architectural features are consistently seen at great houses within Chaco Canyon.

During the Pueblo II period, the pithouses of the Basketmaker and Pueblo I periods were changed slightly and incorporated into room blocks. Archaeologists refer to them as kivas. They were probably used for ceremonial purposes, as opposed to everyday housing as they were earlier. However, Lekson (1984:50-51; 1988) hypothesizes that kivas were primary residences at great houses. Each great house also had at least one great kiva, which were much larger than traditional blocked-in kivas, and had benches around the walls, raised fireboxes, paired masonry vaults, four roof supports, and an entrance through the roof or sometimes a stairway to the side. These great kivas could seat a large number of people, presumably for community events or religious ceremonies.

Excavations in Chaco Canyon have uncovered evidence of social stratification between those living in the great houses and those living at any of the smaller sites (Kantner 2004a:106; Toll 1991). These conclusions are based on the presence of more luxury goods at great houses than any of the smaller sites located either at Chaco Canyon or elsewhere in the San Juan Basin (Cordell 1994:101). This suggests that the residents of Chaco were rulers or represented a sort of centralized hierarchy (Lekson 2006b:27), because the ownership of rare or “special” items is often associated with a ruling class. Luxury goods, such as turquoise and shell jewelry, cylindrical jars, macaw feathers and
skeletons, and copper bells, were imported and required skilled labor to produce, making them rare and elite objects. In fact, more turquoise was found in one room in Pueblo Bonito (in Chaco Canyon) than all other pre-contact sites in the Southwest combined (Mathien 2003). The presence and quantity of these luxury goods suggests that the residents of Chaco were able to obtain these goods, and other people living in the areas did not have as much access to them. Although this is a common interpretation of Chacoan social organization Chaco has been interpreted this as a more egalitarian system (Saitta 1994, 1997).

A smaller population inhabited Chaco Canyon than the high number of rooms within the great houses would otherwise indicate. For example, Chacoan great houses had small kiva to room ratios, as compared to small sites and later more densely populated sites. This suggests that if the Chacoan great houses had more people living in them, they would have more kivas. But because there are relatively few kivas at Chacoan great houses, residential populations were probably much lower than the number of rooms suggest. Chacoan great house rooms were also mostly interior with little light or air circulation, meaning they would have been unsuitable for habitation. Furthermore, there was a limited number of burials found within the canyon (Cordell 1994:101), which also suggests a small permanent population. All of this evidence indicates that Chaco Canyon may have had a limited resident population, and its community architecture may have been built for groups of people who were visiting the canyon, not living there. Chaco appears to have been dominated by smaller, elite group of people who lived in the great houses (Lekson 2006a:91).
Chacoan Outliers

During the Pueblo II period, Chaco Canyon may have acted as a powerful religious or religious center with smaller “outlier” great houses in the San Juan Basin surrounding and supporting it (Kantner and Kintigh 2006:187). These outliers within the region may have communicated with Chaco Canyon, and, at the very least, they were culturally similar to Chaco because they have very similar architectural elements. Outlier great houses in areas peripheral to Chaco were usually the largest structure where people built them, and they were surrounded by communities of smaller structures. These great houses usually had about 20 to 40 rooms. Typically, outlier sites were much smaller than Chaco Canyon great houses, but they usually had a great kiva. These relatively large features suggest that outliers were used as community structures for their neighbors living at the surrounding smaller sites.

Chacoan outliers had a range of architectural characteristics that may have connected them to Chaco, but there is no standardized definition of what makes a site an outlier. In general, outliers are sites that were influenced by Chaco Canyon in some way and manifested this influence through the presence of similar architecture. Architecturally, most had Chacoan style core and veneer masonry, great kivas, and ceramic assemblages similar to those found at Chaco, among other defining characteristics (Cordell 1994:102-103). It has been suggested that the more Chacoan features that outlier great houses have, the closer their connection to Chaco Canyon probably was (Jalbert and Cameron 2000). A larger number of comparable features within them suggests that people who resided there were communicating more directly
with each other to exchange these ideas. Sites are, therefore, defined as Chacoan outliers when they have a number of features that are also found at Chaco Canyon great houses. Modern archaeologists often measure Chacoan influence by the architectural elements of outlier great houses (Kantner and Kintigh 2006:157-159; Neitzel 1994:215).

By looking at a few examples of these communities, it is easier to get an idea about the range of possible relationships between Chaco and its outliers. One example is Chimney Rock, a pueblo on top of a prominent mesa overlooking the Piedra River in southwestern Colorado. It has a distinctive Chacoan style, with core-and-veneer masonry, blocked-in kivas, and many large rooms (Figure 3.1). The Chacoan architecture makes this outlier directly comparable to Chaco Canyon. Its style of construction with kiva roofs, the great kivas, and Chacoan masonry suggest that this site was directly connected to Chaco (Figure 3.2) (Jalbert and Cameron 2000:90). Because of the number of architectural comparisons between Chaco and Chimney Rock, people from Chaco Canyon may have actually built this site.

Figure 3.1: The Chimney Rock Great House has many Chacoan features (image from Eddy 2004:27).
The Chimney Rock Great House is located on a prominent ridge in southeastern Colorado. The great house (left) is located directly below the two “Chimney Rock” formations (right).

The Edge of the Cedars Ruin in southeastern Utah is another such late Pueblo II outlier site. It was located at the border of the area thought to have been influenced by Chaco and only has some of the features that typically classify a great house (Hurst 2000:63). The great house was two stories tall, had rooms with high ceilings, core-and-veneer masonry, has a great kiva, and an earthen mound. Edge of the Cedars was, however, lacking the magnitude and formality of a Chacoan great house, because it was rather small (Figure 3.3) (Hurst 2000:76). From the presence of the Chacoan features, it has been suggested that the residents of this site were influenced by Chaco Canyon yet the extent of that relationship is unclear from the archaeological evidence. The great house’s physical distance from Chaco Canyon and its small size seem to indicate a relatively less connected relationship compared the hypothesized direct connection between Chimney Rock and Chaco Canyon.
Figure 3.3: The Edge of the Cedars Great House was much smaller and less elaborate than other Chacoan outlier great houses (image from Hurst 2000:67).

The Bluff Great House, which is the subject of this research, was a three or four story tall building, partially constructed using Chacoan core-and-veneer masonry (Figure 3.4) (Cameron and Geib 2007:344). Many features at Bluff are comparable to Chacoan great houses, for example, room sizes were fairly large much like Chaco. Like Chacoan great kivas, the great kiva at Bluff had a series of Chacoan floor features and was about the same size. This outlier great house was built on a prominent river terrace overlooking the San Juan River, prominent locations like this were also common for Chacoan outliers. The Bluff Great House also had Chacoan-style earthen architecture with an encircling berm, a terrace, and road features all built by modifying the landscape. These architectural features, found at Bluff, are characteristic of Chacoan great houses and seem to connect the Bluff Great House to Chaco Canyon in some more direct way than the smaller Edge of the Cedars Great House.
Figure 3.4: The Bluff Great House was a three to four story tall Chacoan outlier great house (image modified from Cameron and Geib 2007:343)

Prehistoric roadways are another example of the interconnectedness of sites in the Pueblo II period, as they connect many sites to each other and to Chaco Canyon. Roadways are typically about three to twelve meters wide, and built by clearing stones and earth to create a shallow depression (Van Dyke 2007:145). They run in straight lines and do not curve or dip to accommodate topographic relief, which suggests some sort of ceremonial purpose of the roads, where the direction of the road was communicating a specific message. Some roads lead to specific areas of resource acquisition while others lead to directly from site to site, and, occasionally, they go apparently nowhere (Cordell 1994:104). The exact use of these prehistoric roads is unknown, but it has been suggested that they were probably not built for transportation, because such wide pathways would not have been necessary when people traveled exclusively on foot. But, because roads provided the easiest walking path on the landscape, if people needed to travel in those directions they probably walked on the roads, even though the large roads were probably
built for some purpose other than solely for human travel (Van Dyke 2007:148). Though the exact uses of roads are unknown, roads that appear to go nowhere may represent ideological connections between sites and some sort of natural feature or Chaco Canyon (Cordell 1994:104). Perhaps they represented Chacoan cosmographic principles or the general features of the Chacoan universe. But whatever their prehistoric purpose their presence shows a close relationship between sites that they connect. Certainly roads represent a manipulation of the landscape and undoubtedly show that sites and people that resided there were connected to other sites and people through roads (Van Dyke 2007:148).

The Relationship Between Outliers and Chaco Canyon

One possible relationship between outliers and Chaco Canyon is that people from Chaco Canyon were directly responsible for the construction of outliers such as the Bluff Great House. This idea centers on the fact that outlier great houses may have been initiated and constructed with direct input from the people living at and controlling Chaco Canyon. Archaeological evidence for this is can generally be found in the degree of similarity between Chacoan great house and outlier architecture. Of course, such a relationship assumes that very similar structures must have been built by the same group of people and, therefore, indicates a close relationship between sites with the same architectural elements. A different hypothesis can also be generated that could suggest that these architectural features were common throughout the region and similarities between different sites are indicative of a shared culture, not necessarily a direct relationship between the two sites.
Chaco Canyon and the outlier villages may also have had economic relationships. Perhaps the regional system between Chaco and its outliers was a network of exchange with Chaco at the redistributive center, either run cooperatively or by elites. In this cooperative scenario, the Chaco Canyon great houses were storerooms for the redistribution of goods from outliers to other outliers, with Chaco in control at its center. Chaco would have been an egalitarian distribution center for dividing food in the event of a local agricultural shortfall (Judge 1976). If this distributive system was organized by elites, rather than egalitarian, these ruling elites would have taken a tax for their services and the system would have been more centrally controlled. The problem with these economic hypotheses about Chacoan control is that both circumstances are unlikely. Archaeological evidence indicates that trade was largely localized around outlier sites, and Chaco Canyon was the only site to acquire items from a significant distance (Kantner and Kintigh 2006:167). There is little evidence at outliers to suggest that they were getting items from any distance away, which is what would have occurred if Chaco were a redistributive center. In fact, the only site with evidence of long distance trade items is Chaco Canyon. The outliers themselves were not acquiring many trade goods from any redistribution from Chaco. Thus, the purpose of the Chaco center was not to redistribute goods between outliers, and the outliers were not exchanging goods with Chaco, and therefore it is unlikely that Chaco was redistributing goods from outlier to outlier.

If this economic system was based on elite rulers taking goods from outliers as a method of supporting themselves (Sebastian 1991), it is easier to see why Chaco would have needed to establish outliers. Perhaps Chacoan leaders may have needed outliers to
gain access to items like food, ceramics, and labor for construction, but they would not necessarily have been giving items back to the outliers in return (Kantner 2004a:109; Lekson 2006a:92). This relationship therefore would not necessarily have resulted in an exchange of goods, but instead in a one-way passage of goods moving to Chaco. As such, Chaco Canyon may have been a capital of some kind, using influence and direct control of outliers to obtain material goods from outliers (Kantner 2004a:110)

Perhaps Chaco Canyon may have also relied on indirect influence, instead of directly controlling the outliers. Outliers could have been independent entities that were influenced by Chaco and the relationship between them constituted a system to support social exchange (Kantner and Kintigh 2006:174; Mahoney 2000), rather than just a capital with regional sub-capitals. In this scenario people living at Chaco Canyon may have provided political validation to leaders at outlier sites in exchange for the support of the outliers through material goods and construction labor (Jalbert and Cameron 2000; Kantner and Kintigh 2006). This political validation would have benefited both parties as people at Chaco would have gained material items and labor and outlier communities would gain endorsement and validation. In this way Chaco was not controlling outliers, but was instead giving then some sort of political validation in exchange for trade goods, like food and ceramics.

Outlier communities could have also been linked to each other and Chaco Canyon people through ritualized social ties as well as economic and political ties. Connections to Chaco Canyon may have functioned as a social network for large-scale social and ritual occasions, and as an observation center of seasonal changes or farming schedules
(Kantner and Kintigh 2006:186). In this case, Chacoan leaders would have acted as mediators between the supernatural realm and the general population (Sebastian 1992:149). Mediation would have elucidated respect and reverence for the Chacoan way of life, perhaps to the extent of architectural imitation. But the relationship would not have necessarily meant that the Chacoan leaders were in charge of the outliers or stimulated construction at the sites.

If Chaco just had an indirect influence over outlier culture, it might help to explain the range of Chacoan characteristics present at outliers, such as the smaller Edge of the Cedars Great House and fact that Bluff was only partly built using core-and-veneer masonry. However, these potential relationships between Chacoan communities and its outlying communities were no doubt complex and diverse. Some sort of continuum of all these possibilities likely existed in actual practice (Neitzel 2007). It is also likely that some outlier great houses may have been directly controlled by Chaco Canyon while others were more indirectly influenced to varying degrees and for varying reasons. Outlier great houses probably exchanged ideas with each other, rather than just with Chaco Canyon, making all of these relationships much more nuanced than all the hypotheses discussed above. This is particularly true when considering architectural connections, because outlier sites may have been mimicking other outlier architecture instead of Chaco Canyon architecture (Doyel and Lekson 2001).

**Pueblo III**

Between A.D. 1150 and 1300, in the Pueblo III period, there was large-scale abandonment of Chaco Canyon and Pueblo II outlier structures. Great House construction
ended within Chaco Canyon and it was abandoned around A.D. 1150 (Cordell 1994:119).
People seem to have left Chaco by A.D. 1200 in favor of the northern San Juan where
they built large pueblos and cliff dwellings. The exact reason for this large scale
migration away from Chaco Canyon is unclear (Cordell 1994:120), but it is known that
people drastically changed the way they lived to live in larger groups with more
defensive architecture. By A.D. 1300, these later Pueblo III buildings in the northern San
Juan were abandoned (Sebastian 1992).

Both of these abandonment’s probably had environmental (Dean and Doyel 2006)
and sociopolitical causal factors (Judge and Cordell 2006) that together made living in
Chaco Canyon and then the entire San Juan unfeasible for ceremonial and political
purposes. Although the timeline for outlier great house activity during the Pueblo III
period is much less clear, some abandonment of Chacoan outliers occurred within
approximately the same time period as Chaco Canyon’s abandonment (Kantner and
Kintigh 2006:184). Construction seems to have continued during the Pueblo III period on
some outliers, mostly those in the northern San Juan area (as is documented here for the
Bluff Great House).

The Bluff Great House

Site Construction and Habitation Timeline

The Bluff Great House outlier site had an occupation and construction history
lasting hundreds of years. University of Colorado excavations found ceramic evidence to
suggest the first occupation the river terrace was in the Basketmaker III (Cameron
2009f:298). Also, excavators found parts of at least two pithouses dated to the
Basketmaker III and/or the Pueblo I period. Close to the Bluff site, during the Pueblo I period, there was a large village site about 700 meters away and below the river terrace. But there was probably also some Pueblo I occupation on or near the Bluff Great House site. Unfortunately, before the GPR surveys little else was known about the pre-Pueblo II occupation of the site because the University of Colorado excavators’ research questions focused on the site’s Pueblo II period occupation and avoided excavating pre-Pueblo II structures.

There is ceramic evidence for occupation at this site during the early Pueblo II period (A.D. 900-1000), but this evidence is questionable because these ceramic deposits were not in situ (Cameron 2009f:298). The middle Pueblo II period (A.D. 1000-1075) has an even less certain occupation history. From this period there is evidence of regional depopulation, and populations around the Bluff site probably decreased as well. After these relatively low population levels, people from elsewhere migrated to the Northern San Juan, thereby returning the population to its earlier size or perhaps even larger. During the early and middle Pueblo II period the population of the Bluff Great House site (and possibly the entire region) may have decreased dramatically, and then increased again in the middle to late Pueblo II.

Major great house construction took place between A.D. 1075 and 1150 (Cameron 2009f:298) to build the Bluff Great House. This construction probably had two episodes, although there was no discernable temporal difference between the two. The first construction was probably western side, built of single course masonry common to Pueblo I and II sites in the area. The second constructed section was the eastern side and
had core-and-veneer masonry, a common Chacoan masonry style. After living in the eastern section for several decades, part of it was torn down and the debris from that demolition was used to build the terrace in the back of the great house in the late Pueblo II (Cameron 2009f:298). The site’s great kiva was probably built during at the same time as the great house’s initial construction. The Bluff Great House was built in several episodes during the late Pueblo II period, beginning around A.D. 1075, and it was constantly being remodeled until its abandonment at the end of the Pueblo III period.

The Bluff Great House was probably still occupied when Chaco Canyon was abandoned in A.D. 1200. In the early Pueblo III period (1150-1200), the site was remodeled suggesting that people were still living at the great house (Cameron 2009f:300). Towards the end of this period, people began to deposit trash in some of the rooms and kivas. The terrace was then “capped” with more deposits, to make it even larger. In the middle Pueblo III (A.D. 1200-1250), there were more trash deposits in the room blocks and people were primarily living within the blocked-in kivas. The final great house construction was on the east kiva in the room block (Cameron 2009f:300). Then the great house was abandoned completely around the end of the Pueblo III period, long after Chaco Canyon was abandoned. This abandonment was probably triggered by the same environmental and social stress that caused the entire region to be abandoned in A.D. 1300. But, throughout the entire Pueblo III period, even after Chaco Canyon was abandoned, people were still living in and modifying the Bluff Great House.
The size of the population of the Bluff Great House varied throughout its occupation, but it was generally not as high as might be inferred from the size of the great house. To infer what this size might have been, there are two primary ways to estimate population: by the number of rooms or the number of kivas. Estimations based on the number of rooms put the population between 33 and 120 people (Cameron 2009f:301). If only the rooms with outside access are considered, thereby excluding rooms that would not have been inhabitable because they had no light or fresh air, there would have been 15 to 16 households (one household per suite of rooms with outside access) (Cameron 2009f:302). Household size varied, but each household likely had 4 to 6 people in it. If, on the other hand, one estimates population based on the number of small blocked-in kivas, there would have been between 1 and 4 households (Cameron 2009f:302). These population estimates represent the people who lived at the great house as permanent residents during the Pueblo II period. Still, many people from the surrounding areas probably took part in activities or community events at Bluff. The Bluff Great House had a permanent population of between 6 to 120 people, and it also had temporary groups of visitors staying there.

Activities done at the Bluff Great House would have ranged from feasting to craft manufacturing. There is archaeological evidence of feasting in the ceramic record, though the relative paucity of grinding stones found suggests that much of the food preparation took place elsewhere (Cameron 2009f:302). This is referred to this as the “pot-luck” model in which people from surrounding sites came to Bluff for feasts and brought food
to share. The few large ceramics that indicated any food preparation for feasting only dated to the beginning of the Chaco era around A.D. 1075. After that period food was brought to the site, rather than prepared there (Cameron 2009f:303). Utility ceramic vessels demonstrate no change in form throughout the occupation of the great house, but white-ware (decorated) ceramic forms changed in the post-Chaco period. Whereas bowls dominated ceramic finds from excavations of older objects, mugs were used more commonly in the later periods (Cameron 2009f:303). This might further suggest that food was brought to the site and was not stored at Bluff, because neither mugs nor bowls are good food storage vessels. These vessel types are, however, used for eating and drinking. Using this ceramic evidence, the Bluff Great House was a location used for community feasting.

Faunal deposits in the middens suggest that during the Pueblo II occupation of the great house, residents had special access to large game. There were many more large game animals found in the Bluff middens as opposed to the amounts of large game found within the region’s other middens (Cameron 2009f:304). This may suggest that the people living at Bluff were more elite than their neighbors, because they enjoyed better access to a high status resource like meat. Evidence of craft production at Bluff is limited to ground stone and bone tools for weaving and ornament production (Cameron 2009f:302). There is also not much evidence of ceramic crafting. There were no production areas excavated, so little is really known about any manufacturing. According to the excavation record, the Bluff Great House was used for feasting and perhaps limited
craft manufacturing. These types of activities suggest the site was used for community events and maybe not used for daily chores like manufacturing.

The residents of the Bluff Great House interacted with the rest of their region, particularly during the Pueblo II period. Most of the faunal remains are local, but a significant number of the Pueblo II ceramics found at the site are from outside of the Northern San Juan area (Cameron 2009f:304). According to their tempers and styles, these ceramics came from areas to the southeast (Cameron 2009f:305). During the Pueblo III period, there is less evidence of a ceramic exchange than during the Pueblo II, suggesting that the people of Bluff were relatively isolated during this time (Cameron 2009f:306). Chipped stone was mostly local, but there were some non-local stones imported from commonly used quarries (Cameron 2009f:305-306). Ornaments were also mostly local, but there were some imported exotics such as marine shell (Cameron 2009f:306). Some high status materials common in Chaco Canyon, such as turquoise, azurite, and malachite, were not found at Bluff (Cameron 2009f:306). These patterns suggest that Bluff residents had access to limited sorts of trade items, perhaps through their relationships to other outlier sites. This limited trade may have stemmed from loose affiliations with the groups that had these items, but the people of Bluff did not have the same access that Chaco Canyon did to these high status goods during the Pueblo II period.

The trees used to construct the Bluff Great House were all local, unlike Chaco and Aztec, and people did not need travel long distances to acquire lumber (Cameron 2009f:304). Even though there is archaeological evidence of cotton weaving done on site
during the Pueblo II and II periods, the cotton was probably imported (Cameron 2009f:305). Cotton could have been grown in the Bluff environment, but there is little evidence to suggest that happened, no cotton farming implements or seeds were found at the site. In any event, the residents of Bluff were actively engaged with other groups in the region, as suggested by goods obtained through trade.

The relationship between builders and residents of the Bluff Great House and Chaco Canyon in the middle Pueblo II period is still unknown. Cameron believes that Chaco had direct control over the building and leadership of the Bluff Great House (2009f:309). Her evidence for this is that architectural variability between the Bluff Great House and other great houses was actually not that great, given that the variability at Bluff probably resulted from its’ long-term occupation and remodeling. The excavated portions of the great kiva at Bluff also bear a remarkable resemblance to great kivas at Chaco. Furthermore, the earthen architecture at Bluff, (the berm and terrace) was remarkably similar to features such as the Pueblo Bonito mounds and the terrace at Kin Kletzin. Cameron also interprets construction at Bluff during the Pueblo III period as evidence that Chaco builders built and lived at Bluff. Because these builders were not emulating Chaco, but were Chacoan, they did not need the canyon’s influence to continue building. Cameron concludes that the Chacoan people directly influenced the building and design at the Bluff Great House.

It is also possible that the Bluff Great House was more independent. The continuation of construction at Bluff after Chaco’s abandonment could suggest some sort of independence. The social structures at Bluff and Chaco were not so interdependent that
Bluff society was abandoned along with Chaco. There was new construction at Bluff after the abandonment of its “capital,” and some of this construction was on what might have been a community structure (i.e. the terrace). This suggests that community events still took place and that the people living at the Bluff Great House had an organizational structure independent of Chaco Canyon. However, Bluff was not independent of its regional community and was deserted when the entire area was abandoned in A.D. 1300.
Chapter 4: Ground-penetrating Radar Methodology and Field Methods

Introduction

This project integrated excavation data and ground-penetrating radar to investigate the organization of buried architectural elements of the Bluff Great House. Ground-penetrating radar is a geophysical technique that is becoming popular with archaeologists for its ability to map buried features both in depth and extent. It allows archaeologists to collect a large amount of subsurface data quickly with no ground disturbance. The GPR data are acquired through the transmission of electromagnetic pulses propagated from a surface antenna, which reflect off of buried objects, geological, and architectural features, and then received back at the ground surface (Conyers 2004a). The amplitudes of the waves that make up what is called a trace and are recorded as well as the time that elapsed between the sending and receiving of the pulses (measured in nanoseconds). Together all of the traces collected consecutively, when stacked together along that transect line, make up a reflection profile (Figure 4.1). Many reflection profiles are arranged in a grid, having x and y dimensions on the ground surface and z data (depth from which the reflections were recorded) to produce three-dimensional data. The velocity at which energy travels through the ground can be estimated and used to calculate depth in the z dimension by converting radar travel times to distance in the ground.
Figure 4.1: Each reflected wave from a soil unit is combined to form a trace (image from Conyers 2004a:26)

Ground-penetrating radar is an ideal technique for mapping site features that cover a large area in an efficient and ethical manner. Traditional archaeological excavations can take months to dig and sometimes years to interpret. Ground-penetrating radar data for an entire site can be collected, processed, and sometimes interpreted in a few hours. These data can then be used to target excavations to answer research questions or by themselves to make interpretations about the site’s subsurface architecture and how it has changed over time. Also, full-scale site excavation is an inherently destructive practice that is often ethically questionable. Frequently, descendent groups do not support the excavation of their ancestral sites, particularly in the case of ceremonial locations like kivas. And there is a general consensus by archaeologists that cultural remains should be preserved as much as possible for the future (Society for American Archaeology 1996). By excavating a site, many elements are often destroyed, leaving less information for future researchers with potentially more technological advances.
There are several different manufacturers of GPR equipment, but all of the systems operate upon similar principles with slightly different modifications. For this research, I used a Geophysical Survey Systems, Inc. (GSSI) Subsurface Interface Radar (SIR) 3000 system. This system collects data continuously at a set rate along transects aligned in a rectilinear grid, where each reflection can then be placed at a known location in three dimensions (Figure 4.2). Radar reflections when displayed in profiles are assigned colors within a gray scale to reflect their different intensities. A very strong reflection will be black and a weaker reflection waveform will be a lighter gray. When one looks at reflection strengths in profile, you can see different reflection intensities within the ground. When all profiles showing the strength of reflections are all lined up sequentially within the grid and the space within each profile is filled with additional data points from interpolation software and a horizontal map of reflection strength at various depths in the ground is produced (Figure 4.3).
Figure 4.2: Each profile is collected in a rectilinear grid and its location is known in relationship to the other profiles. The profile is a depiction of the strength of reflections within a transect, where stronger reflections are black and weaker are lighter shades of gray.

Figure 4.3: Slice maps like this are used to interpret horizontal features from the data profiles.
The success rate of GPR surveys is largely dependent on soil composition, water saturation, feature depth, and surface conditions. Electrically conductive or highly magnetic soils and sediments will absorb radar energy, rather than reflect it (Conyers 2004a) and therefore produce limited reflections of subsurface features. The best conditions for propagation and reflection of radar energy are dry sediments and soils without clay, making some areas of the southwestern United States an ideal location for GPR surveys (Conyers and Cameron 1998; Conyers and Osburn 2006). The depth archaeological features are buried can also affect the ability of GPR surveys to intersect them. If a buried feature’s size and dimensions are too small, GPR may not be successful. Ground conditions and vegetation can also prevent energy from getting into the ground by preventing the antenna from making continuous contact with ground surface.

**Ground-penetrating Radar Method and Theory**

Ground-penetrating radar involves the transmission, reflection and recording of electromagnetic (radar) energy. Reflections from features in the ground occur when there are changes in the physical and chemical materials along an interface. When electromagnetic energy, sent from a transmitting antenna encounters that sharp change some of that energy is reflected back to the receiving antenna. The remaining energy continues to travel deeper into the ground until it encounters other differences, and then more energy is reflected back to the surface from those deeper layers. Energy not reflected back toward the surface will eventually dissipate with depth. A transmission antenna generates the pulses of energy and their returns are received by a paired receiving antenna, both of which are encased in single fiberglass box (Figure 4.4). Pulses are sent at
given rate (in this case forty traces per meter along the transect). The resulting reflection traces are then saved, with one trace every 2.5 centimeters, resulting in an evenly spaced dataset along the transect lines. Distance is measured using a survey wheel attached to the antenna (Figure 4.5). When the survey wheel is not moving no traces are collected. The survey wheel allowed me to record the profile length within the data set and have a consistent number of traces within each meter.

![Figure 4.4: Radar energy is sent through a transmitting antenna, it reflects on subsurface changes and then amplitudes of those reflections are recorded with the receiving antenna (image from Conyers 2004a:137).](image)

![Figure 4.5: The antenna is connected to the survey wheel to measure distance.](image)
When the traces of electromagnetic energy are received their amplitudes are also recorded. The amplitude of the waveform indicates the strength of the reflection. With greater contrast between materials, the reflected waves will be stronger and the amplitude of the reflected waves will be greater (Conyers 2004a). High amplitude reflections can indicate the presence of cultural features, such as walls or floor surfaces, or geologic changes. For example, a clay floor would appear as a very high amplitude reflection because it is extremely different than the dry sediments surrounding it, and therefore produce a very high amplitude reflection. An understanding of what causes reflections and creates amplitudes within a three-dimensional volume of the ground is crucial to understanding what features will look like within the ground.

The amount of time it takes radar energy to be transmitted, reflected at depth, and then received back at the surface is called two-way travel time. This time is measured in nanoseconds (units of billionths of a second) (Conyers 2004a:11). Two-way travel time can be converted to a measurement of depth by using the velocity of the radar energy. Velocity can be determined through hyperbola fitting (Conyers 2004a:116). Hyperbolic reflections are produced from subsurface point sources, such as rocks or the tops of walls. Radar energy leaves the antenna at wide angle, reflecting energy from a large area within the subsurface. As the antenna collects data across a transect, the large area of energy reflection it produces causes the radar energy to reflect off a point source before it is over the source, while it is over the source, and after it has moved away. This produces a hyperbolic reflection because the travel time of that energy is larger both before and after the antenna is over the point source due the longer distance it travels to hit the point.
source at an angle. The hyperbola geometry is directly related to the velocity of the energy. Hyperbolae are fit using a model curve that has a known geometry and a velocity that is produces that geometry. To do this fitting, I used a software package called \textit{GPR-Slice} developed by Dean Goodman (2009).

Radar energy velocity is dependent on the materials in the ground through which it travels. Certain subsurface materials will allow fast or slow transmittance of energy. For example, fresh water is a slow conductor of radar energy and air is fast. Moisture content within the subsurface is one of the dominant factors influencing the propagation of energy (Conyers 2004b). If the soil and sediments have absorbed a great deal of moisture, the radar velocity will be slowed a great deal.

Soil and sediment conditions at the site have a significant impact on the depth penetration of GPR data. Highly conductive ground materials (such as those that contain salt or conductive clays) will attenuate radar energy (Conyers 2004a:55). When radar energy attenuates, energy is not reflected and subsequently information for that time depth are not recorded. This causes poor resolution at the depth of the attenuating material. Also, if energy is attenuating it is not continuing beyond that particular depth and data resolution beyond the attenuating material are lost. This is particularly problematic with soil content that blocks energy penetration at shallow depths above features of interest. Some areas will not be suitable for GPR due to their highly conductive sub-surface materials.

Surface conditions also affect the maximum depth and resolution of radar energy. Areas with large amounts of surface vegetation, rock, or uneven surfaces will cause
“coupling” problems, where the antenna loses contact with the ground surface. When coupling with the ground surface is lost, energy is leaving the antenna and going into the air instead of the ground. In the recorded data this results in difficult to interpret amplitude changes (Conyers 2004a:70). Some uneven surfaces require the removal of vegetation or obstructions prior to conducting a GPR survey. It is important to take care when collecting data to keep the antenna in contact with ground surface as much as possible.

The electromagnetic frequency of the radar waves is an important variable to conducting a ground-penetrating radar survey. Frequency is a measurement of the speed of energy oscillation on the antenna of a given size. Specific antenna sizes and oscillation speeds produce energies of a certain wavelength. This frequency is measured in Megahertz (MHz). Antenna frequencies used for archaeology range from about 10 MHz to 1000 MHz (Conyers 2004a:61).

Radar energy wavelength determines the size of features that are able to be resolved and the depth to which the energy will penetrate. Lower frequency antennas (100-300 MHz) produce longer wavelengths and can sometimes penetrate deeper than high frequency antennas (such as 900 MHz). High frequency antennas resolve much smaller features but have poor depth penetration. This is because the longer wavelengths produced by lower frequency antennas tend to spread out more as they travel reflecting more surface area, missing smaller discontinuities (Conyers 2004a:65). Because lower frequencies spread out more at depth, less of a energy will be reflecting off of relatively small point sources. This will affectively average out the reflections from a small feature.
Higher frequency antennas with smaller wavelengths spread out less and will not miss smaller discontinuities. But, longer wavelengths will produce waves that penetrate deeper into the subsurface. Therefore, a compromise must be made when selecting the antenna frequency for a survey between depth penetration and feature resolution.

This compromise between depth of penetration and possible resolution is not entirely binding though because labeled antenna frequencies are actually just the center frequency of that antenna. Frequencies transmitted from that antenna vary from about a half below the center to twice above with the center frequency being the most commonly transmitted (Figure 4.6). This means that a 400 MHz center frequency antenna generates wavelengths from about 200 MHz to 800 MHz (Conyers 2004a:39). Frequency variation is important because it means that if a medium frequency antenna is used (such as 400 MHz) some of the benefits of depth penetration from the lower frequency and the benefits of the higher frequency resolution will be combined in the recorded waveform. Each frequency can then be extracted during data processing to isolate the different frequencies. Through filtering frequencies, I found that higher frequencies were better for looking at walls. This is exactly as radar theory suggests. Later in the chapter I will discuss this further.

Figure 4.6: The labeled frequency of an antenna is its center frequency. Actual antenna wavelength carry around that center (image from Conyers 2004a:40).
For this project, I used a 400 MHz center frequency antenna hoping to achieve a compromise between depth penetration and resolution. The subsurface material was dry and sandy with a velocity of about 0.13 meters per nanosecond (one way travel time). Attenuation occurred at about 25 nanoseconds (or about 1.75 meters) due to highly conductive surfaces allowing fewer radar waves to propagate through them. Through an assessment of the past archaeological excavations I knew this depth would be sufficient depth penetration to map features of interest.

**Field Data Collection**

Data are collected by pulling the antenna across the ground surface. I established rectilinear grids over the features of interest and pulled the antenna along lines within the grid at a spacing of 50 centimeters. The spacing was determined by calculating the area of the sub-surface that radar energy spreads to, also referred to as antenna footprint size, and spacing radar transects so footprints would overlap. This insures that data are collected for the entire sub-surface. As the antenna is pulled, the antenna transmits radar energy pulses into the ground.

Before data are collected in the field, settings are adjusted in order to produce clear data. Because radar energy attenuates as it travels through the ground the later (deeper) reflections will have lower amplitudes than the earlier (shallower) reflections (Conyers 2004a:90). Range gains are applier to all of the reflection profiles in order to raise the amplitude of later reflections to make them more visible. To set these gains a scale is applied to the data that adjusts waveform amplitudes so they are all visible, this is typically a linear or exponential curve that increases the amplitudes of the later waveform
amplitudes within a known scale. These gains are applied in the field and can be changed again in post-processing (which will be discussed later). In the field, these are set considering the subsurface variables that affect amplitudes. To set the gains the antenna is moved across much of the ground surface to be surveyed so that the gains can be set to the highest possible amplitudes and the rest of the amplitudes will remain within the scale. It is important to ensure that the gains do not increase the amplitudes too much, because if any radar wave goes off scale this will result in clipping. Clipped data will not be recorded. This technique allows for better visualization of subtle features in the profiles.

Vertical filters are also applied in the field to remove high and low frequency noise that often results from system and external interferences (Conyers 2004a:95). These filters were set around a center frequency of the antenna within the specified range of that antenna. In this case the high-pass filter was 200 MHz and the low-pass filter was 800 MHz, meaning that reflections recorded were all between only these two frequencies.

The final data collection parameters involve setting the data collection time window. The time window, or distance in time within the ground that the GPR system is recording data, also needs to be set in the field. This can be determined by looking at the depth of radar energy attenuation in the field. It is extremely important that the time window is open wide enough so that deeper features of interest are not left out. A time window that is too narrow will miss potentially important reflections. In general, it is better to collect a larger than needed time window because attenuated data can always be cut out at the bottom, but if features of interest were missed profiles must be recollected.
to add depth. At Bluff, data were collected to forty nanoseconds. Finally, setting up the
top of the time window is used to make sure that the first reflection recorded in the trace
is the ground surface, it is referred to as setting the zero position. The zero position
should be placed so the ground surface is not exactly at zero nanoseconds and it is visible
within the traces and profiles (Conyers 2004a:91). The time window and zero position
determine the amount of data collected in the vertical dimension in the field.

**Data Processing**

Ground-penetrating radar data can be processed into graphic profiles in which
high amplitude reflections are shown with darker colors and low amplitude reflections
with lighter colors. Each of these profiles were collected at a given transect in a larger
grid. Data processing begins with a visual interpretation of these profiles to look for
interesting high amplitude reflections. These reflections are noted, particularly when they
are continuous throughout several profiles. The amplitudes along transects can be
resampled and interpolated between transects to produce horizontal slices within the grid.
These slices are used to interpret horizontal features from the block of data. In these
slices, high amplitude reflections are depicted with bright red and low amplitude
reflections with blue (Figure 4.3). Slices are representations the changes in reflectivity (as
recorded in wave amplitudes) at specific depths across a grid. When changes in amplitude
can be directly related to changes of materials in the ground they become analogous to
arbitrary excavations levels standard in archaeological field methods. These horizontal
slice maps of high amplitude reflections are further used to make interpretations about the
reflections collected within a grid.
After collecting GPR data, range gains can be adjusted in post-acquisition processing to change the amplitudes of reflected waves. This process is important because the SIR 3000 software actually records amplitudes in the field at a scale two-thirds larger than the user set gains. Recorded amplitudes are much smaller than they appear in the field, making it difficult to visually interpret the raw profiles. Data can be regained to increase the amplitude of waveforms adding a new gain curve and applying it to all of the profiles (Figure 4.7).

![Raw Data vs. Gains Applied to Data](image)

**Figure 4.7:** The raw data is difficult to interpret because it the amplitudes are all very small, by changing the gain curve data reflections are stronger.

Removing background noise also makes profiles easier to interpret visually.

Background noise is defined as other electromagnetic energy recorded that is within the frequency range of the antenna (Conyers 2004a:71-72). Because GPR antennas use
electromagnetic energy frequencies similar to those used for television, FM radio, cell phones, and other communication devices these device signals may be received by the antenna as well. This noise can occasionally be filtered out using frequency filtering (see below) if the frequency of the noise is known.

The horizontal banding caused by the “ringing” of the antenna and the noise within electronic components of the system and antenna is recorded in most profiles and called “system noise” (Conyers 2004a:123). This noise is present in most GPR profiles in the form of horizontal bands that often obscure reflections of interest. To remove these horizontal bands, an arithmetic process is used that sums all of the amplitudes of reflections collected within 200 contiguous traces and divides by the number of traces added. The result is a composite of all reflections that occurred within all places in the time window and are common to all of the traces (within the 200 contiguous traces). This composite is subtracted from the data set to display only non-horizontal reflections (Conyers 2004a:124-125). The resulting data contains minimal horizontal banding that crosses the entire reflection profile and therefore you can see features more clearly (Figure 4.8).
Figure 4.8: After the gains were changed the background noise was removed to make profile reflections look more clear.

Coupling problems are caused by loss of surface contact between the antenna and the ground, surface material changes, and antenna tilt as it is moved along the ground. These variations in the way radar energy is transmitted and reflected in the ground often make the profiles look unclear and can produce confusing discontinuous high amplitude reflections when viewed in profile. When surface contact is lost, these changes are produced along the contact between the antenna and the ground surface, where there might be a gap and therefore varying amounts of free space. Transmitted energy would then potentially travel some distance in the air (not directly coupling with the ground), reflect directly back to the receiving antenna from the ground surface therefore leaving little energy to penetrate into the ground (Conyers 2004a:28). If the surface material
changes, the amount of energy that travels through that material will also change. Because different materials transmit energy in varying amounts, surface material changes create changes in the amplitudes of reflected energy below them. Depth of energy penetration might also change when that energy moves through different surface materials (Conyers 2004a:69). Also, when the antenna tilts slightly as it is moved over small bumps on the ground surface, transmitted waves are briefly sent out at different angles. Those varying wave paths, and resulting returning reflections produce discontinuous amplitudes in a few traces along a transect directly adjacent to each other. All of these changes in a reflection profile (generally produced by coupling differences) cause profiles to be difficult to interpret.

To remove these discontinuities a process called horizontal smoothing or boxcar filtering was used. This uses trace averaging algorithms to smooth out the data. In this process a given number of adjacent reflection traces is averaged and then replaced by a composite trace, eliminating abrupt changes in amplitudes caused by coupling problems (Figure 4.9). Smoother data is easier to visually interpret as profiles and it also produces clearer amplitude slice maps when the processed profiles are visualized in that method.
Migration is a two dimensional mathematical computation used to eliminate hyperbolas generated from point sources in the ground (Conyers 2004a:128). The process collapses the axes of the hyperbolas back to their source (the apex at the point source). The velocity of the ground, which affects the geometry of the hyperbola axes, is calculated and the reflections that produce the hyperbola axes are then migrated to their correct position. When this is done reflections generated from walls or other small point sources appear as single reflections. When all profiles in a grid are processed this way and then those are used to produce horizontal amplitude maps, the resulting images of narrow or discrete objects in the ground become much more distinct (Figure 4.10).
Figure 4.10: Raw data (above) from the plaza had the background removed, smoothing applied, and migration to make it easier to interpret (below). Migration removed the tails from the hyperbolas.

Frequency filtering is used as an aid to the interpretation certain features known to be between specific frequencies. For example, smaller point reflections, such as walls, are reflected by high frequency radar energy. Vertical or band pass filters remove reflections recorded with specified frequencies (Conyers 2004a:95). This processing technique allowed for the removal of frequencies from profiles. When only the reflections recorded with high frequency are shown it is often possible to see features more clearly within horizontal slice maps (Figure 4.11). This is because higher frequencies have better
resolution of smaller features. Frequency filtering eliminates reflections from slice maps that may not be of interest.

![Background Removed, Horizontal Smoothing, and Migration](image1.png)

![Frequency Filtering (500 to 700 MHz)](image2.png)

**Figure 4.11:** Frequency filtering eliminated all data that did not fall between 500 and 700 MHz. In the bottom profile you can see only reflections that were recorded with frequencies between 500 and 700 MHz.

Profiles can be corrected for the topography of a specific horizon within the subsurface. When radar profiles are collected topographic variation is not visible because they are all collected with the same time window regardless of the visible grade. For instance, the terrace the Bluff Great House was a horizontal feature built during a prehistoric occupation period at the Bluff Great House when it was built and used. Post-occupation depositional processes such as windblown sand and fallen wall debris change the ground surface on top of what was originally a horizontal feature. To produce a map of amplitudes along this surface, which is not parallel to the present ground surface, GPR
Slice was used to draw the terrace horizon on each profile and alter the profiles relative to the terrace horizon (Figure 4.12). After the terrace horizon is corrected for, it appears horizontal and the rest of the profile is adjusted in relation to it. Topography can also be added to an entire profile to adjust for hills or mounds and allow horizontal features within the hill or mound to be mapped horizontally.

![Background Removed](image1)

![Topographic Correction](image2)

**Figure 4.12**: The terrace horizon was corrected for using GPR-Slice in order to see the terrace as a flat surface.

**Bluff Great House Ground-Penetrating Radar Data Collection**

At the Bluff Great House, four GPR grids were collected and positioned to answer research questions about site construction and layout through time (Figure 4.13). All field collection parameters were based on knowledge from previous excavation data, field conditions, and visual analysis of the site. Processing these data from each of these grids
was a complicated process involving customized procedures for each grid. The final interpretation of these grids includes both the interpretation of individual grids and the site as a cultural landscape throughout its habitation. The term cultural landscape refers to the way people created, connected, and reshaped their environment (Anschuetz, et al. 2001; Clark and Scheiber 2008; Jackson 1997; Relph 1976).

Figure 4.13: The four areas surveyed were the terrace, plaza, berm and pithouse site (image modified from Cameron and Geib 2007:343).

**Terrace**

The terrace feature, located adjacent to the northern wall of the great house (Figure 4.13), was constructed late in the Pueblo II and early Pueblo III period (Cameron 2002:345). It is a particularly interesting feature because terraces of this style are fairly
unique in sites that were influenced by Chaco. This architectural feature’s construction was also dated to after the abandonment of Chaco Canyon by previous excavations, making it particularly interesting because elsewhere new construction on Chacoan sites was thought to have ended after the central Canyon polity was abandoned. Therefore, the architectural styles and construction techniques used on this terrace and their similarities to Chacoan sites may help answer questions about how invested in Chacoan ideas the residents of Bluff were after the abandonment of Chaco Canyon.

This feature was excavated in 2004 when the University of Colorado Field School dug a backhoe trench intersecting the feature and put two small test units on top of it. These excavations determined the extent, the stratigraphy, and the approximate date of the feature’s construction. The GPR slice maps from the terrace helps to further define its extent and stratigraphy in a more comprehensive fashion. Rather than looking at just the trench profile, GPR horizontal slice maps allows for a more complete view of the entire terraces stratigraphy. Particularly when the slice maps are compared to excavation data, a robust picture of the entire terrace in time and space can be produced.

In the field I established a 52 x 14 meter grid to cover the terrace feature and excavation units (Figure 4.14). The radar profiles were collected in the y-direction (each 14 meters long) in order to parallel the backhoe trench. Because of this the two data sets could be directly compared. There was a steep drop on northern edge of the terrace and the edge of this drop marks the extent of the terrace. The GPR grid could not extend off the terrace to the north due to this drop. In all other directions, the grid covered the entire terrace, in order to see the entirety of the feature.
Figure 4.14: The terrace is located directly to the north of the great house.

After the data were collected in the field, I adjusted the amplitude gains, removed the background noise, applied horizontal smoothing, applied a 3x3 low pass filter, and corrected the profiles for the terrace horizon. The 3x3 low pass filter averages the horizontal time slice by substituting every three traces with a boxcar filter of those traces. Then the space between the data profiles was interpolated and horizontal amplitude slice maps were produced for the terrace (Figure 4.15). The high amplitude plaza surface showed up very clearly within the horizon slice maps. Also, a segment of prehistoric road that was unintentionally part of the grid shows up as an extremely high amplitude reflection. This indicates that the terrace was an intentionally compacted surface.
The plaza feature is located in the center of the Bluff Great House (Figure 4.16), and was most likely constructed at the same time as the great house. Plazas are a common area for community organization in modern pueblos and also probably during prehistory, making this a central gathering place at the great house. The University of Colorado had an excavation unit in the plaza where they uncovered part of an early pithouse dated to A.D. 500-700 or the Basketmaker III period (Cameron 2009d:127). The plaza is an interesting feature to map using GPR because, like the terrace, it is an extensive surface that does not lend itself to complete excavation. Ground-penetrating radar data interpretations helped to define the plazas composition and construction. For example,
many plazas are built up from the ground surface and artificially leveled. This GPR survey attempted to determine how the terrace was built and if there were any architectural features either on or below the plaza.

![Figure 4.16: The plaza is located south of the great house.](image)

In the field, I established a 24 x 18 meter grid over the plaza. Unfortunately a modern road intersects the plaza area, thereby decreasing the area available for survey. The GPR profiles were collected in x-direction (24 meters long). To process these data, I removed the background, applied horizontal smoothing, migration, and frequency filtering. The processing of the data made images that were clear, making it possible to see a pithouse and room block structure underneath the plaza (Figure 4.17). These earlier
structures were abandoned and covered over to form the plaza during the habitation of the great house.

Figure 4.17: Slice maps of the plaza were produced using processed data to look at features in plan view.

*Berm*

The Bluff Great House berm is a constructed earthen mound that surrounds the great house. The berm was an architectural feature that appears to have been built specifically to define the perimeter of the great house. This feature may have been a community organization structure that defined the great houses boundaries letting people know when they were inside the structure. Ground-penetrating radar data were collected in order to determine how this berm was constructed, either in a single construction episode or as a gradual and perhaps formal accumulation of trash. Excavation units by the University of Colorado on the berm indicate that it was built out of household refuse and demolition materials (Cameron 2009c:271). The area surveyed was located in the
southeast corner of the site on the section of the berm that was built up the most (Figure 4.18). The grid was 16 x 12 meters in size with profile spacing of 1 meter apart.

![Berm Diagram](image)

**Figure 4.18:** This section of the berm is located to the southeast of the great house, but the berm extends around the entire south section of the structure.

These data were processed minimally. Investigation of the data profiles alone was sufficient to determine the composition of the berm. Because there was no architecture within the berm, a profile view of the berms composition was useful. To make this visual interpretation easier the background noise was removed and smoothing applied to profiles. Basic topographic correction was done in *GPR Slice* to get an idea about the composition of the profiles (Figure 4.19). These profiles indicate the complex nature of
the berms composition, this complexity is probably the result of multiple deposition events over time.

![Figure 4.19: Bluff berm profiles were corrected for topography using topographic estimates of berm height.](image)

*Early Pithouse Site*

To the south of the great kiva, a grid was surveyed that was thought to contain a pithouse dated to an earlier period (Figure 4.20). This grid was intended to help answer questions about habitation at this site over time, as the pit house was thought to be early in age. For example, multiple habitation structures within a longer temporal scale might indicate that the location of the Bluff Great House had a more extensive history than previously thought. This more extensive history could then indicate that the Bluff Great House site was not chosen just as the result of Chacoan influence, but had been a site of habitation for generations. A 29 x 20 meter grid was established in this area.
Figure 4.20: The grid to the southwest of the great house was thought to contain one or more early pithouses.

To process these data, migration, background removal and horizontal smoothing were all utilized. These profiles were then interpolated and sliced to look at horizontal architectural features. The slice maps, when compared to vertical profiles, provide a robust method of investigating architectural features through time. This was a complex grid to interpret because there are number of geologic features, but there were also a number of pithouses in different locations (Figure 4.21). The pithouses are superimposed on each other in a way that suggests long-term habitation with many construction
episodes, contributing to the idea that this location was inhabited long before it became a Chacoan outlier.

Figure 4.21: A slice map from this area shows one of the pithouses.

For this site GPR worked extremely well to investigate the subsurface composition of the highlighted features. Each feature required specific processing and data collection parameters. But, with thoughtful application of processing techniques, all of the data produced interesting and complex maps and profiles for interpretation. Through using the GPR data sets in conjunction with excavation data knowledge about the history of the Bluff Great House has increased.
Chapter 5: Interpretations

The University of Colorado excavations from the Bluff Great House exposed features and artifacts that helped in understanding the great house’s construction and remodeling timeline (Cameron 2009a). Their excavations were concentrated on the Pueblo II architectural features of the Bluff Great House as a way to study the great house and its general surroundings. In the process of doing this, they also uncovered other architectural features, which were commented on, but as they were not helpful in their immediate research concerning the great house, they were not followed up on. Those finds played a role in this thesis, as the GPR data now can be used to project outward from those limited excavations to study larger area of the plaza, thus using this data to answer look at more extensive features such as buildings with no surface expression (Figure 5.1).
Figure 5.1: This site map shows the areas in which I conducted GPR surveys (in red) and the relevant University of Colorado excavations (in tan) (Cameron and Geib 2007).

Excavations, such as those tests done by the University of Colorado at the Bluff Great House, are an excellent method to look at specific site details and allow remains to be dated by materials found in them. This kind of information is only possible through excavations. In excavations detailed understanding of construction techniques, building materials, the contents of middens, and other subtle details can be examined. The excavation work done at the Bluff Great House was able to date specific construction episodes, look at detailed stratigraphic composition of features, and determine construction sequences of architectural features (Cameron 2002, 2009a; Cameron, et al.)
1997; Cameron and Geib 2007). This is important because these excavations were crucial to my understanding of the GPR data, as they allowed direct correlations with all my subsurface information. In addition, those excavations encountered building phases much earlier than the great house, and are one of our only pieces of direct evidence of these earlier inhabitants of Bluff. When that information from the limited excavations was combined with GPR data, the extent of those remains could be determined. That led directly to an understanding of the site’s habitation patterns through time, which was one of the subjects of my research.

This method of combining excavation data with GPR potentially provides more information about archaeological sites than either of the two methods could when used singularly. Ground-penetrating radar maps and profiles allow excavation information to be extended outward over large areas that remain buried. Together the two data types can be used to progress from the known to the unknown. This method is to identity and study excavated features and correlate these to reflection features in the GPR profiles and maps. Individual horizons, fill features, and intrusive features in the subsurface stratigraphy that may not have been visible in the limited excavations can then be identified. Orientations of features, built with cut stone or compacted surfaces, can also be mapped using GPR. In addition, subtle variations in chemical and physical properties of the soils are often visible in GPR data that might indicate cultural features such as compacted living surfaces and post holes, which might be missed in a traditional excavation. While ground-penetrating radar cannot determine the specific information that excavations can, it can map spatially extensive features in a way that is limited by using only standard
excavations. When combined, excavation and GPR data produce a more complete three-
dimensional map of features than could be obtained with any single technique. In this
process GPR maps can be used to produce images of much more extensive areas than just
a few excavations allow for interpretations to be based on the entire breath of the site,
rather than just small excavated areas.

At the Bluff Great House, the effectiveness of the technique of combining GPR
and excavation information is best exemplified by the work done on the site’s north
terrace (Figure 5.1). An excavation trench was located approximately at the midpoint of
the back wall of the great house extending to the north about 19 meters by the University
of Colorado (Cameron and Geib 2007). The placement of this trench was made solely by
positioning it perpendicular to features of interest in the great house (Cameron and Geib
2007). As a result it exposed the terrace surface, but as I will discuss more below, missed
some important cultural features that could be seen adjacent to trench using GPR. In this
case, if the trench had been placed after the GPR had been collected then it would have
been possible to target the trench’s location to learn more about how people were using
the terrace. But this is not standard archaeological practice, and the usual random
trenching often results in excavations that miss potential evidence for pursuing specific
research questions. The combination of GPR methods with excavation, in this case,
would have resulted in the ability to strategically place the trench.

Subsequent to the trenching smaller excavation units on the terrace found other
features, However, many of the other important features that the GPR imaging identified
remain invisible under many centimeters of surface soil. Fortunately, for this thesis
research, the trench and other smaller excavations produced enough information about the Bluff north terrace so I was able to determine that GPR would be a good tool to explore the excavation data more fully. After the GPR data were collected and processed, a number of new features were found that no one had considered for the terrace including the road and some very subtle structures that were only visible through using certain GPR processing techniques. This process of integrating the GPR reflection profiles with information from nearby and adjoining excavations yielded a much more inclusive map of important buried features, many of which could not be known using any other method.

**The Plaza**

The feature referred to as the Bluff Great House plaza was located to the south of the great house’s room block and was visible from both the great kiva and the room block (Figure 5.1). Its surface was a compacted and smoothed, built on the natural river terrace sediments and in some cases directly over top of some previously inhabited dwellings. The exact time of the plaza construction is unknown, but it was likely constructed at the same time as the great house, around the middle of the Pueblo II period. It can be readily identified today, because the partially buried surface sheds water, precluding penetration and therefore vegetation is much sparser on the plaza than the surrounding area (Figure 5.2). This area was a natural choice for GPR exploration because its broad, open, and flat surface lent itself to data collection. Also, the presence of pre-plaza architectural features discovered by the University of Colorado excavations indicated that there was the possibility to discover additional previously unknown cultural features below. The plaza surface itself is difficult to examine using traditional excavations, as these excavations
can expose only small parts of this broad area. The GPR images produced from data collected in this area was useful in examining the site’s pre-Pueblo II habitation as well as construction and modification of the plaza itself, both of which I will discuss below.

![Image of a plaza]

**Figure 5.2:** The Bluff Great House Plaza was an artificially created surface, causing less water to penetrate into the soils and this results in less vegetation on the plaza than elsewhere on the terrace.

Prehistorically, plazas were probable gathering places at many of the significant Chacoan great houses. In some of the larger structures plazas were open spaces within the great house enclosure itself (Lekson 1984, 2006a, 2007). Plazas with a similar architectural composition, were also used by later Pueblo groups as a location for important for rituals and ceremonies, which has been documented by historic and ethnographic records (Hegmon 1989:10). Historically and ethnographically, not only were plazas ritual community centers, but also loci of daily activities. For instance, people gathered in plazas to participate in daily tasks such the cleaning of clothes and dishes, food preparation, and craft production. However, because of the large amount of cultural change that took place since Chaco time, it may be unwise to directly compare known historic and ethnographic uses of plazas to those that were used 800 years ago.
Although changing usage of these architectural features must be considered, architectural similarities between prehistoric and more recent plazas suggest that there are likely at least general similarities in their use over time. In a general sense, therefore, I will attempt to place interpretations about the Bluff Plaza’s prehistoric use within context using historic, and ethnographic studies.

There are substantial architectural similarities between plazas over centuries, including the way they were built and designed. Most were centrally located, had compacted, and often artificially leveled surfaces. The architectural similarities between prehistoric and recent plazas are notable and allow some analogies to be made about their use. For example, in the historic and ethnographic periods, evidence from both the plazas’ central locations within the pueblos, and accounts of activities suggests that plazas were gathering places (Hegmon 1989:10). Because prehistoric plazas were also centrally located and had similar construction features, it seems likely that this general use can be inferred. While studying the Bluff Great House plaza, these historic and ethnographic uses are considered along with archaeological evidence to examine the plaza as a community gathering location.

Around A.D. 1000 formal enclosed plazas began to appear at Chaco Canyon (Lekson 2007:31). Prior to that time, smaller sites throughout the San Juan Basin often had areas that were analogous to plaza surfaces, but they were not a formalized great house element. These plazas, built around A.D. 1000, were bounded by room blocks, leveled, and often surfaced. Even though plazas were common, not all great houses had enclosed plazas, for instance Kin Kletso and Wijiji at Chaco Canyon did not (Figure 5.3).
However, the plaza at Bluff is similar to the standardized Chacoan plaza as defined by Lekson (2007:31). That standardized model for a plaza consists of an enclosing berm at Bluff, instead of a wall as used at other sites in Chaco Canyon. While the berm at Bluff appears to take the place of a bounding wall of the plaza, it is otherwise directly analogous to a “typical” enclosed Chacoan plaza.

Figure 5.3: Many great houses at Chaco Canyon have plaza areas within their walls or in front of them (image modified from Lekson 1984:3).

During the University of Colorado excavations, an excavation unit was opened up in the plaza area (Figure 5.1) (Cameron 2009d:127). Below the plaza surface the excavators encountered a stone alignment of unknown function, a potential use surface, and a possible pithouse wall. It was hypothesized that what was described as a use surface may actually have been adobe wash from an eroded wall. Most significantly,
north of the linear stone alignment, excavators uncovered a pithouse wall. Associated ceramics suggest that this pithouse was used during the Basketmaker III or Pueblo I periods, time periods which I outlined in the background chapter (Cameron 2009d:127). From this information alone, it appears that this structure was inhabited before the great house was constructed. A 2.7 meter long segment of the pithouse wall was ultimately exposed and it was found that this dwelling burned prior to its abandonment. Evidence for this are pieces of burned daub and oxidized sandstone is in the middle of what would have been the pit house depression. Nothing more is known about this feature from the excavation observations. It was determined that this feature was not associated with the great house and because the research at that time was focused on the great house only, little more was done with this excavation. As I will discuss more below, the GPR survey produced a number of important images and maps of this and other associated architectural features that build on this limited information to show exciting and previously unknown aspects of the Bluff occupations, long prior to its focus as a Chaco great house.

Sometime after the pit house described above was abandoned, the Bluff Great House room block and plaza, constructed between A.D. 1075 and 1150, were built on a leveled surface, prepared for their construction (Cameron 2009d:104). The floors of the excavated lower story rooms of the great house were all within a few centimeters of each other in elevation, suggesting that the uneven river terrace, which is the natural ground surface in this area, was very accurately leveled to create this horizontal building surface. This type of leveling is not uncommon in Chaco construction and archaeologists have
found similar evidence of leveling at a number of sites at Chaco Canyon proper (Lekson 1984, 2006a, 2007). For instance, the large great house, Chetro Ketl, was built on such a remarkably prepared and elevated surface that today visitors have to climb up 1.75 meters off the flood plain to stand on to the plaza (Figure 5.4) (Lekson, et al. 2007:159). Also, it is likely that underneath the plaza at Pueblo Bonito are several early pit structures (similar to the Bluff example discussed above) that were intentionally covered in later building stages to form a prepared plaza surface (Lekson 1984:127). Other great houses, including Kin Kletso, Peñasco Blanco, and many more, had the existing terrain modified prior to construction (Lekson 1984), by either removing or adding dirt. Often during this process previous building features were altered and earlier architecture was filled and covered to provide the foundation for later construction. This suggests that the modification of the Bluff Great House followed a similar pattern to these sites at Chaco Canyon. It further suggests that one might expect to see some similar preparation of the Bluff plaza surface, which would suggest an even greater connection between the Bluff Great House and Chaco Canyon. As I will discuss below, this is exactly what was found in the GPR analysis of the plaza. This evidence shows that Bluff shared values about site construction and its plaza mimicked those at Chaco Canyon.
Figure 5.4: The Chetro Ketl Plaza was built up 1.75 meters above the canyon’s natural floor, thus demonstrating that the plaza surface was elaborately prepared (image from Lekson, et al. 2007:161).

The GPR survey of the plaza included the University of Colorado excavation unit and a large unexplored section of the plaza. Unfortunately, much of the plaza to the southeast was destroyed by the construction of the modern road (Figure 5.1). The GPR survey did however cover much of the pithouse discovered by the University of Colorado, another earlier pithouse next to the pithouse, and the remains of a pre-plaza rectangular room block (Figure 5.5). The linear stone alignments and the surface feature mentioned in the excavation report are not specifically visible as extensive features in the radar slice maps, suggesting that they may have been spatially limited deposits. The linear alignment uncovered in the University of Colorado excavation was not visible in the GPR reflection profiles either (Figure 5.5), but small features, such as these, could easily be overlooked as there are many other point source reflections visible in profiles from debris other than the wall. It appears that the compacted surface (the possible adobe
melt) seen in the excavation unit was not visible in the reflection profiles from the plaza, causing me to hypothesize that this unit was probably part of the adobe melt around the edges of the pithouse. The GPR data did map the plaza surface, two pithouses, and a room block.

Figure 5.5: The pithouse and room block are related to each other within the plaza of the great house. This image shows the two architectural features and the excavation unit from the plaza excavations.

Underneath the plaza surface, the extent of the partially excavated pithouse was mapped along with an associated room block to its northwest (Figure 5.5). These two architectural features, which are likely pre-Pueblo II in age, were the most visible
structures seen in the plaza grid. The plaza surface itself was visible in profile as a shallow horizontal surface, which I will describe in more detail below.

The pithouse and room block’s location seem to suggest that these features were associated with each other, as they are both at about the same depth below the plaza surface and very close to each other. It is likely that these two structures together made up a Pueblo I habitation because they form a typical Prudden unit (Kantner 2004a:70; Prudden 1918), which was common in that period. In this typical household a pithouse is directly associated with an above ground room block. Throughout the American Southwest, during the Pueblo I period people often lived in pithouses in front of small rectangular room blocks (Sebastian 1992:27). Together these structures likely housed a family or extended family group.

The other pithouse located stratigraphically lower than the Prudden unit is older and larger (Figure 5.6). It is likely dated to the Basketmaker III period, because it does not have an associated room block and is older than the other Pueblo I pithouse. Little is known about this pithouse, because it has never been excavated, but it does provide more evidence of early site habitation even before the Pueblo I period. This Basketmaker III occupation of the river terrace was extensive and not limited to the later plaza area. The area’s early sites and inhabitants will be discussed more in the next section of this chapter.
In order to understand the nature of the long-term occupation of Bluff prior to the great house’s construction in Pueblo II time, these pre-plaza sites need to be placed within the cultural landscape of the area. The most important and extensive nearby Pueblo I village was located about 700 meters to the east of the Bluff Great House area, in a much more protected location nearer the floodplain and below this high bluff on which the great house was later built (Conyers and Cameron 1998). The people living at this site must have been interacting with the people that lived on the river terrace frequently. While the nature of that proposed interaction is not known from the GPR analysis alone, the presence of a separate Pueblo I site within view of a large, densely populated village just down slope to the east suggests that the occupants of the two sites while aware of each other were intentionally separated.

The inhabitants of the smaller Pueblo I site on the hill appear to have made a deliberate decision not to live in the lower village, but instead to locate themselves just outside of it on a prominent landscape feature, perhaps with other nearby, and still
hypothetical Pueblo I habitations (Lekson, personal communication, 2009). This prominent location for the small household found by GPR in the plaza may have been a reflection of Pueblo cultural values of those inhabitants where visual prominence was more important than residing with the other people in the area. This is an interesting segregation of people at this time, and suggests that the people living on the river terrace were asserting both their independence and their commitment to visual prominence.

This common pattern in the region, of smaller sites surrounding a community core, has been seen often at other Chacoan outliers and each grouping of can be defined as a community (Kantner and Kintigh 2006:157). It is likely that the large Pueblo I site just below the Bluff site near the floodplain was the community gathering place for many of the smaller Pueblo I sites nearby (including the small household discovered with GPR). In this way perhaps the cultural landscape was not so much different than later in time, after Chaco influence had become preeminent. During Pueblo II time when the Bluff Great House on the hill acted as the community structure and gathering place for people that lived in smaller sites, the lower settlement appears to have been abandoned. These two periods, the Pueblo I and Pueblo II, may have been both using similar community structures in the same general area, first below the river terrace and then on top of it.

The GPR maps and profiles, along with the excavation data show that the pithouse and room block were abandoned and then burned prior to building the plaza in Pueblo II time. This burning was probably as part of a termination ritual, common during important transitions in cultures. During this ritual the visible pithouse and room block
stones were probably recycled and used in the construction of the great house. After the pithouse destruction there would have been a circular depression in the ground (a common occurrence in this area of the Southwest) and perhaps a small rubble pile from the room block’s superstructure. When great house construction began around A.D. 1075 this depression and rubble pile would have probably still been visible. The GPR profiles show a level plaza surface on top of the pithouse indicating that the surface depression was filled and leveled to create the flat plaza, much in the same manner that the plazas in Chaco were built (Figure 5.7). In GPR profiles there is a uniform, horizontal reflection along the base of the plaza surface, where the leveling occurred across the plaza (Figure 5.8).

Figure 5.7: The plaza surface is present above the pithouse and room block. This profile is located at about 12 meters in the slice map (Figure 5.5).
Figure 5.8: The plaza surface is visible on this profile, which does not have any architectural features below the plaza. This profile is located along the northern side of the slice map (Figure 5.5).

The Bluff Great House plaza had a complex timeline. The archaeological record for the plaza started in the Basketmaker III and Pueblo I periods with a pithouse and then the Pueblo I pithouse and room block. The people living in these habitation structures were part of a larger community within the immediate area. At this time people were locating some structures in prominent places, in a way that is commonly associated with Pueblo II great houses, but actually became common in the Basketmaker III period (Van Dyke 2007:67). Even if the community structure was not located quite as prominently, the people who built on the prominent river terrace were using the higher location for a reason. After the habitation structures were abandoned, much later the great house plaza was constructed. The builders of the great house removed all surface signs of the earlier structures, leveling the plaza in a way that referenced the plazas at Chaco Canyon. This plaza was a central gathering place for community and its compacted surface was probably used for a variety of activities from ceremonies to everyday chores. Together
these features provide evidence about the way people lived and how this specific areas
use transitioned from the Pueblo I and Pueblo II occupations of the site.

The Early Pithouse Site

The Bluff Great House is postulated to have had intermittent occupation
beginning in the Basketmaker III period, if not earlier (Cameron 2009d:104). Pottery
sherds and structural remains from the bottommost levels of most excavation units
provide evidence that the area had pre-Pueblo II earlier inhabitants. Furthermore, there
was a Pueblo I pithouse, a room block and a Basketmaker III pithouse below the plaza of
the great house (Figures 5.5 and 5.6), is evidence of these earlier occupations.

A backhoe trench excavated by the University of Colorado (Cameron 2009d:104),
southwest of the great kiva, was meant to investigate the area’s natural stratigraphy.
Instead, this trench accidentally located a pithouse, dated either to the Basketmaker III or
Pueblo I periods (Figure 5.9). No additional archaeological work was done in this trench.
Evidence from all these tests around the great house indicate that perhaps early structures
were much more common on the river terrace than previously thought. These excavation
results and the structures I found in GPR surveys support this hypothesis that the great
house was built in an area that had been already intensively occupied, perhaps for
centuries. While little is known about these early features or their occupants, their
presence is important to a study of the Bluff Great House history and how this area was
used through time.
Figure 5.9: The early pithouse site surveyed was located to the southwest of the Pueblo II great house (image modified from Cameron and Geib 2007:343).

I collected a grid of GPR data in the approximate area of the backhoe trench to the southwest of the great kiva, labeled on the map “Pithouse Site” (Figure 5.9). The goal of this GPR survey was to determine the extent of that previously encountered pithouse and look for any additional or related cultural features nearby. In the GPR amplitude slice maps, two pithouses are visible (Figure 5.10), which appear to have been occupied during different time periods in the same general area as the backhoe trench. The GPR reflection profiles over these features show that one was built on top of and overlapped the other (Figures 5.10 and 5.11). Both are about six meters in diameter and there are no
other structures nearby. Because these pithouses have no associated room blocks, which is more characteristic of the Pueblo I period Prudden units (Kantner 2004a:70; Prudden 1918), it is hypothesized that they date to the Basketmaker III period. Absolute dating is impossible, as no artifacts were uncovered from the trench. Even if the exact dates of the construction of these houses are still unknown, their presence yields additional evidence of the earlier precursors to the more substantial building that occurred with the construction of the Bluff Great House.

Figure 5.10: The two pithouses (outlined by white circles) were each constructed and occupied during different periods, therefore located at different depths. The shallower house was built partially on top of the earlier structure.
Figure 5.11: This profile of the pithouses has wall reflections from both pithouses.

There was no documentation as to the location of the backhoe trench and I consequently had to rely on the memory of one of the excavators when I was setting up the GPR survey (Mark Bond, personal communication, 2008). Therefore, it is possible that the GPR survey missed that pithouse completely. There is no evidence in the amplitude slice maps (Figure 5.10) of a trench or any damage done to either pithouse by the backhoe, suggesting that these two are in addition to the one encountered by the University of Colorado. One possibility is that in this small area southwest of the great kiva were at least 3 pit houses that date to Basketmaker III period.

When all the pithouses from the GPR surveys and the excavations are accounted for there appears to be at least five that probably date to Basketmaker III or Pueblo I periods, just to the southwest of the great house. Two are located underneath the plaza, two, and possible a third are southwest of the great kiva (Figure 5.10). There are also likely a number of others in this general area, which was not mapped by GPR. In fact, Steve Lekson mentioned to Larry Conyers that he has surface evidence for a number of
pithouses to the northeast of the great house, but this idea has not been tested (personal communication to Larry Conyers from Steve Lekson, 1995). All this evidence seems to show that in a small area of the high river terrace contains a high density of dwellings, which were inhabited long before the great house was constructed.

The hypothesized dense habitation, during the Pueblo I and Basketmaker III periods, and the long period the Bluff river terrace was occupied, prior to the Pueblo II great house construction, suggest that this area may have been the location of some sort of community grouping. Its organization may have been similar to other Basketmaker III or Pueblo I villages that have been excavated elsewhere in the San Juan Basin (Kantner 2004a:59) where several dozen pithouses have been documented. This has implications that there were organized groups of people living in aggregated villages in this general area in the Basketmaker III, Pueblo I, Pueblo II, and Pueblo III periods.

The GPR reflection profiles show that one pithouse in this grid was occupied and then abandoned, and then a later pithouse was built almost directly on it (Figure 5.12). The people who built and lived in the younger pithouse were no doubt aware of the previous inhabitants and may have been the same people or their descendants. There was probably at least a surface depression or some remains from the earlier pithouse when construction began. Even if there was no surface evidence, the construction of the second pithouse would have intersected the first and been visible at that time. Research done elsewhere on Basketmaker III and Pueblo I pithouses suggests that people lived in these types of structures for only about thirty to fifty years before they abandoned them and were building a new home nearby (Kantner 2004a:70). It is now apparent that this
common tradition continued, following the same pattern at Bluff. Whatever the timing and affiliation of these people, the two pithouses, built so close to each other, and the density of other similar features in this area are good evidence that this general area was popular for a long period of time.

**Figure 5.12: The higher pithouse overlaps the lower pithouse.**

Long-term occupation of the high river terrace at Bluff throughout time is not surprising considering its prominent position on the landscape. Sites throughout the San Juan Basin used prominent locations of this sort long before the Pueblo II great houses were built at these visually important elevated locations (Van Dyke 2007:67). The views from these elevated areas and there visibility to those looking from below toward the high ground appear to have been important to this location’s inhabitants. A building’s location made a statement to both the site’s inhabitants and other people living in the area (Lewis 2003; Relph 1976; Sventzell 1997). Locating a structure on the Bluff river terrace would have made a constant visual statement to the residents of the nearby region, as it was easily visible from a distance. Also, the people who lived on this elevated river terrace
could easily see their neighbors and therefore were constantly able to see their community.

The Bluff river terrace was not the most convenient location to live, as it was located far above the most desirable agricultural area to the south. But, that location’s visibility and the statement that visibility made would have compensated for this minor inconvenience. Visual prominence of habitation structures, a trait often associated with great houses, appears to have been a long-term cultural phenomenon.

This type of long-term occupation seen at Bluff is also unsurprising on a site such as this, because the people who occupied the area, presumably for centuries, must have created a social memory (Van Dyke 2007:93), which would have still been in place when the great house was built. At that time of its construction the Pueblo II builders would have known (or been part of) that previous history and by locating their structure here they would have been referencing and acknowledging their heritage and this collective memory (Van Dyke 2007:93). Even if the Pueblo II builders were not the direct descendents of the earlier inhabitants, they were at least culturally related and would therefore have been familiar with the archaeological footprint of their ancestors.

The people building Pueblo II great houses derived their cultural background from people the living before them in the San Juan Basin. This type of cultural memory and continuance is particularly visible archaeologically in architectural elements. For instance, the earlier period’s everyday pithouses were transformed into what we now call “kivas” during Pueblo II time, hundreds of years later (Lekson 1988). This is evidence that the same culture that developed the pithouse living quarters, simply refined and
modified that semi-subterranean form into the more ceremonial kiva. In this area both the location on the river terrace site and the architectural styles show this cultural conservatism and continuity over centuries.

This concept of place and cultural continuity over generations is demonstrated at Bluff. The cultural identities of the people living in this area during the Basketmaker III and Pueblo I periods undoubtedly influenced people in the Pueblo II period either directly through oral histories or indirectly through established ways of living (Relph 1976:3). The people that lived on the Bluff river terrace prior to the construction of the Chacoan era great house must have played a role in creating the culture where people constructed great houses (Pauketat 2007). Culture is constantly created and modified by everyday living situations the future is always shaped by actions in the present (Pauketat 2001). In this way, the actions and habits of the earlier groups constantly modified and created their own culture, which influenced the culture of the Pueblo II people (Anschuetz, et al. 2001; Low 2000:161). In general, the Pueblo II people, including those who built the Bluff Great House and the great houses at Chaco Canyon, were influenced by their history, part of which was created at sites like the Bluff river terrace. By studying these earlier groups an understanding can be gained as to how the later groups living patterns developed and were perpetuated through time.

Hundreds of years before people built the Bluff Great House on the river terrace, their ancestors had built similar (but smaller structures) in the same area. These people selected the river terrace for its prominent location and visibility. The people living in later time periods were aware of the earlier people who lived on the river terrace and, in
fact, seeing ancestral site features may have made the area more desirable. The history of
the river terrace potentially explains why it later became the location for the building of
the Pueblo II period great house, as there was also a social memory that set the stage for
the later construction.

**Earthen Architecture: The Berm and Terrace**

Features such as, roads, berms, mounds, and terraces are common cultural
features in the San Juan Basin during the Pueblo II period (Cameron 2002). There is a
greater concentration of these types of features at Chaco Canyon than in any other area of
the region (Lekson 2006a) but many sites in the region had one or all of these features.
Even though they were more prevalent and perhaps larger at Chaco these types of
features appear to have been important earthen architecture associated with many great
houses.

Archaeologists consider roads, berms, mounds, and terraces to have been part of
the ritual landscape during the Pueblo II period (Cameron 2002; Stein and Lekson 2001;
Toll 2001). These features appear to have been used to delineate ritual space and may
have provided platforms for conducting these activities. In archaeological research done
in Chaco Canyon around the end of the nineteenth century and the beginning of the
twentieth, many mounds were thought to be nothing more than trash piles (Judd 1964).
Reexamination of earlier excavation data and more recent excavations seem to show that
the mounds had walls and stairs (Lekson 1984:75; Stein, et al. 2007:Plate 8.10; Stein, et
al. 2003:39). More recent re-examination of some of these Chaco mounds suggests that
they were likely constructed for ceremonial events. For instance, the Pueblo Bonito
mounds, long considered trash mounds, contain bounding walls and capping surfaces (Lekson 2006a). This is strong evidence that these features were built for a distinct purpose, before later on being used as trash refuse areas. It has even been suggested that some mounds were built during certain special ceremonial events (Toll 2001).

In contrast, Wills (2001) argues that, although the earthen mounds may have been used for ceremonies, they were not built specifically for ceremonies and are just made up of complicated layers of trash. Wills points out that these layers, which others believed to have been “ritual depositions”, are not laterally extensive, which one would expect to find in a mound that was built by large community ceremonies. Rather, the trash deposits are more jumbled, which he suggests is more consistent with the random dumping of trash. Still, no matter how these features were built they were large structures at great houses and were architecturally important enough to be shaped and common forms were used throughout the region. People across the San Juan Basin, in the Pueblo II period, constructed features out of the earth and were apparently using them for ceremonies and rituals.

Mounds were probably first constructed in the San Juan Basin during the Pueblo I period (A.D. 700-900) and material evidence from them suggests that they may have had some ritual importance even early on (Cameron 2002). It is common to find burials in these early mounds, suggesting that they were perhaps part of some sort of mortuary ritual. By the Pueblo II period, if not earlier, formal earthen architecture was part of the ritual landscape throughout the Chacoan region (Cameron 2009c:266). Features made out of earth are seen commonly at sites within Chaco Canyon proper and throughout the San
Juan Basin. Outlier sites, such as the Bluff Great House, often had associated road fragments, mounds, and berms (Jalbert and Cameron 2000), all of which were earthen features similar to those described elsewhere during this time. Earthen architecture, however, is not as common in the Northern San Juan region, as other parts of the Chacoan world (Cameron 2009c:269). Perhaps in this part of the Southwest agricultural disturbance, lack of archaeological visibility, and a limited sample size may have lessened the appearance of these features today. Or perhaps they were constructed out of different materials to the north of Chaco, which were more easily eroded. Obviously these features still do exist at some sites in this region, because at the Bluff Great House, there is both a berm, common to great house sites throughout the San Juan Basin, and a terrace, which is a less common feature, described only at Chaco Canyon and a few other sites (Cameron 2002, 2009c; Cameron and Geib 2007).

The Berm

At the Bluff Great House an earthen berm seems to form a boundary around the site’s plaza with breaks in it for the prehistoric road, which is a common way berms were thought to have been used (Figure 5.13) (Cameron 2009c:266). Similar berms are recorded at the Newcomb Great House and the Navajo Springs site, to the south and west of Chaco Canyon respectively (Cameron 2009c:267). There berms both encircled the great houses and have breaks in them for roads, much like the Bluff Great House berm. The Hinkson site berm is also similar to Bluff in that it was constructed after the abandonment of Chaco Canyon (Cameron 2009c:267). Below I will outline evidence that suggests that the Bluff berm construction continued or started after the abandonment of
Chaco as well. Berm features apparently were a way that people living in these outlier communities organized their site’s boundaries and defined their plaza areas much in the same way that the front walls of Chaco Canyon’s great houses enclosed the plaza.

Figure 5.13: The Bluff Great House berm formed a conceptual boundary around the sites plaza with breaks in it for prehistoric roads (image modified from Cameron and Geib 2007:343).

The University of Colorado excavated three units on the Bluff Great House berm including a long trench on the southeastern portion of berm and nearby a 1x1 meter unit (Figure 5.13). Also, a 1x1 meter unit was placed on the western berm. The unit on the western berm contained ceramics dating from the middle to late Pueblo II period (A.D. 1075-1150) and other materials dating from this period (Cameron 2009c:283). On the
southeastern berm, the excavated trench stratigraphy was enormously complicated, as it was composed of many different overlapping layers (Cameron 2009c:285-286). Materials found within this part of berm ranged from household refuse to building materials and their complex stratigraphic layers suggests they may be the product of dumping in basket loads. The other excavation on the southeastern berm was also stratigraphically complex in a similar way. Judging by these excavations, the berm appears to be generally composed of trash and building materials that were haphazardly deposited, and the ceramic ages suggest they were added to and modified throughout both the Chaco and Post-Chaco eras.

Using excavation data, Cameron (2009c:295) hypothesized that the Bluff Great House berms were not constructed as formally as those at Chaco. Instead, they suggest that the Bluff berm was built more haphazardly, perhaps through dumping basket loads of trash and building materials. They also hypothesize that the Bluff berm is more comparable to berms at outliers, which also circle the front of sites with breaks in them for incoming roads. The only differences between the other outliers’ berms and the Bluff is that at Bluff the berm was taller and was not built from sterile soil. The others appear to have been built from sterile soils and were not as high (Cameron 2009c:266-269). None the less, the Bluff berm still surrounded the important plaza space in front of the great house in a similar way to other berms elsewhere.

It also appears that the Bluff berm serve the same purpose as the front walls of the larger Chaco Canyon great houses, where they prominently defined the inside of the great house area and limited its access visually. The Bluff berm perhaps served more as a
symbolic barrier and less a visual impediment. It did, however, still let people know whether they were inside or outside of the great house grounds, which included the plaza and great house.

Ground-penetrating radar results from the berm largely support the findings of Cameron and Geib (2009c). The 13 berm profiles, once corrected for topography, show complex stratigraphic layers (Figure 5.14), consistent with the dumping of multiple baskets of fill with different consistencies, much as described in the excavation trench. As all of my GPR profiles seem to confirm the results of the University of Colorado, I concur that the whole of the berm was composed of multiple layers of trash and circled the great house much in the way that has been discussed in previous publications concerning it (Cameron 2002, 2009c; Cameron and Geib 2007).

**Figure 5.14: The berm is made up of overlapping layers of deposited materials.**

*The Terrace*

Cameron and Geib define terraces as a modified landscape feature that creates a flat surface where normally the ground would slope (Cameron 2009c:270). For the
purposes of this thesis, I would like to extend that definition saying a terrace is also a feature attached to the great house and was leveled as a space for activities, but not necessarily as a foundation. This is different from a plaza because the terrace is built in addition to the plaza, another separate level feature. Using this definition, terraces were flat places used for ceremonial and daily activities, much like plazas, but they are artificially leveled and can also contain complex architecture.

The Bluff Great House terrace has very few architectural analogies around the Chacoan region. Features built to create level foundation for further building and to raise great houses above the natural plain are often called terraces (Cameron 2009c:270). Chetro Ketl, the second largest great house in Chaco Canyon, has a raised foundation underneath the great house (Lekson, et al. 2007). Pueblo Alto, on Chaco Canyon’s northern rim, an elevated foundation underneath it consisting of low retaining walls filled with sand (Cameron 2009c:270). The Aztec Ruins Great House, to the north of Chaco, has a possible terrace directly in front of its enclosing wall. However, none of these features really resemble the terrace at the Bluff Great House, which does not appear to be built as a foundation of any kind. I am not sure the Bluff Great House terrace can really be compared to these foundation features.

The Tsin Kletzin Great House, on Chaco Canyon’s southern side (Figure 5.15), has a terrace feature that is very similar to that at the Bluff Great House. Its’ terrace is located against the northern (back) wall just as at Bluff (Figure 5.16). The Tsin Kletzin terrace is bounded by stones and filled with dirt to elevate it above the natural ground surface (Figure 5.17). Although this great house has never been formally excavated,
according to its masonry styles, it is thought to date to the early twelfth century (Lekson 1984:238), about the same period as the estimated construction of the Bluff terrace (which was built between A.D. 1075 and 1150).

Figure 5.15: Tsin Kletzin (circled in red) is located on the southern side of Chaco Canyon (image from Lekson 1984:2).

Figure 5.16: The Tsin Kletzin Great House (left) and the Bluff Great House (right) have very similar layouts (Tsin Kletzin drawing from Lekson 1984:232).
Figure 5.17: The Tsin Kletzin terrace is located to the north of the great house. This photo was taken on the top of the rubble pile from the back wall looking down to the northeast.

These two great houses, one in the Chaco center and one on the periphery of the Chacoan world both have similar shapes (Figure 5.16). Unfortunately, because the Tsin Kletzin terrace has never been studied in detail, its stratigraphy and any potential uses that it was put to are unknown. Because these two terraces at both Bluff and Tsin Kletzin are so similar architecturally, both probably had similar uses and it is possible that the results of the GPR work can help understand functions of these features in general.

The University of Colorado had three excavation units on the terrace feature at the Bluff Great House. The most extensive, was a mechanically excavated trench bisecting the entire feature and the other two units were 1x1 meter squares on either side of the trench (Figure 5.13). The trench was originally excavated in order to identify the terrace’s
stratigraphy and composition and it found that the terrace was constructed as a level surface. The other two units were intended to look at other potential features on this surface, but unfortunately they were too small to determine anything conclusively. It is important to note that, the Bluff Great House terrace is located from the north wall of the great house room block, extending approximately nineteen meters away from its back wall (Cameron 2009c:270-271). The entire terrace area appears to be about 720 square meters. This area was chosen for GPR survey on this feature in order to map the top of this level surface and determine if there were any structures or other features that had been constructed on it.

Using artifacts and stratigraphic layers visible in the trench north of the great house the University of Colorado excavators were able to outline how the terrace feature was constructed (Cameron 2009c:275). At the bottom of the trench, sterile soils capped the alluvial gravel of the river terrace. The first cultural materials found were from the Basketmaker III period, just like in many of the other excavation units nearby, which supports the idea for early occupation of the river terrace. There were also some Pueblo I and early Pueblo II ceramics on top of the Basketmaker III artifacts (Cameron 2009c:275), again suggesting continuous habitation over time. On top of these artifacts there were some construction materials, presumably discarded from the great house building construction during the middle Pueblo II period. This evidence appears to show that the terrace area was constructed some time after the great house, and was an area of trash deposition during its’ construction. After the great house construction there is evidence of activity along a swept surface directly to the north of the great house. Little is
known about its use during this time, except that there was some ground compaction, suggesting some sort of use. At this time this area was not a formally leveled surface, but it did have activities there that presumably necessitated periodic sweeping to clean the area of loose sediments and soils to the north (Cameron 2009c:278).

At some later date another stratum was added on top of this swept activity surface formally leveling the area behind the great house, enlarging it, and creating the feature referred to the terrace. This construction episode is dated using ceramic chronologies to sometime between A.D. 1075 to 1150, within the middle to late Pueblo II period (Cameron 2009c:292). Soils and sediments were added and compacted to create a stabilized, level surface directly abutting the north wall of the great house (Figure 5.13). This indicates a change in use to a more formal, leveled and compacted use area. After this leveled surface was built, the terrace became an architectural part of the great house, just as the plaza was to the south. Later, the terrace was added to and extended to make it larger in a northerly direction. Unfortunately, limited dates were obtained during the backhoe excavation so the dates of this second construction episode to extend it is unknown, though it probably occurred in the Pueblo III period. The trench profiles do however demonstrate that there were multiple building periods in this area to create the terrace.

The two 1x1 meter excavation units on the terrace were located on either side of the trench (Figure 5.13). Artifacts from these units date the terrace’s two construction episodes. The unit located to the west of the trench, on the northern edge of the terrace was place to determine the layout of a possible alignment of stones, that were partially
visible on the surface and also to get a careful look at terrace strata (Cameron 2009c:280). Although the function of the stone alignment still remains uncertain from excavation observations, the unit did identify a stabilized capping layer on the surface dating to the Post-Chaco era (A.D. 1150-1200), which is the only directly dated portion of the terrace surface from ceramics (Cameron 2009c:282). It is most likely that this surface is part of the second terrace construction. The other excavation unit on the terrace was located on the east side of the trench, to the north of the great house, on what appeared to be a discrete surface off the terrace itself (Figure 5.13) (Cameron 2009c:282). All of this unit’s ceramics date to the Pueblo III period, suggesting it was an add-on built around A.D. 1150 to 1200, but little else was determined. Both of these smaller excavation units’ surfaces seem to be dated to about A.D. 1150 to 1200, in the latest construction period of the great house.

The terrace could have been used as either a flat surface for activities (similar to the plaza) or as the foundation for a building extension to the north that was never constructed. Cameron (2009c:295) hypothesized that it was a flat surface for activities. The terrace had no room blocks constructed on it. Also, the terrace was built and added to within a two hundred years with no construction on top of it. This suggests the feature was not built as a foundation, because the no structures were built within a long time period. Also, the terrace receives the day’s first sunlight in the late spring and early summer, making the area a desirable one to be in at those times. Using this evidence, Cameron suggests that it was an area for used activities or perhaps rituals related to the sunrise.
At the Bluff Great House, the terrace extends the site’s prominent location at the top of the river terrace (Cameron 2009c:271). Where the natural slope is down, the terrace fill creates a level surface away from the great houses back wall. This extension from the great house would have been a visually impressive landscape modification. It also formalized another living surface away from the plaza, on a previously uneven surface that would have been much less level without a terrace. This way the terrace provided another smooth surface for activities and was visually impressive.

Using GPR, I surveyed the terrace, setting up my grid on the area that appeared to have a constructed surface. My data directly correlates with the trench profile recorded by the University of Colorado’s excavations. I know this because I collected all of my GPR transects so they were parallel to the trench. Then I could directly compare my profiles to the profile drawings done by the University of Colorado. In order to ascertain that I was looking at the correct GPR reflection to make my interpretations about the terrace surface, I measured the depth of terrace below the ground surface from the excavation profiles. These maps, produced by the University of Colorado excavations, show the entire stratigraphic composition of the terrace, including the level surface (Figure 5.18). Then, I looked at GPR profiles parallel to this trench and at these depths I found and marked the terrace reflection. At this point, when looking at the excavation profiles and my GPR profiles I could see the terrace reflection on each profile because I knew what depth to look for it at.
Figure 5.18: Using stratigraphic drawings of the terrace, I was able to measure how far below the surface the terrace was located (image modified from Cameron and Geib 2007:348-349).

After locating the terrace reflection in the radar profiles, I marked it on all of my GPR profiles. The depths of this layer in the profiles were determined by using the known terrace depths (Figure 5.19). After the terrace was traced in each GPR profile, I corrected each of the profiles using GPR-Slice software, this correction leveled the terrace surface by adjusting the entire profile (Figure 5.20). Then I could produce horizontal slice maps of the terrace and look at the reflections from just above the terrace. These slice maps contained architectural elements built top of the terrace. After locating the terrace and correcting each profile so the terrace was horizontal, my slice maps were all made in relation to the terrace. Therefore, when slice maps were made the visible features on that slice are all in relation to the top of the terrace surface.
Figure 5.19: For each profile the terrace was located according to the depth below the surface it was expected to be, based on the terrace stratigraphy.

Figure 5.20: After the terrace was located, each profile was corrected for topography to make the terrace surface level.

The GPR amplitude slice map constructed directly on the terrace surface displays a number of interesting features, including the Chacoan road and four structures (Figure 5.21). The Chacoan road is visible as a high amplitude reflection at the western edge of the terrace and along the road there are two smaller features. The edges of these features are composed of point reflections, possibly generated from small stones or adobe that could make up the walls of these structures. Against the northern edge of the terrace there is a large rectangular feature made up of subtle hyperbolic and high amplitude surface
reflections. Similarly, there is a smaller rectangular feature closer to the great house, also with subtle reflections on its edges. The terrace surface itself produced a high amplitude radar reflection along its compacted surface, which is visible in all of the profiles. The age of these features built on the terrace is unknown as the surface on where they were built (the earlier Pueblo II or later additional surface built in Pueblo III time) can not be differentiated. It is most likely that the structures on the terrace are from the latest period, just before abandonment in Pueblo III time, as some remnant of them was still extant when the surface was covered with wind blown sand and silt.

Figure 5.21: A slice map from the topographically corrected data displays two rectilinear and two circular foundations of structures built on the terrace. The Chacoan road is the red area on the western side of this grid. Arrows point to features.

The highest amplitude reflection on the GPR slice map and profiles is the Chacoan era road. The road shows up as a series of high amplitude reflections within profile located to the west of the terrace (Figure 5.22). These high amplitude reflections were result of the highly compacted impermeable road surface. The higher dielectric permittivity caused by the water retained in the compacted road materials produced radar energy that spread out less and attenuated less than the surrounding areas, which were
less compacted. The focusing is visible in the profiles and the slice maps, because rather than attenuating with depth, like most GPR reflections, the amplitudes for the road remained consistently high throughout the profiles depth. Roads were used for symbolic connections to Chacoan cosmography, ritual processions, and probably for the every day travel of people that approached the great house (Van Dyke 2007:148). This road is actually located off of the terrace surface and was probably constructed during the Pueblo II period.

![Figure 5.22: This profile was collected on the prehistoric road and it is composed of the highly compacted, very reflective materials that the made up the road.](image)

Often roads had a number of features associated with them, such as shelters or shrines. On the terrace at Bluff, adjacent to the road, are the remains of two small circular structures. The reflections generated from these features are subtle but still visible. They are probably composed of the compaction of the terrace soils and perhaps adobe and stones that were used in their foundations (Figure 5.23). Their superstructures were most likely adobe or they may not have had full sized walls. These structures could be road-related shrines or short-term “camp sites” for visitors to the great house. Road related shrines or *herraduras* are common small circular stone features associated with roads.
(Hurst and Till 2009:67-69). Compared to rest of the terrace surface adjacent to the road, these circular features were more heavily used and may have had walls made of adobe or stone.

Figure 5.23: These profiles each have hyperbolas on the terrace surface that are examples of what the edges of the circular features look like in profile. They could be reflections from adobe melt or stone building materials.

The terrace area at the Bluff Great House may have had a function similar to the plaza, as it was a large, flat area, adjoining the great house. In this larger “plaza-like” area, the rectilinear structures could be evidence of space that was devoted to craft production or household chores and have functioned in that capacity over a long period of time. These types of activities may have produced a more compacted surface because
they intensively used small areas causing greater ground density or even artifact concentrations than the less used areas.

In the center of the terrace there are the remains of two subtle rectangular features. The larger was about 6x6 meters in diameter and the smaller about 5x5 meters (Figure 5.21). The larger feature lines up with the northern edge of the terrace and the smaller is closer to the great house. They were probably not originally stone structures because there are no remnant rubble piles and other stone masonry structures as there are at the great house proper just to the south. In the small excavation unit to the west of the trench, were found some adobe and stone linear alignments, which are likely associated with the large rectangular feature (Figure 5.24). These features may have functioned as ephemeral shade structures during the Pueblo III period.
Figure 5.24: The excavation unit from the terrace may have been a segment of materials somehow associated with the NW structure.

These subtle rectangular features could have been shade ramadas, with adobe and stone around the base that created shade from the sun during the warmest times of the year. Elsewhere these types of structures were used for a number of activities including daily chores and craft production (Kantner 2004a:69). Because the construction of ramadas was relatively simple and their materials could easily be removed or recycled over time when they were needed for something else. If the superstructures were made of mud and sticks, these materials would easily degrade over time, so it is no wonder they are no longer present in this area. The GPR reflection profiles show only very subtle reflections that were produced along the edges of these features (Figure 5.25), which
supports the idea that they had stone or adobe elements, as seen in the nearby excavations. While there is only a subtle contrast between the floors and foundations of these structures and the terrace surface proper, it is no wonder that they are difficult to see in traditional excavations.

*Figure 5.25: These profiles each contain edges of the rectangular features on the terrace.*

Insubstantial structures of this sort could have been moved according to the whims of its users, which may explain why there is so little surface expression of them remaining on the terrace. However, the two square-like features indicate that this area was heavily used and people were modifying it to make it more comfortable. If people were not using this area of the great house they would not have taken the time to build temporary structures like these. They were probably not aesthetically pleasing structures
and this type of shade structure was not meant for any other purpose other than to increase the comfort of people while they spent time in this area.

The GPR results support the interpretations of the University of Colorado excavators that the terrace was heavily used and formally constructed. The GPR results show structures on the terrace that were unknown to these excavators, these structures were likely very informal, vary in size, are not symmetrical and appear to be ephemeral unlike most of the other great house features. Most great house architecture, like the Bluff berm and room block, is more formal and permanent. Those features are symmetrical and appear to be built with some sort of architectural goal and definitely prior planning. In contrast, the terrace structures were more likely unplanned and used for more short-term functions. The use of these informal architectural elements on this terrace was therefore more likely for household chores, rather than as a ritual platform as is interpreted for the plaza in the front of the great house. Their haphazard arrangement contrasts greatly with the formal architecture of the great kiva and the berm surrounding the plaza in where features were quite symmetrical and certainly not ephemeral. The logical conclusion is that at least during the Pueblo III occupation of the Bluff Great House the terrace was an informal area for household chores and maybe social activities.

The location of these features outside of the great house berm or more sacred confines is also important. People did not build these structures inside the berm on the plaza, an area that has often been hypothesized as an activity surface at other great houses. This suggests that at Bluff the use of the great house was different from other great houses during the Pueblo III period. People may have shifted their daily activities to
a new place. Instead of working in the plaza, as people probably did during the Pueblo II period, they constructed another area to use for these types of activities. This suggests that values had changed and the plaza was no longer viewed as the primary everyday activity area. Because these structures on the terrace are informal, unlike all of the architecture from the Pueblo II period (plaza, great house, great kiva, first terrace construction, and possibly the berm) that was formal, it is possible that the people living at the Bluff Great House had much less formal behavior. This may be because during the Pueblo III period the way people lived was much less formal. Perhaps during this time period the Bluff site was less of a community-gathering place and was a habitation site only, functions that would have required much less formal architecture.

During the Pueblo III period, after the abandonment of Chaco Canyon, people were using the Bluff Great House very differently than before. In general, there was a shift in the way people were living between the Pueblo II and Pueblo III periods across the San Juan Basin. This was a time of transition and much construction outside of Chaco Canyon within the San Juan Basin (Cordell 1994:124). The layout of structures was changing to include more defensive features and house larger numbers of people (Cordell 1997:195). All of these changes in the way people were living suggest that there may have been more people living at the Bluff Great House, needing a larger work area. Also, the people living here were generally restructuring the way they lived and the types of architecture that they built. This would be indicated by the shift in the way the terrace was used, as a work area for people living at the great house.
Chapter 6: Synthesis

During the Pueblo II and Pueblo III periods, the Bluff Great House was a large, multi-roomed structure with architecture that suggests that it was used for community gatherings. Those features were a plaza, terrace and great kiva that were built to accommodate large numbers of people as well as many rooms in the great house proper for housing people. The archaeological timeline of the site, as determined from the results of the University of Colorado excavations and my GPR surveys, indicates that the general Bluff site was important as a location for habitation long before the great house itself was constructed. This evidence shows that the high river terrace was the location for multiple habitations beginning in the Basketmaker III period and continuing until final abandonment of the area about A.D. 1300, at the end of the Pueblo III period.

Results of the GPR mapping found several structures, built between the Basketmaker III and Pueblo III periods, which were spread across the Bluff river terrace in the general vicinity of the great house. In the Pueblo I period, there was a pithouse and room block, now found below the great house plaza surface. It is also possible that there were more Pueblo I habitation structures nearby on the river terrace, which were not the surveyed as part of this thesis. About 700 meters below the river terrace, there was a more densely populated Pueblo I village that was probably somehow associated with all
of the structures on top of the terrace. Unfortunately, that lower site has been largely
destroyed and no archaeological work has ever been done on it.

Even during Pueblo I time, when there were many people living below the
terrace, people continued to live high on the bluff of the river terrace, which shows that
this prominent location continued to be valued as a residential site. These Pueblo I sites
taken as a whole are evidence that large numbers of people were living in this general
area long before the construction of the great house about A.D. 1100. It is likely that the
long-term habitations on the river terrace set the stage for the Bluff Great House
construction in the Pueblo II through building the first residences, which established the
river terrace as a desirable place to live.

The great house, built on the river terrace in the Pueblo II period, provided its
inhabitants and visitors an excellent view across the river valley. Rising prominently on
this topographic feature it was also visible to others from a distance. This would have
been important because the Bluff Great House was probably a place for community
events and other activities that involved many people. Every time community member
saw the great house they were likely reminded of activities that occurred there, as
memories of this community were tied to the place where community events were
located. This reminder would have been important because thinking about these
community events would keep people involved in the events taking place at the great
house. Involvement of surrounding people in the area would also have been important
because their labor was needed to not only build but also remodel the great house.
**History of the Bluff Great House**

The material record and archaeological evidence shows continuity in artifact and architectural styles throughout time throughout the San Juan Basin. There is little doubt from the material record and analysis of many sites in the area that these people belonged to single cultural group, but one that changed in important ways through time. For example, pithouses used in the Basketmaker and Pueblo I periods, were still being built during the Pueblo II period but their function changed as they evolved into kivas. In the Pueblo II period, these semi-subterranean structures were typically constructed out of stone and built inside the confines of the great house instead of as free-standing structures, but their shape, and potentially some of their uses did not change (Lekson 1988). Therefore elements of the earlier architecture were still being used and modified by the descendents of that cultural group many hundreds of years later. In a general sense then we can say with some authority that earlier Basketmaker and Pueblo I people influenced the culture of the Pueblo II people, as we can see from the architectural evidence that is preserved.

In the archaeological record of the area, the first large pithouses, similar to great kivas, were built during the Basketmaker III period, and were meant to hold perhaps an entire community (Lekson 2006a:70-71). This architectural style, consisting of similar structures called “great kivas”, were later constructed as part of great houses in the Pueblo II period throughout the area. That is definitive architectural continuity over centuries, which suggests a sort of cultural continuity throughout the region from Basketmaker III through at least the Pueblo II, and perhaps the Pueblo III periods. While
specifics about these forms of architecture changed, the structures were nevertheless recognizable from one period to the next, which suggests that the people and their culture were probably generally the same over time. While ideas about architecture may have changed subtly, they derived from the same cultural context and therefore the same group of people. This idea is remarkable when applied to Bluff because it suggests that the people who built the pithouses on the river terrace in the Basketmaker III would have been culturally and perhaps genealogically the same as those who built the great houses about 300 years later. The builders of the great house at Bluff were therefore probably strongly influenced by earlier groups from the Basketmaker III and Pueblo I and would have recognized these early architectural styles as similar to their own buildings, which they emulated in many ways.

At the Bluff site there were at least three Basketmaker III pithouses and one Pueblo I structure identified with GPR directly in front of the great house, with additional un-studied structures in the general vicinity. Throughout the Northern San Juan Region there are a large number of Basketmaker III and Pueblo I sites that appear to contain early community structures, or the precursors to what would later be great houses (Hurst and Till 2009:75). These early community structures, while still poorly understood and little studied, may have included a great number of architectural elements, such as plazas or large pithouses, meant to hold large numbers of people, just as similar structures did in later periods. The location of the now destroyed, but aerially extensive Pueblo I village just down slope from the Bluff Great House might have had one of these early community structures, described generally by Conyers and Cameron (1998) using surface
depressions, artifacts, and some GPR data. These early community structures, while still poorly understood, may have included a great number of architectural elements, such as plazas or large pithouses, meant to hold large numbers of people, just as similar structures did in later periods. The information from Bluff suggests, therefore, that not only did the Basketmaker III and Pueblo I groups have similar architectural styles, but they appear to both value community activities in similar types of spaces (e.g. the plaza and great kiva).

The people living at all of these early Basketmaker III and Pueblo I sites at Bluff likely exchanged ideas with others in the region, and can be seen archaeologically at least in the uniform architectural styles that occur throughout the region (Kantner 2004a:76). This demonstrates that the pre-Pueblo II people at Bluff were products of their culture and history, and expressed this by building pithouses and other structures in the style common to that time period, all on the prominent Bluff river terrace. The culture of the Basketmaker III and Pueblo I periods appears to have been organized regionally where people exchanged ideas about architecture and ways of living.

There is some suggestion that in the early Pueblo II period, there may have been some depopulation at Bluff and the area around Bluff (Cameron 2009b:20). This is suggested by a limited amount of buildings and artifacts dated from that period found in the Northern San Juan (Hurst and Till 2009:76). Perhaps the entire population left the area for unknown reasons, or the population level at Bluff declined significantly and therefore archaeological evidence for them is minimal. However, by middle to late Pueblo II time, when the Bluff Great House was built (about A.D. 1075), the Bluff area appears to have been either re-populated by immigrants or there was some combination
of population growth in the indigenous people, with an inflow of people from elsewhere. These appear to be the people that built the great house on the prominent bluff. Regardless of where these people who built the Bluff Great House came from, they would have recognized the cultural signature of their ancestors through the architectural remnants and artifacts that remained from Basketmaker III and Pueblo I time. They may have even had oral histories about their possible ancestors that had lived in this area. The site would have contained a significant cultural signature left by the Basketmaker III and Pueblo I periods in the form of pithouses and perhaps even the ruins of room blocks. These people then built their great house on the same site as their ancestors, which was likely a conscious decision to reference their ancestors. I can see this because the great house was located directly on top of and near many earlier sites that I mapped using GPR.

If these people that built the great house were the direct descendents of the people who had been living in the area during the Basketmaker III and Pueblo I periods they may had an oral histories that referenced this site specifically. If they were newly arrived immigrants they might not have inherited stories that specifically addressed the people who had previously lived at this site, but they would still have recognized their cultural ancestors by looking at the same archaeological evidence that we see today. Surface expression of early structures on the river terrace, such as pithouse depressions, rubble piles, and artifact remains would also have been recognizable as kiva-like structures and ancestral houses, as the way people lived during this time did not change significantly from the Basketmaker III to the Pueblo II periods. This site was perhaps
important to them as it had been used previously by ancestral people, making it the location “historic” and significant with its social memories from the past. The GPR maps and the excavations show this continuity with much evidence for earlier structures both below the great house and surrounding it.

Oral histories are an important way people understand their environment in which cultural continuity occurs. In his book, *Wisdom Sits in Places*, Basso (1996) ethnographically tracks the oral histories of the Western Apache, which are associated with various natural places. For these people the landscape forms a complex palimpsest of their history with individual, seemingly “natural” places playing an integral role in historical events and their creation mythologies. These stories were each based at a specific location and in fact the landscape provided a series of mnemonic devices that people used as a tool to pass down knowledge. Landscapes and prominent features on them provide mnemonic devices because they assist memories about events that occurred at specific places, they are a physical reminder of events. Although the inhabitants of the Bluff Great House, and its pre-Pueblo II structures, did not have a written language, it is probable that they had an oral history tradition similar to the Western Apache, which has also been documented anthropologically in many other groups around the world. It is therefore likely at Bluff that evidence of earlier structures on the landscape would have been a historical “text” for later groups to recognize the signature of their ancestors. This would have led to an increased importance for this site as the historic location of ancestral homes.
When people built the Pueblo II great house at Bluff in about A.D. 1075 they chose a location near and on top of a conglomeration of earlier structures, which suggests they were acknowledging the presence and even histories of the earlier inhabitants or even their ancestors. Van Dyke (2007:92) suggests that when migrants moved south to Chaco Canyon during the Pueblo II period about this same time, similar types of acknowledgment may have occurred. She points out that evidence for earlier occupations, similar to what no doubt was present at Bluff, was also present at Chaco Canyon, left over from as early as the Basketmaker III period. The Chaco builders in the Pueblo II period may have recognized the archaeological footprint of their ancestors and specifically chose to place their impressive great houses at the same locations where ancestors lived. This concept, when applied to Bluff, suggests that the people who built the great house would have had similar reminders. When they moved on to the river terrace after a presumed hiatus of almost a century (Cameron 2009b:20) they could see the archaeological evidence of the Pueblo I inhabitants both at this site and also at the larger village below. This recognition would have made this particular area even more meaningful and therefore a desirable location to build a great house.

Acknowledging the earlier Basketmaker and Pueblo I inhabitants of the area around the Bluff site by building in the same place would also have been important because the actions of these earlier people were the beginnings of the most impressive structure in the ancient history of the area, the great house (Pauketat 2007). It is clear that ideas about architecture, which had been well developed during earlier periods, were perpetuated at Bluff (or throughout the general area) for hundreds of years. As a
demonstration of how strong this cultural continuity was, some of these same types of structures, such as kivas, that can be seen archaeologically are still used by modern Pueblo groups today. While we can only see the preserved architectural remains from prior to Pueblo II time with GPR and excavations it is also likely that when people passed down ideas over time, they may have also been telling stories about their history and the way their ancestors lived. This site is an excellent example of cultural continuity over time that was present across the Chacoan world. The Bluff Great House location in general was a historically important site before the great house was even constructed. This history was likely the reason the great house was built and the reason the people chose to build on the same river terrace as their ancestors.

**Landscape**

During the early tenth century, proto-great houses in Chaco Canyon proper were not particularly unique and were much like all habitation structures all over the Four Corners area (Van Dyke 2007:78; Windes 2004). At this time people in the San Juan Basin had developed large community structures in some places, including the McPhee Pueblo in the Northern San Juan Basin, Kin Bineola south of Chaco, as well as other sites, both closer to, further away from, and at Chaco Canyon.

The proto-great houses in early Pueblo II time were also not necessarily “special” in Chaco Canyon proper. While proto-great houses varied in size and style, all seemed to have been community structures with many of the characteristics of a great house. They often had blocked-in kivas and larger rooms, architectural styles later known as distinctive of Pueblo II great houses. These early great house-like structures appear to
have been used domestically for general every day living, but material remains found in them include turquoise and evidence of other craft activities, which suggests that they may have also served some ritual purposes (Windes 2004:85). At this time, in the early Pueblo II, there is little to suggest that what would be the central location of Chaco Canyon had reached the level where the people that lived there had become any more influential than any other in the area.

This relatively simple, but widespread, shared architecture appears to change dramatically at Chaco in the middle Pueblo II period, about A.D. 1050, when larger great houses were built and the canyon became the “capital” of the region. The larger more elaborate great houses, located at Chaco Canyon, still retained the basic elements of architecture that had been used for centuries, but they also included core-and-veneer masonry, were constructed many stories tall, contained larger rooms, and many other features thought of today as distinctly “Chacoan”.

Archaeologists looking at it today suggest that the impressive and partially unique architecture of Chaco Canyon great houses may have actually been much more of a regional “phenomenon” than an isolated architectural occurrence (Doyel and Lekson 2001; Kantner and Kintigh 2006; Windes 2004). It is possible that the people who resided at Chaco and those that built the proto-great houses across the region, designed and invented many of the architectural practices that were emulated and copied across the region throughout Pueblo II time. Some researchers have concluded that the basics of “Chacoan” architecture may have been invented and developed across the region, rather than at canyon alone. Perhaps elements of the great house form may have actually been
developed regionally earlier on in the proto-great houses and then later combined. Perhaps some of the features that we think of as distinctly “Chacoan”, such as blocked-in kivas, may actually have been developed earlier as a cross-regional cultural expression. This would be similar to the cross-regional development of the Basketmaker III and Pueblo I period architecture, where ideas were exchanged and people shared a common architectural design. At the Bluff Great House site, the new immigrants to the area during the early Pueblo II period may have come from areas where these proto-great house architectural styles were already prevalent, and therefore the great house at Bluff reflected these styles that were already regionally common when they constructed about A.D. 1075.

However, during the middle Pueblo II period, Chaco Canyon structures were purposely built larger and became more unique than other similar buildings in the region at this time. They were built very impressively, were large, and constructed in close proximity to each other. This appears to suggest that something unique was going on at Chaco Canyon during that time, as far as the social organization of the canyon. But, architectural styles at great houses both within the canyon and at outliers at this time were fairly unified, suggesting there was at least some cultural unity and some shared values among all the people in the area by A.D. 1050. Certainly the presence of community integration structures such as great kivas and plazas at many of the outlier sites at this time implies that the people living there were hosting community events in similarly arranged spaces, such as plazas and great kivas. These types of community structures are seen at Bluff also starting about A.D. 1075. Perhaps the Bluff Great House architectural
elements, which were seemingly tied to Chaco Canyon, actually were influenced by the regional architectural patterns and this architecture may show no direct connection to Chaco Canyon at all.

Chaco Canyon and many of its outliers also had roads connecting them to each other by around A.D. 1050. Because many of these roads lead directly to Chaco Canyon or at least point in that direction, they suggest that Chaco was a central location for all of these sites. The presence of roads is often used as an indicator of a site’s cultural, economic, and political connection to Chaco Canyon. However, roads did not always directly link other outlier sites to Chaco Canyon. For example, the road at the Bluff Great House, found with GPR, does not seem to connect the great house to Chaco Canyon as it is leading to the northwest, away from Chaco. At the Bluff Great House the roads (one mapped by the University of Colorado going to the southwest toward Chaco and one using the GPR data that projects to the northwest) appear to be short features. Perhaps roads such as these may have been a common piece of architecture at this time and were not a direct connection to only Chaco Canyon. In building the roads at Bluff, the residents may have been emulating other sites that had roads (besides Chaco). Perhaps they were using these roads to symbolically link Bluff to other outliers or express some unknown cosmographic principle (Van Dyke 2007:148). It is possible that the presence of roads was not an indicator that the residents of the Bluff Great House were directly linking their area to Chaco Canyon, but the roads could have had a more local purpose.

The architecture of the Bluff Great House, including its roads (one of which was mapped with GPR), road features on the constructed terrace (the small circular features
also mapped with GPR), a great kiva, core-and-veneer masonry, and a blocked-in-kiva shows that the great house at Bluff was analogous to many other Pueblo II outlier sites in the region. Also, all of these architectural elements at the Bluff Great House seemed to directly emulate those at Chaco Canyon at this time. These features could suggest that Bluff was either directly associated with Chaco Canyon or a number of outliers that it appears to resemble just as closely. It is difficult to determine what to conclusion is best supported, because the architecture at the Bluff Great House seems to be closely associated with many other sites’ architecture.

Directly to the north of the Bluff Great House room block there is a large constructed terrace attached to the north wall of the great house. This terrace was built during the Pueblo II and Pueblo III periods and maps made from GPR data found two structures built on top of the terrace that are thought to date to the Pueblo III period, after the abandonment of Chaco Canyon. These structures were irregularly constructed and ephemeral, unlike any of the Pueblo II architectural elements at Bluff. These features are hypothesized to be informal shade ramadas built on the terrace. Throughout the region, during the Pueblo III period, architecture was much less formal, but interestingly, the building continued long after the abandonment of Chaco, particularly throughout the Northern San Juan. This change in the formality of architecture occurred across the regional and seems to indicate a major change in the way people organized themselves. Perhaps it was a transition from more formal architecture, to a more defensive style consisting of larger communities (Cordell 1997:195). Or perhaps it indicates a transition from a more formal social organization to a more isolated, less formal way of living.
These two architectural elements are further evidence that the people living at the Bluff Great House were following regional patterns that continued long after Chaco was abandoned, and suggests that instead of being directly tied to Chaco Canyon the people at Bluff instead shifted their style, just like others did in the region.

The Bluff Great House architecture during the Pueblo II could have been influenced by people from many different sites both at Chaco Canyon and its’ outliers. Also, these architectural ideas may have actually been developed much earlier at proto-great houses and Chacoan architectural ideas may not have originated at Chaco and were first built regionally. In general, at Bluff it is difficult to determine if outlier great house architecture was imitating Chaco Canyon or just other outliers with some of the same features. It is also difficult to determine if any outlier that has “Chacoan” architecture is trying to imitate Chaco great houses or is just building in the architectural style common in the region, perhaps the people building and designing outliers (including Bluff) during the Pueblo II period could have been actually been mimicking popular architectural styles prevalent throughout the region. All these pueblo groups both in Chaco Canyon and all the peripheral sites in the San Juan Basin may have only shared an organizational expression, architectural values, and some cultural values that were developed together and that they exchanged with each other, but were perhaps not directly connected to Chaco (Doyel and Lekson 2001:17).

Unfortunately, because such a small percentage of Chacoan outliers have been studied intensively or excavated, architectural patterns alone cannot fully be compared between many outlier sites (Windes 2004). This makes it difficult to determine if the
great house at Bluff is more comparable to other outliers or to the Chaco Canyon proper. This comparison would tell archaeologists how much variation existed between sites. Less regional variation between individual sites might suggest a closer relationship between those sites and more variation would suggest a lack of communication between those sites. What we do know about outlier sites suggests that they have many common elements between them, just as I discussed the common occurrence of berms between Bluff and many outliers. These comparisons between other outliers and the Bluff Great House suggest that the people living at Bluff were communicating with outliers and not just Chaco Canyon. In order to truly study the connection between Bluff and the region, more needs to be known about the rest of the region’s architecture.

The Landscape Archaeology Method

When archaeologists study a site they often use a sampling method to decide where to locate their excavations. While saving time and money, and preserving cultural resources, by only excavating a small sample from the site they often miss the important buried cultural features. This leads directly to making biased hypotheses about the existence of features and their layout, or density, because excavated features may not be representative of the total site architecture. Often a broader spatial layout of a site is necessary in order to make interpretations about what people were building and how they were using a site (Cooney 1999; Johnston 2005; Kvamme 2003; Lucas 2004; Robin 2002). All, or most, cultural features preserved on the landscape need to be analyzed in order to make interpretations about how they related to each other. An examination of all a site’s features is rarely possible in standard archaeological projects, and it is made
possible only by integrating excavation information and geophysical mapping. Therefore by looking at a more complete map of features at Bluff, I was able to make more complete interpretations about features built on the site and how they changed through time.

For example, the University of Colorado excavation data from the terrace was used to understand the basic terrace stratigraphy and determine construction dates, which are very important, but these excavations found no architectural features on the terrace from just one trench and two small excavation units. Without using the GPR information for the whole terrace surface, the structures on it would have been completely missed. Only with the inclusion of GPR could a more holistic map of the features on top of the terrace have been produced, as Kvamme (2003) illustrates at other large sites. Kvamme also concludes that any interpretations about a broad and complex site within its landscape must rely on as complete of an analysis of the site’s layout as possible, using geophysics.

Considering the entire site’s architectural layout, can be applied to understanding a regional landscape such as the northern San Juan Basin. Instead of just studying sites individually, where a specific site may not be representative of the entire region, comparing sites across the region allow archaeologists to make judgments about what is typical or anomalous in the Northern San Juan. While it is unrealistic to expect archaeologists to completely map every outlier site in the Chaco world in order to make a complete and realistic interpretation of prehistoric human interactions, nonetheless a general knowledge of the archaeology in the area gives individual sites contextual
background about what it diverse or typical. For instance, by looking at how elements at outliers compare it might be possible to determine if the Bluff Great House architecture was more similar to other outliers it may have interacted with or with Chaco Canyon specifically.

When looking at the Bluff Great House and only the impressive architecture at Chaco Canyon (which is the best documented site in the region) Bluff appears to be most comparable to Chacoan great houses. For instance, the constructed terrace to the north of Bluff’s great house is similar to the terrace at Tsin Kletzin at Chaco, which shows that the people at both sites had nearly identical architectural elements built around the same time in the late Pueblo II period. This may lead to the hypothesis that they were communicating with each other directly. The great house at Bluff also had core-and-veneer masonry, blocked-in kivas, and a great kiva, much like those at Chaco. Bluff also had architecture that was several stories tall and had Chacoan-style roads extending from it. The Bluff berm may even have been built to resemble the shape of a Chacoan great houses front wall. Using these pieces of evidence it is possible to see a direct connection between the Bluff Great House and Chaco Canyon where ideas were directly shared. Bluff’s level plaza, berms composed of trash, and back terrace all appear to suggest that it was directly connected to and exchanging ideas with Chaco Canyon, which had similar architectural elements in the Pueblo II.

But the main problem with directly comparing these architectural features at Bluff with other sites in Chaco Canyon proper is that it overlooks the nature of possible other similar features at other (much less intensively studied) outlier sites throughout the area.
For example, berm features are present at a number of outliers (Cameron 2009c:266), but no similar features are found in Chaco Canyon proper. Features like the berm, core-and-veneer masonry, the great kiva, and blocked-in kivas were also built at Bluff perhaps not to emulate Chaco Canyon, but to express more general cultural values common throughout the area. In the construction of the berm at Bluff, the people could have been mimicking other outliers or have simply been building this structure in the way they considered most appropriate at that time throughout the region. Also, after construction ended at Chaco Canyon, building continued at Bluff and at other outliers even when they no longer were directly under Chaco influence. These comparisons cannot be made unless a landscape method, like that done using geophysics to completely map a site, is used to look at the entire region. As it is, important comparisons between Bluff and other outliers could be missed due to a lack of information about other outliers.

Conclusions

These thoughts about the exchange of architectural ideas across the region over time do not mean that Chaco was not a central place for many if not all of these outlier great house sites. I only suggest that the people who built and perhaps lived at Chaco Canyon might not have been the sole originator of the architectural styles known as “Chacoan”. Perhaps instead these ideas were generated from a variety of pueblo people at a number of places and they spread out regionally through informal communication and influence, not necessarily from a central place.

The architecture at Bluff fits into a regional context from when it was first inhabited in the Basketmaker III to the Pueblo III, before, during, and after Chaco
Canyon was considered the central place. This architecture perhaps follows ties common in the region from its first habitation to the construction episodes of a great house in the Pueblo II and Pueblo III. The entire region, therefore, could have influenced the Bluff Great House during all of its earlier habitations and it does not seem logical that during the Pueblo II period influence came from only Chaco Canyon. As the Pueblo II architecture at Bluff is analogous to many other sites located outside of Chaco Canyon it can be suggested that architectural ideas were not centralized in Chaco Canyon alone (at least those used at Bluff). Perhaps historically, architectural ideas were exchanged before Chaco was so central. Perhaps these architectural ideas are so similar across the region because all of the “Chaco” architectural styles in the Southwest have common, regional, historical background. The architecture during all of the habitation periods at Bluff fits into these regional patterns, suggesting that it was part of this exchange of ideas.

While there was a regional exchange of ideas at this time, perhaps with Chaco at its center, the Puebloan world as a whole consisted of many Chacoan outliers and Chaco Canyon itself was the center of this integrated and multi-functional system. There might have been no singular “function” for Chaco, as the evidence from Bluff and elsewhere suggests where individual great house outliers were constantly defining and creating their own definitions of themselves. This is visible at Bluff through architectural elements like the terrace, which were modified as the function of the great house became less formal in the Pueblo III. The terrace did not have just one function, but its uses changed with the changing cultural values throughout Pueblo III time. Everyday actions, influenced by a long and complex cultural history, combined together to form the identity of the people
affiliated with the Bluff Great House (Pauketat 2001, 2007). These identities influenced
decisions about architecture and community relationships, which began in the
Basketmaker III with pithouses and lasted through the Pueblo III period when the Bluff
Great House was used much less formally.
Chapter 7: Conclusions

For this research I combined GPR with excavation data to get a more spatially extensive map of the architecture at the Bluff Great House. Using traditional archaeological excavation methods, Cameron and Lekson of the University of Colorado excavated this site from 1995 to 2004 (Cameron 1997, 2002, 2009a; Cameron, et al. 1997; Cameron and Geib 2007). However, such excavations cannot effectively or efficiently map spatially extensive areas because they only uncover small areas of a site. To investigate the large expanse of unexcavated areas, I used GPR to make maps of the Bluff Great House plaza, berm, terrace, and several pithouses. I used the excavation data in combination with GPR slice maps to interpolate from known features found within excavation units to unknown features visible within slice maps. The results of using the two methodologies allowed me to more completely interpret changes to the architecture found within the plaza, the berm, the terrace, and the pithouse and their use over time, without needing to excavate each area completely.

Many interesting features would have been missed without the spatially extensive GPR surveys, and these features were visible after the combination of new maps produced from a compilation of GPR and excavation data. Within the plaza grid I was able to spatially define and map two pithouses, one older pithouse and a newer one that is associated with an above ground room block. The newer pithouse and room block can be
tentatively dated to the Pueblo I period by the layout of the pithouse and room block, which were characteristic of habitations for that time (Prudden 1918). These two pithouses indicate that the Bluff river terrace had long been a site of habitation. The architecture of these pithouse features is interesting because they exhibit elements common to architecture in the broader region, suggesting the inhabitants at Bluff during those times, were in communication with people living at neighboring sites and were not isolated. Those general elements are the pithouse shape and the Prudden unit habitation layout.

Also within this grid, GPR profiles and maps showed that the plaza had been leveled and packed down when it was used as the great house plaza during the Pueblo II building phase. This leveling is noteworthy because it indicates a modification of the landscape to formally prepare a Pueblo II great house plaza, directly on top of the ruins of previous buildings. This leveling and compaction of a plaza is a construction technique common in other great houses lived in during that time (Lekson 1984; Lekson, et al. 2007). The plaza GPR grid indicates that construction at Bluff followed patterns specific to the San Juan Basin, and the inclusion of these common architectural elements suggests a wide sharing or diffusion of ideas across the region. This sharing appears to have occurred not just during the Pueblo II period when the great house was built, but also before, as seen by through the Basketmaker III and Pueblo I habitations on the terrace.

Mapping of the pithouse site to the southwest of the great house identified two overlapping pithouses. These pithouses are most likely from the Basketmaker III period as they have no associated above ground room blocks. The two structures were occupied
at different times with one built on top of the ruins of the previous building. Together, they demonstrate the long-term occupation of this river terrace. This evidence documents that people had inhabited this site, probably beginning in the Basketmaker III period, and they built and lived in these pithouse structures for generations from approximately A.D. 500 to 700.

About A.D. 700 descendents of the same people who had lived there for generations began building Pueblo I structures, such as those found today underneath the later plaza surface. During the Basketmaker III and Pueblo I periods, people continued to live on the river terrace and interacted with their neighbors. Uniform types of structures over this long time suggest such interactions were widespread and well established. Moreover, the Bluff architectural styles resembled structures that were contemporary in those periods throughout the San Juan Basin. Together, the Basketmaker III and Pueblo I occupations of this site indicate that the great house, constructed about A.D. 1075, was built within a long-term historical context. Perhaps the Pueblo II selection of this river terrace as the site for great house construction was influenced by preceding occupations, which imparted greater importance to the site, than it would otherwise have had, because it was as an ancestral living area.

The berm around the Bluff Great House plaza seems to mark the front boundary of the great house, much like the front walls of Chaco Canyon great houses. The GPR profiles collected over the berm show complex stratigraphic layers consistent with the dumping of multiple layers of fill. This fits with excavation results suggesting that the berm was the product of dumping basket loads of debris during multiple constructions.
episodes. The berm was probably at least partially constructed as late as the Pueblo III period, long after the abandonment of Chaco Canyon. People were still constructing features modeled after Chacoan buildings at this time. In some way this architectural style (the encircling berm that seemed to emulate Chacoan great house front walls) was still important after Chaco Canyon had no more influence. In a general sense, the Bluff berm seems to imitate many other boundary berms at other outliers in the region. These common berm features indicate that the Bluff berm was built to emulate these other outlier features, perhaps rather than the more formal built walls of Chaco Canyon. The timing of the Bluff berm, which was finished long after Chaco’s abandonment, also suggests that the berm may not have been imitating Chaco. Instead they may have been emulating bounding features common at other outliers that were still inhabited during the Pueblo III.

Bluff’s inhabitants during the Pueblo III period seem to have still communicated with their surrounding communities, because the residents of Bluff may have actively modeled their architecture off of berms at other outliers, which are dated to the Pueblo III time or earlier. This continuity over time, throughout the Northern San Juan, is indicative of the exchange of ideas and some sort of organization long after Chaco. Because these ideas were exchanged after Chaco’s influence had ended, outliers like the Bluff Great House may not have been dependent on any central “capital” for their cultural ideas at all. During any time period ideas could have been exchanged in this same way, no central capital appears to be needed to spread these architectural styles.
The GPR profiles from the terrace behind the great house to the north were integrated with excavations and corrected for topography. Based on the corrected reflection data, I was able to create amplitude slice maps directly along the terrace surface. These maps show several interesting features that had been built directly on top of the terrace surface. While these features are difficult to date, they were probably constructed and used during the Pueblo III period. Excavation results in this general area show that the terrace was first built during the Pueblo II period and then additions were made during the Pueblo III period. Ground-penetrating radar profiles of the terrace could not differentiate between these two construction periods. Because these additions were the last construction on the terrace, the features on top of the terrace are probably dated to the Pueblo III period. Therefore, during the Pueblo III period an addition was built on the terrace and several interesting features were constructed on top that addition.

A Chacoan-style road was also located with GPR along the west margin of the terrace, leading to the north, away from Chaco. It is difficult to date this road feature as it was not excavated by the University of Colorado, but most at great houses roads in the San Juan region were built by the end of the Pueblo II period so this feature was probably first built during this time. Associated with, and directly to the east of the road are the remains of two small circular features that are similar to the herraduras, or shrines, commonly found along prehistoric roads throughout southeastern Utah (Hurst and Till 2009:67-69). As this prehistoric road points to the north it is showing a connection between the Bluff Great House and perhaps the Comb Wash, Cottonwood Falls or Edge of the Cedars communities, which are found in that direction. The road was not directed
towards Chaco Canyon and thus does not demonstrate any direct connection between Chaco and Bluff, only between Bluff and its neighbors. This is good evidence that when this road was built in the Pueblo II period people were closely connected to their regional community and not necessarily Chaco Canyon.

The GPR results on the north terrace also found two larger foundations of ephemeral structures, which were probably built in the Pueblo III period. These features do not appear to have been constructed for long-term use and seem more informal than the rest of the great house’s architecture. Only the foundations are preserved, and the superstructures were likely perishable materials such as adobe or wood. These features construction and use on the terrace at Bluff long after the abandonment of Chacoan “capital” is significant as they indicate that people were still using the terrace surface in many interesting ways during this period. The Bluff terrace was built to emulate other features found at Chaco, it was built long after Chaco’s abandonment, this shows that cultural ideas still resonated in this area well into the Pueblo III period. The ephemeral nature of the buildings on the terrace, however, show that people were using this architectural feature for informal, everyday activities, which differs from the ritual purposes that Chacoan terraces were thought to serve.

There were important cultural changes between the Pueblo II and Pueblo III periods that have been well documents elsewhere. In general, during the Pueblo III period, after Chaco’s abandonment, it has been recognized that people lived in larger groups and their architecture was less formal than in the Pueblo II period. Despite these changes, however, there was still very recognizable and important cultural continuity
over the centuries that span these two periods. At Bluff this continuity is apparent in the berm features, which appear to have been constructed both before and after Chaco’s abandonment. The continuity is also particularly visible in the terrace, where its initial construction mimicked Pueblo II terraces, such as the terrace at Tsin Kletzin at Chaco Canyon. This emulation appears to have occurred even though the Bluff terrace was at least partially constructed long after the abandonment of Chaco and the abandonment of Tsin Kletzin.

The GPR maps demonstrate that during the Pueblo III, the terrace was still heavily used as work areas and other features were constructed on it. These features were perhaps used as temporary habitations, craft production areas, or shade ramadas during the Pueblo III. They are consistent with the types of less formal architecture common to the Pueblo III period, but they were built on a feature that is very much Pueblo II in style. The combination of these two styles of features (one common to the Pueblo II and the other common to the Pueblo III) used simultaneously demonstrates both cultural continuity and the transitioning of culture expressions at Bluff. This continuity appears to have occurred without any central cultural capital from which ideas “originated”, indicating that Chaco was not needed to enforce or encourage architectural styles that have long been considered characteristic of Chaco Canyon. The new architectural ideas in the Pueblo III at Bluff occurred in conjunction with other innovations in the region, indicating that Bluff was perhaps influenced more by local or regional patterns and ideas. All of this is good evidence that throughout the occupation of the Bluff site cultural
continuity and new innovations influenced architecture and that both of these influences were perpetuated over a very long period of time.

Throughout the occupation of the Bluff site, its residents appear to have communicated widely with their neighbors, at least in ways that can be seen through preserved architecture. For example, at Bluff and elsewhere in the Basketmaker III and Pueblo I periods, people in the San Juan Basin were living in similar ways, building similar types of architecture, all without any influence of a central capital. A large amount of the uniform architecture seen later at Bluff was likely a result of an exchange of ideas much like during these earlier periods.

My interpretation of the Pueblo III architecture seen with GPR and from excavations suggests that during the Pueblo III period, people at Bluff continued to be influenced by and interact with their more direct and nearest neighbors. These interactions would have likely occurred in much the same ways as they had been for centuries, even during the time that Chaco was the central “place”. However, when archaeologists compare outliers to Chaco Canyon many of these apparent regional interactions and culturally continuous features between outlier sites may be overlooked. Perhaps when different ideas that were used when constructing buildings at Bluff are compared to regional timelines and other outlier sites during the Pueblo II and Pueblo III periods it might be possible to see if the Bluff site was emulating architectural styles seen regionally or styles specific to Chaco Canyon. This is only possible if many more outlier sites are studied, which has not been the case to date.
Ideas for Further Research

Future research at Bluff and other outlier communities may eventually clarify regional and local relationships between sites throughout their occupation history. In order to effectively make comparisons between the many outliers, archaeologists must study many outliers that are thought to have been influenced by Chaco. Future studies should also focus on a mapping and dating site architecture, much as at Bluff to test ideas about comparisons between site feature layout and the regional timeline. This research direction would be best explored through the continued use of GPR and targeted excavations, as done in this project at Bluff, to better map and date sites with minimal destruction of their archaeological resources. A broad aerial coverage of a site’s subsurface architecture is impossible with only limited excavations as important features will be missed, just as happened during Bluff excavations (Kvamme 2003). If features, such as those found with GPR at Bluff, are missed the more complete occupational history will remain unknown and potential connections between sites might be overlooked.

Archaeologists in possession of a more detailed and complete understanding of the outlier layouts and construction dates, using some of the methods employed here, can potentially examine how outliers and Chaco Canyon were connected, or not, over time. Comparative studies covering a long occupational history could potentially enable researchers to determine more completely how people related to and influenced each other in many ways. For example, the Bluff Great House during Pueblo II period through its final abandonment about A.D. 1300, was most likely locally influenced, but still large
geographic sphere of inter-relationships with other people. People may have drawn ideas from many different influences, not just Chaco, and the entire landscape surrounding the Bluff Great House has to be considered as potential influence for architecture at Bluff. By studying many outliers and their relationships to each other and Chaco Canyon (particularly with regard to accurate construction dates), it might be feasible to determine how ideas that can be studied using architectural styles and their location on the landscape, were disseminated throughout the region. Sufficient comparative data could then be used to determine if individual outliers were connected to Chaco Canyon, other outliers, or some more nuanced combination of connections.

Archaeologists studying outliers must also examine these sites’ histories more thoroughly. It is well known that the people of the Pueblo I and the Pueblo II periods all over the Southwest exhibited a general common culture, and one finds a significant cultural continuity between periods. People from each period, were influenced by their predecessors. If the historical roots of the Pueblo II great house were better understood, it might be possible to understand the origins of Pueblo II architecture. Knowing these origins would help to determine if the architecture commonly associated with great houses developed regionally or perhaps only in the Chaco Canyon center. This might answer questions about why the Chacoan-style architecture was so popular during the Pueblo II period. If the origins of this architecture were much more regional, their development might be visible in the archaeological record prior to the great houses construction. The apparent historical influences on great houses can only be assessed through study and comparison of many sites’ pre-great house architecture. By
understanding historical influences, researchers might determine the origins of the Chacoan great houses.
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