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The Distribution of Paleoindian Debitage from the Pliestocene Terrace at the Topper Site: An Evaluation of a Possible Pre-Clovis Occupation (38AL23)

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To the Graduate Council:

I am submitting herewith a thesis written by Megan King entitled "The Distribution of Paleoindian Debitage from the Pliestocene Terrace at the Topper Site: An Evaluation of a Possible Pre-Clovis Occupation (38AL23)." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

Dr. David G. Anderson, Major Professor

We have read this thesis and recommend its acceptance:

Dr. Boyce N. Driskell, Dr. Kandace Hollenbach

Accepted for the Council:
Dixie L. Thompson

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

To the Graduate Council,
I am submitting herewith a thesis written by Megan M. King entitled "The Distribution of Paleoindian Debitage from the Pleistocene Terrace at the Topper Site: An Evaluation of a Possible Pre-Clovis Occupation (38Al23)" I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Arts, with a major in Anthropology.

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The Distribution of Paleoindian Debitage from the Pleistocene Terrace at the Topper Site: An Evaluation of a Possible Pre-Clovis Occupation (38AL23)

A Thesis

Presented for

the Masters of Arts Degree

The University of Tennessee, Knoxville

Megan M. King

May 2012

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ABSTRACT

The lithic debitage excavated from units where pre-Clovis material was found were analyzed using mass analysis as well as individual flake analysis. Statistical analyses were performed to test whether or not the assemblages associated with known occupation were similar to those associated with pre-Clovis levels. No significant difference was observed between the physical attributes of the lithic debitage found within strata associated with known prehistoric populations and the lithics found within pre-Clovis aged deposits. Two alternate explanations for these patterns exist: one which argues for the presence of a legitimate pre-Clovis occupation at the Topper Site and the other citing downward movement and/or fluvial processes to account for the presence of debitage below Clovis strata. Future research will be needed to resolve which of these best explains the cultural materials found in pre-Clovis aged deposits at the site.

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CHAPTER I: INTRODUCTION

The Topper Site, a prehistoric chert quarry located along the Savannah River in Allendale County South Carolina, has been utilized and exploited by prehistoric peoples for thousands of years. The site provided an ideal location for prehistoric peoples to camp while procuring large amounts of chert for the production of stone tools. Evidence for the manufacture and maintenance of stone tools has been recovered from within all occupations at the site in the form of lithic debitage. Lithic debitage is not only found within all known cultural occupations, but is also found within strata below Clovis occupations, the last stratum currently accepted as representing the earliest widespread cultural occupation in the Americas. Given that each of the populations occupying the Topper Site presumably utilized the same reduction technology and tool stone, it is hypothesized here that the physical characteristics and overall proportion of lithic debitage should be distributed similarly within each of the cultural occupations. If the patterns continue within the pre-Clovis aged sediments, then it is hypothesized that the artifacts found within these levels, barring relocation, are part of a legitimate pre-Clovis assemblage.

The lithic debitage excavated from units where pre-Clovis material was found were analyzed using mass analysis as well as individual flake analysis. Debitage was characterized by form as well as by specific technological attributes. The occurrence of each debitage category, as well as the occurrence of specific attributes within each of the sample units, was recorded for nearly 4000 individual pieces of debitage. It was assumed that debitage located within each specific cultural stratum was part of a lithic debitage assemblage. It was possible, therefore, to compare the assemblages one to another; this also included all debitage located below the Clovis horizon. Statistical analyses were performed to test whether or not the assemblages associated with known occupations were similar to those associated with pre-Clovis levels. Based on this analysis, it was determined that there is no significant difference between the physical attributes of the lithic debitage found within strata associated with known prehistoric populations and the lithics found within pre-Clovis aged deposits. This analysis alone, however, is not enough to definitively state that the debitage located below Clovis was produced by people living at the site prior to arrival of this basal population. Based on this study two competing hypotheses emerged; one which argues for the presence of a legitimate pre-Clovis occupation at the Topper Site and the other citing downward movement and/or fluvial processes to account for the presence of debitage below Clovis strata. Future research will be needed to resolve which of these best explains the cultural materials found in pre-Clovis aged deposits at the site.

THE ANTIQUITY OF HUMANITY IN THE AMERICAS

The peopling of the Americas is as exciting as it is a controversial area of study. Like any other scientific endeavor, theories regarding the colonization of the New World are susceptible to change and re-evaluation as new data and research objectives are explored. Complicating our understanding of this initial colonization process is the discovery of archaeological sites in both North and South America of pre-Clovis age whose existence renders ambiguous when and ultimately who, the first Americans were that colonized what is now the United States. Such sites have the potential to rewrite the history of the colonization of the New World, while also providing further insight into lives, motivations, cultures, and adaptations of prehistoric peoples. It is important, therefore, to understand the significance of such sites, specifically how their existence change our current models and theories regarding the colonization of the New World. An examination of the pre-Clovis materials from the Topper Site has the potential to add a new perspective to the on-going search for the First Americans.

The American Paleolithic: (Scientific Inquiry and Fiery Debates)

The antiquity of humanity in the Americas has been of great interest from the time Christopher Columbus unintentionally arrived on a small Caribbean island in October of 1492. This voyage, as well as all subsequent voyages embarked upon by European explorers, led to the second greatest colonization event in the New World. The discovery of multiple thriving populations in the Americas enticed European thinkers, scientists, philosophers, and theologians to speculate about the origins of these peoples. Including Native Americans into their world view required Europeans to reference one of their most trusted historical sources, the Bible (Meltzer 1994). The Bible provided one source from with which Europeans could base a series of theories regarding the ancestral roots of American Indians.

One of the most common and presumably oldest theories to be developed by Europeans speculated that Native Americans were among the Ten Lost Tribes of Israel (Hallowell 1960:4). Observations of native customs and practices encouraged this theory, as there appeared to be "corroboration in the customs and traditions of the Indians" with those of the ancient Israelites (Haven 1856 as cited in Meltzer 1994:8). Meltzer (1994:8) notes that identifying Native Americans as "long-wandering Israelites had two undeniable virtues: it explained why those tribes had become lost, and it provided a ready explanation for the Native Americans".

This origin theory persisted among Europeans for nearly 300 years before falling into disfavor (Meltzer 1994:8). In 1590 Fray Francis de Acosta provided one of the first plausible and rational explanations as to how Old World peoples accessed the American continents. This new theory argued that the ancestral populations of Native Americans came to the New World in an "overland migration" somewhere within the northern reaches of the continent where the Old World and the New World were within close proximity to one another (de Acosta 1590, summarized by Meltzer 1994:8). Although de Acosta could not provide concrete evidence for his theory, it essentially provided Europeans with a framework from which they could build a more substantial argument. It would not, however, be until much later in the nineteenth century that serious scientific inquiry and exploration resulted in significant insight into the true origins of the first Americans.

It has been noted by Meltzer (1994) that prior to the mid-19th century it was more important to determine who the Native Americans were than when exactly they had arrived in the New World. It was believed, for example, that their antiquity could be no greater than 6000 years. Once again evidence was derived from Biblical references (Haven 1856:153). The controversy regarding the antiquity of Native American populations only originated after the 1859 European discovery of human remains in direct association with extinct Pleistocene animals (Meltzer 1994:10). This discovery encouraged a vigorous search for an American Paleolithic which resulted in the discovery of archaeological sites yielding artifacts similar to those discovered in Europe. After numerous New World discoveries produced lithic material in ambiguous association with extinct species of animals, or of presumed age, several archaeologists and geologists working at the time (Abbot 1881; McGee 1893; Wright 1889;

Dawkins 1883; Powell 1895) became convinced that there was indeed an Ice Age occupation in the Americas.

Nearly fifty years of intense debate between and within American archaeology and physical anthropology occurred before this question was resolved in the 1920's. Disputes over the American Paleolithic centered around the true age of the "rude" implements that were being identified as artifacts, and the general appearance of the physical remains which were being identified as Paleolithic peoples. Ales Hrdlička, a physical anthropologist with the Smithsonian Institution, was responsible for rejecting many of the skeletal remains found within Pleistocene contexts. Hrdlička argued that skeletal material recovered from within Pleistocene-aged deposits should resemble those of Neanderthals or other pre-modern humans of Eurasia (Boldurian and Cotter 1999:2). Those remains which bore a striking resemblance to modern native populations were argued to be recent in age, regardless of what the geological evidence suggested (Meltzer 1989). Hrdlička and his contemporary William Henry Holmes argued instead that "one should assume these purportedly ancient remains were younger skeletons re-deposited into older strata" (Holmes 1918; Hrdlička 1907 as cited in Meltzer 1989). Compounding this were disagreements about the source and age of the deposits with which archaeological remains were found.

It was not until 1927 that the debate would finally be put to rest. In August of 1927, after two seasons of field investigations at a site located near Folsom, New Mexico, J.D Figgins, Director of the Denver Museum of Natural History, discovered projectile points embedded within the skeletal remains of extinct, late Pleistocene species of bison, *Bison antiquus* (Haynes 2002; Meltzer 1989; Figgins 1927). Upon the advice of Hrdlička, the artifacts where left in the ground to be viewed by visiting scientists. Those visiting professionals included Barnum Brown, paleontologist with the American Museum of Natural History, Frank Roberts, representative of the Smithsonian Institute, A.V. Kidder, archaeologist with the Peabody Museum and his colleague, Assistant Secretary of the Smithsonian Institution Alexander Westmore (Meltzer, 1989, 1994). After viewing the artifacts *in situ* the scientists agreed that the "remarkably fashioned fluted projectile points found embedded in the ribs of the extinct species had entered the formation 'at the same time the bones did'" (Roberts to Fewkes, September 13, 1927 *in* Meltzer 1989:25).

The discovery at Folsom finally provided indisputable proof that the New World had been colonized during the Ice Age, although a calendar age for the site, and other sites containing the same stylized projectile point, would not be known until the 1940's. "At the time of the Folsom discovery it was not possible to estimate the age of the find any more precisely than to say that the association with *Bison antiquus* meant that man was present in America near the end of Ice Age" (Haynes 1969:709). The introduction of radiocarbon dating by Willard Libby provided a means to accurately date archaeological assemblages. Dating deposits was previously based upon stratigraphic depth, an association with extinct animals and cross dating of artifacts and seriation (Taylor 1985). Today it is known that the projectile points found at the site, now commonly referred to as Folsom, characterize a Paleoindian culture complex which existed between 10,900 and 10,600 ^{14}C yr. BP (Powell 2005). Although not the oldest of the American Paleolithic cultures, the Folsom discovery represents an important turning point in American archaeology. First, it served as evidence that Ice Age Americans systematically crafted projectile points that required considerable forethought, precision, and skill. Second, it provided irrevocable proof that humans were contemporaneous with Ice Age animals. It was one of the first archaeological sites in the New World to command the attention of a select group of elite scientists, “whose opinion mattered in gaining resolution, and who could work out the paleontology, geology, and stratigraphy for themselves, and used that information to date the bison remains and the site” (Meltzer 1991:34).

Further proof of early man in the Americas came six years later at the Blackwater Draw site near Clovis, New Mexico. It was here that a projectile point form, which came to be known as Clovis, was found stratigraphically below the Folsom horizon (Stanford 1991). Led by Edgar Howard, and sponsored by the University of Pennsylvania Museum of Archaeology and the Academy of Natural Sciences in Philadelphia, systematic excavations proceeded at the site between 1933 and 1937 (Boldurian and Cotter 1999). Excavations successfully established the presence of Paleolithic peoples with extinct species of mammoth during the terminal Pleistocene, and also defined a stratigraphic distinction between mammoth hunters and later bison hunting populations (Boldurian and Cotter 1999). The distinctive Clovis fluted points associated with Pleistocene mammoth hunting have since been discovered at hundreds of sites across North America (Anderson et al. 2010). Today, “wherever they may be found, these distinctive implements are named Clovis, after their initial, fully reported place of discovery” (Boldurian and Cotter 1999:18). Radiocarbon dating eventually confirmed that the Clovis complex existed between 11,200 and 10,900 radiocarbon years before present, or ^{14}C yr BP (Haynes 2002; Waters and Stafford 2007). It also identified the Clovis culture as the oldest known populations to have existed in the New World, and led to the establishment of the Clovis-First Hypothesis (Haynes 1969).

This model has been referred to as “an elegant articulation of a series of propositions that have both explanatory and predictive power”; and “specifies where earliest colonists came from, the route taken as well as the rate of colonization, what archaeologists should expect to find in the most basal level of the American archaeological record, and the earliest possible age for human occupation” (Bonnichsen and Lepper 2005:9). The Clovis-First model is essentially based on three fundamental premises (Bonnichsen 2005:12); (1) The first hypothesizes that around 11,500 ^{14}C yr BP a group of skilled hunters, carrying a very distinctive ‘fluted’ point, travelled through the ice free corridor and quickly made their way across the vast American landscape sustaining themselves on the herds of large game which they had followed (Haynes 1964). (2) The second premise hypothesizes that the Clovis culture disappeared with, and most likely caused, the extinction of large megafauna about 10,800 ^{14}C yr BP. (3) The third and final premise is that Clovis represents the basal culture that gave rise to all other archaeological traditions in the Americas (Bonnichsen 2005:12). The initial colonization was further believed to have been followed by a rapid population explosion and the expansion of said populations into most parts of the Americas by the beginning of the Holocene, 11,500 calendar years ago (Meltzer 1993). By 1965 the Clovis-first hypothesis was a widely accepted theory for the initial colonization of the New World, and in the decades following, research into the peopling of North America markedly expanded the late Pleistocene archaeological record (Grayson and Meltzer 2003:588).

Clovis-First Debate

For the next few decades the Clovis-First model remained the strongest, and most widely accepted, candidate for explaining the initial colonization of the Americas. However, by the 1980's archaeologists began to discover sites in both North and South America that appeared to date well before the recognized 11,500 ^{14}C yr BP entry date. The discovery of such sites, now termed pre-Clovis, led scholars to question the legitimacy of Clovis as the first inhabitants of the New World. Bonnichsen and Lepper (2005) have, for example, challenged the three underlying premises of the Clovis-First model. They argue instead that (1) Clovis does not represent the first group of people to have entered the New World; that in fact the Americas were peopled several times by different groups; (2) regional diversification exists among Clovis populations as a result of responses to global environmental change; and (3) several North American archaeological co-traditions are as old, if not older than Clovis; thus Clovis is not ancestral to all North and South American populations (Bonnichsen and Lepper 2005:12). While these challenges are intriguing and certainly controversial, we must wait until more evidence is available to fully evaluate them.

Despite the number of sites with possible evidence for pre-Clovis populations in the Americas, there is rarely widespread agreement pertaining to the legitimacy of pre-Clovis sites. In the last three decades, for example, more than a dozen sites have been discovered that have yielded dates that make them older than Clovis, but few have much credence in the scientific community (Wheat 2012). One of the challenges consistently faced is that many do not adhere to the specific set of criteria that were established to legitimize early archaeological sites. These criteria maintain that a site must include (1) undeniable artifacts or human remains; (2) an indisputable context, such as direct stratigraphic association with extinct Pleistocene animal remains; and (3) a valid and reliable control over chronology – or undisturbed stratigraphy (Haynes 1969:714). Any site yielding potential evidence for a pre-Clovis occupation in the New World was carefully evaluated to determine whether it had (1) genuine artifacts or human skeletal remains in (2) unmixed geologic deposits accompanied by (3) reliable pre-Clovis age radiometric ages (Haynes 1969; Grayson and Meltzer 2003:542). Very few, if any of the earliest recorded pre-Clovis sites, were accepted as legitimate (Dincauze 1984).

While pre-Clovis sites continue to be reported throughout the New World, one of the standards long demanded by advocates of the Clovis-First model is that more than one unequivocal site of pre-Clovis age needs to be found in an area in order to prove the existence of these early populations (Bonnichsen and Lepper 2005:12). It is believed that if humans reside in a region, there should be multiple archaeological signatures of their existence. Thus, multiple sites with similar ages and artifact assemblages would provide the best possible evidence to support the presence of pre-Clovis populations in the Americas (Bonnichsen and Lepper 2005:12).

An additional standard often cited as a means to qualify sites as pre-Clovis is the presence of diagnostic artifacts found in undisturbed Pleistocene contexts (Meltzer 1989:480). This standard is based on the assumption that, technologically speaking, characteristics found within pre-Clovis lithic assemblages must logically lead to Clovis. That is, pre-Clovis lithic assemblages should contain characteristics similar to, but not necessarily identical to Clovis technology. Such characteristics might include some aspect of bifacial thinning, channel fluting, and blade technology (Collins 2002). Meltzer (1989:479) has argued in fact, that it is wrong to dismiss archaeological evidence because it does not fit chronological or diagnostic expectations.

He has proposed that there may have been multiple migrations into the New World, many of which may not have been successful. “Unsuccessful or failed migrations would be those that penetrated the continent but subsequently disappeared without issue or without detectable mixture with indigenous groups” (Meltzer 1989:480). It is reasonable to hypothesize then, that each migratory population could have brought with them distinctly different technologies making it virtually impossible for archaeologists to predict what an assemblage would look like for each individual population that entered the New World. Bryan (2004) argues further that archaeologists should abandon their reliance on finding diagnostic tools when searching for early sites. One of the questions to frequently arise, however, is how then do we determine whether an assemblage is legitimately pre-Clovis in age if we have nothing to compare it to? At this point, there is no simple answer to this question.

As stated earlier, of the possible pre-Clovis sites that have been reported in the last three decades (see Figure 1), only a handful have been considered legitimate in the public and academic realms; although no one pre-Clovis site has been universally accepted by Paleo-Indian scholars (Wheat 2012). A large majority of the other sites have been dismissed by many researchers because they have either failed to provide any substantial evidence that meet the aforementioned criteria (Haynes 1969), or information regarding these sites have yet to be fully published and are therefore relatively unknown.

Pre-Clovis in the Americas

The first site to convince most archaeologists that there was an occupation in the Americas prior to arrival of Clovis populations was discovered at Monte Verde, Chili in the late

1970’s (Dillehay 1997; Meltzer et al. 1997). Located in South America, Monte Verde has been dated to 12,500 ^{14}C yr BP, making it one of the earliest known human occupations in South America. There is, in addition, a second possible occupation at Monte Verde which was dated much earlier to ~ 33,000 ^{14}C yr BP (Meltzer et al. 1997:659). Excavated by Dillehay and Pino starting in 1976, the site has yielded an abundance of information regarding the lifeways of its earliest occupants. The site has provided, for example, hundreds of artifacts including several different kinds of stone tools, preserved wooden implements interpreted as digging sticks and spears, 42 different species of edible plant, evidence of at least 12 timber and earthen structures, imported trade goods, and a preserved human footprint (Dillehay 1989, 1997). While providing a plethora of information regarding its inhabitants, Monte Verde has also stimulated many

Figure 1. Late Glacial Maximum, North America, showing the general locations of several possible pre-Clovis sites. Image courtesy of PIDBA and Steven J. Yerka and Dyke et al. 2003.

questions regarding its occupation. Kelly (2002:136) for example, asks "how do we explain the presence of people in South America at the same time or prior to their appearance in North

America?" Archaeologists are thus beginning to rethink not only when populations began to arrive in the New World, but also how they got here.

In addition to Monte Verde there are several other pre-Clovis sites that have peaked the interest of Paleoindian archaeologists. In Eastern North America these sites include Meadowcroft Rockshelter, Pennsylvania; Cactus Hill, Virginia; Saltville, Virginia; and Topper, South Carolina (Bonnichsen and Lepper 2005:13, Anderson 2005; Goodyear 2005a). There are also a series of sites located within the area of land once referred to as Beringia – the region today includes Alaska, the Yukon Territory, northeast Siberia, and the now submerged Bering Sea platform. These sites include Old Crow and Bluefish Caves. Other potential pre-Clovis sites, referred to as the Nenana Complex, are located within the Nenana Valley of Alaska and include Owl Ridge, Dry Ridge, and Walker Road. More recent discoveries of pre-Clovis in the New World come from the Debra L. Friedkin site located in central Texas (Waters et al. 2011). While some skepticism is still attached to many of the sites mentioned, Saltville and Topper in particular, there is for the most part, a general consensus that people did arrive in the New World prior to Clovis populations (Wheat 2012). The questions that remains however, is when? As such it is increasingly important to continue excavations at each of the sites to demonstrate their legitimacy.

THE TOPPER SITE (38AL23)

The Topper site, (38AL23), is a prehistoric chert quarry and quarry-related habitation area located on a Pleistocene terrace of the Savannah River in Allendale County, South Carolina

(Figure 2). The location was discovered in the mid 1970's by local resident David Topper, who later shared his discovery with a group of interested archaeologists. One of the archaeologists was Dr. Albert Goodyear, a researcher at the South Carolina Institute of Archaeology and Anthropology, current director of the Allendale Paleoindian Expedition and principal investigator of the Topper Site investigations (Goodyear and Steffy 2003). Testing at the site began in the early 1980's as part of a larger survey designed to map a suite of chert quarries in Allendale County (Goodyear and Charles 1984). Additional testing at Topper in 1984, 1985, and 1986 set out to document the stratigraphy and history of the site. This process revealed an extensive occupational history spanning from Clovis to the Late Prehistoric (Goodyear 2000; Waters et al. 2009:1300). From 1998 to the present, the Topper site has been excavated annually for six weeks each summer by a team of from 40 to as many as 100 researchers, students and volunteers.

Prior to 1998 no units were taken deeper than the Clovis age level since the project director thought it was the oldest possible occupation (Goodyear 2003:23). However the 1997 reporting on the discoveries at Monte Verde in South America and discoveries at Cactus Hill, Virginia in 1998 prompted Goodyear and his research team to excavate below what was known to be Clovis age sediments. These excavations resulted in the discovery of an unusual lithic assemblage located as much as two meters below the Clovis level in sands and an old terrace associated with what is now known as the Pleistocene floodplain and terrace (Goodyear

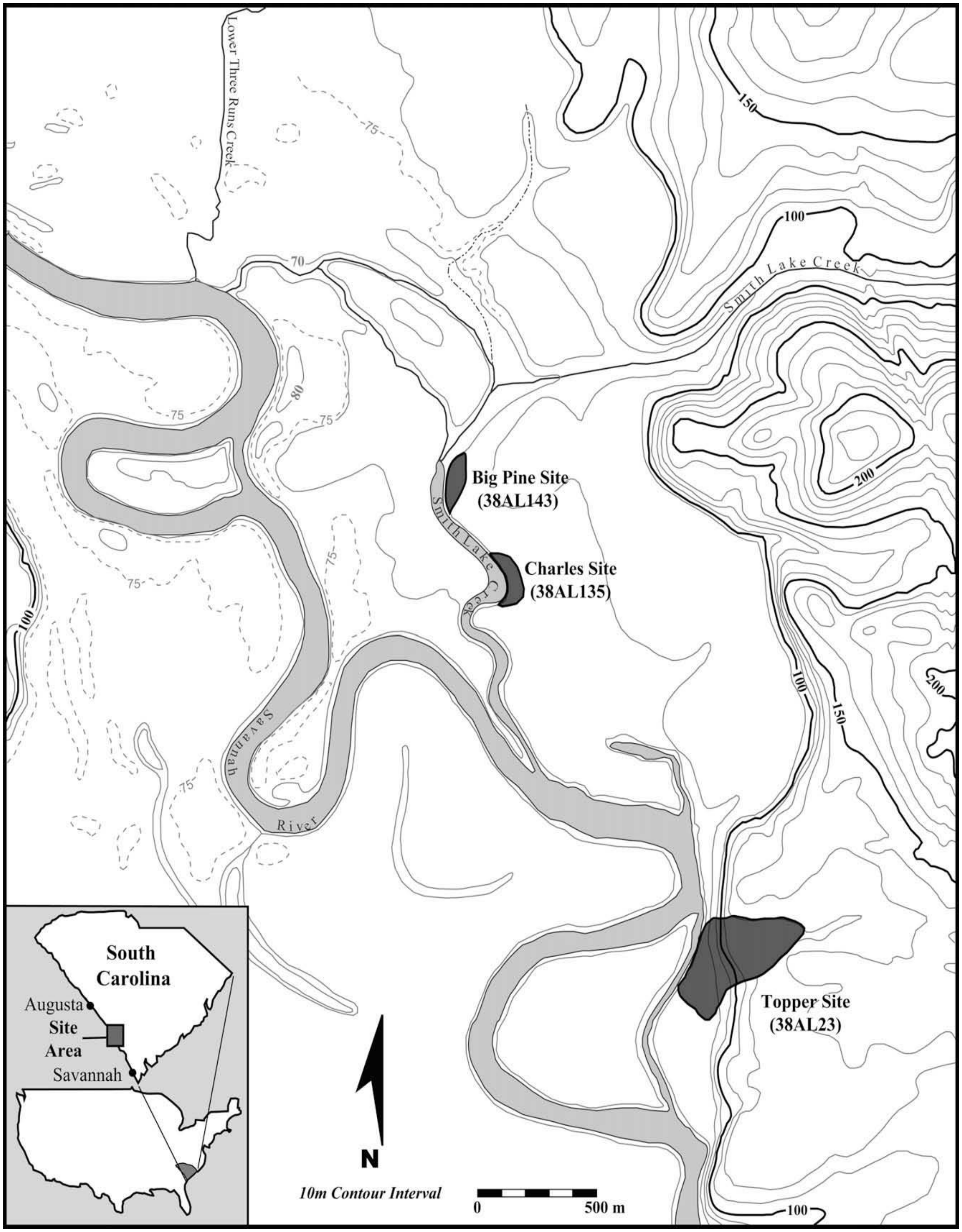


Figure 2. Map of Allendale study area, South Carolina showing the location of the Topper and Big Pine Tree sites. Image courtesy of Waters et al. 2009.

2003:23). Subsequent excavations have continued to produce lithic material from below the Clovis horizon. The primary question and controversy regarding Topper deals first with the question of whether the lithic materials found below the Clovis deposit are products of human manufacture or the product of natural processes, and second, if they are humanly manufactured are they in primary stratigraphic context?

SITE SETTING AND STRATIGRAPHY

Topper (38AL23) is part of a larger quarry complex which includes the Big Pine Tree site (38AL143), a terrestrial chert outcrop, and a related quarry (38AL139); all of which are located on floodplains and terraces that flank the Savannah River (Figures 2,3). The first terrace lies almost 99m above mean sea level (amsl) and within this sandy alluvium fill is the Big Pine Tree Site. The second terrace, and the one examined for this study, is located 101.5 m amsl and colluvium covers most of the first terrace (Waters et al. 2009:1300). The archaeological components at Topper are buried within the fill of this terrace and in the overlying colluvium (Waters et al. 2009:1300). Much of what we see at the site today is the result of processes that began about 14,000 years ago, soon after the end of the Last Glacial Maximum (LGM). This dramatic shift in temperature and precipitation resulted in major hydraulic changes in the Savannah River which dropped river elevation at Topper to its present level (Goodyear and Steffy 2003).

It is assumed that by the time Clovis populations arrived in the area around Topper, the waters had receded enough in the Savannah River to expose the chert cobbles and iron stained quartz cobbles that were subsequently exploited by Paleoindian and Archaic

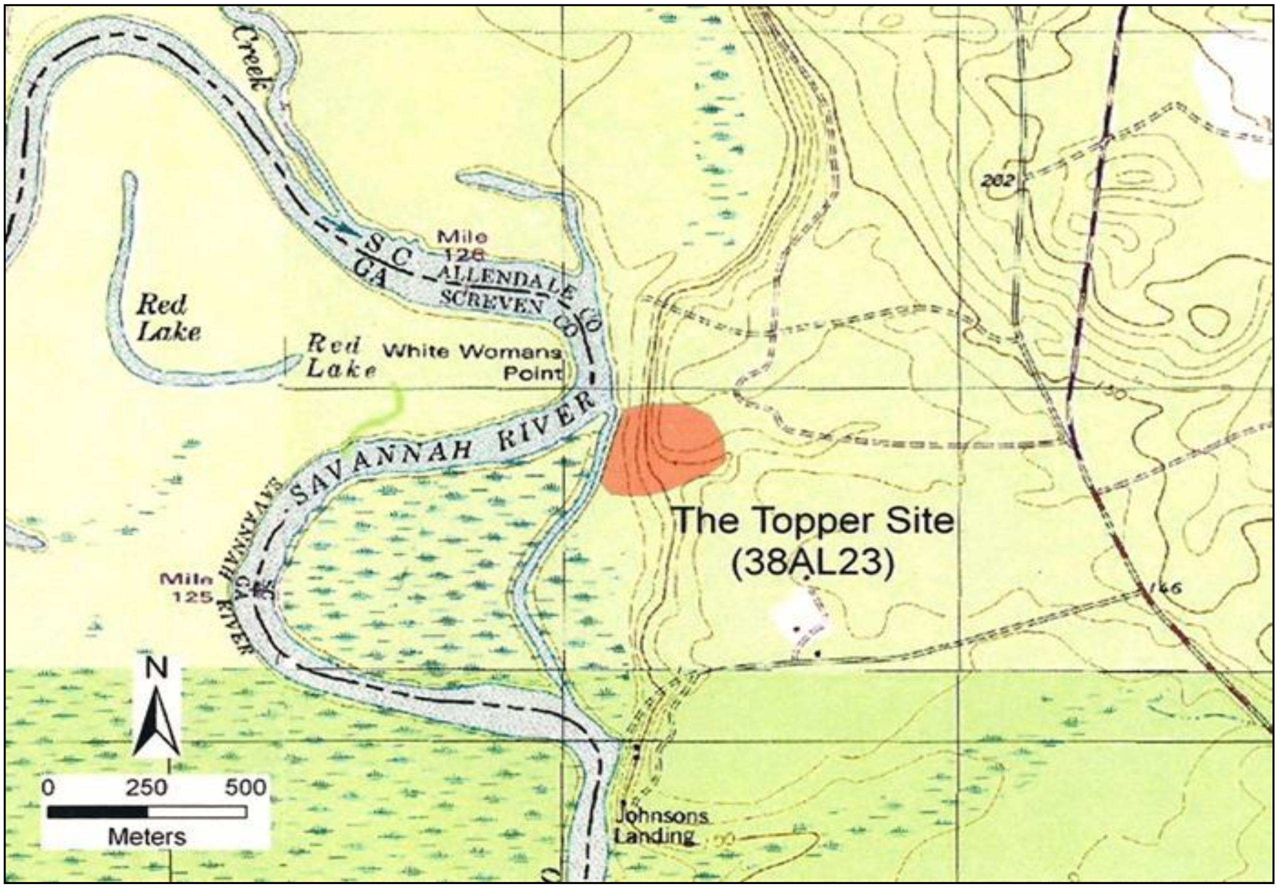


Figure 3. USGS Topographic Map with location of the Topper site (38AL23). (Martin Quadrangle. Published in 1989) Image from Miller 2007.

peoples (Goodyear 2000). Clovis populations would have had almost unlimited access to high quality chert; material that could have been retrieved on land as well as from the river bottom. The cobbles recovered from the river contain a distinctive butterscotch colored cortical surface, unlike those recovered from terrestrial sources (Figure 4). The difference is inferred to have been caused by continual polishing and water action which effectively erodes off the limey cortex revealing the glossy outer rind (Goodyear 2006:14).

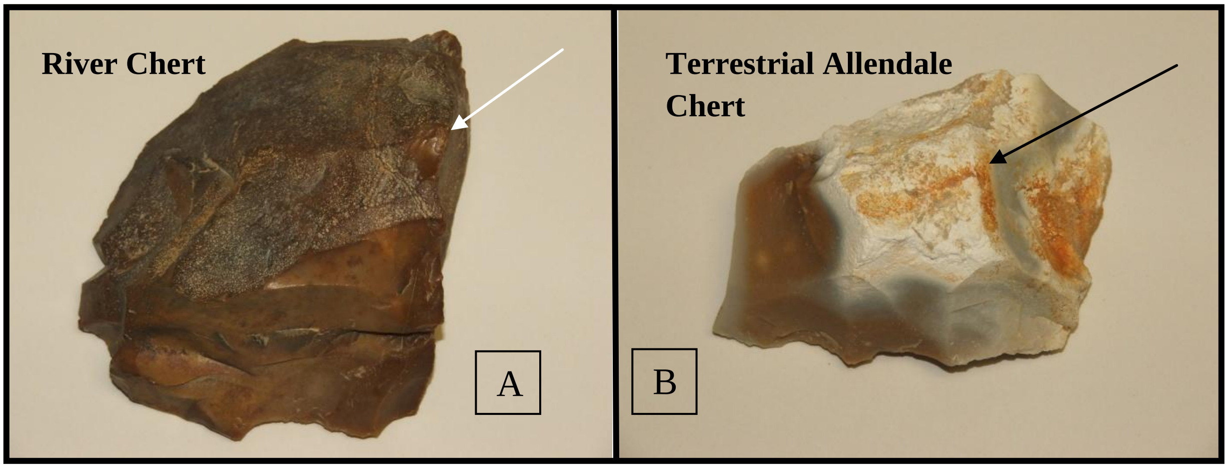


Figure 4. Allendale Chert. Figure A represents the smooth butterscotch colored river chert and Figure B represents the light colored terrestrial Allendale Chert with a chalky white cortex.

Although several geological studies were conducted at the Topper site (see Goodyear and Foss; 1993; Goodyear, 1999) an additional study was undertaken by Waters et al. (2009) in 1999 that sought not only to define the stratigraphy at the Topper site but also to try to date the possible Pre-Clovis component at the site using radiocarbon and luminescence techniques (Waters et al. 2009:1301). A series of backhoe trenches were excavated to expose the alluvial and colluvial stratigraphy (Figure 5). Stratigraphic profiles were recovered for a number of these trenches as well as from excavation areas at the north end of the site (Figure 6). Waters et al. (2009) identified a series of stratigraphic units that they correlated with the sites' archaeology. Samples for radiocarbon and luminescence dating were collected from these profiles to provide the age estimates of the geological deposits (Waters et al. 2009:1302).

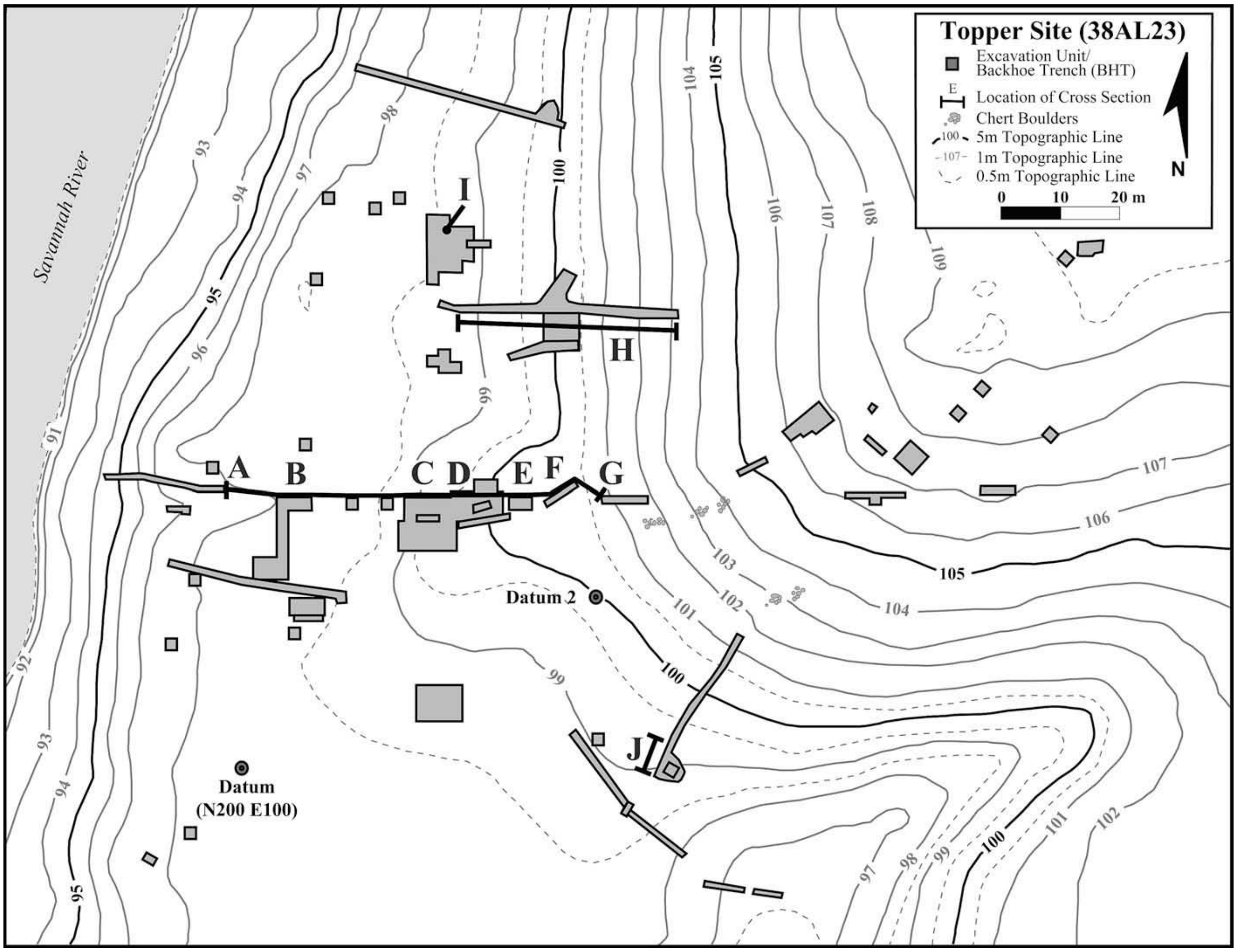


Figure 5. Map of the Topper site showing the location of excavated areas and trenches. Letters A-J designates the location of specific profile cross-sections as shown in Figs. 6 and 7. Image courtesy of Waters et al. 2009.

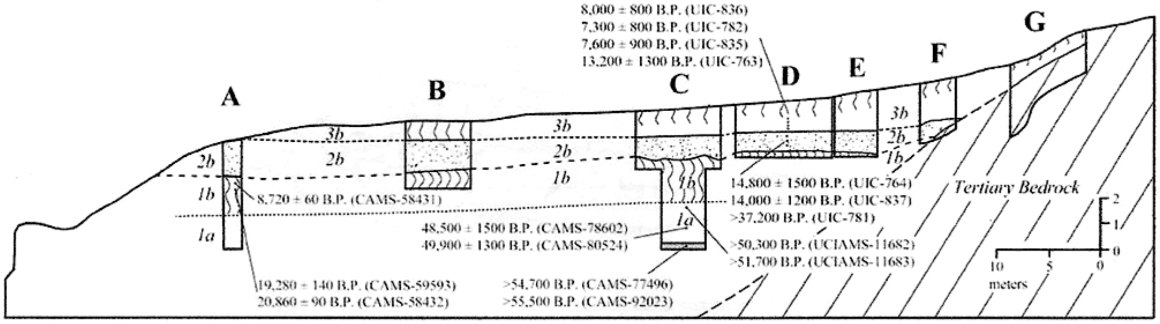


Figure 6. Cross-section of the Late Quaternary stratigraphy of the Topper site (locations at depicted in Figure 5) Image courtesy of Waters et al. 2009:1303.

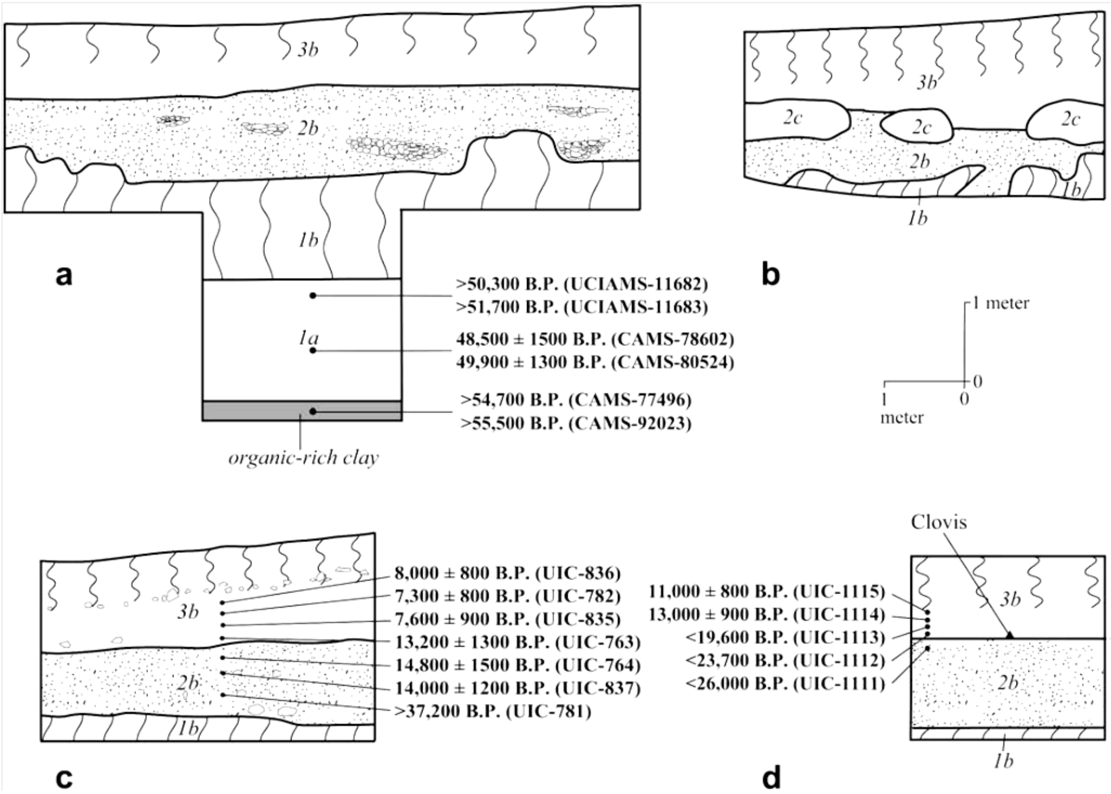


Figure 7. Detailed cross section showing the stratigraphy and dates obtained at specific locations along the cross-section line A-G (Fig. 5) and two other localities. a. Area C (Figure 5 and 6); b. Area J (Figure 5); c. Area D (Figures 5 and 6); d. Area I. Image courtesy of Waters et al. 2009.

At Topper late Quaternary deposits were found to include both alluvial and colluvial sediments, all of which rest unconformably against an eroded scarp of Tertiary-age bedrock (Waters et al. 2009:1303). Alluvial deposits generally consist of loose, unconsolidated soil or sediments which have been deposited and shaped by some non-marine water action (Hills 1946). This lower bedrock consists of a weathered, red colored deposit of sand, silt, and clay which has been proposed to be part of the Miocene Altamaha Formation. It is capped by Quaternary eolian sands and colluvium that were found to contain artifacts from Clovis populations (Waters et al. 2009:1303). These eolian and colluvial sediments can be divided into three major units- designated by Waters et al. (2009) as 1 through 3, from oldest to youngest. The units were further subdivided into smaller subunits, designated with lower case letters a b, and c (see Figures 6, 7 and 8).

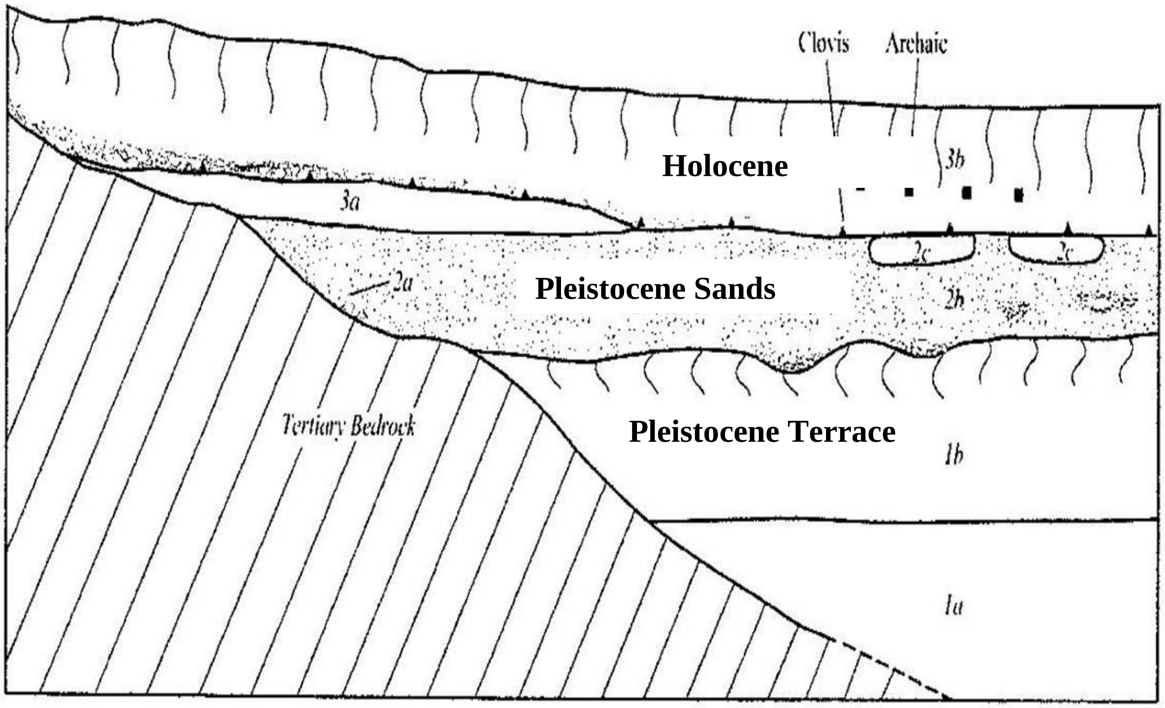


Figure 8. Generalized stratigraphy of the Topper Site showing the position of Clovis and Archaic strata. Image courtesy of Waters et al. 2009:1304.

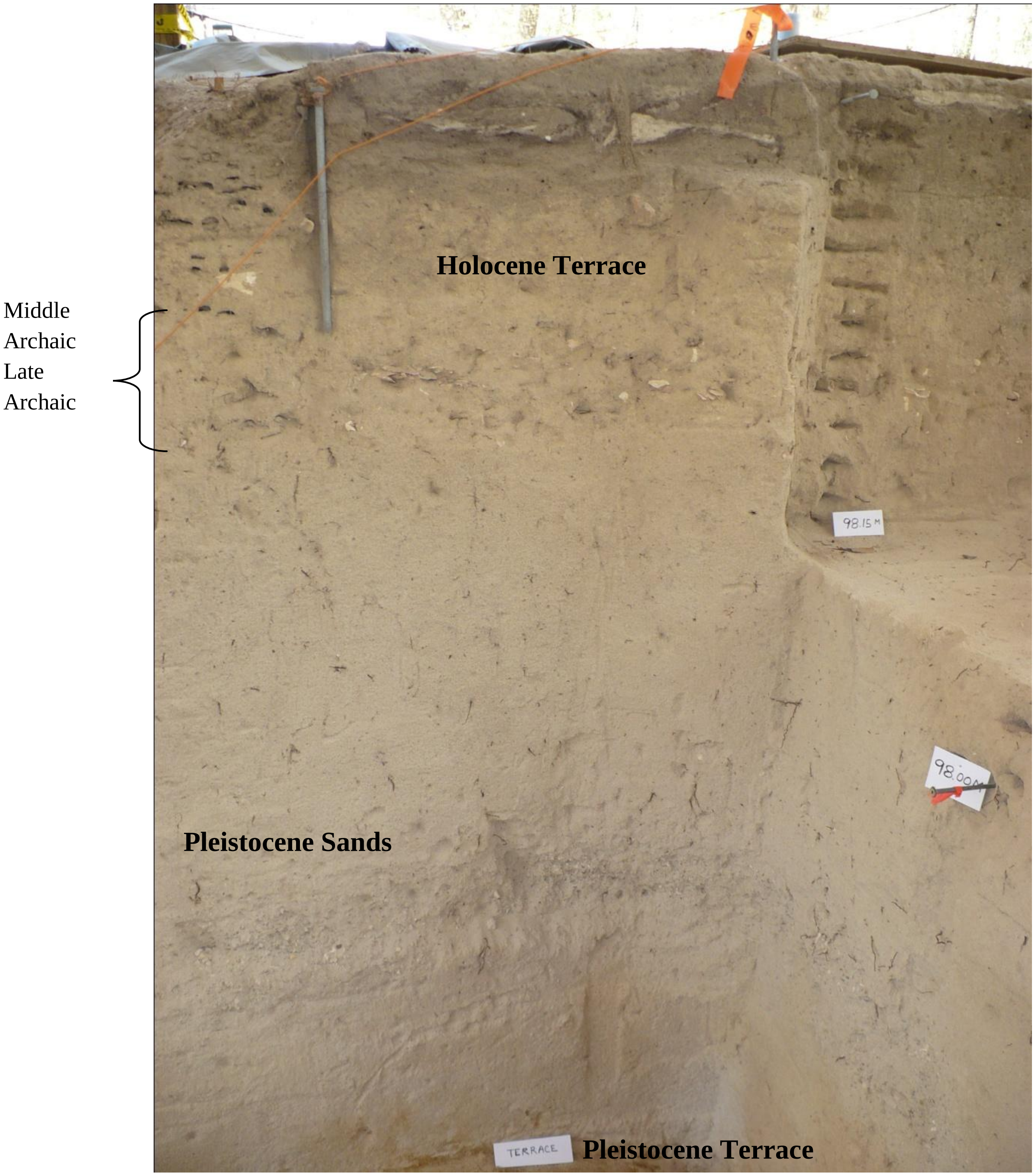


Figure 9. Stratigraphic Profile of Excavation Unit at Topper Site.

Unit 1 is represented by a sequence of sediments that were deposited by a "meandering prehistoric Savannah River" (Waters et al. 2009:1303). Unit 1a, then, has been identified by the authors as representing deposition within the channel and point bar of the Savannah River, while unit 1b reflects deposition by overbank processes on the river flood plain (2009:1303). It was noted by Waters et al. (2009) that the upper portion of unit 1 has been altered by pedogenic processes that created a weak Bt which was extremely susceptible to erosional processes. Within these sediments, Goodyear (2005a) has recovered chert pieces that have been identified as possible pre-Clovis artifacts as well as a concentration of charcoal that had the appearance of a possible hearth (Waters et al. 2009:1303).

Unit 2 (see Figure 8) consists of sediments that have been deposited by both colluvial and fluvial processes. Unit 2a has been identified as being a product of colluvial processes, consisting mainly of gravels and sands that accumulated along the edge of the erosional scarp. Groups of isolated gravels occur on the eroded scarp and as identified by the authors, there is one case where gravels have accumulated at the base of the scarp as weathered chert pebbles and cobbles that most likely rolled down the side of the slope that formed the edge of the channel (Waters et al. 2009:1303). Unit 2b, also known as the Pleistocene Sands, overlies the eroded surface of Tertiary bedrock, a dark colored overbank unit, also referred to as the gray silty clay terrace and otherwise referred to by Goodyear as the Pleistocene Terrace. Found within unit 2b are small gravel filled channels (50-140 cm wide; 5-30 cm deep) and in some places, large chute channels (3-5 m wide; 0.5-0.8 m deep). Chute channels were encountered within the test units excavated for this thesis. Within these channels were dense concentrations of fairly small, round and semi angular pebbles, cortical debris, and what appeared to be flaking debris. Further discussion of these is contained Chapter 4. The sediments which encompass unit 2b are interpreted as having been deposited in a fluvial environment that had multiple shallow channels which may have been part of a braided fluvial system (Waters et al. 2009:1304). The authors found that the north-south orientation of the channel boundaries indicates paleo-river flow parallel to the present Savannah River (2009:1304). This unit, which has produced some of the potential pre-Clovis artifacts in the past and the majority of those discussed in this thesis, has been designated by Goodyear as the Pleistocene Sands (PS) (Figures 8 and 9).

Overlying the sandy alluvium of unit 2b is unit 2c, which is composed of gray sandy silty clay that forms discontinuous masses that range from 1 to 2 m long and 0.5 m thick (Waters et al. 2009:1304). These sediment bodies have been identified as either overbank flood deposits or isolated pockets of fine-grained sediments that accumulated in channels and depressions that existed on the surface (Waters et al. 2009:1304). A micromorphological examination of this unit indicated that the upper 30 cm had been altered by a period of relative stability occurred over at least 2000 years of pedogenesis. This created weak structures with clay bridging occurring between the sand grains. Unit 2c (Figures 7 and 8) represents the last time that fluvial deposition occurred at the Topper site. Luminescence dating suggests that this deposition most likely ceased around 15,000 ^{14}C yr BP, after which the river downcut and abandoned the floodplain, effectively creating Terrace 2 (Waters et al. 2009:1308).

Unit 3 formed through colluvial processes and is composed on sediments that were shed from the adjacent hillslope onto the abandoned terrace. This unit has been further divided into two subunits. The oldest of these units, 3a, disconformably overlies the sands of unit 2b and is a brown silty sand that shows evidence of soil development indicated by a 70 cm thick, brown soil horizon that has weak structure (Water et al. 2009:1304). Overlying this layer is unit 3b which was found to be ubiquitous across the site. This unit consists of silty sand with intermittent gravels that become more and more abundant toward to the slope. In some places within this unit, those that are closer the slope, the gravels become quite thick and grade downslope into a stone line (Waters et al. 2009:1304). Pedogenic processes also occur within this unit, particularly within the upper 60 cm, creating a weak Bw horizon (Waters et al. 2009:1308). Clovis artifacts have been found within unit 3b near the base of the strata (Figures 6,7). Diagnostic artifacts above this horizon indicate a cultural sequence that ranges from Early, Middle, and Late Archaic to Woodland near the top (Goodyear, 2001). Unit 3 has been designated by Goodyear as the Lower Terrace, however for the purpose of this study it will be referred to as the Holocene Terrace (Figures 7, 8, and 9).

DATING THE TOPPER SITE

Organic remains such as wood, bone, or charcoal are rare at the Topper site as acidic sands have destroyed much of the organic materials (Goodyear 2000). Where wood and plant macrofossils are found it is likely that they have been introduced by plant bioturbation into older sediments, or were "in situ lignified plant remains that were preserved in rare reducing environments that escaped oxidation by the vertically fluctuating water table" (Waters et al. 2009:1304). Those samples that were processed for radiocarbon dating were taken from humic acids within flood basin sediments and paleosols of unit 1, and charcoal and humics from unit 3b, while all other dates obtained from units 2 and 3 were obtained using luminescence dating (Figure 7).

Samples of humic acids taken from unit 1a, the deepest and oldest of the strata (see Figure 7), yielded dates of 44,300 ± 1700 ^{14}C yr BP , 45,500 ± 1000 ^{14}C yr BP, and 49,900 ±

1300 ^{14}C yr BP (Waters et al. 2009:1305). All of these dates, (Tables 1, 2) however, likely represent minimum ages because they are at the maximum limits of the radiocarbon method (Waters et al. 2009:1305). Six samples of wood, nutshell, and humic acids were also dated from unit 1a. These dates provide a minimum age for unit 1a and indicate that it dates in excess of 50,000 ^{14}C yr BP (Waters et al. 2009:1305). Lithic material has been recovered within units 1a and 1b, and are therefore associated with dates of >50,000 ^{14}C yr BP.

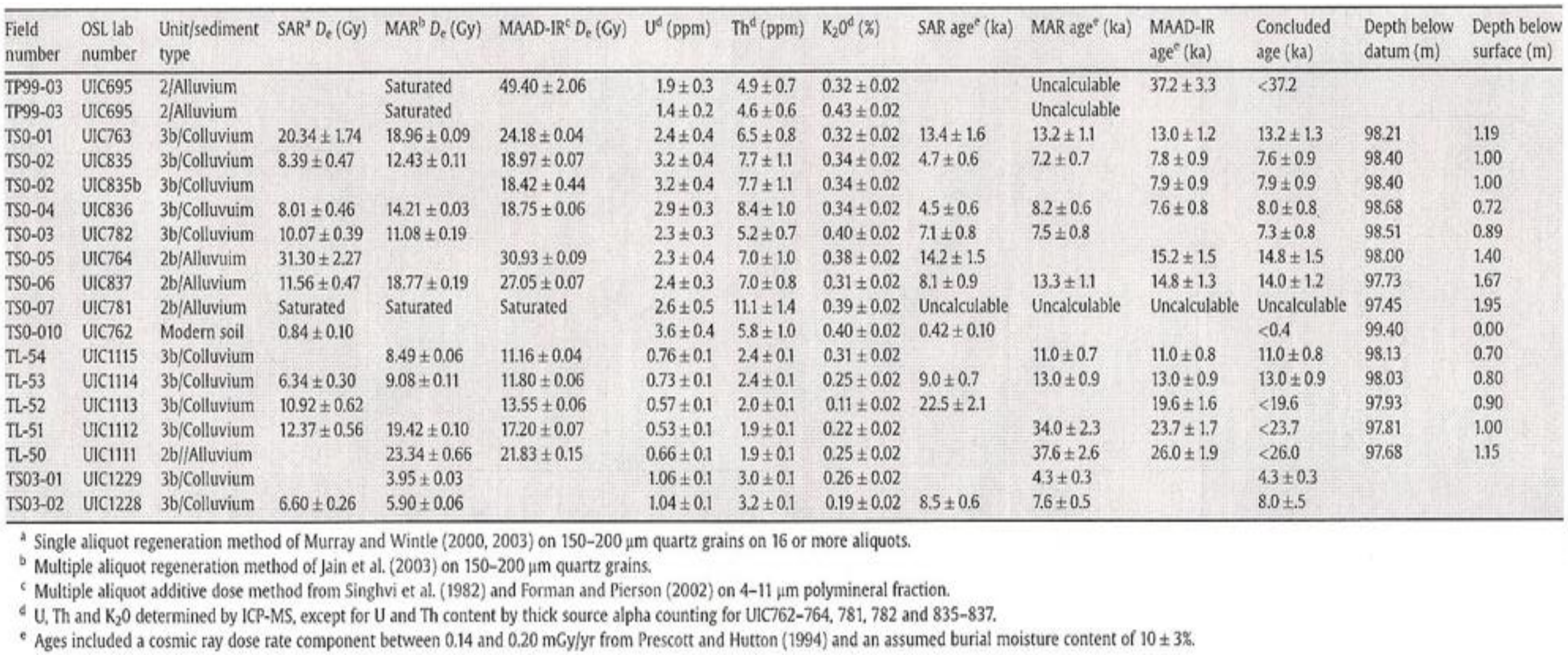
Sediment samples were also collected from multiple locations at the Topper Site for Optically Stimulated Luminescence (OSL) dating (Table 1). The principle of OSL dating is similar to thermoluminescence dating, which was originally developed in the 1960's to date pottery and other fired archaeological materials (Forman 2003:13).

> "When mineral grains are exposed to sunlight for a brief period of time, their inherited luminescence is reduced to a low definable level. Because solar energy rapidly resets the luminescence signals by OSL, the methods can be used to date eolian deposits as well as various deposits of colluvial and fluvial origins, where sediment is either rapidly deposited or exposed to restricted wavelengths and low intensities of light" (Forman 2003:13).

OSL was noted to have worked well to date both the fine and coarse sediments from colluvial and fluvial deposits at the Topper site because these particular sediments contain small amounts of radioactive elements such as uranium, thorium, and potassium which bombard surrounding sediments with electrons as they decay (Waters et al 2009). Some of these electrons become trapped in quartz crystals – the amount of trapped energy is thus used as a measurement of how long the material has been buried (Goodyear 2001:12). Luminescence dating at the Topper site, therefore concentrated on the colluvial-fluvial units 2 and 3, where sediments received an adequate amount of sunlight to reset grain luminescence during deposition (Waters et al. 2009:1306).

Eighteen luminescence ages were obtained from sediment samples collected in stratigraphic order from units 2b and 3b in areas D and I, as well as from three additional samples collected from other portions of the site (Table 2). Within area D two finite ages 14,000 ± 1200 cal yr BP and 14,800 ± 1500 cal yr BP (Figure 7) were obtained from the uppermost portion of unit 2. Two additional OSL ages, 14,400±1200 cal yr BP and 15,200 ±1500 cal yr BP were obtained from sediments at the top of unit 2b. More proposed pre-Clovis lithics and an unusual rock feature occur within unit 2b, meaning that this material could be at least 15,000 years old (Goodyear 2000). Two finite ages were also produced and these ranged from 13,200 ± 1300 yr BP to 7300 ± 800 yr BP. Those dates taken from sediments in area I (see Figures 5, 7) were found to be older than the associated diagnostic artifacts. Waters et al. (2009) believe that this indicates that the sediments had been mixed by bioturbation, which was not evident when the samples were taken (Waters et al. 2009:1308). Accordingly, the samples from this specific area do not accurately date the site. Other dates taken from different locations at the site were found, however, to match archaeological interpretations.

Table 1. Optically Stimulated Luminescence Dates from Topper Site, South Carolina. From Waters et al. 2009.



Field number	OSL lab number	Unit/sediment type	SAR^a D_e (Gy)	MAR^b D_e (Gy)	MAAD-IR^c D_e (Gy)	U^d (ppm)	Th^d (ppm)	K_20^d (%)	SAR age^e (ka)	MAR age^e (ka)	MAAD-IR age^e (ka)	Concluded age (ka)	Depth below datum (m)	Depth below surface (m)
TP99-03	UIC695	2/Alluvium		Saturated	49.40 ± 2.06	1.9 ± 0.3	4.9 ± 0.7	0.32 ± 0.02		Uncalculable	37.2 ± 3.3	<37.2		
TP99-03	UIC695	2/Alluvium		Saturated		1.4 ± 0.2	4.6 ± 0.6	0.43 ± 0.02		Uncalculable				
TS0-01	UIC763	3b/Colluvium	20.34 ± 1.74	18.96 ± 0.09	24.18 ± 0.04	2.4 ± 0.4	6.5 ± 0.8	0.32 ± 0.02	13.4 ± 1.6	13.2 ± 1.1	13.0 ± 1.2	13.2 ± 1.3	98.21	1.19
TS0-02	UIC835	3b/Colluvium	8.39 ± 0.47	12.43 ± 0.11	18.97 ± 0.07	3.2 ± 0.4	7.7 ± 1.1	0.34 ± 0.02	4.7 ± 0.6	7.2 ± 0.7	7.8 ± 0.9	7.6 ± 0.9	98.40	1.00
TS0-02	UIC835b	3b/Colluvium			18.42 ± 0.44	3.2 ± 0.4	7.7 ± 1.1	0.34 ± 0.02			7.9 ± 0.9	7.9 ± 0.9	98.40	1.00
TS0-04	UIC836	3b/Colluvuim	8.01 ± 0.46	14.21 ± 0.03	18.75 ± 0.06	2.9 ± 0.3	8.4 ± 1.0	0.34 ± 0.02	4.5 ± 0.6	8.2 ± 0.6	7.6 ± 0.8	8.0 ± 0.8	98.68	0.72
TS0-03	UIC782	3b/Colluvium	10.07 ± 0.39	11.08 ± 0.19		2.3 ± 0.3	5.2 ± 0.7	0.40 ± 0.02	7.1 ± 0.8	7.5 ± 0.8		7.3 ± 0.8	98.51	0.89
TS0-05	UIC764	2b/Alluvuim	31.30 ± 2.27		30.93 ± 0.09	2.3 ± 0.4	7.0 ± 1.0	0.38 ± 0.02	14.2 ± 1.5		15.2 ± 1.5	14.8 ± 1.5	98.00	1.40
TS0-06	UIC837	2b/Alluvium	11.56 ± 0.47	18.77 ± 0.19	27.05 ± 0.07	2.4 ± 0.3	7.0 ± 0.8	0.31 ± 0.02	8.1 ± 0.9	13.3 ± 1.1	14.8 ± 1.3	14.0 ± 1.2	97.73	1.67
TS0-07	UIC781	2b/Alluvium	Saturated	Saturated	Saturated	2.6 ± 0.5	11.1 ± 1.4	0.39 ± 0.02	Uncalculable	Uncalculable	Uncalculable	Uncalculable	97.45	1.95
TS0-010	UIC762	Modern soil	0.84 ± 0.10			3.6 ± 0.4	5.8 ± 1.0	0.40 ± 0.02	0.42 ± 0.10			<0.4	99.40	0.00
TL-54	UIC1115	3b/Colluvium		8.49 ± 0.06	11.16 ± 0.04	0.76 ± 0.1	2.4 ± 0.1	0.31 ± 0.02		11.0 ± 0.7	11.0 ± 0.8	11.0 ± 0.8	98.13	0.70
TL-53	UIC1114	3b/Colluvium	6.34 ± 0.30	9.08 ± 0.11	11.80 ± 0.06	0.73 ± 0.1	2.4 ± 0.1	0.25 ± 0.02	9.0 ± 0.7	13.0 ± 0.9	13.0 ± 0.9	13.0 ± 0.9	98.03	0.80
TL-52	UIC1113	3b/Colluvium	10.92 ± 0.62		13.55 ± 0.06	0.57 ± 0.1	2.0 ± 0.1	0.11 ± 0.02	22.5 ± 2.1		19.6 ± 1.6	<19.6	97.93	0.90
TL-51	UIC1112	3b/Colluvium	12.37 ± 0.56	19.42 ± 0.10	17.20 ± 0.07	0.53 ± 0.1	1.9 ± 0.1	0.22 ± 0.02		34.0 ± 2.3	23.7 ± 1.7	<23.7	97.81	1.00
TL-50	UIC1111	2b//Alluvium		23.34 ± 0.66	21.83 ± 0.15	0.66 ± 0.1	1.9 ± 0.1	0.25 ± 0.02		37.6 ± 2.6	26.0 ± 1.9	<26.0	97.68	1.15
TS03-01	UIC1229	3b/Colluvium		3.95 ± 0.03		1.06 ± 0.1	3.0 ± 0.1	0.26 ± 0.02		4.3 ± 0.3		4.3 ± 0.3		
TS03-02	UIC1228	3b/Colluvium	6.60 ± 0.26	5.90 ± 0.06		1.04 ± 0.1	3.2 ± 0.1	0.19 ± 0.02	8.5 ± 0.6	7.6 ± 0.5		8.0 ±.5		

[a] Single aliquot regeneration method of Murray and Wintle (2000, 2003) on 150–200 μm quartz grains on 16 or more aliquots.

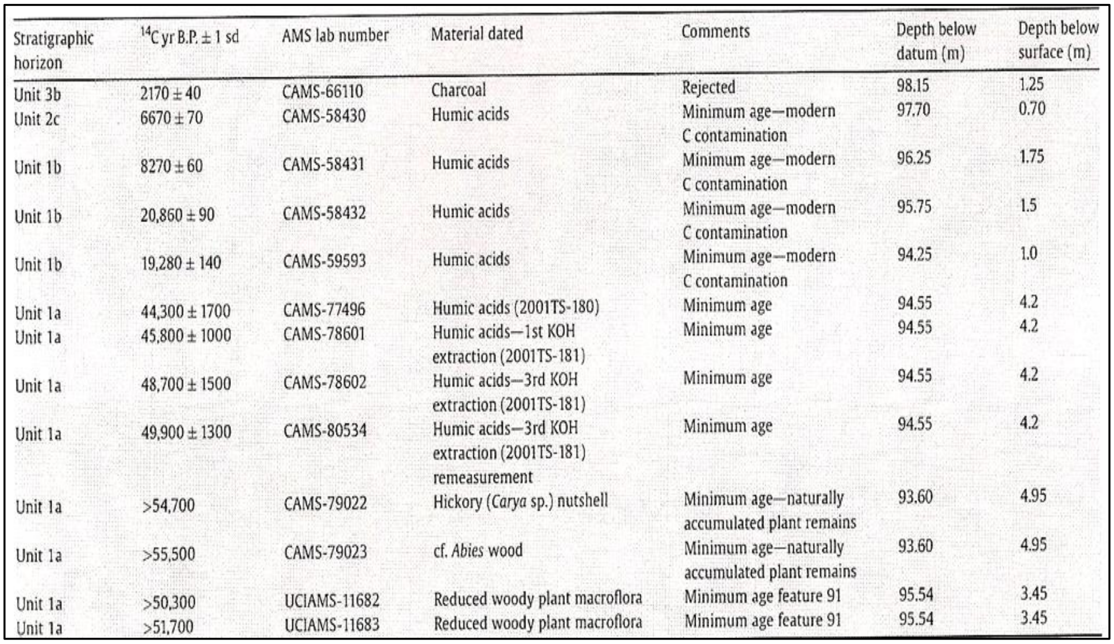
[b] Multiple aliquot regeneration method of Jain et al. (2003) on 150–200 μm quartz grains.

[c] Multiple aliquot additive dose method from Singhvi et al. (1982) and Forman and Pierson (2002) on 4–11 μm polymineral fraction.

[d] U, Th and K_20 determined by ICP-MS, except for U and Th content by thick source alpha counting for UIC762–764, 781, 782 and 835–837.

[e] Ages included a cosmic ray dose rate component between 0.14 and 0.20 mGy/yr from Prescott and Hutton (1994) and an assumed burial moisture content of 10 ± 3%.

Table 2. AMS dates from Humic Acids and Organic Remains at the Topper Site. From Waters et al. 2009.



Stratigraphic horizon	^{14}C yr B.P. ± 1 sd	AMS lab number	Material dated	Comments	Depth below datum (m)	Depth below surface (m)
Unit 3b	2170 ± 40	CAMS-66110	Charcoal	Rejected	98.15	1.25
Unit 2c	6670 ± 70	CAMS-58430	Humic acids	Minimum age—modern C contamination	97.70	0.70
Unit 1b	8270 ± 60	CAMS-58431	Humic acids	Minimum age—modern C contamination	96.25	1.75
Unit 1b	20,860 ± 90	CAMS-58432	Humic acids	Minimum age—modern C contamination	95.75	1.5
Unit 1b	19,280 ± 140	CAMS-59593	Humic acids	Minimum age—modern C contamination	94.25	1.0
Unit 1a	44,300 ± 1700	CAMS-77496	Humic acids (2001TS-180)	Minimum age	94.55	4.2
Unit 1a	45,800 ± 1000	CAMS-78601	Humic acids—1st KOH extraction (2001TS-181)	Minimum age	94.55	4.2
Unit 1a	48,700 ± 1500	CAMS-78602	Humic acids—3rd KOH extraction (2001TS-181)	Minimum age	94.55	4.2
Unit 1a	49,900 ± 1300	CAMS-80534	Humic acids—3rd KOH extraction (2001TS-181) remeasurement	Minimum age	94.55	4.2
Unit 1a	>54,700	CAMS-79022	Hickory (*Carya* sp.) nutshell	Minimum age—naturally accumulated plant remains	93.60	4.95
Unit 1a	>55,500	CAMS-79023	cf. *Abies* wood	Minimum age—naturally accumulated plant remains	93.60	4.95
Unit 1a	>50,300	UCIAMS-11682	Reduced woody plant macroflora	Minimum age feature 91	95.54	3.45
Unit 1a	>51,700	UCIAMS-11683	Reduced woody plant macroflora	Minimum age feature 91	95.54	3.45

EXCAVATION HISTORY AND THE TOPPER ASSEMBLAGE

The archaeological investigations at the Topper site have recovered artifacts ranging from Mississippian to Clovis and perhaps even pre-Clovis in age. Goodyear (2005:108) argues that the time sensitive artifacts are in order by depth, indicating that there was likely a gentle burial of the Holocene record with minimal human and natural disturbances. Clovis artifacts have been recovered in every area at the Topper site, including the terrace, hillside, hilltop, and even in the Savannah River where chert was readily available (Steffy and Goodyear 2006:147) Included among the Clovis tool assemblages are numerous small utilized chert flakes, unifacially retouched flakes, burins, burin spalls, and microblades (Goodyear 2000:19; also see Miller 2007). OSL (see Table 2) dates at the base of the colluviums in unit 3b produced a date of 13,500 ± 100 ^{14}C yr BP, which is very close to the accepted date of Clovis in the New World (Waters and Stafford 2007). The pre-Clovis artifacts, on the other hand, have only been recovered from the pre-Clovis excavation block, an area of the site also referred to as the lower Pleistocene terrace (and herein, the Pleistocene Sands and Pleistocene Terrace). Some ideas as to why this occurred will be discussed in a later chapter.

While there is an extensive Clovis occupation at Topper, the controversy surrounding the site has to do with the presumed cultural materials coming from below the fluted point horizon. It is more relevant to this discussion to focus attention on the pre-Clovis assemblage rather than the Clovis, as the Clovis occupation at Topper is unequivocal. However, it is crucial to this study to have an understanding of all lithic material recovered from the Topper site. Relevant to this discussion is the apparent difference in chert utilized by Clovis people and the chert found below the Clovis horizon. While this chert does fall within the range of what is traditionally described as Allendale chert, there are obvious differences in color and texture between the cherts recovered from within the Holocene Sands versus those found within the Pleistocene Sands and Pleistocene Terrace (Goodyear 2000:19) (Figure 10). As mentioned earlier, cherts originating within the Savannah River have a distinctive glossy rind, while terrestrial sources have a thick chalky cortex. Cherts with the distinctive glossy rind have yet to be found below Clovis sediments. However, the majority of the material recovered from within pre-Clovis sediments has been severely degraded and is therefore more difficult to accurately identify. This material has been described as being poorly silicified with good cryptocrystalline material present only in minor portions (Goodyear 2000:20). It has not yet been confirmed whether or not the differences between the so-called ‘river’ and hillside’ cherts at Topper are due to the degree of weathering or age (Figure 4).

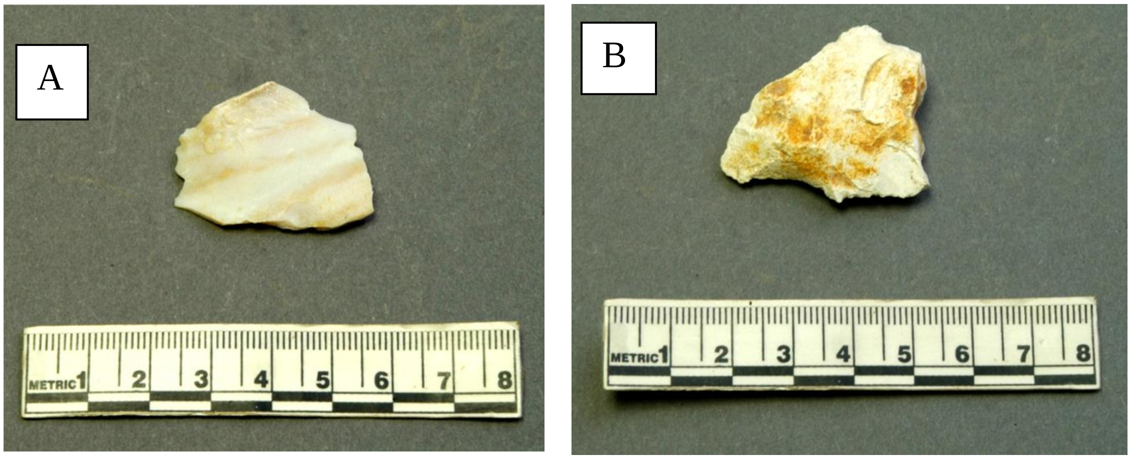


Figure 10. Characteristic chert artifacts recovered at the Topper Site. Figure A represents an interior flake with good cryptocrystalline structure, while Figure B also represents an interior flake but it is poorly silicified.

Chert exposed to, or submerged under water for significant periods of time, however, can become desilicified over time. It is possible that the material found below the Clovis horizon was once of a higher quality, but long exposure to water and other elements has altered its appearance and internal structure. Goodyear has proposed, on the other hand, that perhaps the high quality river cherts did not become exposed until about the time those Clovis toolmakers arrived at the site (Goodyear 2001:13). If denied the high quality material that was readily available to Clovis knappers, pre-Clovis tools would have been manufactured out of what was available, such as the weathered cobbles found traditionally on the hillside (Goodyear 2001:13). However, evaluating the nature of this problem involves factors such as the sites geomorphological history as well as the weathering properties of Allendale chert.

Most of what has been recovered within the pre-Clovis aged sediments, besides what appears to be lithic debitage, are materials that have been described by Goodyear as being microlithic ‘artifacts’ and burin-like ‘tools’ made by a technique called bend-break (Figure 11). It has been described by Goodyear (2001) as a “simpler technology than the sophisticated method used by Clovis knappers” (2001:12). Lithic experts often distinguish between three intentional types of fracture associated with the production of stone tools. These include hertzian, wedging, and bending initiations (Andrefsky 2004; Cotterall and Kamminga 1987; Crabtree 1972; Odell 2004).

Figure 11. Characteristic bend-break found at the Topper Site.

A bend fracture, like those characteristic of the Topper “bend-breaks” are created when force is applied to the center point of a flake, with no opposing force directly under the point of impact. This force will cause the flake to snap transversely, and with no propagation phase, the force travels straight down through the impact point essentially creating a ninety degree fracture angle (Jennings 2011; Crabtree 1972). “Bend-manufacturing yields trihedral and quadrahedal spalls that mimic burin spalls. These spalls do not have striking platforms or bulbs of force created by burinating a flake” (Goodyear 2005a:111).

The thick edges that are created by these breaks are often utilized for scraping and engraving tasks and are known to be expedient in nature. They have also been documented in Holocene-age assemblages as well as in Clovis and Folsom age assemblages in North America

(Bergman et al. 1987; Frison and Bradley 1980; Waters el al. 2011). It is not known however, whether these breaks were intentionally created by prehistoric knappers for use as tools as Goodyear would suggest. An experimental study conducted by Jennings (2011) compared bend and radial fractures produced by intentional flake percussion to those produced by incidental breakage during biface reduction and flake trampling damage. Because both breaks can occur with high frequencies intentionally, as well as accidentally through trampling, he cautions that "evidence of invasive resharpening along breaks and use-wear analysis may be the only means for conclusively demonstrating that these breaks were an important toolkit component" (Jennings 2011:7). So far hundreds of these specimens identified by Goodyear as bend-breaks have been recovered from previous excavations within pre-Clovis sediments. What has not been found within pre-Clovis levels, however, is substantial evidence for the production of bifacial or unifacial chipped stone tools, although apparent flakes or flake fragments have been found in some incidences, as documented in subsequent sections of this thesis .

One artifact discovered during the 2009 summer excavation from within the Pleistocene terrace, does appear to have been bifacially worked (Figure 12). This artifact, although considerably weathered, also appears to have been subjected to thermal alteration; note the pink discoloration on the surface. The location of this specimen and its similarity to objects recovered from within the Middle Archaic Late Archaic (MALA) levels, where thermal alteration was commonly employed, leads me to believe that this artifact may have originated from one of the MALA layers. But, because the artifact appears to have been subjected to episodes of weathering and degradation, it is difficult to say with any degree of certainty where and hence the piece originated.

Figure 12. Probable bifacially worked artifact recovered from within the hard-clay Pleistocene terrace.

In addition to the bend-break type artifacts, other finds from previous years of excavation include a large boulder which is hypothesized to have been used by pre-Clovis people as an anvil (Goodyear 2005a). Evidence for this interpretation comes from several scars on the upper surface of the boulder which is hypothesized by Goodyear as having been the result of smashing. Recovered next to this boulder were two chert pieces identified as spalls. Other chert cobbles recovered among pre-Clovis sediments were found to exhibit lines of force in multiple directions, potential flake scars which seem to exhibit hard terminations that often result in hinges.

The presence of small flakes with striking platforms and bulbs within pre-Clovis sediments may also be indicative of human manufacturing processes as small flakes may represent by-products of retouch or stone tool manufacture. Other materials previously recovered among pre-Clovis aged horizons at Topper include possible blades, endscrapers, and sidescrapers (Goodyear 2005a:8). Dr. Marvin Kay, a microscopic use-wear specialist known for having analyzed material from the Monte Verde site (Dillehay 1997), examined a number of pre-Clovis artifacts from Topper. These use wear studies remain unpublished.

All excavations prior to the 2004 field season stopped at the hard contact of the clay Pleistocene terrace, or unit 2b as previously identified by Waters et al. (2009). Lithic materials, like those mentioned above, were recovered above this point in the white Pleistocene alluvial sands that overlie this hard terrace. It was believed that no further human occupations could have existed below this point. In 2004, however, it was decided that excavations would continue into the terrace to test the hypothesis that pre-Clovis artifacts could in fact be deeper in the terrace and not just bioturbated into the upper few centimeters of the deposit.

The upper 50 centimeters of the Pleistocene Terrace was systematically removed using shovels and trowels with the fill screened in a number of 1x1m units, using 1/8th inch mesh screens. Chert debris was found, including possible artifacts. As a result, additional one meter units were opened into the Pleistocene Terrace by hand using trowels, leaving as many potential artifacts in place as possible for photography and piece plotting. During excavations deep into this terrace, about a meter below the upper boundary, a basin shaped charcoal stain was discovered, that was designated feature 91. Because the stain was hypothesized to be a hearth, a number of specialists were consulted. The specialists included Dr. Sarah Sherwood, geoarchaeologist from the University of Tennessee, Dr. Larry West of the Department of Soils and Crop Science of the University of Georgia, and Dr. Mike Waters, the primary geoarchaeologist on the project.

Dr. Stafford, a radiocarbon dating specialist, also examined the hearth-like feature and collected charcoal samples, obtaining ages of > 50,300 ^{14}C yr BP and > 51,700 ^{14}C yr BP (Table 1). It has not yet been determined whether or not this feature is a hearth (Goodyear 2005). However, the dates recovered from the area have stimulated a lot of interest and speculation, as probable chipped stone artifacts have also been recovered in sediments as deep as this feature (Goodyear 2005a). These lithics include more of the proposed bend-break tools, a possible modified chert core, simple unifaces, as well as a graver spur. The graver spur is the only unquestionable artifact of human manufacture recovered in horizons below Clovis (Goodyear 2009), although whether it was made and deposited in pre-Clovis time, or is the result of bioturbation from above has not been determined. Excavated material from within these controversial units was not available to me for analysis. I therefore did not have the opportunity to analyze any of the probable lithic artifacts.

The 2009 summer excavations at Topper produced the materials examined for this study. which came from a total of six 1x1m units opened into the Pleistocene sands and Pleistocene terrace deposits in the pre-Clovis excavation block at Topper, as described in more detail in Chapter 3. Several potential artifacts were recovered from within the pre-Clovis horizons. These include a possible chopper tool (Figure 13), a flake with possible evidence of use wear or edge damage (Figure 14), and several other large flakes which appear to have differing degrees of edge damage (Figure 15). Only those artifacts excavated during the 2009 summer field season were analyzed and included in the following project. Further information regarding this assemblage and its location within the Topper site will be detailed in Chapter 3.

Figure 13. Apparent chopper-like tool recovered during the 2009 excavations.

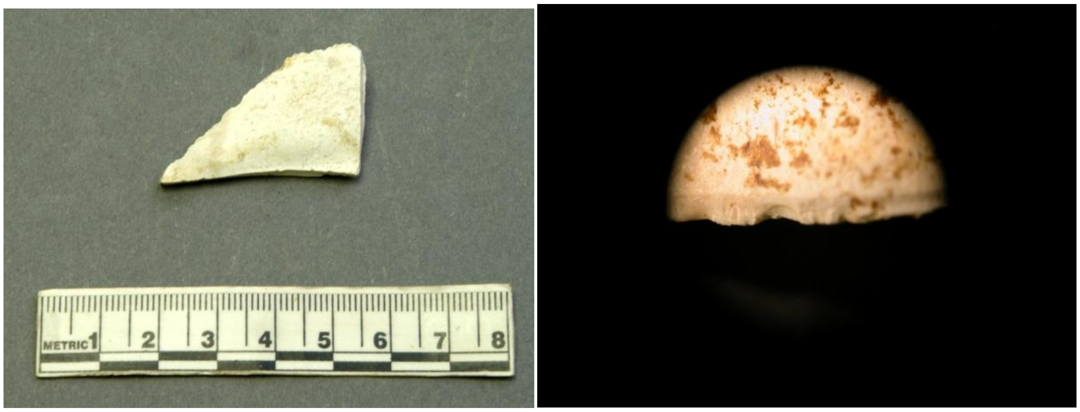


Figure 14. Probable modified flake recovered from within the pre-Clovis Pleistocene sands. Picture to the right showing magnified edge damage or use-wear.

Despite the amount of lithic material that has been recovered from within pre-Clovis aged deposits at the Topper site, very few have been systematically examined. This is an essential step in demonstrating whether they are of human origin or not. The technology has been characterized by its non-bifacial character and its emphasis on microlithic artifacts, specifically those identified as bend-breaks or burin-like tools (Goodyear 2005a:111). Demonstrating whether the material recovered from the 2009 excavations was of human origin was the primary goal of this analysis. Another was to evaluate whether the materials could have been bioturbated from an overlying horizon, introduced through stream flow, or created by natural agencies. The analysis herein were directed to providing a basic description of a sample of the assemblage from the site, and examining its context.

Figure 15. Probable artifact recovered from the pre-Clovis Pleistocene sand sediments. Picture to the right shows magnification of edge damage or possible use-wear.

Reactions to this assemblage and the OSL and radiocarbon dates at Topper have ranged from enthusiasm to extreme skepticism. Many question the fact that the assemblage is improbably consistent over a long span of time, from between > 50,000 and 15,000 yr B.P. (Waters et al. 2009:1310). Others are more accepting (Wheat 2012), although even these comprise only a small minority among the scholars exploring the question of the peopling of the Americas. Continued excavations and research are needed in order to authenticate the pre-Clovis occupations at Topper. More specifically, these studies must take into account and test the stratigraphic integrity of the units in question, and must also consider those site formational and post-depositional processes which may have contributed to the deposition and degradation of the assemblages. This thesis is directed at resolving at least some of the questions regarding the nature of the pre-Clovis lithic assemblage at Topper.

CHAPTER 2: RESEARCH DESIGN

INTRODUCTION

Archaeological investigations throughout history are often at a disadvantage; as one must base a majority of the inferences and assumptions about a culture on a limited amount of data. The most frequently recovered material in the archaeological record used to infer past human activity has been stone tools and associated debitage. Given the ubiquitous distribution of these remains and the amount of information that must be gained from them, it is important for archaeologists to be trained in lithic analyses. The more detailed and problem focused the analysis one can conduct with the lithics, the better insight one will get into the lifeways of the peoples living and working at that particular archaeological site (Kooyman 2000:1). The archaeological materials excavated from the Topper site (38AL23) are no different; nearly all of the material recovered from the pre-Clovis Excavation Block and associated hillside units consists of stone tools and the debitage associated with their production. The analysis of lithic debris has become an invaluable tool for deciphering components of archaeological sites. The application of mass and attribute analysis are thus the primary analytical tools utilized in the examination of the lithic from the Topper site.

This chapter provides a description of the projects research design and the archaeological sample examined. I first outline the goals of the project based on the material recovered during the 2009 excavations. In the second section the analytical methods and procedures used in the analysis are presented, with reference to supporting technical writings. The final section of this chapter discusses the possible post-depositional processes affecting the sample.

The research conducted for this project attempted to utilize non-subjective and replicable methods of data analysis. Counts and weights were systematically recorded over a range of categories, and attribute data were collected on lithic debitage using electronic equipment, such as digital calipers. Visual observations were taken following a strict set of guidelines described later in this chapter to ensure the replicability of the analysis.

RESEARCH GOALS

Excavations conducted at Topper have demonstrated that the multi-component site was occupied intermittently over a span of thousands of years from modern times back to the Clovis era and possibly much earlier. From the Clovis period to the present, each group of inhabitants left behind clear archaeological signatures of their presence. Within those known cultural horizons there is direct evidence for humans manufacturing stone tools from locally available Allendale chert. It would be reasonable to assume then, that earlier populations, those that may have been in the New World prior to Clovis, would have taken advantage of the available chert resources and utilized the area for this, and perhaps other, natural resources

Each of the documented archaeological components at the Topper site, including the hypothetical pre-Clovis occupation, utilized Allendale chert for tool stone. Recognized components from late prehistoric to Clovis utilized similar technologies to produce tools. It is hypothesized here that the distribution of lithic debitage, produced from similar materials utilizing similar technologies, should be similar for each of these documented components. If true, these patterns of debitage should be replicated in any pre-Clovis lithic components at the site that were made from Allendale chert if similar technologies were employed. Where critical patterns of debitage are overwhelmingly shared between undisputed temporal/cultural assemblages and potential pre-Clovis assemblages, the probability is very low that the pre-Clovis assemblage results from dislocation since dislocation of artifacts rarely results in replication of original assemblage patterns of size, shape, and other artifact attributes. On the other hand, if the patterning of debitage is dissimilar, there is a greater probability that the lithic material was either displaced or created using differing technologies. Critical to such an analysis is an understanding of stone tool manufacture, use, and discard, site formation processes, and the kinds of those post-depositional processes that can affect an archaeological lithic assemblage.

Research Sample

The analysis reported here was conducted on a suite of lithics and lithic debris recovered from six 1x1 meter test units located within the pre-Clovis Excavation Block of the Topper Site (Figures 16 and 17). While many units had been excavated in the pre-Clovis Excavation Block and were potentially available for analysis, only those which had been opened from the surface of the A horizon down into the Pleistocene Terrace in consistent 1 x 1 m units were used. It was crucial for this particular analysis to have units that represented complete stratigraphic profiles; specifically those units which accurately represent deposition from the Holocene Sands down into the older pre-Clovis Pleistocene Sands and Pleistocene Terrace deposits. A complete profile is necessary to show the vertical distribution of debitage and is especially important for evaluating the stratigraphic integrity of a unit. Given the quantity of material present, which was formidable given that the site was a quarry, the sample units were more than sufficient to examine the vertical distribution and characteristics of the material.

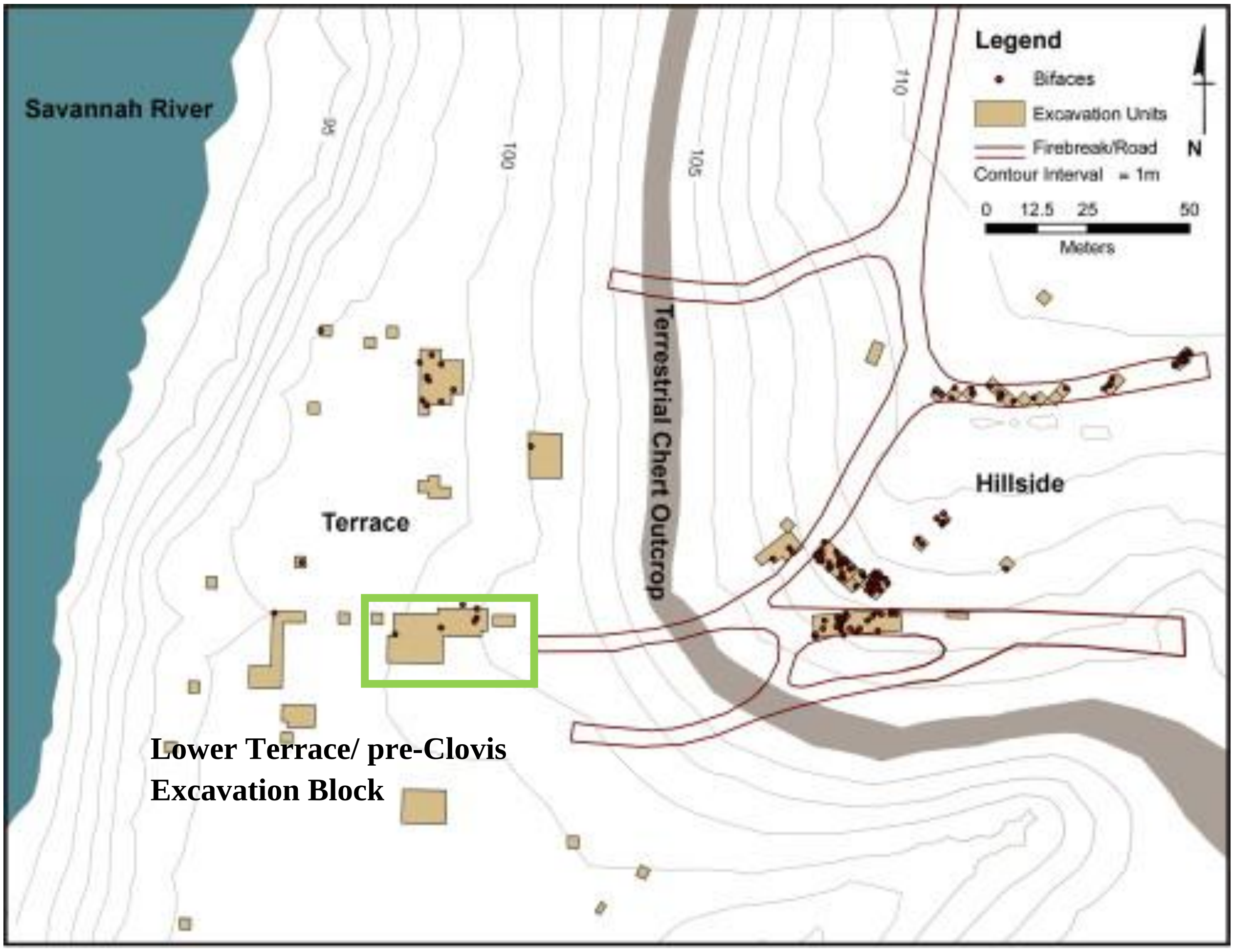


Figure 16. Topographic map of Topper Site showing the location of the pre-Clovis excavation block. Image adapted from Miller 2007.

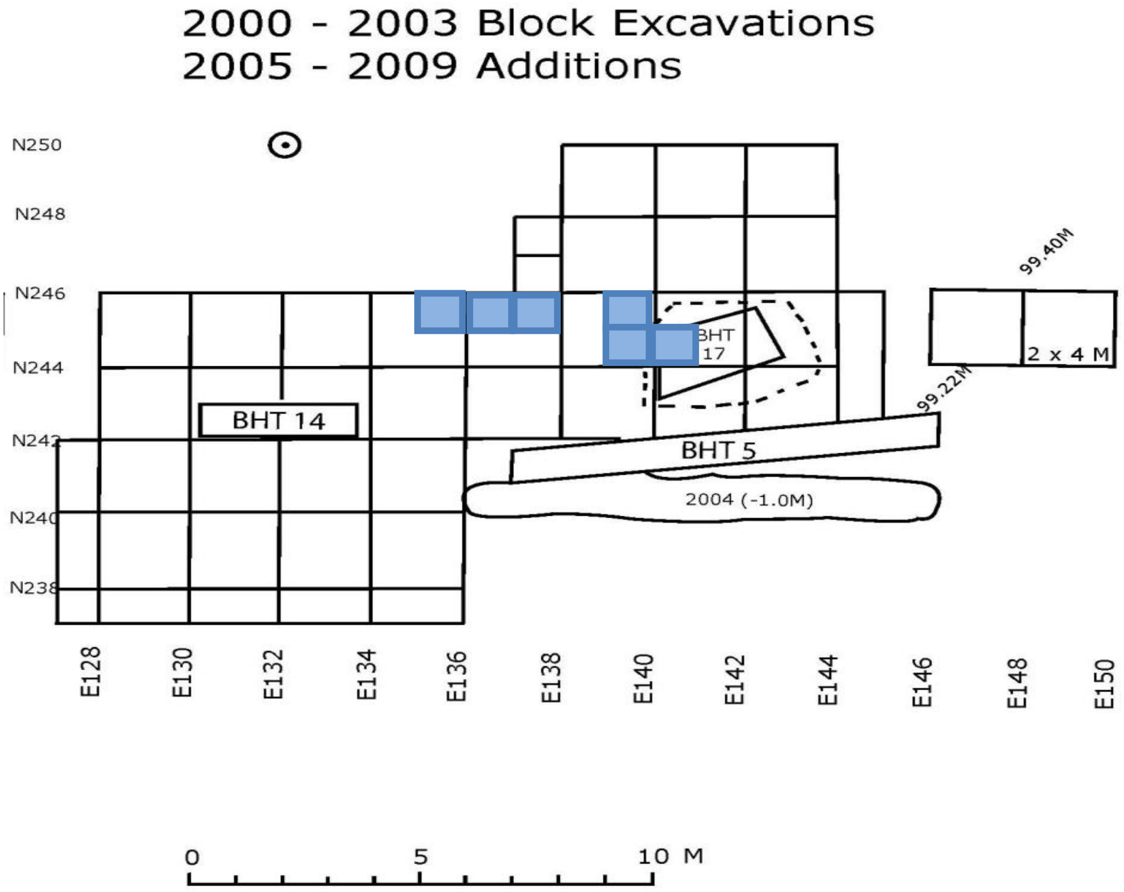


Figure 17. Plan view of pre-Clovis excavation block, showing excavated units.

LITERATURE REVIEW

The objective of any study of archaeological remains is to reconstruct and understand past human culture. Most archaeologists want to understand in what environment(s) past people lived, how they exploited these environment(s), and how they adapted to the possibilities and limits of that environment (Kooyman 2000:2). Human culture is, after all, the human response to these challenges. But in order to be able to make these kinds of conclusions, archaeologists must study the material recovered in the archaeological record since significant aspects of the interaction of humans with their environment is visible through their use and manufacture of technology (Kooyman 2000:2).

Assessing Stone Tool Properties

The research that was conducted with materials from the Topper site involved the examination of the properties of the stone tools and debitage, and the different aspects of the lithic-tool manufacturing and maintenance process represented in the excavation sample. How local Allendale chert was worked and what sorts of byproducts were left behind formed the subject of this analysis. Because stone tool manufacture and use are both reductive processes, there is usually lithic material left behind within the archaeological record. This lithic waste, also referred to as debitage, is a relatively durable byproduct of tool manufacturing and maintenance activities and, moreover, provides a seemingly direct link to discrete episodes of prior human behavior (Ahler 1989:85-86).

Debitage analysis has been defined by Fish (1981:374) as the systematic study of chipped stone artifacts that are not cores or tools. Studies of lithic debitage have become increasingly fundamental for archaeologists to interpret prehistoric behavior, as they provide essential information for reconstructing prehistoric technology and patterns of behavior (Fish 1981:374).

> As a waste product from past human activities, flaking debris is likely to have been deposited at or very near its locus of origin within past cultural systems. Thus flaking debris is recognized as holding special potential for unraveling the spatial structure of many past cultural systems" (Binford and Quimby 1963).

It is has been demonstrated that it is not always a straightforward matter distinguishing tools from flaking debris or naturally fractured lithic material (Cotterell and Kamminga 1987:675). When examining flakes and flake tools like the materials found at Topper, it is critical to employ attributes which can be used in the identification of humanly produced flakes versus those produced by natural agencies. To do this Patterson (1983) has suggested one follow four steps: 1) identify all typical man-made lithic attributes that nature is least likely to simulate; 2) analyze the lithic collection in question for the presence or absence of these attributes; 3) identify the attributes that are present in quantitatively significant amounts; and 4) demonstrate the likelihood of human manufacture by examining combinations of attributes. The latter is increasingly important, as studies emphasizing only a single attribute are likely to be unconvincing, while studies where multiple lines of evidence point to a conclusion are more believable (Patterson 1983: 299). An initial examination of the pre-Clovis assemblage from Topper revealed that the vast majority of this lithic material is flakes of various shapes and sizes, cortical debris, and cortical and chert shatter.

It is important to establish definitions for all of the material being examined so the study can be replicated accurately in the future. Flakes are defined as any object detached from larger stone masses; this treatment, however, includes natural as well as human fracture (Shott

1994:70). By definition, shatter differs from flakes in that it includes all cubical and irregularly shaped chunks that lack bulbs of force, systematic alignment of fracture scars on faces, striking platforms, and points of flake initiations (Root 2004:73).

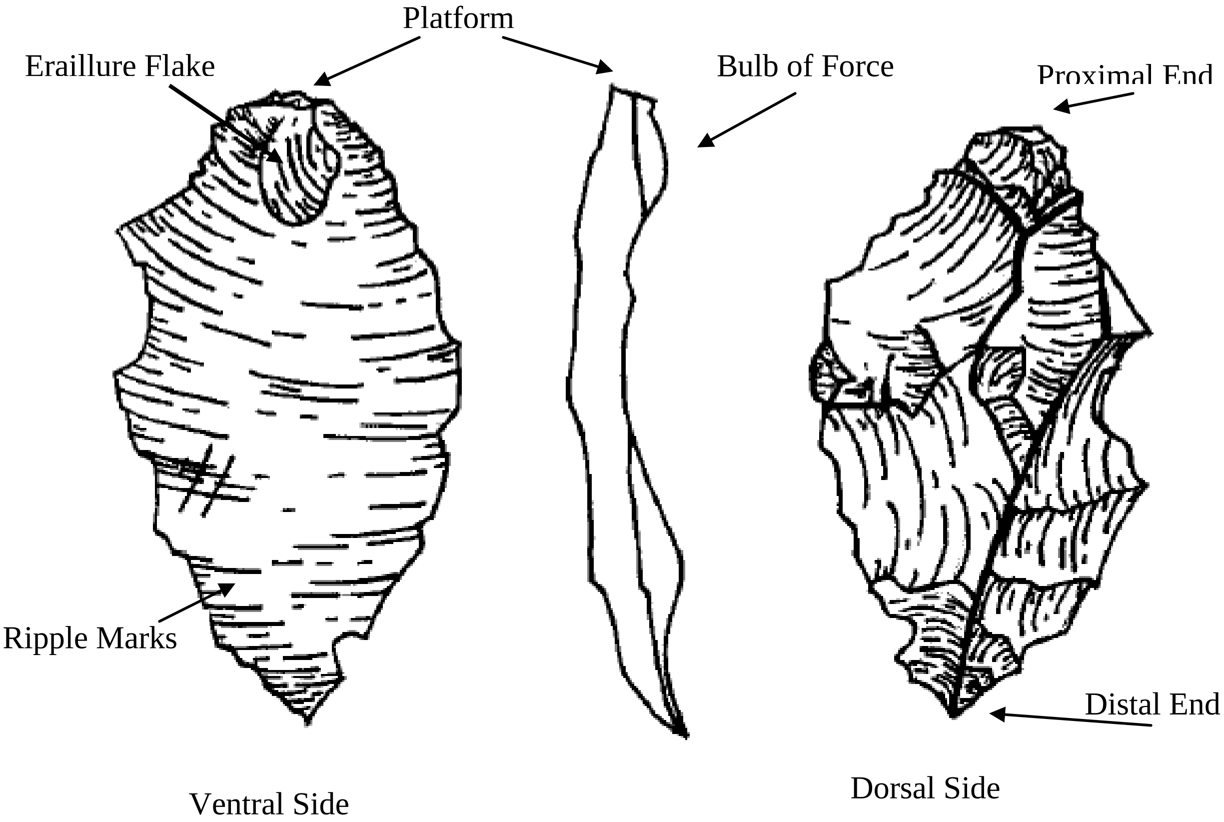


Figure 18. Conchoidal flake showing common elements and terminology.

When distinguishing a naturally produced flake, from one that has been intentionally detached, it is crucial to look for certain attributes (Figure 18). These distinctive features include prepared, crushed, or faceted striking platforms, prominent bulbs of percussion, bulbar scars and negative dorsal bulb, evidence of previous flake removals on the dorsal surface, ripple and radial lines, differential weathering of flakes, cortex on the striking platform and dorsal surface, and patterned edge removals or edge damage (Patterson 1983). These attributes often result from percussion- type fractures produced primarily by humans during stone tool manufacturing processes (Patterson 1983:299). It should be noted that not all humanly modified flakes will exhibit all of the above attributes, however it is hoped that they will exhibit enough that a definitive answer can be made as to whether or not they were naturally or humanly made. Moreover, concentrations of specimens showing these typical man-made attributes in discrete spatial areas is further evidence demonstrating the likelihood of human activity (Patterson 1983:299).

Patterson (1983) has suggested that the aforementioned characteristics be used to determine the nature of lithic debris. It has been demonstrated, however, that natural forces also have the potential to produce most of these attributes to at least some degree. Peacock (1991), for example, examined the attributes proposed by Patterson (1983) (prepared, crushed, or faceted striking platforms, prominent bulbs of percussion, bulbar scars and negative dorsal bulb, evidence of previous flake removals on the dorsal surface, ripple and radial lines, differential weathering of flakes, cortex on the striking platform and dorsal surface, and patterned edge removals or edge damage) and determined that statistically not all of them are reliable indicators of human production. It was found, for example, that only six of these attributes successfully separated known artifacts from known naturally produced lithic materials. Three of these variables are related to percussion flaking, which is presumed to be how most flakes were struck in early stone tool industries: (1) prominent bulbs of percussion, (2) radial lines, and (3) bulbar scars. The other three variables are known to be related to repeated percussion: (4) amount of cortex, (5) number of flake scars on dorsal surface, as well as (6) the presence of a negative dorsal bulb (Peacock 1991:354). The remaining variables were shown to be produced just as readily by natural agencies.

An additional attribute, patterned edge damage or edge removals, and also has the potential to distinguish made-made lithics from those produced under natural conditions. It is far more complicated, however, to distinguish natural damage from damage produced by human production, use, and discard. The distinguishing characteristic here is evidence for patterned edge removal; it is thought that nature is random and therefore it is not likely for natural forces to remove many consecutive flakes on a core or modified flake (Patterson 1983:320). In addition, strictly unifacial, in addition to intentional bifacial flaking, is also identified as an indicator of human manufacture. Patterson (1983) has argued that completely unifacial tools would be one of the most difficult items for nature to reproduce by random forces; it would be difficult for fortuitous forces to create the long, uniform, parallel flake scars characteristic of purposefully retouched unifacial tools (Patterson 1983:303). Those removals which are the result of natural processes are often short, uneven, and steeply transverse, and occur on flakes with amorphous shapes. The most frequently cited situation where nature has been known to create edge damage is when material is carried unidirectionally in streams and agitated by sand or stones (Figure 19), or when material is transported down hill (Patterson 1983:304). When examined, these materials exhibit edge damage which is confined to abrasion and short, steep, transverse flake scars (Patterson 1983:304). It does often prove difficult, however, to distinguish between edge modification that is the result of nature and that which was removed purposefully by a knapper during use or trampled, as per the discussion at the end of this chapter.

It is increasingly important, then, for archaeologists to be aware of the nature of a site and the processes that could have affected the assemblages deposited there. Because the Topper site has not only been intensely occupied, but has also been affected by fluvial and colluvial processes, the ability to distinguish between material that was intentionally flaked and material that was modified through natural agencies is a complex and challenging task.

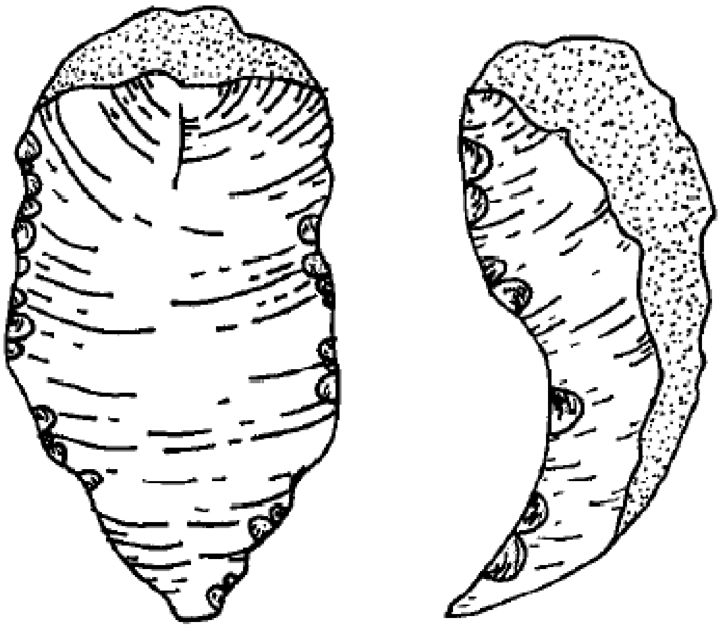


Figure 19. The damage caused by agitation of a flake in water with sand, stones, etc.

Mass Analysis

One of the most popular types of debitage analysis, and one that was conducted with materials from the Topper excavation sample (Andrefsky 2001:3), is what has been referred to as aggregate or mass analysis. Shott (1994) has defined aggregate analysis as a method that analyzes an entire collection using non-technological criteria to subdivide the assemblage before considering the technology that was used to create it (Shott 1994). The characteristic most often studied in aggregate analysis is the general size distribution of the debitage sample. However, other variables such as mean size and mean weight for the sample as a whole or for some subset of the sample may be of interest (Ahler 1989:86). Mass analysis is most frequently applied to lithic assemblages, given that it is a quick and easy way to generate data from large debitage samples.

When utilizing this technique, all lithic material from an excavation, or in this case a series of 1x1 units, is sieved through a series of progressively smaller screens. Traditional mass analysis employs graduated screens ranging from 1.0 inch to 5.613mm. For this project a U.S.A. Standard Testing Sieve set was employed; it included six screen sizes: 9.5mm, 7.925mm, 5.613mm, 3.962mm, 2.794, and 2.0mm. The number of pieces, total weight, and the number of cortex-covered pieces (flakes, flake fragments, and shatter) are commonly recorded for each screen size (Kooyman 2000:62). Ahler has noted that size grading, moreover, provides a potentially more efficient method for rapidly measuring both the upper size limit in a flake sample and information about the overall and average size distribution in that sample (Ahler 1989:90). The general size distribution of a flake sample can be effectively documented by recording relative counts of flakes across size grades.

After the initial subdivision of an assemblage, statistical methods are then employed to characterize the lithic material (Larson 2004:8). This specific type of analysis has proven useful as a method for differentiating site type and manufacture trajectories of lithic debris (Odell

2004:130), and is generally advocated for three reasons: replicability, effectiveness in examining large assemblages, and the reductive nature of stone tool manufacture (Carr and Bradbury 2004:21).

Attribute Analysis

An alternative to mass analysis is the examination of individual flakes for key attributes, like the six previously identified by Patterson (1983). It is a method commonly referred to as attribute analysis or individual flake analysis, and it too was conducted with materials from the excavation sample at Topper. In this method, emphasis is shifted to individual flakes which are either classified by some typology or by those key attributes which can be measured, tabulated, and recorded (Knudson 1973, Henry and Odell 1989, Fish 1979, Patterson and Sollberger 1987, Magne 1985). It is a technique most often used to examine stage and reduction questions, but also has the potential to provide information regarding manufacturing techniques. It can, for example, help distinguish between hard and soft hammer percussion and percussive versus pressure flaking. It is often successful because each flake essentially contains significant data on discrete behavioral episodes that can be observed through the identification of key attributes.

Debitage attribute analysis essentially begins with the selection and recording of certain debitage characteristics. However, unlike mass analysis; debitage typological analysis examines attributes on individual specimens (Andrefsky 2001:9). This type of analysis is not dependent upon size classes; however, the specimens should be large enough to be able to accurately record attributes. Those attributes most commonly recorded include striking platform characteristics, amount of dorsal cortex, dorsal facet counts, and the type of flake termination. In addition to these attributes, the length, width, thickness, and weight of the individual flakes is often examined and recorded. These attributes are often analyzed by researchers searching for trends within a population, issues of production sequence, and reduction techniques (Andrefsky 2001:9).

POST-DEPOSITIONAL PROCESSES CONSIDERED FOR THIS STUDY

A great deal can happen to an archaeological assemblage and related debitage subsequent to its deposition. A number of non-cultural processes are known to alter or disturb flakes, stone tools and debitage. These processes include trampling, plow damage, episodes of degradation as a result of fluvial, colluvial, and alluvial processes, impacts from cave-roof fall and sediment compaction, thermal damage, as well as wind or waterborne sediment abrasion and displacement (Rasic 2004:112). The effect that these and other processes have on artifacts has been referred to as taphonomy. Taphonomy is traditionally defined as the study of the processes involved in the transformation of organic remains into fossils. In recent years however, it has been applied by archaeologists in a more general sense that refers to the changes not only to organic materials such as bone and shell undergo following deposition, but also to stone tools and lithic debitage (Hiscock 1985,2000). Rasic (2004:114) has noted that “materials such as lithics undergo an analogous process of transformation during their use, discard, burial, and recovery”. Archaeologists must not assume that the preservation they encounter in an assemblage is representative of the actual prehistoric patterns of activity and use, as the landscape is not static, but rather is dynamic and constantly changing (Waters and Kuehn 1996:484).

A taphonomic perspective on debitage is thus a useful one because it focuses attention on observable changes imparted to flakes and flake assemblages between the time they were created and the point at which they are studied by archaeologists (Rasic 2004:114). "It prompts archaeologists to consider how differential fragmentation, attrition, and alteration of flakes are likely to have affected archaeological patterning" (Rasic 2004:114). These changes, likewise, affect those attributes that are routinely measured in debitage analysis. These include flake size and weight, item counts within various analytical classes, flake completeness, cortical coverage, and raw material appearance and texture (Hiscock 1985, 1990, 2002, Prentiss and Romanski 1989).

The vertical and horizontal distribution of debitage can also be examined as different taphonomic processes not only affect flake attributes but can also disperse debitage (Rasic 2004:113). Tani (1995) has noted that "taphonomic changes can be seen either as noise that obscures the 'true' behavioral patterning that is the goal of research or as important sources of information in their own right because they supply clues about past cultural and environmental processes" (1995:101). Breakage for example, whether the results of trampling or stream flow, both increases the number of artifacts and reduces their mean size, potentially creating more noise within the archaeological record (Pryor 1988). It would be unwise to make any conclusions regarding any assemblage before investigating all of the agents that could potentially be responsible for its presence and condition in the archaeological record.

Waters and Kuehn (1996) note that degradation events also have the ability to diminish the completeness of the geologic and archaeological records, thus leaving archaeologists with an incomplete record of the history and nature of a site. They note that, "the greater the number, duration, and intensity of erosion events, the greater the destruction" (1996:484). Moreover, destructive or erosional events in the archaeological record are not always represented or definable. When analyzing any archaeological assemblage, it is therefore essential to address several questions: What post-depositional processes could have altered the debitage or the assemblage, and how did these processes operate? How might flake attributes and assemblage characteristics be altered? What is the relative degree of impact that different taphonomic agents have on flake assemblages? And lastly, what kinds of positive contributions can knowledge of taphonomic processes tell us about issues such as site occupation history and site structure (Rasic 2004: 113)?

As stated earlier, there are several processes that can alter or displace lithic material prior to their excavation. The processes considered here include episodes of weathering and stream deposition, thermal stress, and trampling. Each of these processes has the potential to significantly alter material in the archaeological record making it potentially difficult to interpret the archaeological record correctly.

Erosion and Stream Deposition

Natural processes, such as weathering and erosion, can destroy or change culturally created patterns of artifact distribution and taphonomy (Rick 1998). Erosion is, in fact, one of the most common forces acting on artifacts after their deposition in the archaeological record. Because landscapes are not static, but rather are dynamic and continually changing, one must assume that archaeological sites once part of a prehistoric cultural system are essentially destroyed over time, "thus fragmenting the record of human settlement and activity for any time period" (Waters and Kuehn 1996). Those natural processes acting upon an assemblage or site have the ability to alter, disperse, or completely wipe out evidence pertinent to an archaeological investigation. Archaeologists must discern whether or not the patterns of preservation at sites are actually representative of the prehistoric patterns of activity.

It has been demonstrated that, during the Pleistocene, worldwide weather patterns fluctuated considerably. Intermittent warming and cooling cycles in particular are known to have affected river and stream volumes. In some cases, for example, stream and river volumes would have been subjected to larger than usual annual elevation variations due to increases in precipitation or meltwater (Shackley 1978). This could have resulted in episodes of flooding, ultimately resulting in cycles of deposition and erosion on the landscape. For sites like Topper, located in a floodplain/terrace setting, the archaeological assemblage would have been subjected to processes associated with fluvial action as well as colluvial deposition from the nearby hillside. Fluvial action can, for example, preserve archaeological material through deposition, redeposit a part or the entirety of a site, or can in fact completely destroy archaeological sites by processes of erosion and/or degradation (Waters 1988:213). Petraglia and Potts (1994) have noted that water flow is one of the most important post-depositional site formation processes that can significantly alter the integrity of a site. The overall completeness of the archaeological record located within a fluvial environment is directly dependent upon the extent of aggradational and degradational episodes, as well as upon the stability of the landscape (Waters 1988:213). Those sites located within higher velocity floodplains have greater chances of becoming dispersed or destroyed. Isaac (1967) found that under both hard and sandy bed conditions, flakes and small implements may be removed from as assemblage, as long as the critical flow velocity is sustained. In a fluvial environment, for example, the movement or displacement of artifacts is dependent upon their size, velocity of water flow, the space between the artifacts and particles, and the texture of the ground on which the water is flowing (Shackley 1978:56).

Thermal Stress

The characteristics that are likely to influence the susceptibility of lithic raw material to thermal fracture include the size and shape of the specimens, the thermal conductivity, and homogeneity of the materials. The larger the specimen, the more susceptible it is to thermal stress because greater temperature differentials develop and portions of the mass heat or cool before other portions (Rasic 2004:118). Flakes, then, are usually expected to heat and cool uniformly because they are generally small compared to chunks of bedrock, cores, or other formed artifacts (Rasic 2004:118). When thermal stress does result in failure, the attributes most often described include frost pitting, potlid fractures, crazing, the detachment of angular debris, and scaling (Rasic 2004:118). Rasic (2004) notes further that in the cases where thermal stress results in the detachment of angular debris, this material is found to lack points of applied force.

Three mechanisms likely to cause thermal fracture in the archaeological record have been identified as insolation, wildfire, and human controlled fire features. Insolation, heat originating as solar radiation, is also conditioned by slope and aspect, changing cloud cover, wind, and other microclimatic variables (Rasic 2004:119). It is the rate of the temperature change that has been found to cause fracture in rock masses. Rasic (2004:119) has noted that “geologists now recognize insolation weathering as an important rock mechanism, particularly in cold regions where temperature differentials between cold air and sun-warmed rock can be high and therefore it is worth considering as a potential agent in flake alteration”. In colder regions lithic (and other) material has the potential to undergo freeze-thaw cycles. Frost action, also known as gelification, frost wedging, freeze-thaw weathering, and frost shattering, has been defined as the mechanical disintegration, splitting, or break-up of rock by the pressure of freezing water in cracks, pores, joints, or bedding planes in that rock (Hilton 2003).

Because frost action is considered a potential mechanism for the fracture of rocks, it has been argued by some (Rasic 2004; Hilton 2003) that rock fracture or artifact attrition as the result of freeze-thaw actions is actually a rare occurrence in archaeological contexts; and further when operable is unlikely to have significant effects on lithic artifacts (Rasic 2004:120). A majority of the damage observed in freeze-thaw experiments were found to be the result of thermal stress rather than actual frost action. True frost damage is documented to occur only after thermal fatigue had produced cracks which allowed for water to permeate, freeze, and further fragment the sample (Rasic 2004:122). Rasic (2004:122) has noted that many of the experimental weathering tests often exaggerate the frost susceptibility of rocks by widely exceeding parameters that would be experienced by rocks under natural conditions.

Trampling

Of the post-depositional processes discussed thus far, trampling is another serious agent affecting lithic and debitage assemblages (Rasic 2004:127). Not only can trampling cause significant damage to the artifacts themselves, but it has also been shown to cause the vertical displacement of materials. The factors that influence the effects of trampling damage and artifact movement include substrate characteristics, raw material characteristics, artifact and flake size and shape, as well as the duration of trampling exposure. Of the variables mentioned, substrate hardness has been shown to be one of the most important. The other variable that conditions resistance to trampling is the shape of the artifacts or flakes, particularly the thickness.

It has been found, for example, that flakes that are thin relative to their maximum dimension - such as blades, or bifacial thinning flakes are more sensitive to breakage than those that are thicker. Fragmentation and breakage as a result of trampling can thus alter the way an assemblage is interpreted and even change the way a whole archaeological site is interpreted.

It has been recognized that trampling or treadage can result in edge damage or artifact modification. When assessing any lithic artifact, specifically those of flake-based industries, one cannot simply assume that ultimate tool form was the direct result of raw material type, production technique, or retouching episodes. It has been demonstrated that post-depositional processes, such as trampling, affect artifact distribution, but it can also affect artifact preservation and condition. Among artifacts that have been trampled "the artifact damage consists of irregular, abrupt or alternate edge modification, the blows often directed at nearly right angles to the edge, rather than delivered oblique to the edge as in normal retouch" (McBearty et al. 1998:109). Bordes (1961) calls these "pseudo-tools", as they are often misidentified as Paleolithic formal tools.

Because trampling can produce damage that resembles intentional retouch, experiments have been conducted in an effort to clarify its effects. Experiments performed by McBrearty et al. (1998) were intended to replicate conditions that artifacts might be subjected to after discard, and before complete burial. They also examined the relative contributions of differences in raw material, substrate, and artifact density to the degree of edge damage (McBrearty et al. 1998:111). A similar experiment conducted by Tringham et al. (1974) concluded that edge damage produced by trampling can be distinguished from edge wear produced by use on the basis of three criteria: (1) the location and orientation of damage scars along the flake perimeter are random; (2) trampling scars are more elongate than those produced by use; and (3) the scars produced by trampling occur on one flake surface only, that is, the surface opposite that which faced the treader (Tringham et al. 1974:192).

The experiment conducted by McBrearty et al. (1998) was similar to that of Gifford-Gonzalez et al. (1985) in that assemblages were tested on two separate substrates, a loamy substrate and a sandy substrate and trampled on by two individuals at a time walking at a normal pace and wearing rubber-soled shoes. All of the experiments conducted by McBrearty et al. (1998) produced broken pieces, edge-damaged pieces, and pseudo-tools. Experiments conducted within the loamy substrate, however, produced more damaged artifacts, many with substantial edge modification that mimic deliberate retouch and places them in the pseudo-tool category. Many of the pseudo-tools created by the experiments so closely resembled Paleolithic formal tools that they were classified according to the standard typology of Bordes (1961) which was devised for artifacts of the European Middle Paleolithic.

McBrearty et al.'s (1998) experiment effectively demonstrated that trampling can result in mechanical damage (crushing, polishing, or striations) that resembles intentional edge modification or use. Several artifacts were found to resemble formals tools, specifically those artifacts that were trampled on loam, a fine-grained, relatively impenetrable substrate (McBrearty et al. 1998:123). In addition, the experiment also concluded that higher artifact densities also increase the likelihood of damage as they are more likely to come in contact with one another during treadage. More importantly, the experiment found that lithic material that has sustained damage as the result of treadage is often mistaken for formal tools.

ASSESSING STRATIGRAPHIC INTEGRITY

Besides causing fragmentation and edge damage, trampling has also been demonstrated to cause material to be vertically displaced. Gifford-Gonzalez et al. (1985) have noted that archaeologists traditionally conceived causes of vertical displacement to be post-depositional, disturbance phenomena, either biological or geological (1985:804). Such processes which have been documented to cause the vertical displacement of artifacts are cycles of wetting and drying in sandy deposits (Cahen and Moeyersons 1977), solification, cryoturbation, groundwater penetration, differential compaction, plant growth, and soil fauna (McBearty et al. 1998:109). These actions can effect vertical movement of artifacts, some without creating any discernible traces of movement (Gifford-Gonzalez et al. 1985:804). Villa (1982) has gone as far as stating that “without evidence to the contrary, layers and soils should be considered as fluid, deformable bodies…through which archaeological items float, sink, or glide” (Villa 1982:287).

Given the sandy nature of the Topper site, then, it was a distinct possibility that the assemblage of lithic material located within pre-Clovis aged sediments could have been derived from an overlying cultural stratum.

Gifford-Gonzalez et al. (1985) experimented with human trampling on loose substrate in an effort to demonstrate the extent to which material can move and also to test whether or not trampled assemblages exhibit any distinctive hallmarks such as size-sorting (Gifford-Gonzalez et al. 1985:805). The experiment demonstrated that treadage by humans can cause substantial downward migration of objects in loose, sandy substrate, and that no clear correlations exited between sizes attributes of pieces and their depth below surface. In addition, the authors concluded that there was a difference between the vertical displacement of assemblages trod upon from an initial position on the surface versus those trampled after sediments have covered the scatter (Gifford-Gonzalez et al. 1985:817). While this experiment was successful in showing that artifacts trampled in sandy substrates have the potential to migrate vertically, one should not forget to take into account other processes that account for the vertical movement of artifacts. Bioturbation or wetting and drying cycles, as previously noted, can also cause artifacts to move between substrates. In addition, one should take into account site structure and overall stratigraphy before concluding that trampling caused the vertical displacement of artifacts.

It is important, then, to be able to effectively determine if material has been displaced vertically. Such a task, however, is not straightforward or easy. Rowlett and Robbins (1982) have suggested that one way to estimate the original content of an assemblage subject to post-depositional movement is through the process of refitting (Rowlett and Robbins 1982:78). They developed an additional method of assessing assemblage content which includes the following set of assumptions: (1) 90 percent of all artifacts originally deposited in a stratum will remain in that stratum; (2) 7 percent of all artifacts will migrate from their original stratum to the next stratum above; (3) 3 percent of all artifacts will migrate from their original stratum to the stratum below; (4) all artifacts deposited originally in the top stratum, which after post-depositional migration reach the soil surface, will be recovered as members of their original stratum; and (5) all artifacts deposited originally in the lowest stratum, which would move into bedrock, are recovered as members of their original stratum. The method, which is based on the vertical movement of coin molds from an Iron Age hillfort site in southwestern Luxembourg, consists of a series of calculations and equations which assess the proportion of original material deposited in each stratum. This specific method has not been tested on lithic materials; however, it may prove to be just as applicable on lithic materials in the archaeological record. The authors do note that, “assumptions (1-5), on which this procedure is based, are obviously provisional, pending more accurate and precise specifications of post-depositional migration trajectories (properly constrained by soil type, artifact mass, climate conditions, length of burial, etc.)” (Rowlett and Robbins 1982:81).

Material that has been subjected to taphonomic processes such as stream flow; trampling or thermal stress has the potential to contribute substantial “noise” to any typological analysis. In fact, the attributes most commonly associated with flake debris can be altered so significantly that interpretations about tool production, maintenance behaviors, as well as occupational histories can be completely misinterpreted. In order to reliably interpret any archaeological assemblage, like the pre-Clovis materials found at Topper, one must take into account site setting, stratigraphy, and the taphonomic processes most likely to have occurred. Although these taphonomic agents can complicate interpretations about stone tools and maintenance behaviors, their consideration must, as done in the chapter that follows, be integrated into the lithic analysis (Rasic 2004:132).

CHAPTER 3: MATERIALS AND METHODS

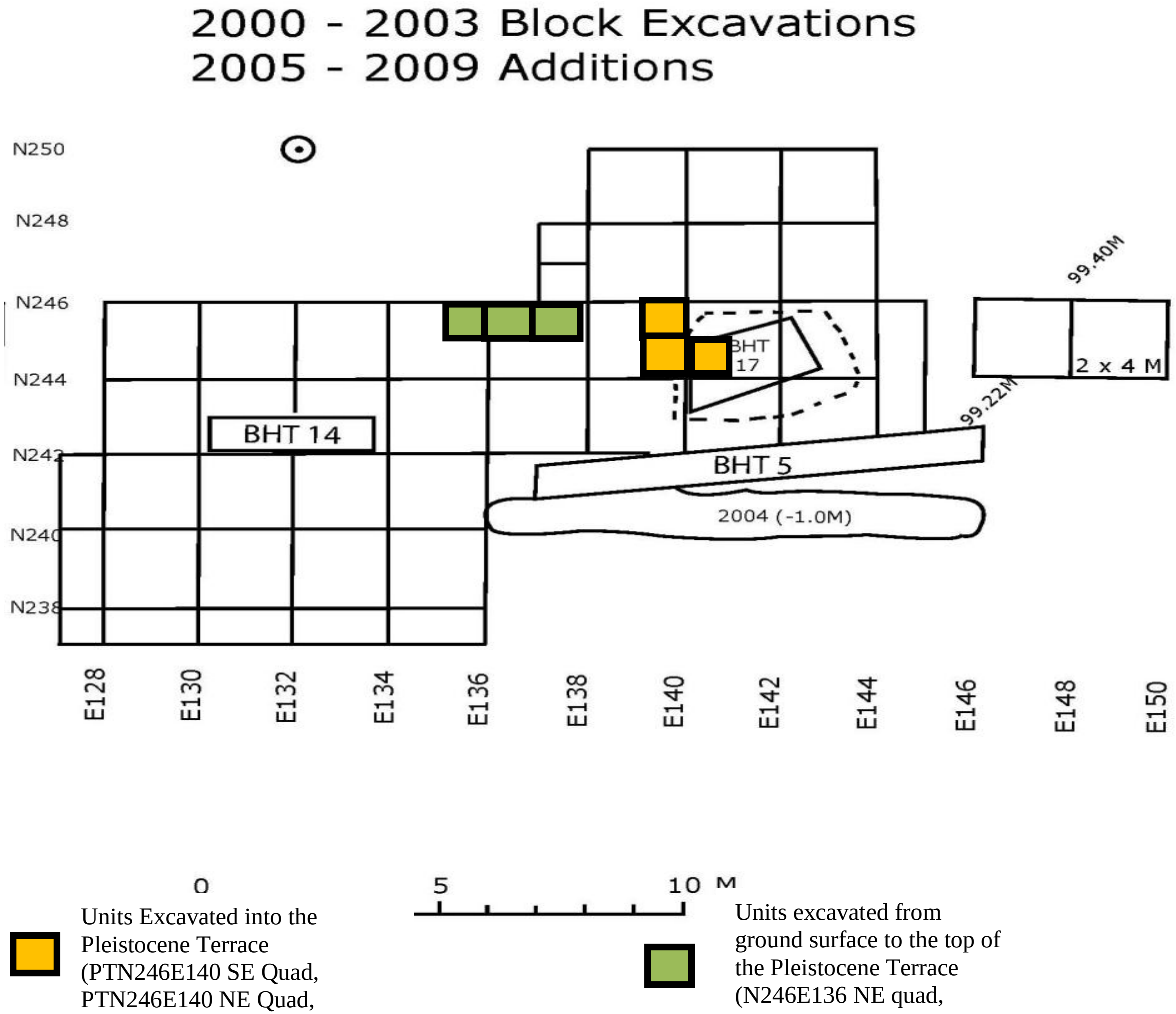
SAMPLE

Sample Location

The units used for this analysis were excavated from within the pre-Clovis Excavation Block at the Topper site, at the base of the hillside where chert boulders outcrop (Figures 16 and 17). Material recovered and analyzed was excavated from a total of six 1x1 meter test units (Figure 18). Three of these particular units were chosen because they had been systematically excavated from the surface down nearly two meters to the top of the hard silty clay Pleistocene Terrace and therefore represented a complete stratigraphic profile (Figure 20). Two of these test units include the NE and NW quads of a 2x2 meter unit N246E138 while the third excavation unit consists of material excavated from the NE quad of unit N246E136. These three test units contain material spanning from the Mississippian to possible pre-Clovis aged assemblages in the Holocene Terrace and Pleistocene Sands; however, they did not contain any material from within the Pleistocene Terrace (hereafter, PT). Their location within the pre-Clovis Excavation Block was arbitrary.

As mentioned in the previous chapter, dates recovered from within the PT exceed 20,000 radiocarbon years, and evaluation of the pre-Clovis assemblage mandated consideration of excavated material from this deposit. Because no test units from the 2009 excavations were excavated continuously from the surface into the PT, it was necessary to include three additional test units which began at the surface of the Pleistocene Terrace and continued into this older material. These three units, the SE quad of PTN246E140, the NE quad of PTN246E140, and the SW quad PTN246E142 therefore contain only material from within this hard terrace sediment.

Given the time constraints of the short summer field season the PT units consist of only two to three levels each excavated in 5cm increments. At the time this study was conducted no other materials from the PT were available analysis.



🟨 Units Excavated into the Pleistocene Terrace (PTN246E140 SE Quad, PTN246E140 NE Quad, PTN246E142 SW Quad)

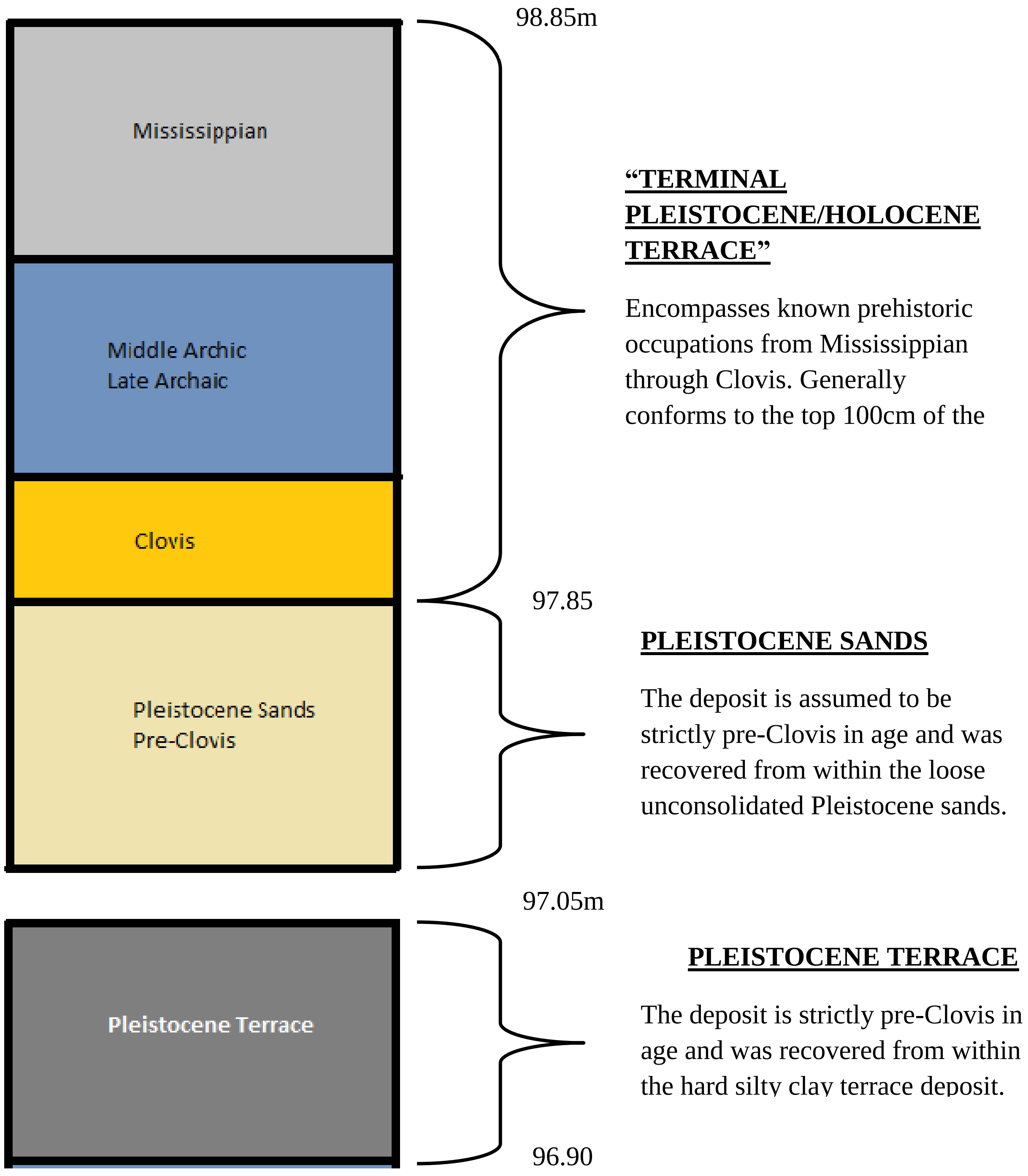
🟩 Units excavated from ground surface to the top of the Pleistocene Terrace (N246E136 NE quad, N246E138 NW Quad, N246E138 NE Quad).

Figure 20. Close up view of the Pleistocene Terrace excavation block at the Topper Site.

Instead of presenting analyses each individual test unit, one complete stratigraphic profile was prepared which incorporates the data from each of the aforementioned units. The combined column sample was subdivided by major geological strata as well as by the presumed cultural affiliation of the associated materials (Figure 21). Those levels associated with the Holocene Terrace (HT) date after ca. 13,500 cal yr BP and contain deposits with known cultural occupations ranging from late prehistoric through Paleoindian/Clovis times. Deposits associated with the loose unconsolidated Pleistocene Sands (PS) include only pre-Clovis aged material. This level, assumed to date between 13,500 and 15,000 to 20,000 year ago, terminates at the hard silty clay surface of the Pleistocene Terrace. Materials recovered from within the Pleistocene Terrace (PT) are deposits dated between 20,000 and 50,000 ^{14}C yr BP.

Sample Size

The Holocene Terrace sediments were systematically removed in 10cm levels by both shovel skimming and toweling. Removed sediments were then systematically screened though 1/8inch mess screens. When the Pleistocene Sands interface was identified, levels were excavated in 5cm increments and everything was screened using ¼ and 1/8 inch mesh screens.



“TERMINAL PLEISTOCENE/HOLOCENE TERRACE”

Encompasses known prehistoric occupations from Mississippian through Clovis. Generally conforms to the top 100cm of the

PLEISTOCENE SANDS

The deposit is assumed to be strictly pre-Clovis in age and was recovered from within the loose unconsolidated Pleistocene sands.

PLEISTOCENE TERRACE

The deposit is strictly pre-Clovis in age and was recovered from within the hard silty clay terrace deposit.

Figure 21. Vertical profile of test unit showing the cultural components and brief description of how the units are vertically identified.

The three test units (N246E136-NE, N246E138-NE, and N246E138-NW) associated with the Holocene Terrace and Pleistocene Sands consist of nearly 2 cubic meters each of excavated material. Each unit produced thousands of pieces of lithic debitage, cortical debris, and several pockets of river pebbles (see Appendix A, Tables 3-8). The units also produced several stone tool artifacts, some of which consisted of crude pre-forms, broken bifaces, and nearly complete bifaces. All of the material recovered from the screening process was included within the following study. The only exception comes from two levels within unit N246E136; these levels consisted of several thousand pieces of lithic debitage. To create a more manageable sample these levels were reduced using a Humboldt Riffle-Type Sample Splitter. Such a device is used to divide or halve dry materials such as cement, gravel, powdered ores, sand, soils, etc. Material poured into the hopper is divided into two equal portions by a series of chutes that discharge the material alternately in opposite directions into separate pans. The sample splitter effectively creates two representative samples of the original.

As mentioned above, excavations within the silty clay Pleistocene Terrace were also excavated in 5cm levels. The hard consolidated matrix of the PT mandated excavators to saturate the surface with water prior to removal with trowels. All of the material removed within the PT was water screened using 1/8 inch mesh screens. The sample provided by the three aforementioned units (PTN246E140 NE, PTN246E140 SE, and PTN246E142 SW) includes only 2 levels, or 10cm, of excavated PT material. Implications of this small sample size will be discussed in the following chapter.

APPLYING MASS AND ATTRIBUTE ANALYSIS

It is generally advocated that multiple methods of analysis, as well as a reliance on other sources of information both inside and outside chipped stone studies, be used to examine a lithic assemblage (Andrefsky 2004; Carr and Bradbury 2004; Larson 2004; Shott 2004). The use of multiple methods of analysis enables the researcher to better understand what is represented in an archaeological assemblage and further enhances the types of information that can be gained from analyzing an assemblage in more than one way. For these reasons the Topper sample underwent mass analysis as well as individual flake analysis.

Application of Mass Analysis

The analysis began by sorting material in each of the individual levels from each of the sample test units. The initial step to sorting this material began by separating out lithic cultural material from debris. Lithic cultural material was defined as flakes — complete or fragmentary, cortical and chert shatter — and any tools or probable tools. Debris consisted of cortical chunks and pebbles.

The next step consisted of running the pebbles and cortical debris through nested U.S.A. Standard Testing Sieves, using six screen sizes: 9.5mm, 7.925mm, 5.613mm, 3.962mm, 2.794, and 2.0mm. The screens were shaken for twenty seconds before processing the material, which consisted of sorting and then weighing the pebbles and cortex separately from each of the six screen sizes. This process was designed to show the distribution of pebbles and cortical debris throughout each of the levels within the designated units. Excavations within the Lower Terrace excavation block at Topper have shown that flooding from the Savannah River created several chute channels which run directly through some of the excavated units, depositing pebbles and debris in the area of the pre-Clovis Excavation Block. The amount of pebbles and debris within each of the excavated levels, and their location, may provide clues to the nature of these deposits. Excessive amounts of river pebbles, for example, may represent an episode of flooding and fluvial deposition. Any lithic material found within those units may have been subjected to stream transport, erosion, degradation and displacement.

During the initial sorting process small flakes were recovered from the within three smallest screens. These flakes, although counted and weighed, were not included within the interpretation-free and individual flake analyses described below, since their size limited the ability to recognize all of the necessary attributes. These small flakes, typically falling between 4.00mm and 2.00mm, are described here as small debitage, and their weights were included in the vertical distributional analysis reported in Chapter 4. The presence or absence of small debitage also has the potential to provide clues to the nature of an archaeological deposit. Small, light flakes, for example, are more susceptible to stream transport and displacement than large, heavier flakes.

Once the debris was sorted out of the assemblage, the cultural material was analyzed and sorted into appropriate categories. This component of the project followed Sullivan and Rozen's interpretation-free model (Sullivan and Rozen 1985). This method of debitage analysis does not depend on making technological inferences at the artifact level. Sullivan and Rozen (1985) argue instead that the interpretation of debitage variability is "enhanced by typologies and analytic categories that describe distinctive assemblages rather than presumably distinctive artifacts"

(1985:755). Such an approach is argued to facilitate reliability within analyses and comparability between them.

Traditional debitage analyses are thus based on the premise that the technological origins of individual artifacts, in this case debitage, can be inferred directly from combinations of key attributes (Sullivan and Rozen 1985:756). It has already been indicated that the individual flake attributes are vital to this analysis; however there was no attempt at this time to associate these attributes with specific chipped stone technologies. Instead these attributes or key variables in conjunction with Sullivan and Rozen's interpretation-free categories (Figure 21) were used to categorize debitage for the application of mass analysis (Sullivan and Rozen 1985:756).

The alternative approach implemented and developed by Sullivan and Rozen (1985:756) was developed based on the premise that debitage analyses should be conducted with interpretation-free categories to enhance objectivity and replicability. One useful way to derive interpretation-free categories is by means of a hierarchical key. The hierarchical key has three dimensions of variability, each with two naturally dichotomous attributes, as described below. The key variables identified as "dimensions of variability" are used to identify their debitage categories. Many of these dimensions of variability are essentially the key attributes outline by Patterson (1983). Based on these variables, Sullivan and Rozen (1985) were able to identify their debitage categories.

The first dimension of variability observed by Sullivan and Rozen in their interpretation-free approach is the presence of a single interior surface. Speth (1972:35) notes that a single interior surface is indicated by positive percussion features such as ripple marks, force lines, or a bulb of percussion. If these features cannot be reliably determined, or if there are multiple occurrences of them, it should be concluded that a single interior surface cannot be discerned (Sullivan and Rozen 1985:758).

The second dimension of variability is a point of applied force. On debitage with intact striking platforms, a point of applied force occurs where the bulb of percussion intersects the striking platform. In those instances where only a fragmentary striking platform remains, a point of applied force would be considered absent. This dimension would not apply to any debitage where a single interior surface was not discernible (Sullivan and Rozen: 1985:758).

The third dimension of variability is the presence or absence of intact margins. Crabtree (1972:63) defines intact margins as those in which the distal end exhibits a hinge or feather termination. Based on these dimensions of variability, Sullivan and Rozen (1985:759) defined four mutually exclusive debitage categories: complete flakes, broken flakes, flake fragments, and debris. A complete flake is identified as one in which all three dimensions of variability are discernible. A broken flake is a flake in which a single interior surface and a point of applied force are discernible; these however do not have intact margins. Flake fragments have a single interior surface, but there are no striking platforms or intact margins. Everything else, shatter as well as cortical debris, are placed within the debris category. The aforementioned categories are considered interpretation-free because they are not linked to a method of technological production nor do they imply a particular reduction sequence (Sullivan and Rozen 1985:759).

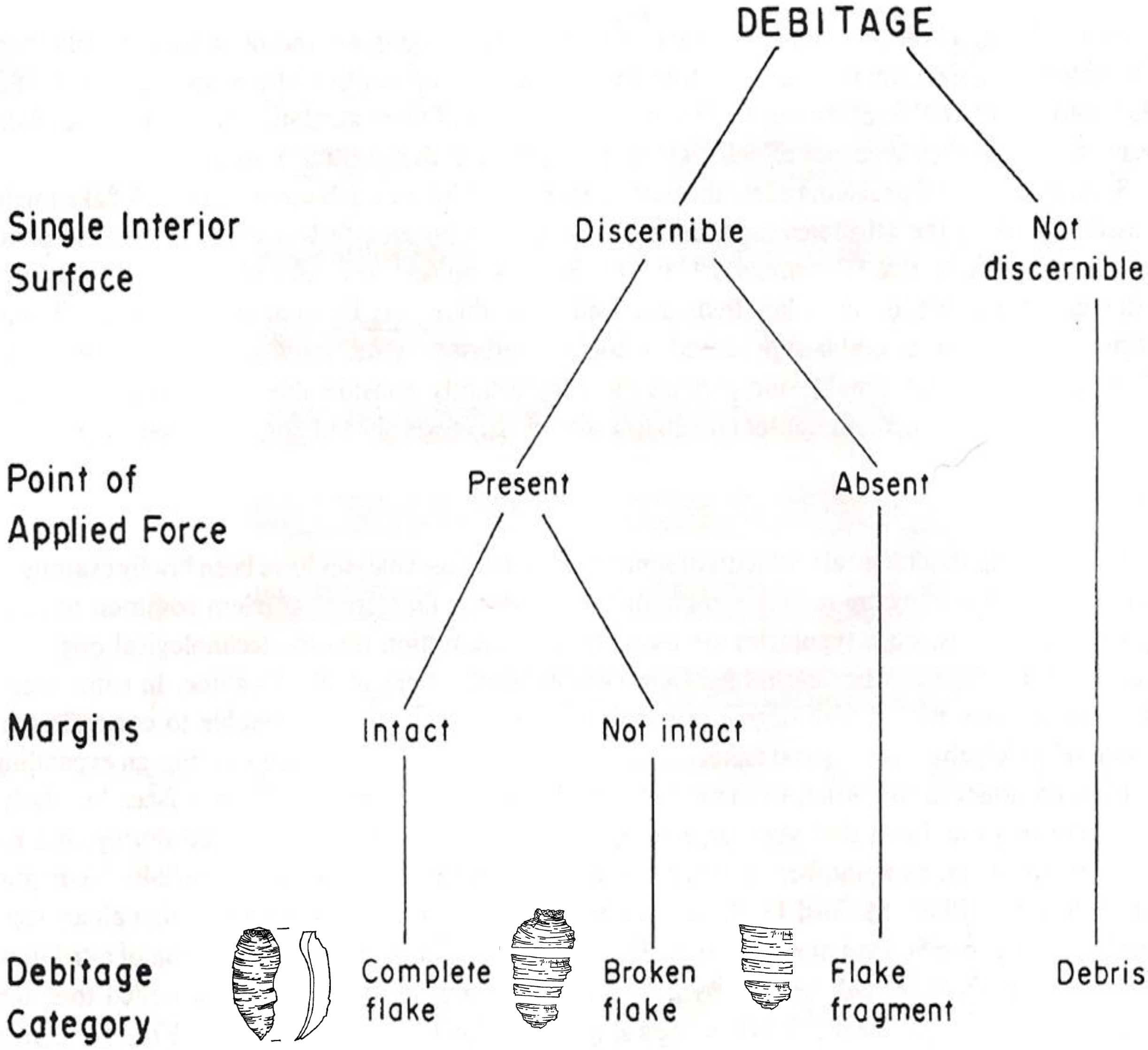


Figure 22. Technological attribute key used by Sullivan and Rozen to define four debitage categories: complete flakes, broken flakes, flake fragments, and debris. Image adapted from Sullivan and Rozen 1985:759.

Sullivan and Rozen's Interpretation-free model essentially provided a guideline for applying both mass and attribute analysis to the Topper assemblage. While I followed this model very closely, it was necessary to modify the categories somewhat (Figure 22). The four mutually exclusive categories utilized for this project included: complete flakes, flake fragments, small debitage, and debris (see Figure 23). A complete flake is the same as those previously identified by Sullivan and Rozen as being one which exhibits a single interior surface, a complete or partial striking platform and complete margins with a clear point of termination. Flake fragments included both broken flakes and flake fragments as defined by Sullivan and Rozen (1985). Small debitage included all small sized debitage greater than 2.0mm but smaller

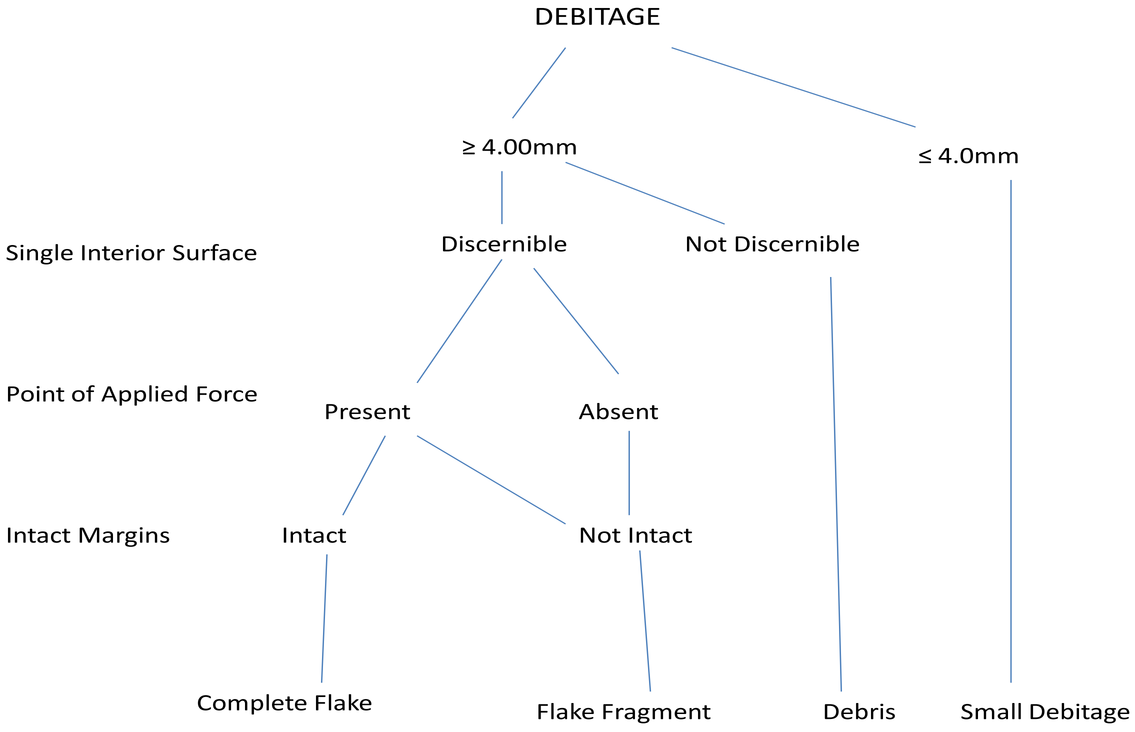


Figure 23. Modified version of Sullivan and Rozen's Interpretation Free Model.

than 4.0mm. In this case it was all of the material which was recovered within the three smallest screens (3.962mm, 2.794 and 2.0mm). Everything else was considered shatter or debris.

Mass analysis was conducted on all of the lithic material, as well as the cortical debris and pebbles, recovered from the six aforementioned test units. The purpose was to document the size and incidence of debitage, debris, and pebbles present, for subsequent use in examining their nature and vertical distribution in the sample. Mass analysis allows lithic analysts to process large amounts of material in a relatively short period of time. The application of the Sullivan and Rozen's interpretation-free model also provided an essential guide to identify and segregate debitage. Once the mass analysis was complete, the debitage had been, sorted, size graded, and weighed within their appropriate categories (Table 3 – 8). A total of 3,960 pieces of lithic debitage were analyzed using mass analysis.

Applying Attribute Analysis

Individual flake, or attribute, analysis was conducted on all complete flakes and flake fragments (as defined above) which fell within the first size grade (>9.5mm) for each of the six test units identified; these were flakes that were ca. ½ inch and larger in size (Appendix A). This selection was made because it was necessary to use only those specimens that were large enough to adequately measure key attributes identified by Patterson (1983) and Peacock (1991) as most likely the result of chipped stone manufacturing processes; these also encompass those dimensions of variability previously mentioned. A total of 1,610 complete flakes were examined using individual flake analysis (Appendix A).

For individual flake analysis, those measured complete flakes were individually examined for the following attributes: the presence or absence of a striking platform, the presence or absence of a bulb of percussion, the presence or absence of dorsal cortex, whether or not the specimen was thermally altered, and what type of termination was present. In addition to these attributes, flake dimensions were also recorded on each individual specimen. These dimensions included platform thickness, flake length, flake width, and flake thickness. As mentioned above, all complete flakes measuring ca. ½ inch and greater were examined during attribute analysis from the six test units with exception to two large samples sizes associated with levels five and six within test unit N246E136-NE quad. In that instance, the sample was split into a smaller portion (see Tables 3-8, Appendix A)

Table 3. Counts, Morphologies, and Weights for all Flakes and Flake Fragments from Unit LTN246E136-NE Quad.

	Flake Morphology					Flake Termination				
Level	Whole	Proximal	Distal	Medial	Hinge	Step	Feather	Outrepasse	T.A	Avg. Weight(g)
NE-01	6	0	2	5	2	2	2	0	4	1.17
NE-02	17	2	11	6	7	7	3	0	15	3
NE-03	115	0	57	29	17	20	76	2	86	1.9
NE-04	264	50	157	127	98	67	99	0	311	1.77
**NE-05	183	10	93	51	69	58	54	2	177	3.31
**NE-06	371	23	178	141	96	143	132	0	327	2.21
NE-07	45	0	17	16	9	21	15	0	37	1.14
NE-08	14	0	3	5	2	8	4	0	8	2.76
NE-09	3	0	0	0	2	0	1	0	0	1.23
NE-10	1	0	0	0	1	0	0	0	0	0.86
Total	**1019**	**85**	**518**	**380**	**303**	**326**	**386**	**4**	**965**	**1.93**
PLEISTOCENE SANDS (PS)										
NE-12	0	0	0	0	0	0	0	0	0	0
NE-13	0	0	0	0	0	0	0	0	0	0
NE-14	0	0	0	2	0	0	0	0	0	2.29
NE-15	0	0	0	1	0	0	0	0	0	0.47
NE-16	0	1	0	1	0	0	0	0	0	1.05
NE-17	0	0	0	0	0	0	0	0	0	0
NE-18	0	0	0	2	0	0	0	0	0	0.69
NE-29	0	1	0	2	0	0	0	0	0	5.96
NE-20	1	2	0	9	0	0	1	0	0	3.61
NE-21	0	1	0	1	0	0	0	0	0	3.12
NE-22	0	0	0	2	0	0	0	0	0	2.51
NE-23	0	1	0	0	0	0	0	0	0	1.52
NE-24	0	0	0	2	0	0	0	0	0	3.08
NE-25	2	1	0	1	0	0	0	0	0	36.12
NE-26	0	0	0	0	0	0	0	0	0	0
NE-26	0	1	0	2	0	0	0	0	0	8.81
NE-28	0	0	0	2	0	0	0	0	0	9.68
NE-29	0	1	0	0	0	0	0	0	0	6.43
Total	**3**	**9**	**0**	**27**	0	**0**	**1**	**0**	**0**	**5.33**

**Represents units reduced with sample splitter

Table 4. Counts, Morphologies, and Weights for Flakes and Flake Fragments from Unit PTN248E140 SE Quad.

	Flake Morphology					Flake Termination				
Level	Whole	Proximal	Distal	Medial	Hinge	Step	Feather	Outrepasse	Total T.A	Avg. Weight (g)
SE 01	0	0	0	1	0	0	0	0	0	1.53
SE 02	0	0	0	1	0	0	0	0	0	0.68
SE 03	0	0	0	0	0	0	0	0	0	0
SE 04	0	0	0	0	0	0	0	0	0	0
SE 05	0	0	1	2	0	0	0	0	1	27.7
SE 06	0	1	0	0	0	0	0	0	0	0.8
SE 07	0	0	0	1	0	0	0	0	0	1.88
SE 08	0	0	0	2	0	0	0	0	0	4.05
SE 09	0	0	1	1	0	0	0	0	0	4.76
SE 10	0	0	2	1	0	0	0	0	1	3.28
SE 11	0	1	0	1	0	0	0	0	0	3.22
SE 12	0	0	0	1	0	0	0	0	0	3.76
Total	**0**	**2**	**4**	**11**	**0**	**0**	**0**	**0**	**2**	**4.305**

Table 5. Counts, Morphologies, and Weights for Flakes and Flake Fragments from Unit LTN246E138 NW Quad.

	Flake Morphology					Flake Termination			
Level	Whole	Proximal	Distal	Medial	Hinge	Step	Feather	Outrepasse	Total T.A	Avg. Weight (g)
NW-01	5	0	3	0	2	3		0	3	2
NW-02	21	0	3	1	4	8	9	0	8	2.44
NW-03	49	0	16	8	10	24	15	0	27	1.37
**NW-04	189	13	52	55	54	80	55	0	119	2.61
NW-05	165	1	40	58	44	59	62	0	120	2.44
NW-06	210	28	83	108	52	87	71	0	196	2.26
NW-07	23	1	10	15	4	11	8	0	22	1.79
NW-08	8	0	0	0	0	4	4	0	4	1.08
NW-09	14	1	3	4	5	5	4	0	5	5.11
NW-10	5	0	1	3	0	2	3	0	4	4.1
NW-11	3	0	0	2	0	2	1	0	3	6.05
NW-12	4	0	0	3	1	1	2	0	2	0.86
NW-13	1	0	0	1	0	0	1	0	1	0.89
NW-14	3	0	0	1	1	1	1	0	1	0.45
Total	**700**	**44**	**211**	**259**	**177**	**287**	**236**	**0**	**515**	**2.30**
PLEISTONCE SANDS (PS)										
NW-15	6	1	0	1	1	3	2	0	4	1
NW-16	3		0	1	2	1	0	0	0	0.56
NW-17	1	2	0	4	0	1	0	0	2	0.42
NW-18	2	5	0	3	0	2	0	0	2	0.58
NW-19	3	7	0	5	1	0	2	0	2	0.59
NW-20	3	6	3	11	2	1	0	0	0	0.61
NW-21	1	3	0	6	0	1	0	0	0	0.67
NW-22	0	0	0	0	0	0	0	0	0	0
NW-23	0	0	1	4	0	0	0	0	0	0.61
NW-24	2	0	0	3	1	1	0	0	0	0.87
NW-25	0	0	0	2	0	0	0	0	0	3.36
NW-26	0	0	1	1	0	0	0	0	0	1.6
NW-27	0	1	2	0	0	0	0	0	1	1.81
NW-28	0	0	0	2	0	0	0	0	0	2.58
NW-29	0	0	0	1	0	0	0	0	0	0.76
NW-30	0	0	0	0	0	0	0	0	0	0
Total	**21**	**25**	**7**	**44**	**7**	**10**	**4**	**0**	**11**	**1.00**

Table 6. Counts, Morphologies, and Weights for all Flakes and Flake Fragments from Unit PTN246E140 NE Quad.

	Flake Morphology					Flake Termination				
Level	Whole	Proximal	Distal	Medial	Hinge	Step	Feather	Outrepasse	Total T.A	Avg. Weight(g)
NE-01	1	0	0	1	0	0	1	0	1	2.89
NE-02	0	0	0	0	0	0	0	0	0	0
NE-03	1	0	0	1	0	1	0	0	1	2.79
NE-04	0	1	6	0	0	0	0	0	1	1.13
NE-05	0	1	0	3	0	0	0	0	0	0.47
NE-06	1	0	0	2	0	1	0	0	0	0.43
NE-07	0	1	0	1	0	0	0	0	0	0.19
Total	**3**	**3**	**6**	**8**	**0**	**2**	**1**	**0**	**3**	**1.13**

Table 7. Counts, Morphologies, and Weights for all Flakes and Flake Fragments from Unit LTN246E138 NE Quad.

	Flake Morphology					Flake Termination				
Level	Whole	Proximal	Distal	Medial	Hinge	Step	Feather	Outrepasse	Total T.A	Avg. Weight (g)
NE-01	10	1	5	5	1	8	1	0	7	1.91
NE-02	24	5	7	11	6	10	8	0	9	1.99
NE-03	16	1	8	13	2	12	2	0	9	2.78
NE-04	60	5	17	25	17	31	12	0	36	2.33
NE-05	81	6	17	24	21	44	16	0	39	2.79
NE-06	36	3	12	15	12	10	14	0	23	1.99
NE-07	5	0	1	2	0	4	1	0	2	0.98
NE-08	4	1	0	1	2	1	1	0	1	5.48
NE-09	5	0	3	3	0	2	3	0	1	1.83
NE-10	1	1	0	1	1	0	0	0	0	9.87
NE-11	5	1	2	2	1	3	1	0	1	1.45
NE-12	3	0	0	1	0	2	1	0	2	1.03
NE-13	2	0	1	5	1	1	0	0	2	1.45
NE-14	2	0	0	3	1	1	0	0	1	1.87
Total	**254**	**24**	**73**	**111**	**65**	**129**	**60**	**0**	**133**	**2.70**
PLEISTOCENE SANDS (PS)										
NE-15	0	4	0	0	0	0	0	0	1	0.28
NE-16	2	1	0	0	0	1	1	0	0	0.69
NE-17	2	0	0	2	0	1	1	0	0	0.75
NE-18	1	1	0	3	0	1	0	0	1	0.57
NE-19	3	2	0	2	0	1	2	0	2	0.33
NE-20	3	2	0	2	0	2	1	0	2	0.3
NE-21	0	2	0	4	0	0	0	0	0	0.6
NE-22	8	6	3	16	4	4	0	0	2	2.37
NE-23	0	2	5	4	0	0	0	0	1	0.34
NE-24	0	0	0	7	0	0	0	0	1	1.24
NE-25	0	0	0	6	0	0	0	0	0	0.76
NE-26	0	0	0	1	0	0	0	0	1	0.8
NE-27	0	0	0	4	0	0	0	0	0	1.22
NE-28	0	0	0	0	0	0	0	0	0	0
NE-29	0	0	0	0	0	0	0	0	0	0
NE-30	0	0	0	0	0	0	0	0	0	0
TOTAL	**19**	**20**	**8**	**51**	**4**	**10**	**5**	**0**	**11**	**0.63**

Table 8. Counts, Morphologies and Weights for Flakes and Flake Fragments from Unit PTN248E140 SW Quad.

	Flake Morphology					Flake Termination				
Level	Whole	Proximal	Distal	Medial	Hinge	Step	Feather	Outrepasse	Total T.A	Avg. Weight (g)
SW-1	2	0	0	0	0	0	1	1	0	1.23
SW-2	0	1	0	0	0	0	0	0	0	0.42
SW-3	0	0	0	0	0	0	0	0	0	0
SW-4	2	0	0	0	1	1	0	0	1	1.38
SW-5	1	0	0	0	0	1	0	0	0	0.86
SW-6	2	1	0	0	0	0	2	0	2	5.43
SW-7	0	0	0	1	0	0	0	0	0	0.37
SW-8	0	0	0	2	0	0	0	0	0	0.21
SW-9	0	0	0	0	0	0	0	0	0	0
SW-10	0	0	0	0	0	0	0	0	0	0
Total	**7**	**2**	**0**	**3**	**1**	**2**	**3**	**1**	**1**	**0.99**

VARIABLES CONSIDERED IN THE ATTRIBUTE ANALYSIS

FLAKE PORTION

Only those flakes which were ½ inch or greater were measured for their attributes. While only complete flakes were measured using digital calipers, it was important to also identify which specific portions of flake fragments were included among the debitage assemblage. Instead of measuring each individual flake fragment, however, they were macroscopically examined and classified as being a distal end, a proximal end, or a medial section of a flake (Figure 24 also see Appendix A). A distal fragment contained a discernible point of termination but lacked a bulb of percussion or a striking platform. A proximal flake fragment contained a bulb of percussion and a discernible striking platform, but lacked any terminal characteristics. A medial flake fragment was a specimen which may exhibit concentric rings, but lacked a bulb of percussion and a striking platform (Andrefsky 2004:87-89). It was important to collect this information because flake condition is often a direct result of the post-depositional processes acting on an archaeological assemblage. It has already been established, for example, that trampling is one process that can break flakes into multiple fragments and can also cause flakes to become vertically and horizontally dispersed (Rasic 2004; McBrearty et al. 1998; Tringham 1974; Gifford-Gonzalez et al. 1985).

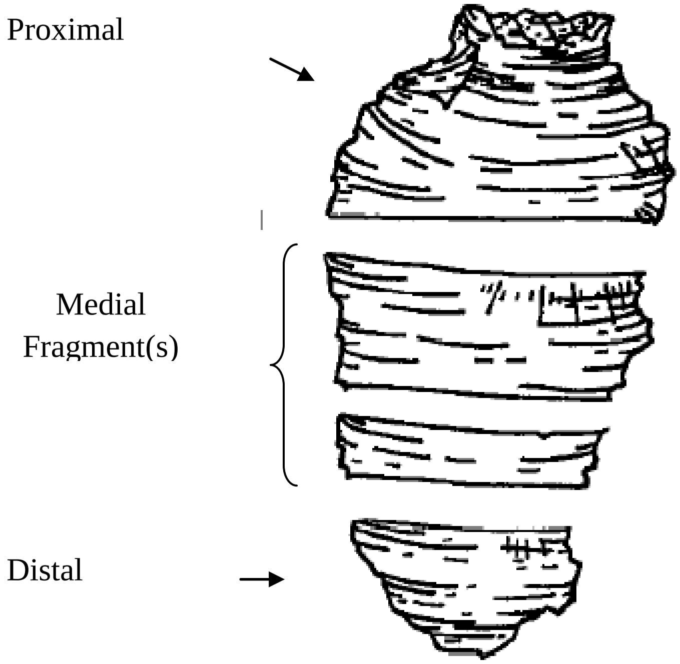


Figure 24. Shattered flake illustrating proximal, medial, and distal fragments.

Flake Termination

Each flake that was defined and identified as being complete (whole) was further classified as having a hinge, step, feather, or outrepassé termination (Figure 25) (Andrefsky 2004:21; Cotterall and Kamminga 1979:104-106). "These categories are often not mutually exclusive on individual flakes as more than one termination type may occur on an edge" (Odell 2004:57). Flake terminations essentially exhibit how force exited the nodule (Odell 2004:56). "Termination may be associated with the direction at which force was applied, qualities of the raw material, topographic irregularities on the outside of the core, and/or internal vugs or fractures (Odell 2004:56-57). Determining the type of termination can, therefore, be somewhat subjective in nature.

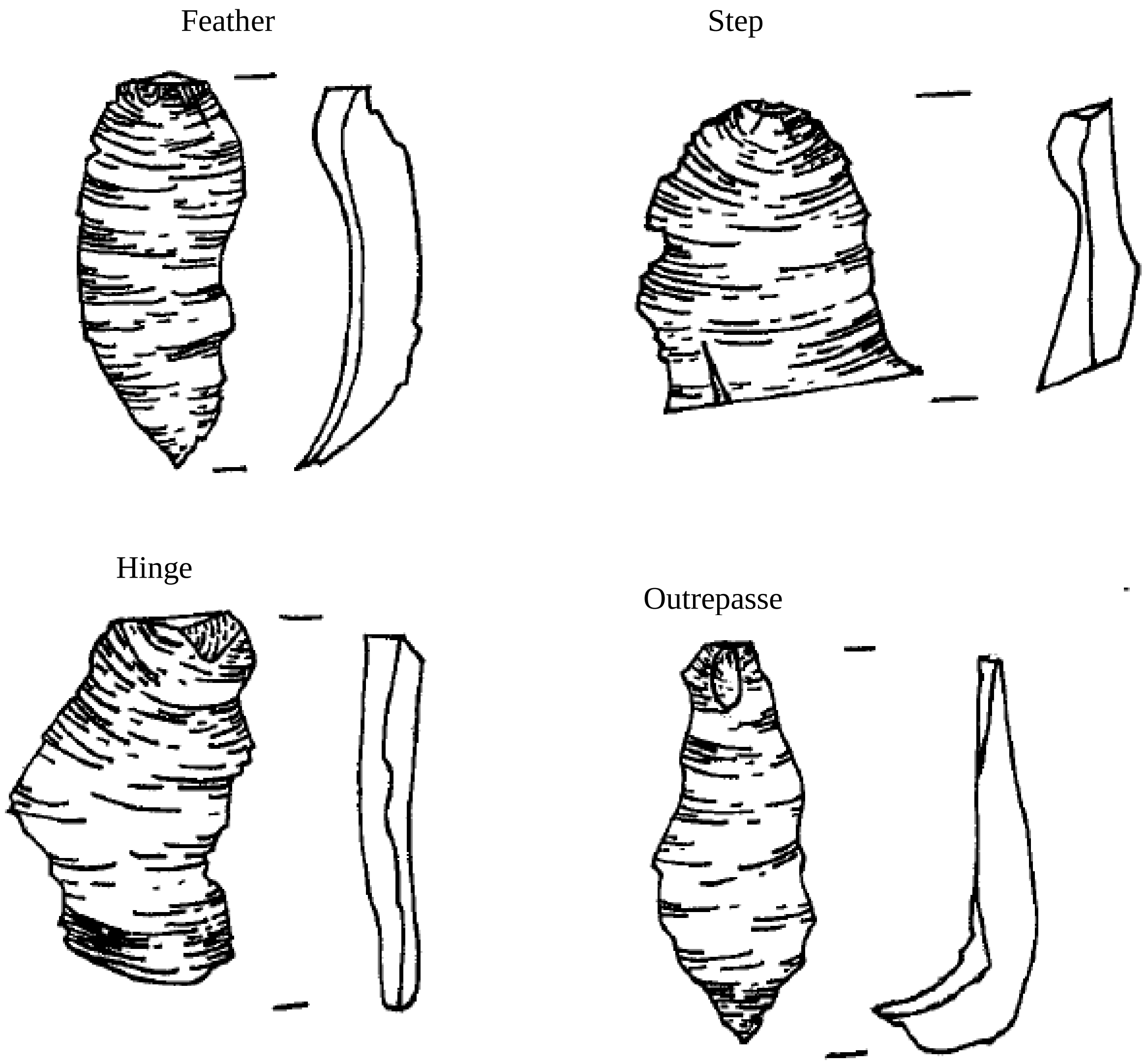


Figure 25. Flake terminations (a) feather termination, (b) step termination, (c) hinge termination, (d) outrepassé termination.

It was determined that the most non-subjective means to determine flake termination, if it was not obvious, was visually, and by feel using a fingertip (Wasilik 2009). Hinge terminations were those in which the distal edge of the flake was considerably rounded (Andrefsky 2004:20; Crabtree 1972: 466; Kooyman 2000:18-19; Odell 2004:56). If the distal end was angular in shape, often times forming a ca. 90° angle, it was classified as having a step termination (Whittaker 1994:107-109). Those flakes which contained remnants of the bottom of a core were classified as an outrepassé termination (Odell 2004:58). The final category, feather termination, refers to a flake that thins out to a point and is relatively thin all around; it is also the type of outcome desired by a flintknapper (Odell 2004:57). The morphology of the distal end of a flake can vary depending on the production method utilized as well as the morphology of the core. The presence of certain termination types often helps archaeologists determine which technology was employed.

Flake Size

Measurement on complete flakes which were ½ inch and greater included each flake's maximum length, width and thickness (Figure 26). These measurements were obtained to a hundredth of a millimeter using a Mititoyo digital caliper. Flake length was measured as a straight line distance from the proximal to the distal end; this line is perpendicular to the wide axis of the striking platform. The wide axis of the striking platform has been defined by the locations on the proximal end of the flake where the striking platform intersects with the lateral margin on the proximal end (Andrefsky 2004:99). Flake width was also recorded as a straight

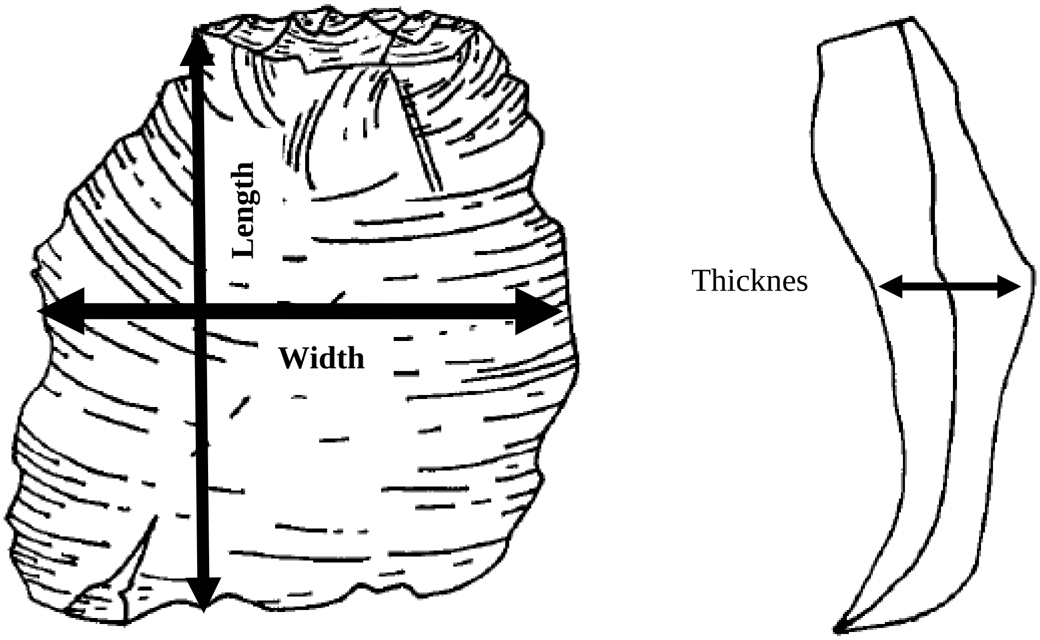


Figure 26. Complete flake illustrating measurement of maximum flake length, flake width, and flake thickness.

line distance perpendicular to flake length. “When this straight line distance intersects the flake at its widest point, it is called the maximum flake width “Andrefsky 2004:99). The thickness of a flake is measured in the same manner as flake width. Flake thickness is the distance from the dorsal side to the ventral side of the flake, perpendicular to the flake length line (Andrefsky 2004:101). It is further noted that size characteristics of debitage can be a good indication of various tool production. Size characteristics can also be elemental when determining whether or not water flow affected the spatial distribution of artifacts (Isaac 1967:33).

Flake Weight

The weight for all analyzed flakes was recorded for each flake to the nearest hundredth of a gram using a digital scale. This includes whole flakes that were measured as well as those flake fragments which were characterized as being proximal, medial, and distal but were not measured. Flake weight, like many of the other attributes being recorded, is useful to study the effects of natural post-depositional processes on the spatial distribution of artifacts. Water flow, for example, has been known to transport material away from its original location. Small debitage, for example, is easily transported by low velocity stream currents (Shackley 1978:85). Larger objects, on the other hand, require much greater stream velocities to transport. Additionally, it has been demonstrated that the spacing of large particles is an important factor in the ability of a current to move them. "Thus a mass of implements in close juxtaposition is less easily transported by the stream than widely separated larger particles (Leopold and Wolman 1960)...if theory is correct, a single casually dropped implement is more likely to be transported by a stream than a conglomeration of material from an occupation site" (Shackley 1978:89).

Cortex

The presence or absence of cortex on each measured flake was also recorded. If the flake being measured contained any portion of cortex, or if any portion of the flake was chalky and non-siliceous, it was counted as having cortex present. The actual area of cortex was not recorded since that was not considered important to the kinds of research questions being addressed, namely, whether the site assemblages were humanly made and generally similar. In some analyses, the amount of cortex is measured as a means to discern the actual production sequence during which the flake in question originated. Odell (2004:127) notes that the amount of cortex cover can vary throughout the reduction sequence and is, therefore, not always a reliable indicator of where in that sequence a flake belongs.

Platform Attributes

Traditionally when conducting flake attribute analysis, the platform of each platform-bearing flake is classified. These classifications can include missing, cortical, flat, complex, and abraded (Andrefsky 2004:95). Striking platforms have “infinite variability”, and there are potentially an infinite number of striking platform types (Andrefsky 2004:94). Striking platforms have also been categorized to include lipped, ground, split, crushed, isolated, plain, and polyhedral (Andrefsky 2004:94-98; Wasilik 2009:23). It is believed that the morphology of the striking platform correlates to the different stages of bifacial production (Shott 1994:80). Because of the variability related to striking platforms and the amount of subjectivity it might entail, it was decided to only record the presence or absence of a point of percussion as well as whether or not the platform contained a lip. Any flake which exhibited any form of visible platform was classified as having that “attribute present”. Those flakes in which a platform could not be identified were classified as having an absent platform.

Bulb of Percussion

It has been argued that the presence of a bulb of percussion is often an indicator of humanly manufactured stone tools (Andrefsky 2004). As such, the presence or absence of a bulb of percussion was recorded on all measured flakes. The relative robustness of the bulb of force has been useful for lithic analysts when classifying flakes as derived from hard-hammer percussion, soft-hammer percussion, or pressure flaking (Cotterell and Kamminga 1987; 1990; Crabtree 1972). Those flakes, for example, which exhibit a diffuse bulb of force and a pronounced lip, have been called soft-hammer percussion flakes (Crabtree 1972:74). Bulbs of force can be measured, however for the purpose of this analysis; only the presence or absence of this attribute was recorded.

Thermal Alteration

It has been documented that many prehistoric and some recent societies that utilized stone tools, particularly those fine-grained siliceous rocks, often deliberately heat treated the stone in an effort to improve its flaking properties (Crabtree and Butler 1964; Domanski and Webb 1992:601). Some of the most notable advantages attributed to thermal alteration, or heat treatment, are improved flakeability, longer flake removals, fewer step and hinge terminations and the production of sharper edges (Crabtree & Butler, 1964; Domanski &Webb, 1992). "While the physical and chemical effects of alteration are well documented, its behavioral implications – the circumstances under which intentional thermal alteration is likely to occur – are not well understood" (Anderson 1979:221). It can be difficult to define both an accepted criterion for the identification of heat-treated material, and an objective measure of the changes in the quality of thermally altered rocks (Domanski and Webb 1992:601-602).

The selection for intentional thermal alteration is believed best to be understood in terms of the properties of altered as opposed to unaltered cherts, and the advantages of employing the process. Thermal alteration has been shown to cause a variety of visual changes in microcrystalline siliceous rocks. It is believed to occur with the melting of microscopic impurities in the intercrystalline spaces of chert. The melted impurities “act as a flux, fusing together the individual cryptocrystals of the chert mass” (Purdy and Brooks 1971:324). The most noticeable of the visible changes includes a darkening in color and an increased luster of flaked surfaces. In addition, heat damage can cause crazing and microfracturing (Domanski and Webb 1992; Rick and Chappell 1983). The most common color change is from yellow/brown to dark red; however the changes depend on the original color of the rock (Domanski and Webb 1992; Purdy and Brooks 1971).

There are a number of advantages to thermal alteration. The first is the marked changes in appearance, including both the luster and texture of the chert. “Altered cherts exhibit (upon flaking) a much glossier surface than unaltered cherts, and are smoother and ‘waxier’ to the touch” (Anderson 1979:222). Other advantages are mechanical in nature, and are directly related to changes in structure. Thermally altered chert tends to be more homogeneous than unaltered material. Greater homogeneity of altered cherts enables them to fracture like glass; flakes are often removed easier with less shatter and waste. Thermally altered chert, being less internally flawed, also produces much sharper cutting edges than possible with certain unaltered cherts (Crabtree 1972, reported in Anderson 1979:223).

In addition to considering why prehistoric peoples may have thermally altered their tool stone, it was also important to consider the kinds of sites where such processes should occur. Anderson (1979) suggests that heat treatment is likely to occur at the raw material source, if the raw material source was of a poorer quality. Allendale chert, a light colored highly siliceous microcrystalline rock, has been described by Anderson (1979:235) as "occasionally of excellent quality", but "the majority is both highly fractured and fossiliferous, a poor quality for knapping". Experiments in which Allendale chert was thermally altered revealed pronounced color changes in this material (Figure 27). High incidences of thermal alteration are evident on diagnostic projectile points made of Allendale chert dating to the Archaic period in the Coastal Plain of South Carolina (Anderson 1979). At the Topper Site thermally altered chert is quite common in the Middle Archaic and Late Archaic occupations. Thermally altered debitage performs and broken bifaces were common in the sample examined from Archaic period levels in the current study. This attribute (evidence for thermal alteration) was recorded for its presence or absence.

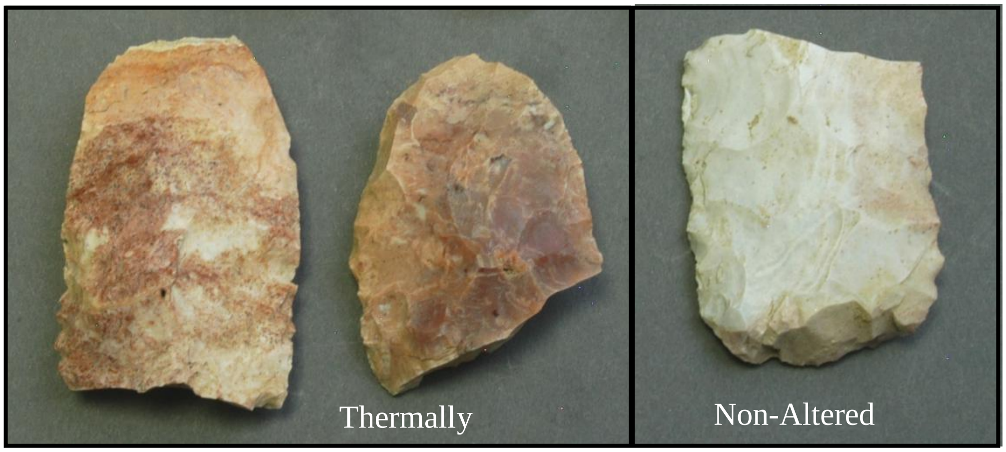


Figure 27. Fragmented bifaces illustrating the difference in color between thermally altered and non-altered Allendale Chert.

OTHER CONSIDERATIONS

During the examination of attributes from the Topper sample it became obvious that there were several levels, located between 98.45 and 98.25 mbd, associated with Middle and Late Archaic occupational floors, where the measurable flakes numbered in the thousands. As mentioned in the beginning of this chapter, only a percentage of individual flakes were examined (refer to Tables 3-8).

While some levels had exceedingly large samples, there were also cases, specifically within the Pleistocene Sands and the Pleistocene Terrace, where there were only a limited number of flakes that had the potential to be analyzed. Because the material was originally processed through 1/8inch mesh screen, there was a reasonable amount of material recovered. Unfortunately most of the material recovered, as demonstrated in the analyses reported in the next chapter, failed to measure greater than a half an inch. In addition to not having a great number of flakes large enough to analyze, many of the flakes within the Pleistocene Sands were extremely degraded. That is, the cherts within these deeper sands have become desilicified over time. The removal of silica has made these particular samples more like the chalky cortical rind found on terrestrial Allendale chert. As such, it was difficult or impossible to identify some or all of the key attributes described above. It should be noted, however, that not all flakes recovered within the Pleistocene Sands were weathered and degraded, although such flakes were extremely rare. The presence of such well-preserved flakes *in situ* with severely degraded material is explored in the next chapter.

CHAPTER IV: RESULTS OF THE CHIPPED STONE ANALYSIS

In this chapter the results of the analysis conducted on the lithic debitage sample recovered from the Topper site Pre-Clovis Excavation Block are presented. The chapter is composed of two major sections. The first section consists of a description of the attribute frequencies as they were recorded on individual flakes. The second section consists of a description of the vertical distribution of the debitage, river pebbles and cortical debris.

ATTRIBUTE FREQUENCIES PER UNIT AND GROUP

The frequency of flake attributes was recorded for those flakes which measured a half an inch or greater. Each of the data tables illustrated below is divided into three distinct groups. The first group contains information on debitage recovered from within material dated to known cultural horizons. These levels are associated with the Holocene Terrace (HT) and include lithic material dated from the Mississippian to Clovis occupations. The second group consists of material recovered from within the soft, unconsolidated Pleistocene Sands (PS). This material has been dated between 13,000 and 20,000 ^{14}C yr BP. The final group consists of data collected on debitage recovered from within the Pleistocene Terrace (PT). This hard consolidated silty clay has been dated between 20,000 and ≥50,000 years' ^{14}C yr BP. This particular sample ended up being smaller than originally anticipated, thus restricting these analyses primarily to the upper two proveniences.

As stated in Chapter Two, each of the documented archaeological components at the Topper site, including the hypothetical pre-Clovis occupation, utilized Allendale chert for tool stone. Recognized components from late prehistoric to Clovis also utilized similar technologies to produce stone tools. It is hypothesized here that the distribution of lithic debitage, produced from similar materials utilizing similar technologies, should be similar for each of these documented components, regardless of population density, duration of occupation, or rate of sediment deposition. If true, these patterns of debitage should be replicated in any pre-Clovis lithic components at the site that were made from Allendale chert if similar technologies were employed. Where critical patterns of debitage are overwhelmingly shared between undisputed temporal/cultural assemblages and potential pre-Clovis assemblages, the probability is very low that the pre-Clovis assemblage results from dislocation since dislocation of artifacts rarely results in replication of original assemblage patterns of size, shape, and other artifact attributes. On the other hand, if the patterning of debitage is dissimilar, there is a greater probability that the lithic material was displaced, created using differing technologies, or even created as the result of natural processes.

Flake Portion

From the total of 3,960 pieces of lithic debitage (complete and broken flakes) analyzed, 2,025 (51.14%) are whole, 827 (20.88%) are distal fragments, 214 (5.40%) are proximal fragments, 894 (22.58%) are medial fragments (Table 9). Based on the following figures, approximately ca. 51.14 % of this material is whole, while the other ca. 48.86 % is fragmented.

Table 9. Frequency of Flake Portions.

Frequency of Flake Portions				
Flake Portion	**HT** (Holocene Terrace)	**PS** (Pleistocene Sands)	**PT** (Pleistocene Terrace)	**All 3 Cultural Layers**
Whole	1973 (53.64%)	43 (18.37%)	9 (18.75%)	2025 (51.14%)
Distal	802 (21.80%)	15 (6.41%)	10 (20.83%)	827 (20.88%)
Proximal	153 (4.15%)	54 (23.07%)	7(14.58%)	214 (5.40%)
Medial	750 (20.39%)	122 (52.14%)	22 (45.83%)	894 (22.58%)
TOTAL	**3678**	**234**	**48**	**3690**

Based on the tables above, one can see that the numbers of complete (whole) flakes and flake portions vary considerably between the strata associated with known cultural occupations and those associated with potential pre-Clovis occupations. One can see, for example, that the total number of measurable specimens decreased markedly in the lower levels associated with the Pleistocene sands and the Pleistocene Terrace. The dramatic decrease within those Pleistocene Terrace levels can, however, also be attributed to the fact that only a limited volume of these deposits was excavated, as well as the fact that much of this material was extremely degraded.

Table 9 also shows that there are considerably more whole flakes present within the Holocene Terrace deposits than any other flake portions; in fact ca. 53.64% of this debitage assemblage was characterized as being complete in nature. Distal and medial fragments constitute ca. 43.46% of the population, with proximal fragments making up only ca. 5.4% of the entire assemblage. It is also evident that the number of proximal fragments does not correspond to the number of distal fragments represented. This proportion and frequency of debitage however, does not continue within the deeper levels associated with the Pleistocene Sands. Instead, the assemblage is characterized by flake fragments, of which medial fragments are the most common, at ca. 49.0%. Whole flakes constitute ca. 26.5%, while proximal fragments make up ca. 16.8% of the population. Based on the proportion alone, it is clear that there are obvious differences between the debitage recovered from within those Holocene Terrace levels and the Pleistocene Sand levels. There are also obvious differences present within the Pleistocene Terrace sample, but the sample size makes it difficult to gage any sort of relationship. A Pearson Chi-Square, comparing whole flakes and flake fragments between the Holocene Terrace and the Pleistocene Sands, χ^2 (1, N=3912) = 23.792, $p < 0.001$ also indicates a significant difference between the two tested populations.

Flake Termination

Of the total of 2025 whole flakes containing a distal end, 558 (27.50%) had a hinge termination, 767 (37.97%) had a step termination, 695 (34.32%) contained feather terminations, and 4 (.19%) were identified as outrepassé flakes (Tables 2). Step fractures appear to be the most common occurrence within each of the represented groups, making up ca. 37.6% of the flakes within the Holocene Terrace, and ca. 53.48% within the Pleistocene Sand levels, although the sample size is quite low in the latter deposits. Step fractures are followed closely in incidence by feather and hinge terminations. While the total number of specimens did differ considerably between the Holocene Terrace and the Pleistocene Sand deposits, the proportion of each category to one another is similar, with the greatest deviation observed among step fractures. Because of the limited number of specimens available from within the Pleistocene Terrace, this part of the sample was eliminated from consideration for statistical analysis.

Table 10. Frequency of Flake Terminations.

Frequency of Flake Terminations				
Flake Termination	**HT**	**PS**	**PT**	**All 3 Cultural Layers**
Hinge	545 (27.62%)	11(25.58%)	1 (11.11%)	557 (27.50%)
Step	742 (37.60%)	23 (53.48%)	4 (44.44%)	769 (37.97%)
Feather	682 (34.56%)	9 (20.93%)	4 (44.44%)	695 (34.32%)
Outrepassé	4 (.20%)	0	0	4 (.19%)
Total	**1973**	**43**	**9**	**2025**

Based on the data in Table 10, one can clearly see some differences between the two tested assemblages of complete flakes. Pearson Chi-Square analyses, however, χ^2 (3, N=2016) =3.699, *p*= .296 demonstrates that there is not a significant difference between the two debitage assemblages based on flake terminations.

Platform Attributes (Non-measurable Attributes)

Of the total of 1,620 complete flakes that were measured during the application of individual flake analysis, 162 (10.00%) had missing platforms, 1,458 (90.00%) had intact platforms (Table 11). The chart below shows that the percent of intact as well as missing platforms is similar among those Holocene Terrace and the Pleistocene Sand deposits. This relationship seems to continue for the presence of lipped platforms, which represent a subset of flakes with present platforms. Once again, comparison with flakes associated with the Pleistocene Terrace, illustrates substantially different proportions; again likely the result of the small sample size.

Table 11. Striking Platform Attributes.

Frequency of Platform Presence				
Platform Type	**HT**	**PS**	**PT**	**All 3 Cultural Layers**
Present	1415(90.47%)	37 (80.43%)	6 (60.00%)	1458 (90.00%)
Missing	149(9.52%)	9 (19.56%)	4 (40.00%)	162 (10.00%)
Total	**1564**	**46**	**10**	**1620**

Based on the data in Table 11, the Holocene Terrace and Pleistocene Sands assemblages appear to be somewhat different regarding platform characteristics. A Pearson Chi-Square χ^2 (1, N=1610) =5.088, *p*= .024 confirms that there is a significant difference between the two debitage assemblages in regards to the presence/absence of a striking platform.

Thermal Alteration

From the total of 3960 complete flakes and flake fragments examined from the deposits, a total of 1,659 (41.88%) specimens show evidence of having been thermally altered, while the other 2301 (58.11%) showed no evidence of having been subjected to heat. The total here includes not only those specimens measured as part of the individual flake analysis, but also those flake fragments which were documented but not measured. For those specimens which were measured as part of the individual flake analysis, 738 (45.90%) showed evidence of having been thermally altered while 871 (54.09%) were not subjected to heat (Table 12). From the data, thermal alteration appears to be similar among both the Holocene Terrace and Pleistocene Sands debitage populations, despite the obvious difference in the amount of measured material. It is also evident that among those levels associated with the Pleistocene Terrace no thermally altered flakes were recorded. One of the likely reasons for this, in addition to the small sample size from the strata, is that most of the material recovered from extremely degraded and could not be accurately identified as being thermally altered.

Table 12. Frequency of Thermal Alteration.

Frequency of Thermal Alteration (Complete Flakes)				
Thermal Alteration	**HT**	**PS**	**PT**	**All 3 Cultural Layers**
Thermally Altered	723 (43.71%)	15(32.60%)	0	738 (45.90%)
Non-Altered	840 (50.79%)	31 (67.39%)	0	871 (54.09%)
Total	**1563**	**46**	**0**	**1609**

A Pearson Chi-Square, however, χ^2 *(*1, N=1609) =3.401, *p*= .183) indicates that there is not a significant difference between the two populations.

Dorsal Cortex

Of the total number of complete flakes analyzed and measured, 446 (27.70%) still contained remnants of the exterior cortex, while 1164 (72.29%) were completely free the original exterior cortical surface (Table 13).

Table 13. Frequency of Dorsal Cortex

Frequency of Dorsal Cortex				
Cortex	**HT**	**PS**	**PT**	**All 3 Cultural Layers**
Cortical	428 (27.35%)	18 (39.13%)	6 (60.00%)	452 (27.90%)
Non-Cortical	1136 (72.63%)	28 (60.86%)	4 (40.00%)	1168 (72.09%)
Total	**1564**	**46**	**10**	**1620**

Both assemblages consist mostly of debitage removed from the interior surface of a core. However, the proportion of this material does differ with non-cortical debris constituting nearly 73% of the debitage recovered from within the Holocene Terrace levels, and 60% within the levels associated with the Pleistocene Sands. A Pearson Chi-Square χ^2 (1, N=1610) =3.088, *p* = .079) showed that these differences were not statistically significant.

Bulbar Presence

From the total of 1,610 complete flakes measured, 1,134 (70.43%) exhibited a bulb of percussion (Table 14). Based on the data in Table 6 one can see that the total numbers of flakes with bulbs of percussion are similar between the Holocene Terrace and Pleistocene Sand strata. Once again the sample size probably affected the percentages within the Pleistocene Terrace levels, and they were thus excluded from statistical analysis.

Table 14. Frequency of Bulbar Presence.

Frequency of Bulbar Presence				
Bulbar Presence	**HT**	**PS**	**PT**	**All 3 Cultural Layers**
Present	1101(70.41%)	33 (78.57%)	4 (40.00%)	1138 (70.44%)
Missing	463 (29.58%)	13 (21.43%)	6 (60.00%)	482 (29.56%)
Total	**1564**	**46**	**10**	**1620**

Based on the table percentages alone, there appears to be no significant difference between the Holocene Terrace assemblage and the probable pre-Clovis assemblage recovered from the Pleistocene Sands. A Pearson Chi-Square χ^2 (1, N=1610) = .039, *p* =.844) corroborates this assumption, indicating that there is no significant difference between the two debitage assemblages.

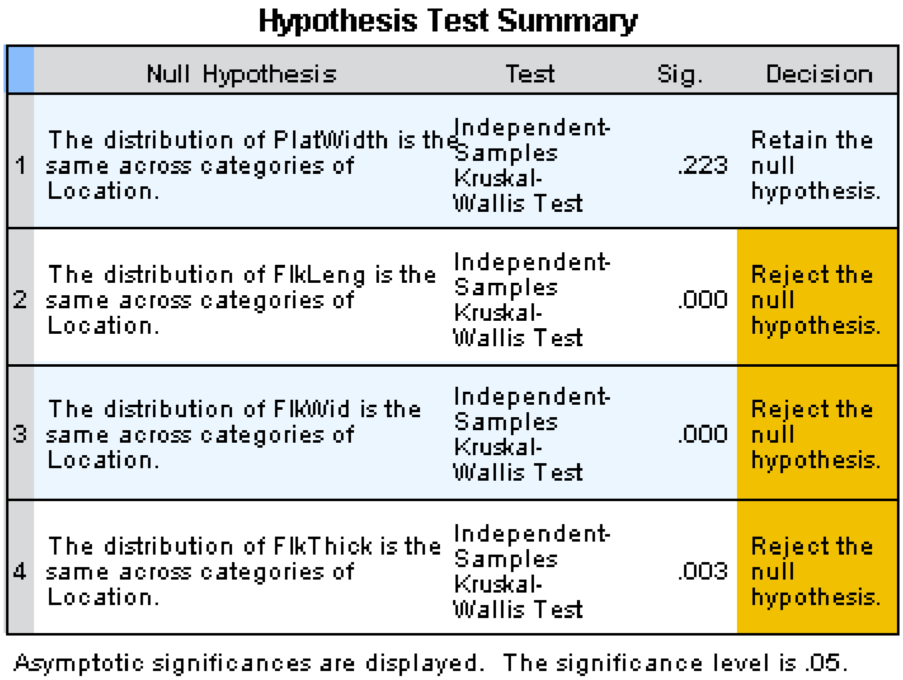
Platform Width, Flake Weight and Size

For each of the 1610 measured flakes the average flake length, width, and thickness as well as the average platform width were recorded for each of the sample strata (Table 15).

Table 15. Average Platform Width, Flake Width, Flake Length, and Flake Thickness.

Average Platform Width, Flake Weight, Width, Length, and Thickness				
Flake Characteristic	**HT**	**PS**	**PT**	**All 3 Cultural Layers**
Platform Width (mm)	9.21	8.27	9.32	8.93
Flake Length (mm)	25.83	20.87	21.28	22.66
Flake Width (mm)	23.94	17.11	17.62	19.56
Flake Thickness (mm)	5.28	4.38	4.92	4.86

While it appears that the average flake size is relatively consistent over all three of the major sampling strata, a Kruskal-Wallis Test indicated that only the Platform Width is the only attribute consistent throughout each of the lithic assemblages. The other attributes recorded are statistically different among each of the three assemblages (see Figure 28).



Hypothesis Test Summary

	Null Hypothesis	Test	Sig.	Decision
1	The distribution of PlatWidth is the same across categories of Location.	Independent-Samples Kruskal-Wallis Test	.223	Retain the null hypothesis.
2	The distribution of FlkLeng is the same across categories of Location.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
3	The distribution of FlkWid is the same across categories of Location.	Independent-Samples Kruskal-Wallis Test	.000	Reject the null hypothesis.
4	The distribution of FlkThick is the same across categories of Location.	Independent-Samples Kruskal-Wallis Test	.003	Reject the null hypothesis.

Asymptotic significances are displayed. The significance level is .05.

Figure 28. Results of Nonparametric Kruskal-Wallis Test.

RESULTS OF MASS ANALYSIS: VERTICAL DISTRIBUTION OF DEBITAGE

The vertical distribution of complete flakes, flake fragments, small debitage, cortical debris and river pebbles was also examined. The following figures are based on the counts and weights recorded during the initial application of the mass analysis, where all of the lithic debitage and debris was categorized into five distinct simplified categories; (complete flakes, flake fragments, small debitage, cortical debris and river pebbles). The purpose of this particular analysis was to illustrate the vertical distribution of debitage and other recovered material within the complete vertical column. Utilizing additional size grades further enhanced this picture by creating various classes of debitage based on size. Not only are we able to compare the types of debitage recovered from within each of the levels, but we can also compare the distribution of this material based on three distinct size classes (9.5mm, 7.925mm, and 5.613mm). The previous analysis was restricted to only those complete flakes measuring a ½ an inch and greater, thus creating a much smaller sample size.

The first three graphs below illustrate the amount, by count, of each type of lithic debitage (complete flakes, flake fragments, small debitage) that was recovered from within every 10cm level; while also illustrating, to some degree, the various size classes of this material. Three sizes classes, 9.5mm, 7.925mm, and 5.613mm, are represented by separate horizontal bars. The purpose is to illustrate potential patterns between each of the major cultural strata. The fourth category discusses the distribution of cortical debris and pebbles recovered from within each 10cm level. It should be noted here that the initial excavation of each of the test units was conducted in 10cm increments until the Clovis occupation, after which excavations preceded in 5cm increments. In order to ensure a level of consistency within this evaluation, all levels were reported in 10cm increments; which means that the levels within the Clovis strata have been combined.

Complete Flakes

The distribution of complete flakes as they appear within the sample is presented in Figure 29 and Table 16. The previous section demonstrated that despite the marked differences in the amount of debitage recovered from the Holocene Terrace and Pleistocene Sands, the two flake assemblages were not significantly different in terms of their physical attributes. Figure 29 indicates that were significantly more complete flakes present within the Holocene Terrace strata. In fact, the presence of complete flakes decreases gradually within each 10cm level, seemingly leveling off between 98.05 – 97.75mbd. The amount of complete flakes does seem to increase again slightly between 97.65 -97.4 mbd, before disappearing all together.

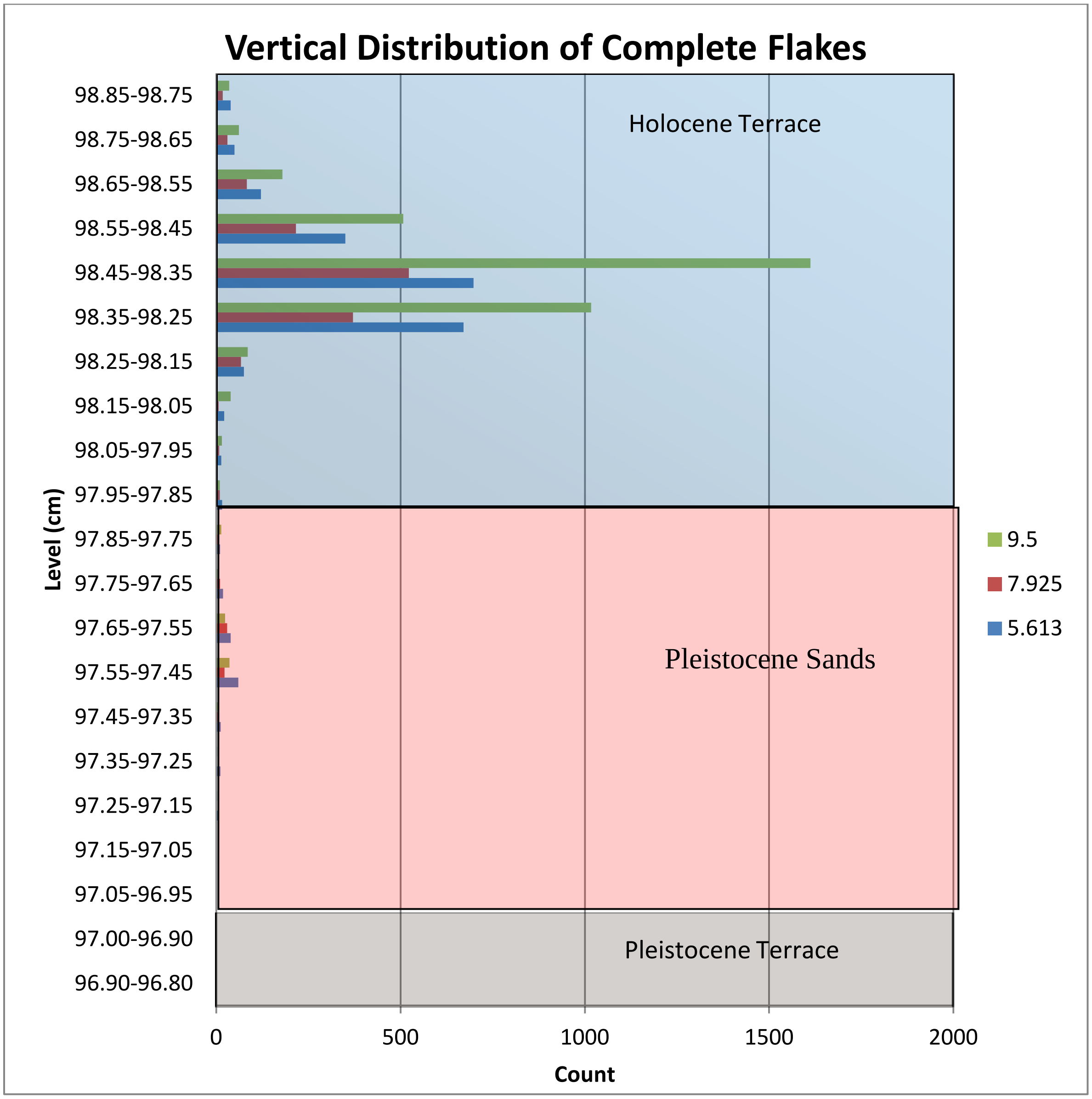


Figure 29. Vertical distribution of complete flakes showing major cultural strata.

Table 16. Vertical Distribution of Complete Flakes Indicating the Exact Counts and Proportions Present Within Each Level.

Complete Flakes			
	9.5mm	**7.925mm**	**5.613mm**
	Holocene Terrace		
98.85-98.75	35 **(38.46%)**	17 **(18.68%)**	39 **(42.85%)**
98.75-98.65	61 **(43.57%)**	30 **(21.42%)**	49 **(35.00%)**
68.65-98.55	179 **(46.73%)**	83 **(21.67%)**	121 **(31.59%)**
98.55-98.45	507 **(47.25%)**	216 (**20.13%)**	350 **(32.61%)**
98.45-98.35	1612 **(56.92%)**	522 (**18.43%)**	698 **(24.64%)**
98-35-98.25	1017 **(49.39%)**	371 **(18.02%)**	671 **(32.58%)**
98-.25-98.15	85 **(37.44%)**	67 **(29.51%)**	75 **(33.03%)**
98.15-98.05	39 **(59.09%)**	6 **(9.09%)**	21 **(31.81%)**
98.05-97.95	15 **(41.66%)**	8 **(22.22%)**	13 **(36.11%)**
97.95-97.85	9 **(26.47%)**	9 **(26.47%)**	16 **(47.05%)**
Totals	**3558 (51.28%)**	**1329 (19.13%)**	**2053 (29.59%)**
	Pleistocene Sands		
97.85-97.75	13 **(46.42%)**	5 **(17.85%)**	10 **(35.71%)**
97-75-97.65	4 (**12.50%)**	10 (**31.25%)**	18 (**56.25%)**
97.65-97.55	24 **(26.08%)**	29 (**31.52%)**	39 (**42.39%)**
97.55-97.45	36 **(30.50%)**	22 **(18.64%)**	60 (**50.84%)**
97.45-97.35	6 **(26.08%)**	5 **(21.73%)**	12 (**84.61%)**
97.35-97.25	2 **(15.38%)**	0	11 (**52.17%)**
97.25-97.15	2 **(28.57%)**	0	5 **(71.42%)**
97.15-97.05	1 **(50.00%)**	0	1 **(50.00%**)
Totals	**88 (27.94%)**	**71 (22.53%)**	**156 (49.52%)**
	Pleistocene Terrace		
97.05-96.95	0	0	0
96.95-96.85	0	0	0
Totals	**0**	**0**	**0**
Grand Total	**3646**	**1400**	**2209**

An examination of the data in Table 16 provides more information regarding the distribution of complete flakes. It was found, for example, that within the Holocene Terrace strata larger flakes are more common. In fact, ca. 51.28% of the complete flakes recovered from within the Holocene Terrace measured 9.5mm and greater. Those flakes falling within the second largest screen, 7.925mm, made up ca. 19.14% of the flakes, with the remaining 29.58% consisting of complete flakes recovered from the screen measuring >5.613mm. The Pleistocene Sands, on the other hand, were dominated by debitage recovered from within the smallest of the three size grades. Within this pre-Clovis aged sand, ca.49.52% of the complete flakes were recovered from within the 5.613mm size screen. Of the remaining flakes, ca. 27.94% measured 9.5mm and greater, and ca. 22.54% consisted of complete flakes recovered from within the screen measuring 7.925mm. A Pearson Chi-Square analysis was done to evaluate the degree of difference between the distribution of complete flakes within the Holocene Terrace and Pleistocene Sands. The results, χ^2 (2, N=7255) = .73.788, p <0.001), confirm that there is a significant difference between the size distribution of complete flakes between the two populations.

It has been established that the complete flakes recovered from within the Pleistocene Sands are proportionately smaller than those recovered from within the Holocene Terrace. The data provided within Table 16 also makes it possible to explore the distribution of debitage within the specific cultural proveniences located within the Holocene Terrace with those from the Pleistocene Sands. From the surface, 98.85mbd to 98.55 there is a cultural occupation within the Pre-Clovis excavation block at Topper which includes Mississippian and Middle Woodland components. From 98.55mbd to 98.15mbd there is a dense cultural occupation which has previously been identified as Middle Archaic, Late Archaic (MALA). Below the MALA occupation, between 98.15mbd and 97.85mbd exists a Clovis occupation. Table 17 provides the distribution of complete flakes within each cultural occupation for each of the three size classes.

Table 17. Proportion of Complete Flakes from Each of the Major Cultural Components within the Pre-Clovis Excavation Block at the Topper site.

Complete Flakes				
Cultural Occupation	**9.55mm**	**7.925mm**	**5.613mm**	**Totals**
Mississippian/Woodland	275 **(44.78%)**	130 **(21.17%)**	209 **(34.04%**)	**614**
MALA	3221 **(52.03%)**	1176 **(18.99%)**	1794 **(28.98%)**	**6191**
Clovis	63 **(46.32%)**	23 **(16.91%)**	50 **(36.76%)**	**136**
Pre-Clovis	88 **(27.94%)**	71 **(22.54%)**	156 **(49.52%)**	**315**
TOTALS	**3647**	**1400**	**2209**	**7256**

This table illustrates only slight differences in the proportion and distribution of complete flakes within each the major cultural occupations with the Holocene Terrace. Within the Pleistocene Sands we can see again a predominant amount of smaller flakes.

Flake Fragments

The distribution of flake fragments within the vertical column sample looks quite similar to that of the complete flakes represented above (Figure 30). However, upon closer examination there are some differences in the proportion and distribution of the two categories of debitage. It was found, for example, that within the Holocene Terrace strata, smaller flake fragments become a common occurrence. In fact, ca. 54.63% of the flake fragments recovered from within the Holocene terrace were recovered from the screen measuring 5.613mm. Of the remaining fragments ca. 27.52% measured 9.5m or larger and ca. 17.85% fell within the size grade

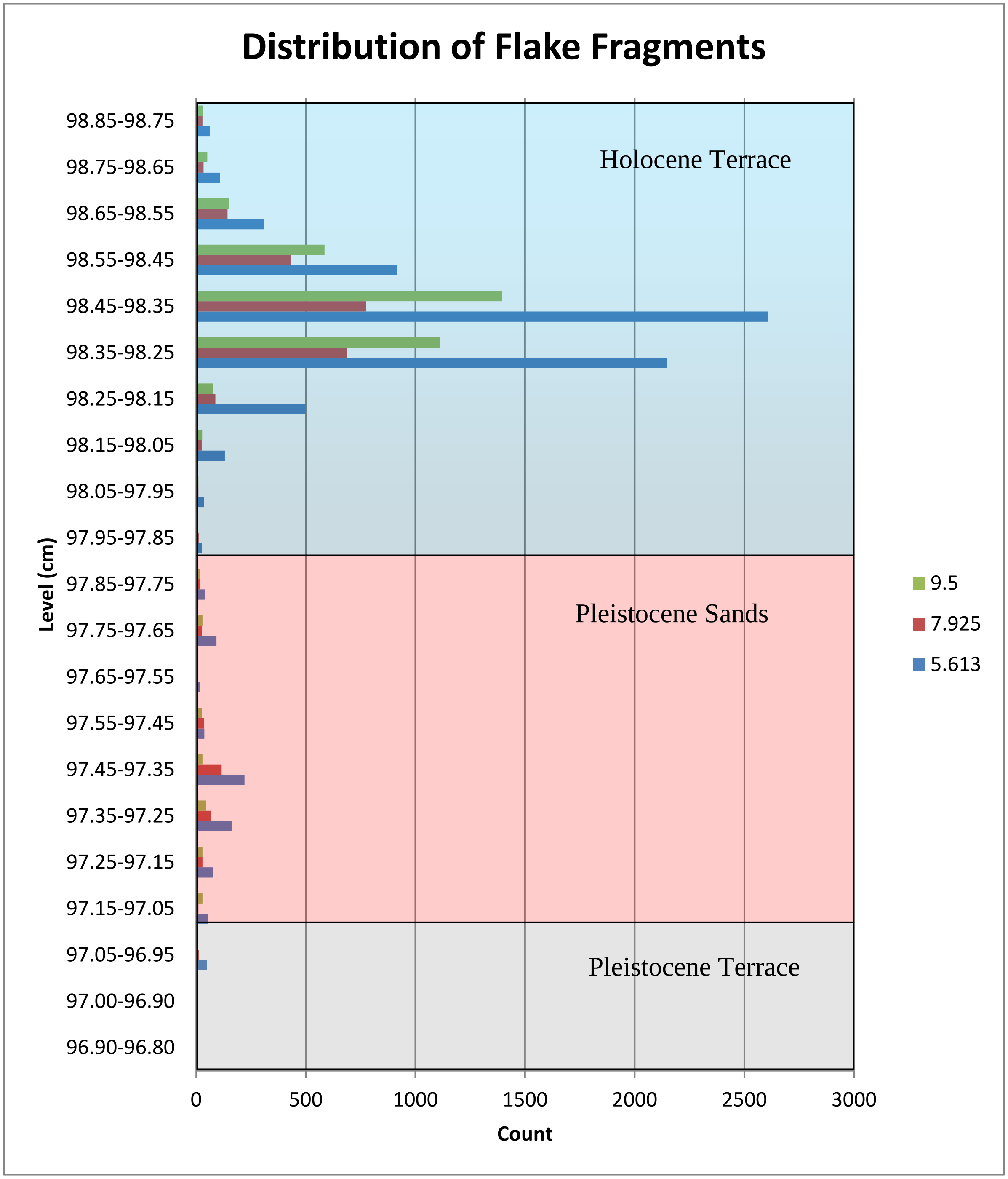


Figure 30. Vertical distribution of flake fragments within each major stratum.

Table 18. Vertical Distribution of Debitage Indicating the Exact Counts and Proportions of Flake Fragments Present Within Each Level.

Flake Fragments			
	9.5mm	7.925mm	5.613mm
	Holocene Terrace		
98.85-98.75	30 (24.79%)	29 (23.96%)	62 (51.23%)
98.75-98.65	51 (26.25%)	34 (17.52%)	109 (56.18%)
68.65-98.55	152 (25.20%)	143 (23.71%)	308 (51.07%)
98.55-98.45	585 (30.24%	432 (22.33%)	917 (47.41%)
98.45-98.35	1395 (29.19%)	775 (16.22%)	2608 (54.58%)
98-35-98.25	1110 (28.13%)	688 (17.43%)	2147 (54.42%)
98-.25-98.15	77 (11.59%)	88 (13.25%)	499 (75.15%)
98.15-98.05	27 (14.83%)	25 (13.73%)	130 (71.42%)
98.05-97.95	10 (17.05%)	10 (17.85%)	36 (64.28%)
97.95-97.85	9 (19.56%)	11 (23.91%)	26 (56.52%)
Totals	**3446 (27.52%)**	**2235 (17.84%)**	**6842 (54.64%)**
	Pleistocene Sands		
97.85-97.75	16 (21.91%)	18 (24.65%)	39 (53.42%)
97-75-97.65	29 (19.72%)	26 (17.68%)	92 (62.58%)
97.65-97.55	6 (18.75%)	8 (25.00%)	18 (56.25%)
97.55-97.45	26 (26.53%)	35 (35.71%)	37 (37.75%)
97.45-97.35	29 (7.94%)	116 (31.70%)	220 (60.27%)
97.35-97.25	45 (16.60%)	65 (23.98%)	161 (59.40%)
97.25-97.15	28 (21.21%)	28 (21.21%)	76 (57.57%)
97.15-97.05	28 (30.76%)	10 (10.98%)	53 (71.01%)
Totals	**207 (17.12%)**	**306 (25.31%)**	**696 (57.56%)**
	Pleistocene Terrace		
97.05-96.95	7 (10.14%)	13 (18.84%)	49 (58.24%)
96.95-96.85	0	4 (40.00%)	0
Totals	**7 (9.58%)**	**17 (21.79%)**	**49 (62.82%)**
Grand Total	**3660**	**2558**	**7587**

measuring 7.925mm. The distribution of flake fragments from the Pleistocene Sands also changes, however somewhat less, between this category of debitage and the complete flake category. The assemblage of flake fragments is still dominated by smaller fragments; ca. 57.57% of the fragments fell within the 5.613mm screen. Of the remaining flake fragments, ca. 17.12% measured 9.5mm and larger and the other 25.31% fell within the size grade measuring 7.925mm. Both assemblages of flake fragments are dominated by smaller size debitage, but a Pearson Chi Square χ^2 (2, N=13,732) = 79.919, *p* <0.001) indicates that there is a significant difference between the size and proportion of flake fragments between the two assemblages.

As with the complete flakes, it was also possible to illustrate the proportion of flake fragments within each of the major cultural occupations (Table 19). This table illustrates that there are similar proportions of debitage from the known cultural occupations within the Holocene Terrace, at least with the Mississippian/Woodland and MALA components. There is some deviation within the Clovis occupation; the Clovis component does contain a higher proportion of smaller fragments and a lower proportion of large flakes than the two overlying strata. The overall distribution of the fragments does seem to vary between each cultural

Table 19. Proportion of Flake Fragments Within Each Major Cultural Occupation for Each of the 3 Size Classes.

Flake Fragment				
Cultural Occupation	**9.55mm**	**7.925mm**	**5.613mm**	**Totals**
Mississippian/Woodland	233 **(25.38%)**	206 **(22.44%)**	479 **(52.18%)**	**918**
MALA	3167 **(27.97%)**	1983 **(17.51%)**	6171 **(54.51%)**	**11321**
Clovis	46 **(16.20%)**	46 **(16.20%)**	192 **(67.60%)**	**284**
Pre-Clovis	207 **(17.12%)**	306 **(25.31%)**	696 **(57.57%)**	**1209**
TOTALS	**3653**	**2541**	**7538**	**13732**

occupation and between each of the three size grades more so than it did with the distribution of complete flakes.

Small debitage

A category of debitage that was not analyzed in the previous section was that of small debitage. Small debitage includes all of the lithic material that remained within the three

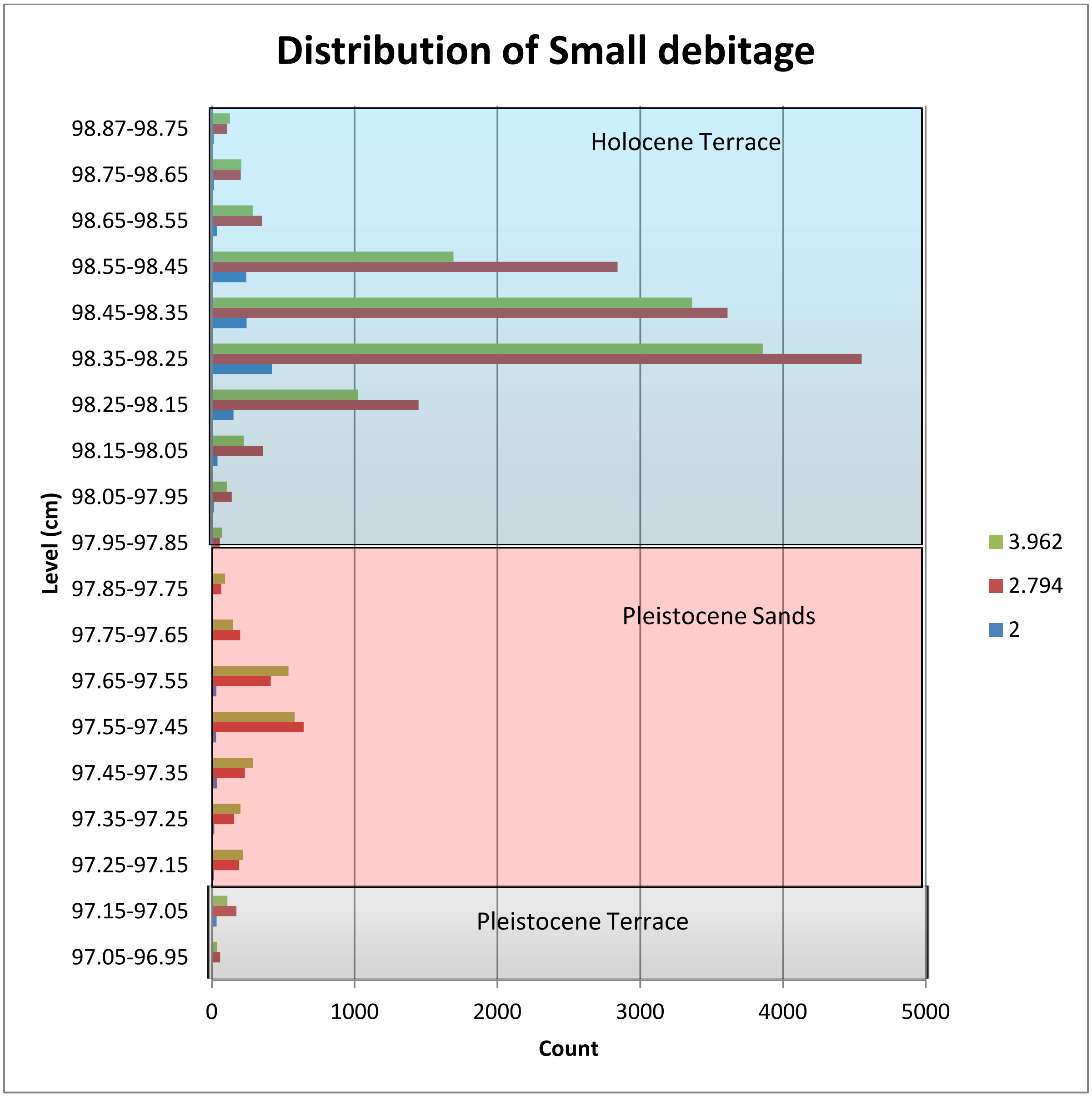


Figure 31. Vertical distribution of small debitage within each major stratum.

Table 20. Proportion Small Debitage per 10cm level and Within 3 Size Grades.

Small Debitage			
	3.962mm	2.794mm	2.0mm
	Holocene Terrace		
98.85-98.75	127 (51.62%)	106 (43.08%)	13 (5.28%)
98.75-98.65	206 (48.81%)	202 (47.86%)	14 (3.31%)
68.65-98.55	286 (42.43%)	352 (52.22%)	36 (5.34%)
98.55-98.45	1691 (35.42%)	2841 (59.52%)	241 (5.04%)
98.45-98.35	3362 (46.58%)	3612 (50.04%)	243 (3.36%)
98-35-98.25	3859 (43.69%)	4552 (51.53%)	421 (4.76%)
98-.25-98.15	1024 (39.03%)	1448 (55.20%)	151 (5.75%)
98.15-98.05	222 (35.92%)	357 (57.76%)	39 (6.31%)
98.05-97.95	104 (40.78%)	139 (54.50%)	12 (4.70%)
97.95-97.85	70 (55.11%)	55 (43.30%)	2 (1.57%)
Totals	**10951 (42.47%)**	**13664 (52.98%)**	**1172 (4.55%)**
	Pleistocene Sands		
97.85-97.75	92 (55.42%)	65 (39.15%)	9 (5.425)
97-75-97.65	148 (42.04%)	198 (56.25%)	6 (1.70%)
97.65-97.55	536 (54.74%)	412 (42.08%)	31 (3.16%0
97.55-97.45	580 (46.36%)	642 (51.31)	29 (2.31%)
97.45-97.35	287 (51.71%)	230 (41.44%)	38 (6.84%)
97.35-97.25	200 (53.76%)	155 (41.66%)	17 (4.56%)
97.25-97.15	219 (51.89%)	189 (44.78%)	14 (3.31%)
97.15-97.05	108 (34.39%)	172 (54.77%)	10 (10.82%)
Totals	**2170 (49.46%)**	**2063 (47.03%)**	**154 (3.51%)**
	Pleistocene Terrace		
97.05-96.95	37 (35.92%)	57 (55.33%)	9 (8.73%)
96.95-96.85	0	0	0
Totals	37 (35.92%)	57 (55.33%)	9 (8.73%)
Grand Total	**13158**	**15784**	**1335**

Table 21. Proportion of Small Debitage Within Each Cultural Occupation and Size Grade.

Small debitage				
Cultural Occupation	**9.55mm**	**7.925mm**	**5.613mm**	**Totals**
Mississippian/Woodland	619 (46.13%)	660 (49.18%)	63 (4.69%)	**1342**
MALA	9936 (51.36%)	8353 (43.18%)	1056 (5.46%)	**19345**
Clovis	396 (39.60)	551 (55.10%)	53 (5.30%)	**1000**
Pre-Clovis	2170 (49.46%)	2063 (47.03%)	154 (3.51%)	**4387**
TOTALS	**12502**	**11627**	**1326**	**26074**

smallest nested screens (3.962mm, 2.794mm, and 2.0mm). The vertical distribution of small debitage does not differ much from that of the complete flakes and flake fragments (Figure 31). It occurs within all of the major cultural occupations in higher densities, and is also present in higher densities with the Pleistocene Sands.

Although the distribution of small debitage appears to be more similar for the Holocene Terrace and Pleistocene Sands, a Pearson Chi Square χ^2 (2, N=30,174) = 79.919, $p < 0.001$) indicates a significant difference between the two populations of debitage. This may be representative a site disturbance or bioturbation. The proportion of small debitage within each of the cultural occupations is similar to one another, with a slight deviation existing within of the Clovis occupation (Table 21). This similarity also continues within the Pleistocene Sands strata. The total overall distribution of lithic material from the Holocene Terrace, Pleistocene Sands, and Pleistocene Terrace demonstrates further the difference between the two debitage assemblages (Table 22).

Table 22. Total Lithic Counts for Complete Flakes, Flake Fragments, and Small Debitage.

Total Debitage			
	Complete Flake	Flake Fragments	Small Debitage
	Holocene Terrace		
98.85-98.75	91	121	246
98.75-98.65	140	194	422
68.65-98.55	383	603	674
98.55-98.45	1073	1934	4,773
98.45-98.35	2832	4778	7,217
98-35-98.25	2059	3945	8,832
98-.25-98.15	227	664	2,623
98.15-98.05	66	182	618
98.05-97.95	36	56	255
97.95-97.85	34	46	127
Totals	**6941 (15.34%)**	**12523 (27.67%)**	**25787 (56.99%)**
	Pleistocene Sands		
97.85-97.75	28	73	166
97-75-97.65	32	147	352
97.65-97.55	92	32	979
97.55-97.45	118	98	1,251
97.45-97.35	23	365	55
97.35-97.25	13	271	372
97.25-97.15	7	132	422
97.15-97.05	2	91	290
Totals	**315 (5.82%)**	**1209 (22.34%)**	**3887 (71.84%)**
	Pleistocene Terrace		
97.05-96.95	0	69	103
96.95-96.85	0	4	0
Totals	0	73	103
Grand Total	**7256**	**13,805**	**29,777**

Pebbles and Cortical Debris

The distribution of pebbles and cortical debris was also examined within a complete stratigraphic profile. Figure 32 illustrates the amount, by weight, of stream pebbles and cortical debris that was recovered amongst the debitage. It is obvious that the profile of distribution has noticeably changed; in fact the profile represented for pebbles and cortical debris is now inverted

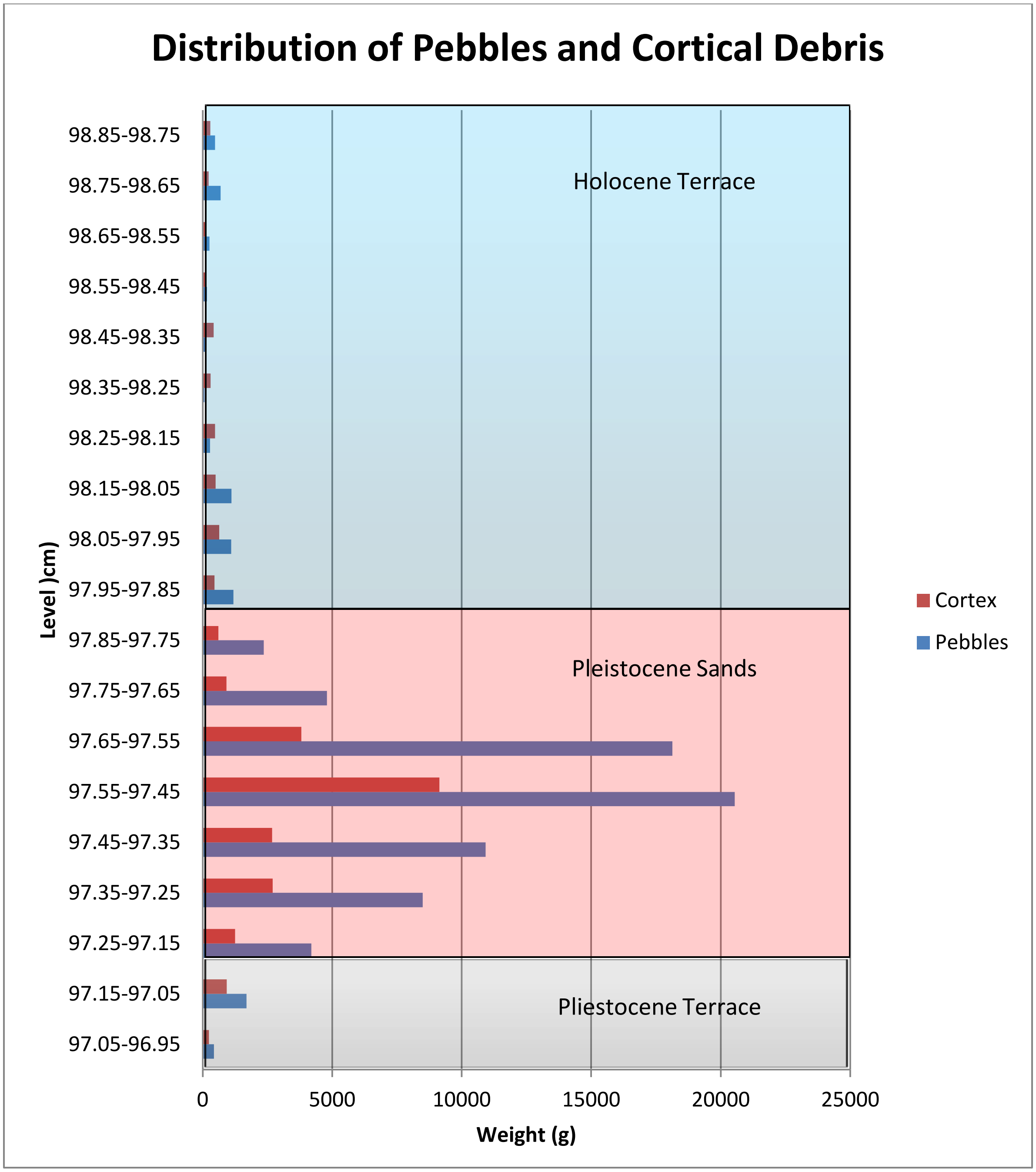


Figure 32. Distribution, by weight, of river pebbles and cortical debris.

from the ones presented previously showing debitage. In the Holocene Terrace levels pebbles and cortical debris are extremely sparse. In contrast, many of the levels associated with the

Pleistocene Sands have considerable quantities of pebbles and cortical debris. It is reasonable to assume that the increased presence of non-cultural material may be due to stream flow and fluvial deposition. If this is the case, one would have to consider the implications for the cultural material that was found incorporated within this matrix (i.e., it may be reworked or brought in from elsewhere?). A correlation analysis was conducted to see if there was any relationship between the amount of lithic debitage and the co-occurrence of pebbles and cortical. The results (Figures 32, 33 and Table 23) indicate that during the Holocene occupations at the Topper Site there is an inverse correlation between the co-occurrence of lithics and pebbles and cortical debris. This relationship confirms that the lithic materials recovered from the Holocene-aged strata were in fact deposited through the manufacturing of stone tools, and were not coincident with, produced by, or carried in through, stream deposition.

Table 23. Correlation Analysis of the Holocene Lithics, Pebbles, and Cortical Debris.

Correlations

		Pebbles_g	Cortex_g	Small Debitage	Whole Flake	Flake Fragment
Pebbles_g	Pearson Correlation	1	.605	-.723*	-.670*	-.687*
	Sig. (2-tailed)		.064	.018	.034	.028
	N	10	10	10	10	10
Cortex_g	Pearson Correlation	.605	1	-.157	-.148	-.139
	Sig. (2-tailed)	.064		.665	.682	.701
	N	10	10	10	10	10
Small Debitage	Pearson Correlation	-.723*	-.157	1	.930**	.958**
	Sig. (2-tailed)	.018	.665		.000	.000
	N	10	10	10	10	10
Whole Flakes	Pearson Correlation	-.670*	-.148	.930**	1	.996**
	Sig. (2-tailed)	.034	.682	.000		.000
	N	10	10	10	10	10

Flake Fragment s	Pearson Correlation	-.687*	-.139	.958**	.996**	1
	Sig. (2-tailed)	.028	.701	.000	.000	
	N	10	10	10	10	10

*. Correlation is significant at the 0.05 level (2-tailed).

**. Correlation is significant at the 0.01 level (2-tailed).

During the Pleistocene, however, there is a direct correlation between the co-occurrence of lithics with pebbles and cortical debris (Table 24 and Figure 33). This relationship does not confirm or reject the hypothesis that the lithics found within pre-Clovis aged sediment were the result of human manufacturing processes. It does indicate, however, that the cultural and non-cultural material was likely deposited at the same time. Whether or not this deposition took place as the result of stone tool production or fluvial deposition cannot be discerned at this time.

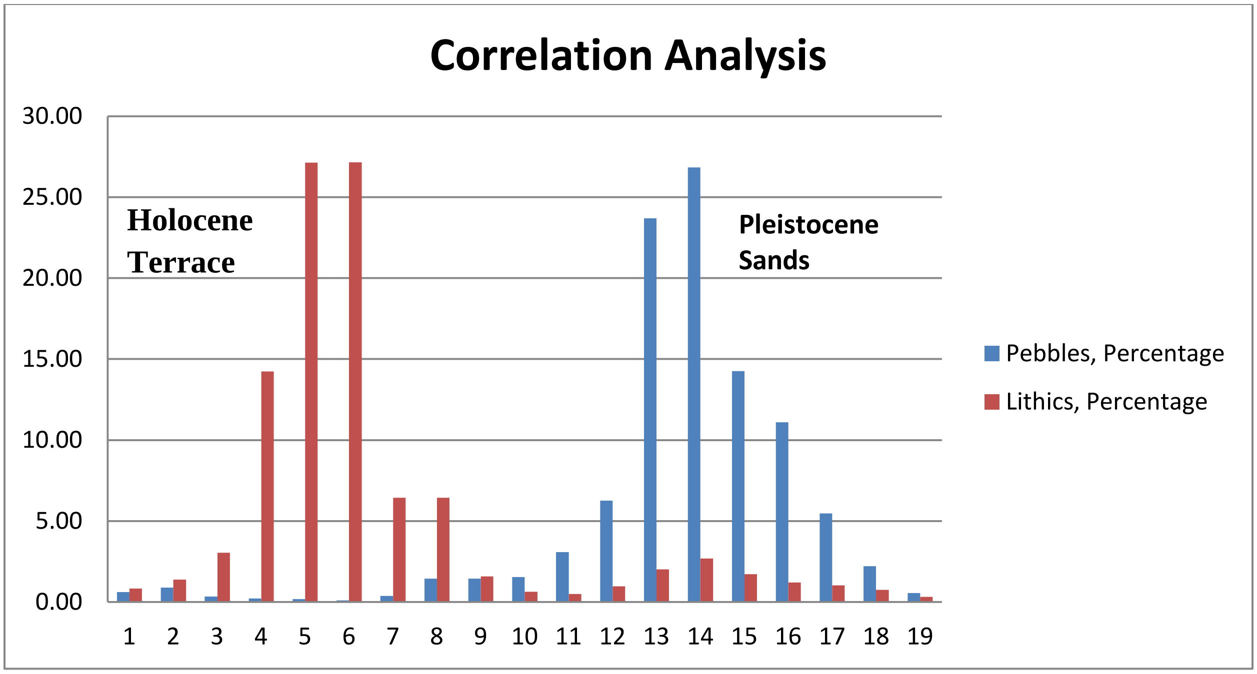


Figure 33. Illustrates the distribution of pebbles and lithics and supports the results of the correlations analysis.

Table 24. Correlation Analysis of the Pleistocene Sands Lithics, Pebbles, and Cortical Debris.

Correlations

		Pebbles_g	Cortex_g	Lithics	Micro	Whole	Frag
Pebbles_g	Pearson Correlation	1	.900**	.974**	.964**	.908**	.053
	Sig. (2-tailed)		.001	.000	.000	.001	.892
	N	9	9	9	9	9	9
Cortex_g	Pearson Correlation	.900**	1	.924**	.927**	.870**	.005
	Sig. (2-tailed)	.001		.000	.000	.002	.991
	N	9	9	9	9	9	9
Lithics	Pearson Correlation	.974**	.924**	1	.971**	.859**	.150
	Sig. (2-tailed)	.000	.000		.000	.003	.700
	N	9	9	9	9	9	9
Micro	Pearson Correlation	.964**	.927**	.971**	1	.925**	-.087
	Sig. (2-tailed)	.000	.000	.000		.000	.824
	N	9	9	9	9	9	9
Whole	Pearson Correlation	.908**	.870**	.859**	.925**	1	-.290
	Sig. (2-tailed)	.001	.002	.003	.000		.449
	N	9	9	9	9	9	9
Frag	Pearson Correlation	.053	.005	.150	-.087	-.290	1
	Sig. (2-tailed)	.892	.991	.700	.824	.449	
	N	9	9	9	9	9	9

**. Correlation is significant at the 0.01 level (2-tailed).

RESULTS OF ATTRIBUTE ANALYSIS

Flaking debris has been identified as a waste product from past human activities that is likely to have been deposited at or very near its locus of origin within past cultural systems (Binford and Quimby 1963). In Chapter 2, however, it was demonstrated that it is not always easy to distinguish flaking debris from naturally fractured lithic material. In order to demonstrate that the lithic debris recovered from below Clovis-aged deposits at Topper is of cultural origin, it was necessary to evaluate this material for evidence that it was produced intentionally by human agency. To do this, all of the debitage recovered from known cultural levels, and that found in the pre-Clovis aged deposits, were analyzed for attributes associated with stone tool production.

Examining debitage for attributes associated with stone tool manufacturing was essential to document that the material found below Clovis humanly was produced. Furthermore it was designed to demonstrate that they were part a legitimate lithic assemblage. The result of the attribute analysis reported above, confirmed that these attributes do occur just as frequently in both populations and that the pre-Clovis assemblage may in fact be representative of a humanly produced lithic assemblage, or alternatively, materials from a more recent occupation transported to these levels.

Flake Portion

While only complete flakes were measured during the attribute analysis, it was important to identify and quantify all flake portions that were present among the debitage assemblages. Based on the results of attribute analysis there are considerably more whole flakes present within the Holocene Terrace levels; in fact over 50% of this debitage assemblage was characterized as being complete. This proportion and frequency of complete flakes however, did not continue within the deeper levels associated with the Pleistocene Sands. Instead, in those levels almost three quarters of the debitage were flake fragments. Medial fragments in particular make up nearly 50% of this debitage population; whole flakes constitute 26%, while proximal fragments and distal fragments comprise the remaining 24%. A Chi-Square analysis (Table 9) based on the completeness of the flakes indicated that these two populations are statistically different and potentially unrelated. This does not mean, however, that the debitage associated with the pre-Clovis aged deposits is not part of a humanly produced lithic assemblage; they are just different. In the samples examined, lithic debris associated with known cultural occupations has a much higher incidence of complete flakes, while much (>75%) of the material associated with the pre-Clovis Pleistocene Sands is fragmented.

The condition of flakes, as noted in Chapter 3, is often a direct result of the post-depositional processes acting upon an archaeological assemblage. A population of debitage that is mostly fragmented, therefore, may be indicative of an assemblage that has been subjected to post-depositional processes. It has already been established, for example, that fluvial processes such as stream flow and episodes of flooding and deposition can create significant disturbances within a lithic assemblage. Fluvial action can also preserve archaeological material through deposition, redeposit a part or the entirety of site, or can in fact completely destroy archaeological sites by processes of erosion and/or degradation (Waters 1988:213). Petraglia and Potts (1994), as recounted in Chapter 3, have argued that water flow is one of the most important post-depositional processes altering the integrity of archaeological sites. The overall completeness of the archaeological record located within a fluvial environment is directly dependent upon the extent of aggradational and degradational episodes, as well as upon the stability of the landscape (Waters 1988:213).

It is also evident, based on the results in Table 1 that there is significantly less lithic debris present within the levels associated with the Pleistocene Sands. While this can be attributed to differing degrees of occupational intensity, it can also be hypothesized that the debitage population located within pre-Clovis aged sands has been removed, transported, or destroyed as the result of fluvial action, thus accounting for the quantity, quality, and condition of material present below the Clovis horizon. The poor condition of the material located within the pre-Clovis aged sands, as well as evidence provided by Waters et al. (2009) suggests, perhaps, that at some point during the Pleistocene this lithic material was subjected to episodes of fluvial processes. These episodes thus may be responsible for the poor condition of the flakes, the fragmented nature of the debitage, and the quantity of material recovered.

Flake Termination

Each flake that was defined and identified as being complete (whole) was further classified as having a hinge, step, feather, or outrepassé termination (Figure 23) (Andrefsky 2004:21; Cotterall and Kamminga 1979:104-106). Flake terminations, as noted in Chapter 3, essentially exhibits how force exited the nodule and have also been associated with the direction at which the force was applied (Odell 2004:56-57). While the total number of complete flakes did differ considerably between those occupations associated with the Holocene Terrace and those materials in the pre-Clovis Pleistocene Sands, the proportions of flake terminations was quite similar.

Statistically, it was shown that there was no significant difference between the two debitage assemblages in terms of flake terminations; this despite of the fact that there was a significant difference between the completeness of flakes between the two strata. The fact that there was no apparent significant differences between the two assemblages in terms of the proportional occurrence of flake terminations may indicate that the lithic debitage found below the Clovis-aged horizon is part of a legitimate (i.e., humanly produced) pre-Clovis assemblage.

Given that flake termination is often attributed to the type of technology utilized, and that there is no significant difference between the two tested assemblages, it is reasonable to presume that the lithic debris associated with pre-Clovis levels was manufactured using the same technology as the debitage recovered from within the site's known cultural occupations. Alternatively, because there was no significant difference between the flake terminations in the Holocene Terrace assemblage and the Pleistocene Sands lithic assemblage, it could also be inferred that these assemblage are one in the same, that is, they derive from the same source, the overlying Holocene Terrace deposits. Because of the loose unconsolidated nature of the sands in which these two assemblages are found, it is quite possible the debitage found within the Pleistocene Sands was derived from overlying strata. If this were the case, the two assemblages would be statistically related based on their technological characteristics.

Platform Attributes (Non-Measurable)

It is accepted by some archaeologists that the morphology of the striking platform on a detached flake has the potential to correlate debitage to the different stages of stone tool production, determine the type of hammer used, the type of objective piece being modified, as well as determining the size of the detached pieces (Cotterell and Kamminga 1987). However, it was demonstrated in Chapter 3 that there is much variability and subjectivity related to striking platform morphology. Striking platforms are often prepared or made by manipulation of the objective piece. They are "created for impact by tool makers who understand the relationship between striking platform characteristics and the size and shape of the detached piece desired"

(Andrefsky 2004:94). In an effort to reduce subjectivity only the presence or absence of a striking platform was recorded.

Just over 90% of the debitage assemblage recovered from within known cultural levels in the Topper sample had striking platforms, while somewhat less, ca.80% of the debitage recovered from within pre-Clovis aged levels also had discernible striking platforms (Table 11). Statistically, the occurrence of striking platforms between the two debitage assemblages was significantly different. This difference could potentially be the result of the weathered condition of the Pleistocene Sands lithics as well as the sample size, but it could also indicate an alternative technique for producing stone tools. It does not, however, indicate whether or not these flakes were the result of human action or natural processes.

Thermal Alteration

It has been documented that many prehistoric and some recent societies often deliberately heat treated tool stone in an effort to improve their flaking properties (Domanski and Webb 1992:601). The notable advantages attributed to thermal alteration include better flakeability, longer flake removals, fewer step and hinge terminations and the production of sharper edges (Crabtree & Butler, 1964; Domanski &Webb, 1992). The most noticeable of the visible changes includes a darkening in color and an increased luster of flaked surfaces. In the case of Allendale chert, a light colored highly siliceous microcrystalline rock; it was not difficult to identify those flakes which had been subjected to thermal alteration.

Documenting incidences of intentional thermal alteration within the debitage assemblages is relevant because of the propensity to heat tool stone changes through prehistory in the study area and across the larger region. In fact, the majority of occurrences of intentional thermal alteration reported in the literature from the Southeast and from the Allendale area, has been attributed to post-Paleoindian occupations Anderson 1979; Sassaman et al. 1990). There is still some speculation, however, regarding the specific cultural affiliation of heat treated tool stone. There are some (Broster 1996) who believe, for example, that Paleoindian populations residing in the Tennessee River Valley were heat treating their tool stone during the same approximate time the Topper site was occupied; therefore recovering thermally altered lithics below Archaic occupations would not be unexpected (although it is currently assumed to be with Allendale chert). Whether or not pre-Clovis populations would have been heat treating their chert is unknown, as very few legitimate pre-Clovis occupations yielding large quantities of lithic material have been recovered in the New World. The results presented above indicate that there is no significant difference between the proportion of thermally altered debitage within known cultural occupations in the Holocene Terrace and the debitage associated with the pre-Clovis Pleistocene Sands. Once again this may indicate there was a legitimate human occupation at Topper prior to the arrival of Clovis populations and that these populations were subjecting their chert to heat in order to improve its flaking properties. Alternatively, it is possible that this debitage was derived from overlying stratum and migrated down into the Pleistocene Sands over time, or that it was deposited as the result of stream flow and deposition.

Bulbar Presence

A bulb of percussion has been identified specifically by Patterson (1983) and Peacock (1991) as a flake attribute likely created during the production of stone tools. The relative robustness, for example, of the bulb of force has proven useful for lithic analysts when classifying flakes as derived from either hard-hammer percussion, soft-hammer percussion, or pressure flaking (Cotterell and Kamminga 1987; 1990; Crabtree 1972). Identifying characteristics such as a bulb of force helps to illustrate that the debitage being examined was produced as the result of human manufacturing activities. The results of the individual flake analysis indicated that within both the Holocene Terrace and Pleistocene Sands debitage assemblages more than 75% of each population contained flakes with discernible bulbs of percussion (Table 14). A Pearson Chi-Square further indicated that there was no significant difference between those whole flakes recovered from known cultural occupations and those recovered from the pre-Clovis aged Pleistocene Sands.

Dorsal Cortex

In the analysis of lithic debitage the amount of cortex is often measured as a means to discern the point in the production sequence when the flake in question originated. As mentioned in Chapter 3, only the presence or absence of dorsal cortex was recorded. Table 13 indicated that within those levels associated with the Holocene Terrace only 27.35% of all flakes analyzed contained remnants of dorsal cortex, while the other 72.65% was free of cortex. This pattern did not continue within the Pleistocene Sand; in fact within the pre-Clovis levels nearly 45% of the flakes contained at least some cortex on the dorsal surface, while the other 55% was cortex free. A Pearson Chi-Square indicated that the differences between the two assemblages were statistically significant. While the presence of dorsal cortex is one of the attributes cited as being related to percussion flaking, it does not necessarily tell us anything else about the debitage assemblage. This attribute alone is not enough to determine whether or not the pre-Clovis debitage is part of a discrete occupation, or if it was part of an assemblage that migrated downward or was deposited during stream flow. However, the greater incidence of cortex in the lower levels could reflect greater initial reduction activity by the first peoples to visit the quarry.

INTERPRETING THE VERTICAL DISTRIBUTION OF DEBITAGE

Characterizing the Debitage Assemblages

The vertical distributions of complete flakes, flake fragments, and small debitage were examined over10cm level and by size class. The intention was to expose potential patterns between each of the major known cultural strata and those levels associated with pre-Clovis aged stratum. The vertical distribution of cortical debris and river pebbles were also examined, by weight, from each 10cm level.

The proportion of each category of debitage, as well as the distribution of this material by size was demonstrated to be significantly different between the Holocene Terrace and Pleistocene Sands lithic assemblages. The debitage recovered from within the Holocene Terrace is characterized by a larger size, a greater quantity of complete flakes, and larger flake fragments.

Within the Holocene Terrace, for example, the lithic debitage consists of ca. 15.34% (Tables 16 and 22) complete flakes, ca. 51.28% of which measured greater than 9.5mm. Ca. 27.67% of the Holocene Terrace debitage consisted of flake fragments, ca. 54.64% of which fell within the second largest screen, 7.925mm. Small debitage was also prominent among the Holocene Terrace debitage, making up ca. 56.99% of the assemblage. The debitage recovered from within the Pleistocene Sands, on the other hand, is dominated by a much smaller, more fragmented debitage assemblage. In fact ca.71.48% of the entire PS assemblage consists of small debitage (Tables 18 and 22). Flake fragments made up ca. 22.34% of the assemblage. And complete flakes make up the smallest class of debitage, making up only ca. 5.82% of the assemblage. These two assemblages are significantly different in term of their size and level of fragmentation, but are not different in regards to many of their physical attributes.

The most obvious difference between Holocene Terrace and Pleistocene Sands assemblages, however, was not within the debitage itself, but within the cortical debris and river pebbles that were recovered amongst the debitage (Figures 32 and 33). Within the upper meter of the Holocene Terrace cortical debris and river pebbles are sparse, increasing slightly within the Clovis deposit. Correlation analysis determined that there an inverse relationship between the presence of lithic materials, and pebbles and cortical debris (Tables 23, 24). This relationship indicated the lithics within the Holocene Terrace were humanly manufactured and were not the result of natural processes. Within the Pleistocene Sands stratum, on the other hand, this non-cultural material increases reaching its greatest concentration between 97.55 to 97.45mbd, before steadily declining again. Correlation analysis (Table 24) determined that within the Pleistocene Sands there is a direct relationship between the presence of lithic material and pebbles and cortical debris, suggesting that these materials were deposited at the same time. The deposition of the pebbles and cortical debris likely represents an episode of fluvial deposition, while the pebbles and cortex are remnants of chute channels created by a prehistoric meandering river.

CHAPTER V: INTERPRETATION AND CONCLUSION

Archaeological investigations at Topper have revealed a site characterized by intense episodes of stone tool production and maintenance. The site, located within an extensive chert quarry on a major river drainage, provided an ideal location for early hunter-gatherers. Excavations at Topper have uncovered a series of occupations spanning from the Mississippian to the Clovis eras and perhaps much earlier. Based on the abundance of lithic material recovered from within the pre-Clovis strata, it has been hypothesized that the Topper site was occupied prior to arrival of Clovis populations. Because these lithics and the associated debitage consisted of the same high quality Allendale chert, analyses were directed to determining whether the pre-Clovis materials were created using the same technological methods of production used by the peoples who created the deposits in the Holocene Terrace, or Clovis age and after.

EVALUATING THE PRE-CLOVIS OCCUPATION AT TOPPER

The majority of the presumed pre-Clovis artifacts and associated debitage examined in this study were came from within what Waters et al. (2009) identified as unit 2b, the Pleistocene Sands, a loose unconsolidated deposit identified as having been formed by both colluvial and fluvial processes (Figure 8). In their investigation of the stratigraphy of the Topper site, Waters et al. identified evidence for discrete episodes of fluvial deposition in this strata; episodes which resulted in the creation of gravel filled chute channels hypothesized as having once been part of a prehistoric braided stream system. As demonstrated herein, archaeological (i.e., likely humanly modified) materials, most small incomplete flakes and small debitage came from these deposits. Based on the distribution of pebbles and cortical debris within the Pleistocene Sands, it is reasonable to hypothesis that such chute channels were present in the columns used in the current analysis, and are in fact likely represented between 97.55 and 97.35 MBD (Figure 30). Waters et al. (2009:205) have noted that significant site disturbances can often be identified in the alluvial record as erosional unconformities or as channel fill. This is extremely significant when evaluating the pre-Clovis occupation from the Topper site because it may indicate considerable disturbance in the Pleistocene archaeological record. Based on this observation, as well as the information and data presented above, I have developed two contrasting hypotheses regarding the pre-Clovis at the Topper Site. It is, however, premature to make a definitive conclusion as to which hypothesis is correct. Additional research will be needed to provide the evidence necessary to make such an evaluation.

Hypothesis 1

The first hypothesis is that it there was no occupation at the Topper Site prior to the arrival of Clovis populations. If this hypothesis is correct, it would mean that the materials recovered from within the older Pleistocene Sands and Pleistocene Terrace sediments are likely the result of different taphonomic processes. The most likely natural processes include bioturbation, freeze thaw action, or erosion and deposition from stream flow. Given the evidence for a fluvial environment during the time the Pleistocene Sands were exposed, and the extremely weathered and fragmented nature of many of the lithics, it seems possible that the lithic material below the Clovis levels was deposited as a result of stream flow, overbank deposition, or episodes of flooding from the adjacent Savannah River. It is possible that episodes of stream flow and deposition contributed to flake breakage within the Pleistocene

Sands, and also reduced their mean size (Pryor 1988). The pre-Clovis lithics have been characterized as being highly fragmented and much smaller than those from overlying strata.

Waters et al. (2009) have already speculated that those units where pre-Clovis lithic material was recovered were subjected to fluvial processes. Episodes of erosion, deposition, and degradation can severely alter a landscape and transport material considerable distances. They can also be severe and violent enough to produce flake-like debris and edge damage on lithic material which mirrors manufacturing debitage.

In addition to the evidence for fluvial deposition and erosion, there was only a limited amount of recognizable debitage available within the Pleistocene Sands; thus shedding more doubt on the legitimacy of this material as being part of an actual pre-Clovis lithic assemblage. When examining known cultural occupations in the Holocene Terrace deposits, like the MALA component, for example, one can clearly see that there is a great deal of debitage present as well as undeniable stone tools. Even though there was significantly less Clovis material present, there were similar patterns of debitage distribution as well as similar distributions of flake attributes for these two distinct cultural occupations. These patterns do, however, continue within the Pleistocene Sands. As stated in Chapter 4, the continuation of these patterns does not necessarily indicate the presence of a legitimate pre-Clovis assemblage. Instead, it may be indicative of the downward migration of lithic material from overlying strata.

If there were no pre-Clovis occupation at Topper, the presence of artifacts in the deeper deposits could have become vertically displaced from the known cultural occupations in the Holocene deposits, and have bioturbated into the Pleistocene Sands and Pleistocene Terrace deposits. Such occurrences can be the result of tree roots and vegetation as well as animal burrowing. It is also important to recall Villa, who stated that “ layers and soils should be considered as fluid, deformable bodies…through which archaeological items float, sink, and glide” (1982:232). Seeing that the Topper matrix consists of loose, sandy, unconsolidated sands, it is likely that some material was able to move downward over time.

The data presented in Chapter 4 could also suggest that the pre-Clovis lithics migrated downward from the Holocene Terrace. Evidence to support this comes from the fact that material located within the Pleistocene Sands is physically, or technologically, no different than the debitage from above. It exhibited characteristics of debitage created during stone tool manufacturing. But, on average, the debitage within the Pleistocene Sands was considerably smaller. Smaller fragments are more likely to move fluidly through a matrix than larger pieces of debitage; thus further supporting this hypothesis.

An additional argument for the downward movement of artifacts is evidence of differential weathering, or erosion. Amongst the Pleistocene Sands and Terrace deposits there were, for example, flakes which exhibited considerable evidence of weathering. However recovered *in situ* with this degraded material were flakes which exhibit very little, if any, evidence of weathering or erosion. Some material recovered also exhibited evidence of weathering, but had relatively recent fractures which revealed chert surfaces that were unweathered and still in possession of good cryptocrystalline characteristics.

Why is it that debitage within the lithic assemblage exhibit differential degrees of weathering and erosion? One hypothesis is that the desilicified material was subjected to, or exposed to, an erosional environment for a longer period of time, while the chert which is still of good cryptocrystalline structure has only recently bioturbated down into older pre-Clovis

Pleistocene Sands and Terrace. The Pleistocene Terrace, where some of the pre-Clovis material was recovered, exhibits much more moisture than the unconsolidated Pleistocene Sands and Holocene levels higher up. It is possible that chert within the drier Pleistocene Sands matrix over thousands of years began to slowly lose those properties which made it knappable, and the process has just not gone as far in the Holocene Levels, which is why the artifacts higher in the deposits appear less weathered. An alternative explanation, however, is that the lower moisture levels in the Pleistocene Terrace better preserved the chert, some of which is still of a superb quality, and that the material which is weathered and eroded is the material which has become vertically displaced from the levels higher up at some point. Both theories are plausible, and both still presume that some materials recovered from below the Clovis levels did not necessarily originate there.

Hypothesis II

The data presented in Chapter 4 also supports an alternative hypothesis. It is quite possible that there was a legitimate pre-Clovis occupation or occupations present at or nearby the Topper Site, but episodes of stream deposition and transport have created an incomplete record of their occupation. Such episodes could be responsible for the severely fragmented and weathered nature of the pre-Clovis lithics. The Topper Site was prone to episodes of flooding and stream deposition from the nearby Savannah River during the time the Pleistocene Sands was formed and maybe when the Pleistocene Terrace formed as well, although that could not be determined in the present analysis. Such episodes may have transported the pre-Clovis assemblage away from the site, or alternatively could have introduced this lithic material from a different location along the Savannah River; suggesting perhaps an alternative location for a pre-Clovis aged archaeological deposit. Waters and Kuehn (1996) have noted that “such episodes of fluvial deposition can be so disruptive that they fragment the record of human settlement and activity for any time period” (Waters and Kuehn 1996:123). If this were the case, the debitage assemblage would be not only being incomplete, but it would have been subjected to several taphonomic changes. Such changes to the assemblage would include breakage and weathering; two characteristics which dominate the Pleistocene Sands lithics.

If the assemblage located within the Pleistocene Sands and perhaps within the Pleistocene Terrace at Topper was transported or erased by episodes of stream flow or overbank flooding, it would explain the small samples that were recovered. Episodes of stream flow and deposition could also account for the fragmented nature of the Pleistocene Sands lithic assemblage. As mentioned above, the debitage assemblage recovered from within the Pleistocene Sands consisted mainly of fragmented flakes, most of which were smaller than the debitage from the Holocene Terrace. However, this pre-Clovis debitage, while being smaller, did possess the same physical characteristics as the debitage from the Holocene Terrace. This would suggest that they were produced during stone tool production, by human agency and not by natural possesses.

The distribution of cortical debris and river pebbles (Figure 32) also suggest that there was at least one episode of fluvial deposition during the time the Pleistocene Sands were exposed. Waters et al. (2009) identified several chute channels in these deposits which they interpreted as part a prehistoric meandering river (Figures 7 and 9). The presence and distribution of river pebbles and cortical debris within the Pleistocene Sands supports their theory that the area of the pre-Clovis Excavation Block was subjected to a fluvial environment during the Pleistocene. The proximity of the excavations to the Savannah River also lends credence to this hypothesis. Episodes of fluvial deposition and erosion most likely also accounts for the degraded nature of lithic debris located within the Pleistocene Sands. If the lithics within the pre-Clovis aged Pleistocene sands were exposed to fluctuating water levels, they might also have been prone to erosional processes that stripped the chert of silica and rendered it chalky.

An additional argument is that the patterns of debitage distribution are different for the some of the Pleistocene Sands levels because the pre-Clovis occupants were using a different manufacturing technique, thus leaving behind a different assortment of debitage. Goodyear (2005a) has argued, in fact, that the pre-Clovis assemblage was created using bipolar technology, not the bifacial technology which was utilized by Archaic and Paleoindian populations. Bipolar technology would have left behind a different archaeological signature, which is perhaps what we are seeing. Bryan (2004), if we recall, argued that archaeologists should abandon their reliance on finding diagnostic tools when searching for early sites. Perhaps, then, it is reasonable that we should also not rely on finding similar distributions of debitage for pre-Clovis assemblages.

If the debitage assemblage located within the Pleistocene Sands is part of a legitimate pre-Clovis assemblage it ultimately means that humans were in the Americas prior to the arrival of Clovis populations. While evidence for a pre-Clovis occupation in the Americas has been found within other parts of the Americas, it has been limited in the Southeast. This type of evidence may provide clues to colonization rates, patterns, and migration routes of the first New World populations.

CONCLUSION

The distribution and characteristics of debitage from known cultural levels within the Holocene Terrace and those associated with pre-Clovis aged Pleistocene Sands in the sample obtained from Topper and examined here was quite similar. Both assemblages contained materials which exhibited technological traits of debitage created during stone tool production. While the data supports the notion that the pre-Clovis debitage was manmade, it does not necessarily indicate that this material was deposited by a pre-Clovis population. As such, it was necessary to propose two contrasting hypotheses. One assumes that the lithic debris recovered from within the Pleistocene Sands was the product of downward migration or fluvial deposition, and therefore does not represent at pre-Clovis occupation. The alternative hypothesis suggests that there was a legitimate pre-Clovis occupation(s) at the Topper Site, but that the deposits were subjected to a fluvial environment, hence their dissimilarity with the overlying assemblages. Episodes of stream flow, deposition, and erosion may have not only transported and fragmented this assemblage; it may also have changed the chemical composition of the chert.

At this time it is nearly impossible to choose between these two hypotheses. To some degree, the data supports each of them. It is clear that continued research and excavation must be done at the Topper site to determine the legitimacy of the pre-Clovis lithic assemblage. Future work should include debitage from within deeper stratum within the Pleistocene Terrace in order to determine the nature of this material and how it compares to the debitage from the Holocene Terrace and Pleistocene Sands.

Continued excavations within the pre-Clovis Excavation Block at the Topper Site mean that there is great potential for future research. Investigating the nature of lithic material within the Pleistocene Sands is crucial when attempting to understand the occupational and depositional history of the site. In order to further assess the legitimacy of the “pre-Clovis assemblage” future researchers should attempt to address several key issues briefly touched upon in this paper. These include the differential preservation of chert within the Pleistocene Sands and Terrace, the possibility of the downward migration of artifacts, the fragmented nature of the pre-Clovis lithic assemblage, and the possibility that there may be additional archaeological sites located upstream from the Topper Site. Future research should also include larger samples from multiple locations at the Topper Site.

Continued examination of lithic debitage from pre-Clovis aged deposits is also necessary if we are to understand the nature of these assemblages. Refitting is technique often practiced by lithic analysts which incorporates both debitage and lithic nodules. It is a productive method for assessing lithic artifact data into individual episodes of production, use, and maintenance by refitting flakes onto tools or cores (Andrefsky 2009). This process attempts to reconstruct an original nodule or flake blank. It has the potential, however, to moreover reveal postdepositional site disturbances and to assess the integrity of occupational surfaces (Jodry 1992). Andrefsky (2009) notes that “refitting can help investigators understand three primary aspects of site assemblages: (1) lithic technological practices that have occurred at a location, (2) taphonomic process at work (site integrity), and (3) spatial associations (2009:84). This practice can be very tedious and time consuming; however it would be extremely useful within the pre-Clovis Excavation Block at the Topper Site.

Future research should also include the detailed examination of the potential tools recovered from with pre-Clovis aged strata. Use-wear analysis, as well at detailed microscopic investigations of flake removals or edge damage, could provide evidence of postdepositional processes, periods of stream flow, or episodes of human trampling. Each of these processes, as discussed in Chapter 2, has the potential to produce pseudo-tools from non-cultural lithic material.

Experimenting with local Allendale chert is an additional avenue researchers should consider in the future. Such experiments should be directed toward replicating artifacts, assemblage characteristics, and frequent types of breakage seen within pre-Clovis lithics at the site. Potential experiments could include trampling and freeze thaw experiments, but should also include experiments directed toward replicating artifacts with different types of core reduction techniques. Experimenting with bipolar vs. bifacial technology might help account for the differences in assemblage size and characteristics. The implications of these types of analyses could provide insight into the peopling of the Americas and the colonization of the Southeast. This analysis has provided some initial insights into the pre-Clovis assemblage found at Topper, but as we have seen, there is still much we wish to know.

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APPENDIX A

Table A. Attribute Analysis Data - Bulk samples.

FlakeID	IDNum	Unit	Location	PlatWidth	FlkLeng	FlkWid	FlkThick	PlatPres	ThermAlt	BulbPres	CortPres
(NE 1) 1	1	N246E136	LT	9.84	16.35	13.48	3.15	Yes	No	Yes	Yes
(NE 1) 2	2	N246E136	LT	5.79	23.63	26.81	5.13	Yes	No	No	No
(NE 1) 3	3	N246E136	LT	7.86	23.36	21.21	5.32	Yes	No	No	Yes
(NE 1) 4	4	N246E136	LT		16.04	19.78	4.08	No	No	No	Yes
(NE 1) 5	5	N246E136	LT	10.74	14.7	21.62	3.69	Yes	No	No	Yes
(NE 1) 6	6	N246E136	LT	5.85	16.54	17.21	3.99	Yes	Yes	Yes	No
(NE 2) 7	7	N246E136	LT	9.93	55.45	45.65	8.31	Yes	No	Yes	No
(NE 2) 8	8	N246E136	LT	10.17	44.84	44.34	9.4	Yes	No	Yes	Yes
(NE 2) 9	9	N246E136	LT	4.3	21.8	20.94	4.25	Yes	No	Yes	No
(NE 2) 10	10	N246E136	LT	12.37	18.55	17.81	3.09	Yes	No	No	No
(NE 2) 11	11	N246E136	LT		21.34	29.07	3.82	No	Yes	Yes	No
(NE 2) 12	12	N246E136	LT	10.69	23.64	36.1	4.58	Yes	No	Yes	No
(NE 2) 13	13	N246E136	LT	7.5	30.3	21.79	6.43	Yes	Yes	No	Yes
(NE 2) 14	14	N246E136	LT	12.13	16.29	19.67	4.5	Yes	Yes	No	No
(NE 2) 15	15	N246E136	LT	7.88	24.79	15.41	2.52	Yes	No	Yes	No
(NE 2) 16	16	N246E136	LT	9.76	17.89	20.45	4.04	Yes	Yes	Yes	No
(NE 2) 17	17	N246E136	LT	8.3	24.78	30.14	8.35	Yes	Yes	Yes	No
(NE 2 18	18	N246E136	LT	13.74	21.09	23.22	5.92	Yes	No	Yes	No
(NE 2) 19	19	N246E136	LT		28.62	23.17	5.12	No	No	No	No
(NE 2) 20	20	N246E136	LT	3.2	23.87	21.07	3.12	Yes	Yes	Yes	No
(NE 2) 21	21	N246E136	LT	4.48	30.22	23.08	3.03	Yes	No	No	No
(NE 2) 22	22	N246E136	LT	5.69	18.77	17.21	2.34	Yes	No	Yes	No
(NE 2) 23	23	N246E136	LT	2.98	16.89	21.41	3.39	Yes	No	Yes	No
(NE 2) 24	24	N246E136	LT	7.79	23.76	18.39	4.42	Yes	No	No	No
(NE 2) 25	25	N246E136	LT	12.86	28.81	20.32	3.89	Yes	Yes	No	No

Table A.1 - Continued

(NE 03) 26	26	N246E136	LT	2.43	31.8	17.89	2.1	Yes	No	Yes	Yes
(NE 03) 27	27	N246E136	LT	9.87	24.05	22.4	4.43	Yes	Yes	No	No
(NE 03) 28	28	N246E136	LT	5.9	46.18	19.45	4.52	Yes	Yes	Yes	No
(NE 03) 29	29	N246E136	LT		22.25	21.72	4.32	No	No	Yes	No
(NE 03) 30	30	N246E136	LT	9.65	17.33	19.34	2.7	Yes	Yes	Yes	Yes
(NE 03) 31	31	N246E136	LT	4.7	35.67	19.01	5.47	Yes	Yes	Yes	Yes
(NE 03) 32	32	N246E136	LT	4.87	20.2	19.46	1.91	Yes	Yes	No	Yes
(NE 03) 33	33	N246E136	LT	4.2	18.32	19.88	3.21	Yes	Yes	No	No
(NE 03) 34	34	N246E136	LT	7.82	40.05	14.04	6.46	Yes	Yes	No	Yes
(NE 03) 35	35	N246E136	LT	7.17	24.77	14.32	5.21	Yes	Yes	No	No
(NE 03) 36	36	N246E136	LT	5.68	22.62	20.93	4.67	Yes	Yes	No	Yes
(NE 03) 37	37	N246E136	LT	8.41	23.51	21.13	6.55	Yes	No	No	No
(NE 03) 38	38	N246E136	LT	4.69	28.84	20.48	10.1	Yes	No	Yes	Yes
(NE 03) 39	39	N246E136	LT	7.97	20.24	22.28	2.92	Yes	No	Yes	No
(NE 03) 40	40	N246E136	LT	4.36	17.81	20.73	1.33	Yes	Yes	No	No
(NE 03) 41	41	N246E136	LT	5.43	26.27	15.84	3.41	Yes	Yes	No	No
(NE 03) 42	42	N246E136	LT	12.06	20.67	22.59	6.05	Yes	No	Yes	No
(NE 03) 43	43	N246E136	LT		25.41	23.44	3.94	No	No	No	No
(NE 03) 44	44	N246E136	LT	8.04	27.87	20.62	4.3	Yes	Yes	Yes	No
(NE 03) 45	45	N246E136	LT	8.3	17.2	22.17	8.3	Yes	No	No	Yes
(NE 03) 46	46	N246E136	LT	12.68	35.84	23.74	4.67	Yes	No	No	Yes
(NE 03) 47	47	N246E136	LT	7.25	22.81	35.14	7.65	Yes	No	Yes	Yes
(NE 03) 48	48	N246E136	LT	7.58	27.68	22.26	6.65	Yes	Yes	No	No
(NE 03) 49	49	N246E136	LT	9.08	39.16	21.27	7.86	Yes	No	Yes	Yes
(NE 03) 50	50	N246E136	LT	16.83	22.68	29.03	6.93	Yes	No	No	No

Table A. 1 - Continued

(NE 03) 51	51	N246E136	LT	6.53	28.25	14.31	2.64	Yes	Yes	No	No
(NE 03) 52	52	N246E136	LT	7.95	22.74	27.42	6.51	Yes	No	No	Yes
(NE 03) 53	53	N246E136	LT	5.89	19.02	20.15	4.1	Yes	Yes	Yes	Yes
(NE 03) 54	54	N246E136	LT		16.87	17.89	3.86	No	Yes	Yes	Yes
(NE 03) 55	55	N246E136	LT	6.04	22.75	27.99	5.93	Yes	Yes	No	Yes
(NE 03) 56	56	N246E136	LT	13.05	21.27	22.96	4.1	Yes	No	No	No
(NE 03) 57	57	N246E136	LT		24.69	22.45	2.89	No	Yes	No	No
(NE 03) 58	58	N246E136	LT	5.94	21.91	18.34	3.04	Yes	No	No	Yes
(NE 03) 59	59	N246E136	LT	12.05	28.47	25.56	3.47	Yes	No	Yes	No
(NE 03) 60	60	N246E136	LT	10.84	28.84	29.91	5.63	Yes	No	Yes	No
(NE 03) 61	61	N246E136	LT	11.66	28.33	23.67	5.13	Yes	No	No	Yes
(NE 03) 62	62	N246E136	LT	11.17	21.19	22.01	5.38	Yes	No	Yes	Yes
(NE 03) 63	63	N246E136	LT	6.03	32.32	21.32	6.3	Yes	Yes	No	Yes
(NE 03) 64	64	N246E136	LT	4.45	36.04	34.35	6.98	Yes	Yes	Yes	No
(NE 03) 65	65	N246E136	LT	8.04	28.47	35.81	5.14	Yes	No	No	No
(NE 03) 66	66	N246E136	LT	14.61	26.28	20.44	4.03	Yes	No	No	Yes
(NE 03) 67	67	N246E136	LT	6.1	26.72	20.69	5.07	Yes	Yes	Yes	Yes
(NE 03) 68	68	N246E136	LT	4.03	23.78	17.26	2.89	Yes	Yes	No	No
(NE 03) 69	69	N246E136	LT		42.72	57.26	18.56	No	No	Yes	No
(NE 03) 70	70	N246E136	LT	6.57	26.33	15.3	4.01	Yes	No	Yes	No
(NE 03) 71	71	N246E136	LT	4.19	21.47	24.97	3.66	Yes	No	Yes	No
(NE 03) 72	72	N246E136	LT	5.13	21.46	32.1	7.88	Yes	No	Yes	Yes
(NE 03) 73	73	N246E136	LT		23.42	15.16	3.32	No	Yes	No	Yes
(NE 03) 74	74	N246E136	LT		25.63	19.07	4.08	No	No	No	No
(NE 03) 75	75	N246E136	LT	5.09	19.7	14.15	3.63	Yes	Yes	No	Yes
(NE 03) 76	76	N246E136	LT	7.57	21.7	20.01	5.73	Yes	No	Yes	No

Table A. 1 - Continued

(NE 03) 77	77	N246E136	LT	14.03	27.15	20.98	5.09	Yes	No	Yes	Yes
(NE 03) 78	78	N246E136	LT	3.77	20.92	16.36	4.43	Yes	No	No	Yes
(NE 03) 79	79	N246E136	LT	2.54	26.52	19.22	3.2	Yes	No	Yes	Yes
(NE 03) 80	80	N246E136	LT	4.87	32.63	26.8	2.89	Yes	Yes	Yes	Yes
(NE 03) 81	81	N246E136	LT	6.34	18.24	19.41	3.34	Yes	Yes	Yes	No
(NE 03) 82	82	N246E136	LT	5.54	28.85	23.84	3.79	Yes	No	No	Yes
(NE 03) 83	83	N246E136	LT	5.39	27.14	20.52	3.68	Yes	Yes	Yes	Yes
(NE 03)84	84	N246E136	LT	13.57	24.45	28.25	7.98	Yes	No	Yes	Yes
(NE 03) 85	85	N246E136	LT	4.78	29.45	19.96	4.14	Yes	Yes	Yes	Yes
(NE 03) 86	86	N246E136	LT	10.37	20.91	24.38	3.4	Yes	No	No	No
(NE 03) 87	87	N246E136	LT	8.91	34.15	21	6.18	Yes	Yes	Yes	Yes
(NE 03) 88	88	N246E136	LT	6.27	22.79	24.54	5.36	Yes	No	Yes	No
(NE 03) 89	89	N246E136	LT	6.52	19.92	32.57	7.86	Yes	No	Yes	Yes
(NE 03) 90	90	N246E136	LT	8.7	20.29	19.22	4.48	Yes	No	No	Yes
(NE 03) 91	91	N246E136	LT	12.89	24.66	29.22	4.53	Yes	No	Yes	No
(NE 03) 92	92	N246E136	LT		24.79	17.06	2.93	No	Yes	No	No
(NE 03) 93	93	N246E136	LT		25.86	21.62	3.64	No	No	Yes	No
(NE 03) 94	94	N246E136	LT	5.25	21.56	18.27	3	Yes	Yes	No	No
(NE 03) 95	95	N246E136	LT		25.82	15.2	2.92	No	No	No	Yes
(NE 03) 96	96	N246E136	LT	7.2	14.19	22.55	3.74	Yes	No	Yes	Yes
(NE 03) 97	97	N246E136	LT	10.66	21.02	23.78	4.47	Yes	Yes	No	No
(NE 03) 98	98	N246E136	LT	10.23	23.57	18.44	4.35	Yes	Yes	Yes	Yes
(NE 03) 99	99	N246E136	LT	12.97	17.06	24.56	5.43	Yes	No	Yes	No
(NE 03)100	100	N246E136	LT	7.3	25.08	21.37	4.2	Yes	Yes	Yes	Yes
(NE03)101	101	N246E136	LT	5.11	24.45	29.65	2.82	Yes	No	Yes	Yes

Table A. 1 - Continued

(NE03)102	102	N246E136	LT	9.43	19.6	34.38	4.38	Yes	No	Yes	No
(NE03)103	103	N246E136	LT	4.13	17.78	20.82	4.52	Yes	Yes	No	Yes
(NE03)104	104	N246E136	LT	5.65	15.76	26.29	4.25	Yes	Yes	Yes	Yes
(NE03)105	105	N246E136	LT	5.69	23.75	13.3	3.54	Yes	No	Yes	No
(NE03)106	106	N246E136	LT	5.46	13.77	18.97	2.44	Yes	Yes	Yes	No
(NE03)107	107	N246E136	LT	4	16.42	16.48	2.54	Yes	Yes	Yes	Yes
(NE03)108	108	N246E136	LT	7.66	23.69	16.5	5.04	Yes	No	Yes	Yes
(NE03)109	109	N246E136	LT		19.02	19.95	2.85	No	Yes	Yes	Yes
(NE03)110	110	N246E136	LT	11.66	17.65	23.38	3.31	Yes	Yes	No	Yes
(NE03)111	111	N246E136	LT	12.24	19.04	15.89	4.52	Yes	Yes	No	No
(NE03)112	112	N246E136	LT	15.38	26.29	25.05	9.81	Yes	No	Yes	Yes
(NE03)113	113	N246E136	LT	6.61	24.96	19.23	2.81	Yes	No	Yes	Yes
(NE03)114	114	N246E136	LT		27.8	22.93	2.2	No	No	Yes	No
(NE03)115	115	N246E136	LT		19.31	14.79	2.11	No	Yes	Yes	No
(NE03)116	116	N246E136	LT	5.97	15.36	21.93	4.01	Yes	No	No	Yes
(NE03)117	117	N246E136	LT	7.37	19.1	13.32	3.56	Yes	Yes	Yes	No
(NE03)118	118	N246E136	LT	7.43	17.24	16.09	3.63	Yes	Yes	Yes	Yes
(NE03)119	119	N246E136	LT	4.65	18.65	15.76	2.92	Yes	No	Yes	Yes
(NE03)120	120	N246E136	LT	6.76	26.21	31.83	4.95	Yes	No	Yes	Yes
(NE03)121	121	N246E136	LT	4.41	16.86	16.42	2.02	Yes	Yes	No	Yes
(NE03)122	122	N246E136	LT	4.71	24.24	20.02	4.6	Yes	No	Yes	No
(NE03)123	123	N246E136	LT	5.96	19.95	24.78	3.45	Yes	No	Yes	Yes
(NE03)124	124	N246E136	LT	7.85	20.47	16.15	2.77	Yes	No	No	No
(NE03)125	125	N246E136	LT	6.97	13.9	21.91	2.83	Yes	No	No	Yes
(NE03)126	126	N246E136	LT	15.66	20.05	15.66	6.1	Yes	Yes	No	No
(NE03)127	127	N246E136	LT	11.37	27.37	18.76	3.78	Yes	No	No	Yes

Table A. 1 - Continued

(NE03)128	128	N246E136	LT	4.1	29.24	16.41	3.61	Yes	No	Yes	No
(NE03)129	129	N246E136	LT	11.3	23.59	15.87	3.83	Yes	Yes	Yes	Yes
(NE03)130	130	N246E136	LT	2.83	19.76	19.4	2.34	Yes	No	Yes	Yes
(NE03)131	131	N246E136	LT	3.88	17.74	21.11	1.32	Yes	No	Yes	Yes
(NE03)132	132	N246E136	LT	4.84	16.89	16.65	3.14	Yes	No	Yes	No
(NE03)133	133	N246E136	LT	4.5	27	15.69	1.74	Yes	Yes	No	Yes
(NE03)134	134	N246E136	LT	4.18	23.47	14.83	3.04	Yes	Yes	Yes	No
(NE03)135	135	N246E136	LT		25.81	17.09	3.53	No	No	Yes	Yes
(NE 03)136	136	N246E136	LT	7.87	21.93	18.85	2.63	Yes	Yes	Yes	Yes
(NE 03)137	137	N246E136	LT	6.78	18.81	17.66	2.51	Yes	No	Yes	Yes
(NE 03)138	138	N246E136	LT	8.61	13.13	16.17	2.5	Yes	Yes	Yes	No
(NE 4)139	139	N246E136	LT		26.77	24.64	6.51	No	Yes	Yes	No
(NE 4)140	140	N246E136	LT	11.76	19.79	28.49	5.29	Yes	No	Yes	No
(NE 4)141	141	N246E136	LT	4.23	33.6	37.05	4.89	Yes	No	Yes	No
(NE 4)142	142	N246E136	LT	6.31	44.24	19.93	5.22	Yes	No	Yes	No
(NE 4)143	143	N246E136	LT	13	26.54	34.7	7.97	Yes	No	No	No
(NE 4)144	144	N246E136	LT	3.55	24.31	35.38	3.83	Yes	No	Yes	No
(NE 4)145	145	N246E136	LT	7.04	26.25	33.34	6.68	Yes	Yes	Yes	No
(NE 4)146	146	N246E136	LT	7.43	35.95	40.55	7.6	Yes	No	Yes	No
(NE 4)147	147	N246E136	LT	7.74	34.19	34.77	8.66	Yes	Yes	Yes	No
(NE 4)148	148	N246E136	LT	7.46	24.15	28.39	4.96	Yes	Yes	Yes	No
(NE 4)149	149	N246E136	LT	4.33	23.82	23.03	2.78	Yes	Yes	Yes	No
(NE 4)150	150	N246E136	LT	8.16	36.1	16.67	8.2	Yes	No	Yes	Yes
(NE 4)151	151	N246E136	LT	9.78	44.9	21.33	6.3	Yes	Yes	No	No
(NE 4)152	152	N246E136	LT	9.09	26.26	36.67	5.57	Yes	No	No	Yes
(NE 4)153	153	N246E136	LT	6.16	35.31	20.6	5.18	Yes	Yes	Yes	No

Table A. 1 – Continued.

(NE 4)154	154	N246E136	LT		29.4	22.92	4.56	No	Yes	No	Yes
(NE 4)155	155	N246E136	LT	6.58	34.65	24.85	6.56	Yes	Yes	Yes	No
(NE 4)156	156	N246E136	LT	10.17	35.66	30.59	5.73	Yes	Yes	No	No
(NE 4)157	157	N246E136	LT	6.44	31.29	39.35	2.8	Yes	Yes	Yes	Yes
(NE 4)158	158	N246E136	LT	10.47	28.05	28.93	6.94	Yes	Yes	Yes	No
(NE 4)159	159	N246E136	LT	6.45	25.5	18.55	3.94	Yes	Yes	Yes	No
(NE 4)160	160	N246E136	LT	4.62	33.71	19.2	2.91	Yes	Yes	No	No
(NE 4)161	161	N246E136	LT	10.5	26.56	27.29	6.33	Yes	Yes	Yes	No
(NE 4)162	162	N246E136	LT	4.51	31.69	24.57	6.27	Yes	No	Yes	No
(NE 4)163	163	N246E136	LT	4.32	46.87	26.36	8.45	Yes	No	Yes	No
(NE 4)164	164	N246E136	LT		33.36	19.45	3.19	No	Yes	No	No
(NE 4)165	165	N246E136	LT	7.38	27.36	23.34	6.63	Yes	Yes	Yes	No
(NE 4)166	166	N246E136	LT	1.95	29.34	15.33	3.05	Yes	No	Yes	No
(NE 4)167	167	N246E136	LT	7.84	22.1	22.88	4.7	Yes	No	Yes	No
(NE 4)168	168	N246E136	LT	8.17	20.15	16.66	3.92	Yes	Yes	Yes	No
(NE 4)169	169	N246E136	LT	7.99	31.65	18.9	6.65	Yes	No	No	Yes
(NE 4)170	170	N246E136	LT	16.17	25.4	22.99	4.31	Yes	Yes	No	No
(NE 4)171	171	N246E136	LT	10.94	27.57	22.61	4.43	Yes	Yes	Yes	No
(NE 4)172	172	N246E136	LT	10.91	35.22	28.25	4.96	Yes	Yes	Yes	Yes
(NE 4)173	173	N246E136	LT	7.76	25.15	16.36	4.29	Yes	Yes	No	No
(NE 4)174	174	N246E136	LT	4.92	30.88	32.07	6.59	Yes	No	No	No
(NE 4)175	175	N246E136	LT	6.66	25.51	19.91	3.78	Yes	Yes	Yes	No
(NE 4)176	176	N246E136	LT	12.92	48.68	23.29	10.25	Yes	Yes	Yes	No
(NE 4)177	177	N246E136	LT	7.91	27.53	26.39	5.41	Yes	Yes	Yes	No
(NE 4)178	178	N246E136	LT	4.32	21.59	26.44	2.78	Yes	No	Yes	No
(NE 4)179	179	N246E136	LT		24.52	28.19	2.87	No	Yes	No	No

Table A. 1 – Continued.

(NE 4)180	180	N246E136	LT	7.06	24.73	17.9	3.46	Yes	Yes	No	No
(NE 4)181	181	N246E136	LT	3.45	25.01	38.01	5.37	Yes	No	Yes	Yes
(NE 4)182	182	N246E136	LT	4.8	39.28	25.92	4	Yes	Yes	Yes	No
(NE 4)183	183	N246E136	LT	6.58	34.95	35.24	7.43	Yes	No	Yes	Yes
(NE 4)184	184	N246E136	LT	8.02	28.72	24.31	4.89	Yes	Yes	Yes	Yes
(NE 4)185	185	N246E136	LT	6.5	32.74	28.54	5.86	Yes	No	Yes	No
(NE 4)186	186	N246E136	LT	9.06	27.08	27.49	2.89	Yes	Yes	No	No
(NE 4)187	187	N246E136	LT	4.63	29.73	15.65	2.49	Yes	Yes	Yes	No
(NE 4)188	188	N246E136	LT	7.76	30.91	19.44	3.52	Yes	No	Yes	No
(NE 4)189	189	N246E136	LT	8.66	27.28	30.76	4.84	Yes	Yes	No	No
(NE 4)190	190	N246E136	LT	6.47	33.84	28.16	4.23	Yes	No	No	No
(NE 4)191	191	N246E136	LT	7.7	34.52	22.24	5.01	Yes	Yes	Yes	No
(NE 4)192	192	N246E136	LT	9.33	26.24	19.51	3.31	Yes	No	Yes	No
(NE 4)193	193	N246E136	LT	7.1	30.88	27.11	5.18	Yes	Yes	No	No
(NE 4)194	194	N246E136	LT	5.57	32.51	18.71	4.54	Yes	Yes	Yes	No
(NE 4)195	195	N246E136	LT	11.11	19.94	24.21	5.93	Yes	No	Yes	No
(NE 4)196	196	N246E136	LT		19.88	21.41	2.79	No	No	Yes	Yes
(NE 4)197	197	N246E136	LT		25.6	22.2	5.9	No	No	No	Yes
(NE 4)198	198	N246E136	LT	7.81	30.22	22.27	3.44	Yes	Yes	No	No
(NE 4)199	199	N246E136	LT	3.24	2.57	23.35	2.21	Yes	No	No	No
(NE 4)200	200	N246E136	LT	5.62	48.48	22.69	5.34	Yes	No	No	Yes
(NE 4)201	201	N246E136	LT	5.89	22.23	26.48	3.39	Yes	No	Yes	No
(NE 4)202	202	N246E136	LT		19.25	25.56	4.06	No	Yes	Yes	No
(NE 4)203	203	N246E136	LT	10.84	27.38	20.05	7.88	Yes	Yes	Yes	No
(NE 4)204	204	N246E136	LT	1038	34.32	22.83	5.45	Yes	Yes	No	Yes
(NE 4)205	205	N246E136	LT	9.35	34.9	15.6	3.98	Yes	Yes	Yes	No

Table A. 1 - Continued

(NE 4)206	206	N246E136	LT	15.58	28.08	25.91	4.87	Yes	No	Yes	Yes
(NE 4)207	207	N246E136	LT	5.82	21.35	17.34	2.63	Yes	Yes	Yes	No
(NE 4)208	208	N246E136	LT	7.99	27.08	18.4	4.11	Yes	Yes	Yes	No
(NE 4)209	209	N246E136	LT	9.05	29.07	33.89	4.33	Yes	Yes	Yes	No
(NE 4)210	210	N246E136	LT	5.3	26.29	15.91	3.32	Yes	Yes	Yes	No
(NE 4)211	211	N246E136	LT	8.61	41.1	23.03	4.51	Yes	Yes	No	No
(NE 4)212	212	N246E136	LT		41.58	14.11	3.25	No	Yes	No	No
(NE 4)213	213	N246E136	LT	7.77	31.43	20.75	3	Yes	Yes	No	No
(NE 4)214	214	N246E136	LT		19.79	16.32	4.32	No	No	No	No
(NE 4)215	215	N246E136	LT	5.33	24.66	24.55	3.62	Yes	Yes	Yes	No
(NE 4)216	216	N246E136	LT		29.41	23.63	3.64	No	Yes	No	No
(NE 4)217	217	N246E136	LT	11.33	20.03	19.22	4.42	Yes	No	No	Yes
(NE 4)218	218	N246E136	LT	6.88	19.12	25.79	4.23	Yes	Yes	Yes	No
(NE 4)219	219	N246E136	LT	5.68	36.64	14.27	4.1	Yes	Yes	Yes	No
(NE 4)220	220	N246E136	LT	9.51	21.32	23.22	4.5	Yes	No	Yes	Yes
(NE 4)221	221	N246E136	LT	5.17	15.02	16.13	4.01	Yes	Yes	Yes	No
(NE 4)222	222	N246E136	LT		24.52	15.43	2.31	No	No	Yes	No
(NE 4)223	223	N246E136	LT	9.37	25.8	17.72	5.79	Yes	No	No	Yes
(NE 4)224	224	N246E136	LT	15.5	22.83	16.37	5.4	Yes	No	Yes	No
(NE 4)225	225	N246E136	LT	8.52	22.65	13.84	3.77	Yes	Yes	No	No
(NE 4)226	226	N246E136	LT	4.76	18.41	18.15	2.29	Yes	Yes	Yes	No
(NE 4)227	227	N246E136	LT	3.83	30.12	19.39	3.47	Yes	No	Yes	No
(NE 4)228	228	N246E136	LT	5.73	19.95	16.8	3.45	Yes	Yes	Yes	No
(NE 4)229	229	N246E136	LT		24.3	20.18	2.6	No	Yes	Yes	No
(NE 4)230	230	N246E136	LT		17.2	20.74	4.27	No	Yes	No	No
(NE 4)231	231	N246E136	LT		23.51	16.55	2.92	No	No	No	No

Table A. 1 – Continued.

(NE 4)232	232	N246E136	LT	7.76	20.15	17.15	3.5	Yes	No	Yes	Yes
(NE 4)233	233	N246E136	LT	7.92	23.49	21.31	4.13	Yes	Yes	Yes	No
(NE 4)234	234	N246E136	LT	8.41	16.31	17.7	3.97	Yes	Yes	Yes	Yes
(NE 4)235	235	N246E136	LT	5.22	30.25	18.13	3.67	Yes	No	Yes	No
(NE 4)236	236	N246E136	LT	8.51	18.73	15.87	2.46	Yes	Yes	Yes	No
(NE 4)237	237	N246E136	LT	3.99	28.54	15.68	4.15	Yes	No	Yes	No
(NE 4)238	238	N246E136	LT	4.6	22.47	15.25	2.85	Yes	No	No	No
(NE 4)239	239	N246E136	LT	5.92	20.92	22.81	3.78	Yes	Yes	Yes	No
(NE 4)240	240	N246E136	LT	4.78	15.63	22.18	2.2	Yes	Yes	Yes	No
(NE 4)241	241	N246E136	LT	8.55	21.1	19.45	4.9	Yes	No	No	No
(NE 4)242	242	N246E136	LT	1.96	23.56	20.26	2.5	Yes	Yes	Yes	No
(NE 4)243	243	N246E136	LT	5.59	21.5	18.97	2.99	Yes	Yes	Yes	No
(NE 4)244	244	N246E136	LT	5.39	20.98	18.15	3.16	Yes	No	Yes	No
(NE 4)245	245	N246E136	LT	4.34	17.43	13.85	2.76	Yes	Yes	Yes	No
(NE 4)246	246	N246E136	LT	5.68	23.24	23.56	3.36	Yes	No		No
(NE 4)247	247	N246E136	LT	5.47	22.84	22.11	2.67	Yes	Yes	Yes	No
(NE 4)248	248	N246E136	LT	9.26	19.89	26.91	4.29	Yes	No	Yes	No
(NE 4)249	249	N246E136	LT	5.07	16.12	26.39	3.66	Yes	Yes	Yes	Yes
(NE 4)250	250	N246E136	LT	4.75	17	16.35	2.58	Yes	Yes	Yes	No
(NE 4)251	251	N246E136	LT	2.85	16.25	16.69	2.56	Yes	Yes	Yes	No
(NE 4)252	252	N246E136	LT	10.45	26.48	17.18	4.23	Yes	No	No	No
(NE 4)253	253	N246E136	LT	4.57	19.68	15.39	2.6	Yes	Yes	No	No
(NE 4)254	254	N246E136	LT		23.99	19.83	1.82	No	No	Yes	No
(NE 5)255	255	N246E136	LT	6.04	57.35	23.87	10.1	Yes	Yes	No	No
(NE 5)256	256	N246E136	LT	7.81	36.46	30.13	6.31	Yes	Yes	Yes	No
(NE 5)257	257	N246E136	LT	5.87	32.27	15.08	2.95	Yes	Yes	Yes	No

Table A. 1 – Continued.

(NE 5)258	258	N246E136	LT	10.32	34.52	34.27	4.66	Yes	Yes	Yes	No
(NE 5)259	259	N246E136	LT	10.57	43.11	37.26	8.03	Yes	Yes	Yes	No
(NE 5)260	260	N246E136	LT	8.17	26.79	27.84	6.3	Yes	Yes	Yes	No
(NE 5)261	261	N246E136	LT	12.28	35	29.23	5.46	Yes	Yes	Yes	No
(NE 5)262	262	N246E136	LT	12.78	38.35	37.91	11.2	Yes	Yes	Yes	Yes
(NE 5)263	263	N246E136	LT	29.51	33.43	29.57	4.08	Yes	Yes	Yes	No
(NE 5)264	264	N246E136	LT	8.03	27.05	32.68	8.67	Yes	Yes	Yes	No
(NE 5)265	265	N246E136	LT	6.72	42.1	25.07	9.01	Yes	Yes	Yes	No
(NE 5)266	266	N246E136	LT	6.11	35	41.05	10.93	Yes	Yes	No	Yes
(NE 5)267	267	N246E136	LT	6.36	34.65	21.365	4.94	Yes	Yes	No	No
(NE 5)268	268	N246E136	LT	4.54	32.8	42.93	6.17	Yes	Yes	No	No
(NE 5)269	269	N246E136	LT	10.88	40.22	36.69	7.08	Yes	Yes	Yes	No
(NE 5)270	270	N246E136	LT	8.91	69.72	64.58	23.38	Yes	No	Yes	Yes
(NE 5)271	271	N246E136	LT	4.88	43.04	20.05	6.15	Yes	Yes	Yes	No
(NE 5)272	272	N246E136	LT		36.61	35.35	4.32	No	Yes	No	Yes
(NE 5) 273	273	N246E136	LT	12.55	54.29	49.34	11.34	Yes	No	No	No
(NE 5)274	274	N246E136	LT	8.96	39.66	52.32	7.25	Yes	No	No	No
(NE 5)275	275	N246E136	LT	6.19	28.3	38.89	8.69	Yes	Yes	Yes	Yes
(NE 5)276	276	N246E136	LT	27.55	59.28	58.34	10.56	Yes	No	Yes	Yes
(NE 5)277	277	N246E136	LT	8.86	52.79	43.02	8.35	Yes	No	Yes	No
(NE 5)278	278	N246E136	LT	4.6	44.11	25.65	6.55	Yes	No	Yes	No
(NE 5)279	279	N246E136	LT	5.07	28.24	21.93	5.39	Yes	Yes	Yes	No
(NE 5)280	280	N246E136	LT	6.04	33.83	30.63	3.97	Yes	Yes	Yes	No
(NE 5)281	281	N246E136	LT	9.52	35.35	39.43	11.57	Yes	Yes	No	No
(NE 5)282	282	N246E136	LT	9.43	41.18	38.97	6.97	Yes	No	No	No
(NE 5)283	283	N246E136	LT	15.07	27.93	30.49	9.46	Yes	Yes	No	Yes

Table A. 1 - Continued

(NE 5)284	284	N246E136	LT		39.66	23.75	4.95	No	No	Yes	No
(NE 5)285	285	N246E136	LT	27.36	56.32	53.3	10.71	Yes	No	Yes	Yes
(NE 5)286	286	N246E136	LT	18.56	53.34	58.11	13.72	Yes	No	Yes	Yes
(NE 5)287	287	N246E136	LT	8.9	43.71	40.95	8.7	Yes	No	Yes	No
(NE 5)288	288	N246E136	LT	33.66	47.96	58.11	12.72	Yes	No	Yes	Yes
(NE 5)289	289	N246E136	LT	8.14	42.22	40.95	7.8	Yes	Yes	No	No
(NE 5)290	290	N246E136	LT	10.76	26.52	34.24	7.95	Yes	No	Yes	Yes
(NE 5)291	291	N246E136	LT	9.3	31.26	21.05	5.81	Yes	Yes	Yes	No
(NE 5)292	292	N246E136	LT		31.26	31.82	12.71	No	Yes	Yes	Yes
(NE 5)293	293	N246E136	LT	4.59	31.51	39.71	6.44	Yes	Yes	Yes	No
(NE 5)294	294	N246E136	LT	13.85	27	42.55	9.26	Yes	No	Yes	Yes
(NE 5)295	295	N246E136	LT	8.66	47.14	35.73	4.92	Yes	Yes	No	No
(NE 5)296	296	N246E136	LT	15.46	36.14	21.82	4.45	Yes	Yes	No	No
(NE 5)297	297	N246E136	LT	12.23	29.55	23.99	4.43	Yes	Yes	Yes	No
(NE 5)298	298	N246E136	LT	11.39	43.27	23.03	4.44	Yes	Yes	No	No
(NE 5)299	299	N246E136	LT	6.39	31.88	22.37	9.37	Yes	Yes	No	No
(NE 5)300	300	N246E136	LT	21.88	39.75	30.36	7.34	Yes	No	No	No
(NE 5)301	301	N246E136	LT	11.48	36.33	36.57	6.64	Yes	No	Yes	No
(NE 5)302	302	N246E136	LT	18.52	35.14	39.5	9.48	Yes	Yes	Yes	No
(NE 5)303	303	N246E136	LT	9.68	37.06	34.22	5.59	Yes	Yes	No	No
(NE 5)304	304	N246E136	LT	8.29	42.51	33.74	4.49	Yes	No	No	No
(NE 5)305	305	N246E136	LT	16.88	34.9	29.05	7.56	Yes	Yes	Yes	No
(NE 5)306	306	N246E136	LT	8.81	29.54	30.54	6.11	Yes	No	Yes	No
(NE 5)307	307	N246E136	LT	9.54	34.15	26.44	4.22	Yes	Yes	Yes	No
(NE 5)308	308	N246E136	LT	8.64	43.95	19.75	5.17	Yes	No	No	No
(NE 5)309	309	N246E136	LT	8.74	40.49	17.95	4.36	Yes	Yes	Yes	No

Table A. 1 - Continued

(NE 5)310	310	N246E136	LT	6.44	33.9	19.48	6.15	Yes	No	No	No
(NE 5)311	311	N246E136	LT	7.45	34.32	36.13	10.95	Yes	Yes	Yes	No
(NE 5)312	312	N246E136	LT	13.75	29.42	43.76	7.61	Yes	No	Yes	No
(NE 5)313	313	N246E136	LT	14.7	37.34	22.87	6.86	Yes	No	Yes	No
(NE 5)314	314	N246E136	LT	7.5	35.18	33.47	7.04	Yes	Yes	Yes	No
(NE 5)315	315	N246E136	LT	8.55	47.15	23.91	6.75	Yes	Yes	Yes	Yes
(NE 5)316	316	N246E136	LT	17.33	36.52	42.38	9.35	Yes	No	No	No
(NE 5)317	317	N246E136	LT	40.89	32.91	66.68	20.32	Yes	No	Yes	Yes
(NE 5)318	318	N246E136	LT	12.46	39.93	36.98	5.59	Yes	Yes	Yes	No
(NE 5)319	319	N246E136	LT	16.91	38.23	29.71	6.13	Yes	No	No	No
(NE 5)320	320	N246E136	LT	12.74	39.45	43.99	11.28	Yes	No	Yes	Yes
(NE 5)321	321	N246E136	LT	11.16	30.68	38.14	9.4	Yes	Yes	No	No
(NE 5)322	322	N246E136	LT	5.89	33.33	39.86	4.16	Yes	No	No	No
(NE 5)323	323	N246E136	LT	9.12	21.63	32.63	7.6	Yes	Yes	Yes	No
(NE 5)324	324	N246E136	LT	11.05	35.39	29.65	6.77	Yes	Yes	No	No
(NE 5)325	325	N246E136	LT	6.59	33.28	31.89	5.68	Yes	No	Yes	No
(NE 5)326	326	N246E136	LT	7.34	32.05	20.48	3.61	Yes	No	No	No
(NE 5)327	327	N246E136	LT	7.07	21.28	22.48	2.42	Yes	No	No	No
(NE 5)328	328	N246E136	LT	5.46	41.49	19.95	3.16	Yes	No	Yes	No
(NE 5)329	329	N246E136	LT	9.84	31.34	37.71	9.75	Yes	No	Yes	Yes
(NE 5)330	330	N246E136	LT	15.91	46.96	42.92	9.02	Yes	No	No	No
(NE 5)331	331	N246E136	LT	8.54	30.73	32.41	8.11	Yes	Yes	Yes	No
(NE 5)332	332	N246E136	LT	5.45	34.8	27.24	5.08	Yes	No	No	No
(NE 5)333	333	N246E136	LT	4.25	31.2	28.47	4.13	Yes	No	No	No
(NE 5)334	334	N246E136	LT	19.75	42.19	32.13	5.96	Yes	No	Yes	No
(NE 5)335	335	N246E136	LT	9.48	38.49	35.08	6.45	Yes	Yes	No	No

Table A. 1 - Continued

(NE 5)336	336	N246E136	LT	11.02	37.76	41.66	4.7	Yes	No	No	No
(NE 5)337	337	N246E136	LT	8.09	47.64	14.12	4.55	Yes	Yes	Yes	No
(NE 5)338	338	N246E136	LT	10.22	33.36	24.89	6.34	Yes	No	Yes	No
(NE 5)339	339	N246E136	LT	6.34	38.28	23.57	5.74	Yes	No	Yes	No
(NE 5)340	340	N246E136	LT	8.2	31.61	21.83	5.62	Yes	No	Yes	No
(NE 5)341	341	N246E136	LT	7.66	41	2306	5.14	Yes	No	Yes	No
(NE 5)342	342	N246E136	LT	16.53	32.47	36.34	7.51	Yes	No	Yes	No
(NE 5)343	343	N246E136	LT	8.4	33.18	30.93	5.36	Yes	No	Yes	No
(NE 5)344	344	N246E136	LT	5.55	30.37	26	3.06	Yes	No	No	Yes
(NE 5)345	345	N246E136	LT	7.08	37.42	20.8	5.91	Yes	Yes	Yes	No
(NE 5)346	346	N246E136	LT	9.92	33.35	27.71	6.38	Yes	No	Yes	Yes
(NE 5)347	347	N246E136	LT	6.87	28.51	21.63	5.14	Yes	No	No	Yes
(NE 5)348	348	N246E136	LT	14.91	37.08	22.06	8.26	Yes	No	Yes	No
(NE 5)349	349	N246E136	LT	15.67	32.37	2.36	5.7	Yes	No	Yes	No
(NE 5)350	350	N246E136	LT	7.32	28.46	1.06	3.78	Yes	Yes	Yes	No
(NE 5)351	351	N246E136	LT	7.57	30.73	19.39	5.57	Yes	No	No	No
(NE 5)352	352	N246E136	LT	7.07	32.29	2.37	6.84	Yes	Yes	Yes	No
(NE 5)353	353	N246E136	LT	9.22	26.41	26.75	4.67	Yes	Yes	Yes	Yes
(NE 5)354	354	N246E136	LT	6.88	27.61	0.07	4.83	Yes	No	Yes	No
(NE 5)355	355	N246E136	LT	15.75	38.46	24.22	4.25	Yes	No	Yes	No
(NE 5)356	356	N246E136	LT	10.85	31.84	8.99	4.68	Yes	Yes	Yes	No
(NE 5)357	357	N246E136	LT	9.24	26.46	5.28	4.14	Yes	No	Yes	No
(NE 5)358	358	N246E136	LT	5.79	28.01	9.09	4.26	Yes	No	Yes	No
(NE 5)359	359	N246E136	LT	5.32	30.88	3.2	5.44	Yes	No	Yes	No
(NE 5)360	360	N246E136	LT	8.7	30.45	2.52	4.12	Yes	Yes	Yes	No
(NE 5)361	361	N246E136	LT	13.52	15.21	2.48	5.03	Yes	No	No	No

Table A. 1 - Continued

(NE 5)362	362	N246E136	LT	5.8	34.86	1	3.95	Yes	No	No	No
(NE 5)363	363	N246E136	LT	6.82	27.35	17.76	5.06	Yes	No	Yes	Yes
(NE 5)364	364	N246E136	LT		19.79	9.76	3.17	No	Yes	Yes	No
(NE 5)365	365	N246E136	LT	20.72	21.12	0.46	7.24	Yes	No	Yes	No
(NE 5)366	366	N246E136	LT	13.03	30.05	8.47	6.83	Yes	No	Yes	No
(NE 5)367	367	N246E136	LT	13.12	28.3	1.15	0.1	Yes	Yes	No	No
(NE 5)368	368	N246E136	LT	8.01	33.74	0.61	6.1	Yes	No	Yes	Yes
(NE 5)369	369	N246E136	LT	13.2	23.71	31.74	0.33	Yes	No	Yes	No
(NE 5)370	370	N246E136	LT	9.37	22	20.17	5.4	Yes	Yes	Yes	No
(NE 5)371	371	N246E136	LT	8.69	27.73	32	8.27	Yes	No	Yes	No
(NE 5)372	372	N246E136	LT	14.41	35.28	34.96	5.32	Yes	No	Yes	Yes
(NE 5)373	373	N246E136	LT	11.59	28.6	33.45	4.07	Yes	No	No	No
(NE 5)374	374	N246E136	LT	6.74	28.02	16.35	0.12	Yes	Yes	Yes	Yes
(NE 5)375	375	N246E136	LT	9.69	27.72	26.89	4.55	Yes	No	Yes	Yes
(NE 5)376	376	N246E136	LT	7.21	26.35	19.58	4.22	Yes	No	Yes	Yes
(NE 5)377	377	N246E136	LT	6.62	26.39	23.54	7	Yes	Yes	Yes	Yes
(NE 5)378	378	N246E136	LT	9.11	16.62	27.66	4.66	Yes	No	Yes	Yes
(NE 5)379	379	N246E136	LT	6.11	32.62	25.36	3.6	Yes	No	Yes	No
(NE 5)380	380	N246E136	LT	9.14	22.02	21.65	2.94	Yes	No	Yes	No
(NE 5)381	381	N246E136	LT	9.2	18.82	14.98	3.11	Yes	No	No	No
(NE 5)382	382	N246E136	LT	8.83	25.12	18.26	3.98	Yes	No	No	No
(NE 5)383	383	N246E136	LT	10.72	28.87	17.95	5.08	Yes	No	No	Yes
(NE 5)384	384	N246E136	LT	9.05	29.61	23.7	5.78	Yes	No	Yes	Yes
(NE 5)385	385	N246E136	LT	8.65	22.25	22.33	2.64	Yes	No	Yes	No
(NE 5)386	386	N246E136	LT	6.35	19.83	39.03	6.62	Yes	Yes	Yes	No
(NE 5)387	387	N246E136	LT	12.03	17.19	22.87	3.91	Yes	No	Yes	No

Table A. 1 - Continued

(NE 5)388	388	N246E136	LT	6.31	23.73	18	3.06	Yes	No	Yes	No
(NE 5)389	389	N246E136	LT		36.92	16.68	3.07	No	No	No	No
(NE 5) 390	390	N246E136	LT	8.84	25.61	27.98	3.37	Yes	No	Yes	Yes
(NE 5)391	391	N246E136	LT	4.2	25.91	24.04	5.46	Yes	Yes	Yes	No
(NE 5)392	392	N246E136	LT	5.46	30.75	23.85	4.28	Yes	Yes	Yes	No
(NE 5)393	393	N246E136	LT	13.55	24.66	18.1	4.23	Yes	Yes	Yes	Yes
(NE 5)394	394	N246E136	LT	3.61	18.72	17.76	5.35	Yes	No	Yes	No
(NE 5)395	395	N246E136	LT	9.23	25.47	23.84	4.79	Yes	Yes	Yes	No
(NE 5)396	396	N246E136	LT	4.29	26.34	25.94	2.53	Yes	Yes	Yes	No
(NE 5)397	397	N246E136	LT	11.7	16.49	18.52	3.98	Yes	Yes	No	No
(NE 5)398	398	N246E136	LT	5.3	22.16	22.52	4.43	Yes	No	No	No
(NE 5)399	399	N246E136	LT	12.69	34.51	22.34	4.78	Yes	No	No	No
(NE 5)400	400	N246E136	LT	3.85	15.8	17.95	3.23	Yes	No	Yes	No
(NE 5)401	401	N246E136	LT	6.62	25.88	27.15	3.73	Yes	No	Yes	No
(NE 5)402	402	N246E136	LT	5.3	22.27	18.49	2.38	Yes	Yes	Yes	No
(NE 5)403	403	N246E136	LT	16.69	19.38	23.53	4.67	Yes	Yes	No	No
(NE 5)404	404	N246E136	LT	6.16	28.1	20.25	3.27	Yes	No	Yes	Yes
(NE 5)405	405	N246E136	LT	6.61	26.96	17.28	2.19	Yes	No	Yes	No
(NE 5)406	406	N246E136	LT	7.58	23.79	18.79	3.05	Yes	No	Yes	No
(NE 5)407	407	N246E136	LT	10.59	27.93	17.5	3.46	Yes	Yes	Yes	No
(NE 5)408	408	N246E136	LT	5.12	21.41	33.31	4.83	Yes	No	Yes	No
(NE 5)409	409	N246E136	LT	4.69	26.59	16.72	2.81	Yes	Yes	Yes	No
(NE 5)410	410	N246E136	LT	14.28	23.5	21.15	3.01	Yes	Yes	Yes	No
(NE 5)411	411	N246E136	LT	3.2	17.65	15.19	3.23	Yes	Yes	Yes	No
(NE 5)412	412	N246E136	LT	4.27	29.46	17.72	3.71	Yes	Yes	Yes	No
(NE 5)413	413	N246E136	LT	5.09	27.15	23.06	2.69	Yes	No	No	No

Table A. 1 - Continued

(NE 5)414	414	N246E136	LT		33.7	29.19	2.92	No	No	No	No
(NE 5)415	415	N246E136	LT	10.96	25.28	15.43	4.5	Yes	No	No	No
(NE 5)416	416	N246E136	LT	5.25	26	21.71	4.66	Yes	No	Yes	No
(NE 5)417	417	N246E136	LT		23.6	23.73	2.56	No	Yes	No	No
(NE 5)418	418	N246E136	LT		24.09	18.17	4.75	No	No	No	No
(NE 5)419	419	N246E136	LT	8.56	26.13	20.51	5.02	Yes	Yes	Yes	Yes
(NE 5)420	420	N246E136	LT	6.59	22.5	15.66	2.85	Yes	No	Yes	No
(NE 5)421	421	N246E136	LT	15.5	34.96	26.71	7.69	Yes	No	Yes	No
(NE 5)422	422	N246E136	LT	11.34	22.48	15.58	3.05	Yes	Yes	Yes	Yes
(NE 5)423	423	N246E136	LT	7.04	18.98	24.58	3.03	Yes	Yes	Yes	No
(NE 5)424	424	N246E136	LT	7.11	28.11	26.9	2.98	Yes	No	No	No
(NE 5)425	425	N246E136	LT	8.86	19.18	19.08	4.78	Yes	No	Yes	Yes
(NE 5)426	426	N246E136	LT	6.11	17.22	19.98	3.35	Yes	Yes	Yes	No
(NE 5)427	427	N246E136	LT	4.83	16.59	17.39	2.23	Yes	Yes	Yes	No
(NE 5)428	428	N246E136	LT	2.98	22.97	16.74	2.79	Yes	No	Yes	No
(NE 5)429	429	N246E136	LT	5.34	27.8	27.61	2.74	Yes	No	Yes	No
(NE 5)430	430	N246E136	LT	7.86	24.77	15.26	4.19	Yes	Yes	Yes	Yes
(NE 5)431	431	N246E136	LT	5.56	24.08	20.77	3.92	Yes	No	Yes	No
(NE 5)432	432	N246E136	LT	8.65	26.62	17.36	3.3	Yes	No	Yes	No
(NE 5)433	433	N246E136	LT	8.93	23.99	20.33	5.79	Yes	No	Yes	Yes
(NE 5)434	434	N246E136	LT	4.85	24.18	20.83	5	Yes	No	Yes	Yes
(NE 5)435	435	N246E136	LT	6.65	17.92	24.11	5.58	Yes	No	No	Yes
(NE 5)436	436	N246E136	LT	5.69	26.67	18.96	2.6	Yes	Yes	No	No
(NE 6)437	437	N246E136	LT	7.21	41.33	30.25	8.64	Yes	No	Yes	Yes
(NE 6)438	438	N246E136	LT	6.25	36.71	37.06	8.71	Yes	Yes	Yes	No
(NE 6)439	439	N246E136	LT	24.84	55.85	28.4	13.39	Yes	Yes	Yes	No

Table A. 1 - Continued

(NE 6)440	440	N246E136	LT	5.99	39.43	25.28	7	Yes	Yes	No	No
(NE 6)441	441	N246E136	LT		31.07	29.66	5.13	No	Yes	No	No
(NE 6)442	442	N246E136	LT	7.4	28.75	26.68	3.43	Yes	Yes	Yes	Yes
(NE 6)443	443	N246E136	LT	6.01	25.63	44.15	5.64	Yes	No	Yes	Yes
(NE 6)444	444	N246E136	LT	11.13	35.12	36.97	12.95	Yes	No	Yes	No
(NE 6)445	445	N246E136	LT	5.16	31.05	27.78	4.53	Yes	No	Yes	No
(NE 6)446	446	N246E136	LT	8.27	37.06	29.49	7.58	Yes	Yes	Yes	No
(NE 6)447	447	N246E136	LT	7.28	35.81	27.68	5.36	Yes	Yes	Yes	No
(NE 6)448	448	N246E136	LT	9.36	40.49	22.49	6.73	Yes	Yes	No	No
(NE 6)449	449	N246E136	LT	6.44	29.95	24.7	4.6	Yes	Yes	Yes	Yes
(NE 6)450	450	N246E136	LT	11.21	22.66	28.55	5.07	Yes	No	Yes	No
(NE 6)451	451	N246E136	LT	12.08	34.82	22.09	3.57	Yes	No	No	No
(NE 6)452	452	N246E136	LT		49.87	31.93	11.94	No	Yes	No	Yes
(NE 6)453	453	N246E136	LT	10.8	31.27	26.68	3.54	Yes	No	Yes	No
(NE 6)454	454	N246E136	LT	8.02	28.43	31.53	6.09	Yes	No	Yes	No
(NE 6)455	455	N246E136	LT	4.18	33.28	27.69	6.88	Yes	No	Yes	No
(NE 6)456	456	N246E136	LT	8.1	55.44	33.54	8.12	Yes	No	Yes	Yes
(NE 6)457	457	N246E136	LT	12.05	39.98	32.07	10.92	Yes	No	Yes	Yes
(NE 6)458	458	N246E136	LT	11.63	32.84	73.75	11.66	Yes	Yes	Yes	No
(NE 6)459	459	N246E136	LT	10.32	29.92	38.75	6.61	Yes	No	Yes	No
(NE 6)460	460	N246E136	LT	6.61	32.43	22.68	4.75	Yes	Yes	Yes	No
(NE 6)461	461	N246E136	LT	9.68	35.53	15.85	7.06	Yes	No	Yes	No
(NE 6)462	462	N246E136	LT	18.75	35.56	37.91	6.79	Yes	No	Yes	No
(NE 6)463	463	N246E136	LT	7.63	31.51	21.87	5.31	Yes	Yes	Yes	No
(NE 6)464	464	N246E136	LT	11.23	34.51	36	7.19	Yes	Yes	Yes	Yes
(NE 6)465	465	N246E136	LT	9.07	32.86	31.37	5.46	Yes	No	No	No

Table A. 1 - Continued

(NE 6)466	466	N246E136	LT		30.93	26.08	5.89	No	No	Yes	No
(NE 6)467	467	N246E136	LT	4.94	44.25	23.63	8.36	Yes	Yes	Yes	Yes
(NE 6)468	468	N246E136	LT	14.96	34.56	26.94	5.28	Yes	No	No	No
(NE 6)469	469	N246E136	LT	5.27	33.44	22.55	6.78	Yes	No	Yes	No
(NE 6)470	470	N246E136	LT	10.72	35.87	55.07	10.25	Yes	No	Yes	Yes
(NE 6)471	471	N246E136	LT	12.77	43.74	22.6	6.56	Yes	Yes	Yes	No
(NE 6)472	472	N246E136	LT	10.17	35.55	20.79	4.47	Yes	Yes	Yes	No
(NE 6)473	473	N246E136	LT	5.57	39.93	24.19	4.48	Yes	Yes	Yes	No
(NE 6)474	474	N246E136	LT	6.46	34.8	19.55	5.69	Yes	No	Yes	No
(NE 6)475	475	N246E136	LT		38.04	18.18	4.42	No	Yes	No	No
(NE 6)476	476	N246E136	LT	4.92	27.06	23.43	5.88	Yes	Yes	Yes	No
(NE 6)477	477	N246E136	LT	5.36	24.54	27.16	4.25	Yes	No	Yes	No
(NE 6)478	478	N246E136	LT	6.92	28.42	33.97	6.7	Yes	Yes	Yes	No
(NE 6)479	479	N246E136	LT	4.49	24.63	20.88	4.44	Yes	Yes	Yes	No
(NE 6)480	480	N246E136	LT	11.02	37.21	23.3	4.18	Yes	Yes	Yes	No
(NE 6)481	481	N246E136	LT	7.12	35.13	25.8	7.07	Yes	Yes	Yes	No
(NE 6)482	482	N246E136	LT	9.11	35.97	27.9	4.44	Yes	No	Yes	No
(NE 6)483	483	N246E136	LT	7.98	25.03	40.6	9.1	Yes	No	Yes	No
(NE 6)484	484	N246E136	LT		37.05	25.25	8.61	No	No	No	No
(NE 6)485	485	N246E136	LT	13.08	34.47	15.51	4.49	Yes	No	No	No
(NE 6)486	486	N246E136	LT	9.02	38.22	24.07	4.99	Yes	No	Yes	Yes
(NE 6)487	487	N246E136	LT	5.92	32.66	20.52	4.4	Yes	No	No	No
(NE 6)488	488	N246E136	LT		17.67	31.11	4.98	No	No	Yes	No
(NE 6)489	489	N246E136	LT	5.9	28.56	18.37	3.74	Yes	No	Yes	No
(NE 6)490	490	N246E136	LT	10.3	35.39	17.91	6.24	Yes	Yes	Yes	No
(NE 6)491	491	N246E136	LT	14.73	31.85	30.55	4.95	Yes	No	No	No

Table A. 1 - Continued

(NE 6)492	492	N246E136	LT	11.81	25.5	29.75	8.78	Yes	No	Yes	Yes
(NE 6)493	493	N246E136	LT	9.3	31.6	31.88	6.3	Yes	Yes	Yes	No
(NE 6)494	494	N246E136	LT	5.69	42.2	21.84	3.38	Yes	No	No	No
(NE 6)495	495	N246E136	LT	7.15	34.57	17.36	3.19	Yes	No	Yes	No
(NE 6)496	496	N246E136	LT	5.27	20.09	32.68	3.36	Yes	Yes	Yes	Yes
(NE 6)497	497	N246E136	LT	13.43	30.43	27.54	6.05	Yes	No	Yes	No
(NE 6)498	498	N246E136	LT	9.09	22.79	24.46	5.18	Yes	No	No	Yes
(NE 6)499	499	N246E136	LT	9.11	34.89	24.9	5.05	Yes	Yes	Yes	No
(NE 6)500	500	N246E136	LT	16.31	26.08	20.14	4.89	Yes	No	Yes	Yes
(NE 6)501	501	N246E136	LT	7.35	31.92	29.06	5.35	Yes	No	No	No
(NE 6)502	502	N246E136	LT	6.06	28.34	18.94	3.74	Yes	Yes	Yes	No
(NE 6)503	503	N246E136	LT	10.11	27.73	23.76	4.22	Yes	No	No	Yes
(NE 6)504	504	N246E136	LT	12.52	24.46	30.49	7.43	Yes	Yes	Yes	Yes
(NE 6)505	505	N246E136	LT	7.89	29.14	33.48	5.39	Yes	No	Yes	No
(NE 6)506	506	N246E136	LT	4.49	54.05	19.9	5.85	Yes	Yes	No	Yes
(NE 6)507	507	N246E136	LT	16.25	24.62	30.66	5.29	Yes	Yes	Yes	No
(NE 6)508	508	N246E136	LT	7.35	21.18	30.84	4.66	Yes	Yes	Yes	No
(NE 6)509	509	N246E136	LT		37.97	20.66	4.54	No	Yes	No	No
(NE 6)510	510	N246E136	LT	8.37	28.31	20.75	5.17	Yes	Yes	Yes	No
(NE 6)511	511	N246E136	LT	5.73	31.83	22.28	4.78	Yes	Yes	Yes	No
(NE 6)512	512	N246E136	LT		33.39	24.51	4.35	No	No	Yes	No
(NE 6)513	513	N246E136	LT	9.57	28.77	18.89	4.6	Yes	No	Yes	No
(NE 6)514	514	N246E136	LT	6.49	30.48	18.97	4.93	Yes	No	No	No
(NE 6)515	515	N246E136	LT		19.17	30.49	5.53	No	No	Yes	Yes
(NE 6)516	516	N246E136	LT	4.21	25.89	20.96	6.76	Yes	Yes	Yes	No
(NE 6)517	517	N246E136	LT	6.29	21.46	22.44	4.83	Yes	Yes	Yes	No

Table A.1 - Continued

(NE 6)518	518	N246E136	LT	10.08	26.93	27.42	4.77	Yes	No	Yes	No
(NE 6)519	519	N246E136	LT	4.75	21.45	26.53	7.46	Yes	Yes	Yes	No
(NE 6)520	520	N246E136	LT	8.64	21.31	29.78	4.35	Yes	Yes	Yes	No
(NE 6)521	521	N246E136	LT	5.26	26.06	27.13	3.68	Yes	No	Yes	No
(NE 6)522	522	N246E136	LT		29.65	38.55	5.65	No	Yes	Yes	Yes
(NE 6)523	523	N246E136	LT	8.04	28.7	25.08	6.41	Yes	No	Yes	Yes
(NE 6)524	524	N246E136	LT	10.88	27.34	28.94	5.5	Yes	Yes	Yes	No
(NE 6)525	525	N246E136	LT	9.43	27.67	17.64	4.51	Yes	No	Yes	No
(NE 6)526	526	N246E136	LT	11.31	18.29	27.98	4.12	Yes	No	Yes	No
(NE 6)527	527	N246E136	LT	9.13	31.52	19.93	3.74	Yes	Yes	No	No
(NE 6)528	528	N246E136	LT	8.31	20.91	18.4	3.81	Yes	Yes	No	No
(NE 6)529	529	N246E136	LT	6.75	23.16	23.95	3.6	Yes	No	Yes	No
(NE 6)530	530	N246E136	LT	6.62	17.66	29.95	6.51	Yes	No	Yes	Yes
(NE 6)531	531	N246E136	LT	7.62	30.2	21.44	3.21	Yes	Yes	Yes	No
(NE 6)532	532	N246E136	LT	5.07	19.31	23.82	4.58	Yes	Yes	Yes	No
(NE 6)533	533	N246E136	LT	5.3	21.65	24.94	3.02	Yes	Yes	No	Yes
(NE 6)534	534	N246E136	LT	8.06	23.94	23.51	5.46	Yes	No	Yes	No
(NE 6)535	535	N246E136	LT	5.48	26.77	20.32	6.56	Yes	No	Yes	Yes
(NE 6)536	536	N246E136	LT	7.25	23.14	20.25	4.11	Yes	No	Yes	No
(NE 6)537	537	N246E136	LT	7.47	23.28	15.05	4.66	Yes	No	Yes	No
(NE 6)538	538	N246E136	LT	6.06	24.94	18.87	4.31	Yes	Yes	Yes	No
(NE 6)539	539	N246E136	LT	12.09	21.01	20	4.13	Yes	No	Yes	No
(NE 6)540	540	N246E136	LT	5.55	25.64	19.79	4.74	Yes	No	No	No
(NE 6)541	541	N246E136	LT	13.34	23.31	22.65	5.02	Yes	No	Yes	No
(NE 6)542	542	N246E136	LT	9.52	34.46	15.66	3.57	Yes	No	Yes	No
(NE 6)543	543	N246E136	LT	6.81	26.97	22.87	6.09	Yes	No	Yes	Yes

Table A.1 - Continued

(NE 6)544	544	N246E136	LT	9.39	25.8	24.17	3.01	Yes	Yes	Yes	No
(NE 6)545	545	N246E136	LT	13.03	19.49	23.33	3.22	Yes	Yes	Yes	No
(NE 6)546	546	N246E136	LT	10.18	31.82	17.69	5.58	Yes	Yes	No	No
(NE 6)547	547	N246E136	LT	11.77	30.35	24.89	3.42	Yes	No	No	No
(NE 6)548	548	N246E136	LT	6.8	23.97	26.39	2.52	Yes	No	No	No
(NE 6)549	549	N246E136	LT	6.38	28.22	26	4.82	Yes	No	Yes	No
(NE 6)550	550	N246E136	LT	6.31	24.25	18.46	2.2	Yes	Yes	Yes	No
(NE 6)551	551	N246E136	LT	5.29	21.96	18.24	3.36	Yes	Yes	Yes	No
(NE 6)552	552	N246E136	LT	4.83	20.33	21.96	2.79	Yes	Yes	Yes	No
(NE 6)553	553	N246E136	LT	7.45	18.36	25.69	3.88	Yes	Yes	Yes	No
(NE 6)554	554	N246E136	LT	8.15	22.67	28.26	7.24	Yes	No	Yes	Yes
(NE 6)555	555	N246E136	LT	6.88	21.7	18.24	4.05	Yes	No	Yes	No
(NE 6)556	556	N246E136	LT	7.58	22.54	17.36	2.75	Yes	Yes	Yes	No
(NE 6)557	557	N246E136	LT	9.36	13.86	18.17	3.65	Yes	No	Yes	No
(NE 6)558	558	N246E136	LT	10.05	26.13	22.75	3.91	Yes	Yes	No	No
(NE 6)559	559	N246E136	LT	13.5	31.38	20.23	4.84	Yes	Yes	Yes	No
(NE 6)560	560	N246E136	LT	15.23	32.61	28.35	5.11	Yes	Yes	Yes	No
(NE 6)561	561	N246E136	LT	13.63	15.14	17.56	3.82	Yes	Yes	Yes	No
(NE 6)562	562	N246E136	LT	6.07	17.54	26.35	4.97	Yes	No	Yes	No
(NE 6)563	563	N246E136	LT	6.77	24.24	26.4	3.91	Yes	Yes	Yes	No
(NE 6)564	564	N246E136	LT	6.87	20.7	23.57	3.04	Yes	Yes	No	No
(NE 6)565	565	N246E136	LT	11.71	20.14	15.59	4.47	Yes	No	Yes	Yes
(NE 6)566	566	N246E136	LT	8.91	20.83	16.95	4.62	Yes	No	No	No
(NE 6)567	567	N246E136	LT	4.02	23.78	20.85	3.01	Yes	Yes	Yes	No
(NE 6)568	568	N246E136	LT	7.69	25.16	24.1	3.51	Yes	Yes	Yes	No
(NE 6)569	569	N246E136	LT	5.96	13.91	20.23	2.47	Yes	No	No	No

Table A.1 - Continued

(NE 6)570	570	N246E136	LT	6.14	19.27	20.69	4.75	Yes	Yes	Yes	Yes
(NE 6)571	571	N246E136	LT	12.28	21.81	19.17	4.33	Yes	No	Yes	Yes
(NE 6)572	572	N246E136	LT	5.81	25.62	13.95	3.86	Yes	No	Yes	No
(NE 6)573	573	N246E136	LT	8.04	61.95	24.43	4.24	Yes	No	Yes	No
(NE 6)574	574	N246E136	LT	6.2	17.08	19.55	5.38	Yes	Yes	Yes	Yes
(NE 6)575	575	N246E136	LT	8.35	36.72	20.54	9.69	Yes	Yes	Yes	No
(NE 6)576	576	N246E136	LT	9.42	42.58	25.54	3.91	Yes	Yes	Yes	No
(NE 6)577	577	N246E136	LT	3.36	22.56	24.84	2.89	Yes	Yes	Yes	No
(NE 6)578	578	N246E136	LT	5.68	22.45	19.69	6.53	Yes	No	No	No
(NE 6)579	579	N246E136	LT		25.53	26.78	3.06	No	Yes	Yes	No
(NE 6)580	580	N246E136	LT	5.01	15.98	17.97	2.47	Yes	Yes	Yes	No
(NE 6)581	581	N246E136	LT	7.15	22.74	18.16	4.2	Yes	No	Yes	No
(NE 6)582	582	N246E136	LT	3.49	22.66	30.25	7.74	Yes	Yes	Yes	Yes
(NE 6)583	583	N246E136	LT	8.61	31.17	19.45	4.64	Yes	No	Yes	No
(NE 6)584	584	N246E136	LT	3.56	18.8	19.09	3.21	Yes	Yes	Yes	No
(NE 6)585	585	N246E136	LT	8.37	21.31	17.57	3.78	Yes	Yes	Yes	No
(NE 6)586	586	N246E136	LT	4.2	27.72	15.54	3.08	Yes	Yes	Yes	No
(NE 6)587	587	N246E136	LT		20.89	17.94	7.51	No	Yes	Yes	No
(NE 6)588	588	N246E136	LT	8.01	19.5	22.98	3.3	Yes	Yes	No	No
(NE 6)589	589	N246E136	LT	3.86	14.43	16.96	1.4	Yes	No	Yes	No
(NE 6)590	590	N246E136	LT	6.04	23.02	20.04	4.71	Yes	No	Yes	No
(NE 6)591	591	N246E136	LT		22.94	20.89	3.52	No	Yes	No	No
(NE 6)592	592	N246E136	LT	7.09	23.28	18.12	4.24	Yes	Yes	Yes	No
(NE 6)593	593	N246E136	LT	5.95	18.26	29.83	7.45	Yes	No	Yes	Yes
(NE 6)594	594	N246E136	LT	9.32	24.18	19.75	3.68	Yes	Yes	Yes	No
(NE 6)595	595	N246E136	LT	7.92	18.84	23.88	3.9	Yes	Yes	No	No

Table A.1 - Continued

(NE 6)596	596	N246E136	LT	3.58	16.61	19.3	6.27	Yes	Yes	Yes	No
(NE 6)597	597	N246E136	LT	3.64	23.96	17.94	4.76	Yes	No	Yes	No
(NE 6)598	598	N246E136	LT	4.52	17.44	15.93	3.5	Yes	Yes	Yes	Yes
(NE 6)599	599	N246E136	LT	5.2	19.67	18.03	3.29	Yes	No	Yes	Yes
(NE 6)600	600	N246E136	LT	16.66	13.97	21.64	4.33	Yes	Yes	Yes	No
(NE 6)601	601	N246E136	LT	5.11	31.21	17.2	3.83	Yes	No	No	Yes
(NE 6)602	602	N246E136	LT	7.36	26.34	15.62	3.56	Yes	No	Yes	Yes
(NE 6)603	603	N246E136	LT	2.9	18.79	21.62	4.95	Yes	Yes	No	No
(NE 6)604	604	N246E136	LT	6.48	16.57	17.26	2.13	Yes	No	Yes	No
(NE 6)605	605	N246E136	LT	6.56	15.32	17.64	3.35	Yes	Yes	Yes	No
(NE 6)606	606	N246E136	LT	10.55	24.62	22.07	6.37	Yes	Yes	Yes	No
(NE 6)607	607	N246E136	LT	11.16	23.6	16.27	4.65	Yes	No	Yes	Yes
(NE 6)608	608	N246E136	LT	9.2	20.06	19.58	2.77	Yes	Yes	No	No
(NE 6)609	609	N246E136	LT	8.15	20	20.75	4.47	Yes	Yes	Yes	No
(NE 6)610	610	N246E136	LT	10.46	30.63	16	3.27	Yes	No	Yes	No
(NE 6)611	611	N246E136	LT	10.47	14.65	17.9	4.43	Yes	No	Yes	Yes
(NE 6)612	612	N246E136	LT	6.59	12.32	22.56	8.51	Yes	No	Yes	No
(NE 6)613	613	N246E136	LT	9.17	17.24	19.46	4.53	Yes	No	No	No
(NE 6)614	614	N246E136	LT	7.27	21.79	20.36	2.9	Yes	Yes	Yes	No
(NE 6)615	615	N246E136	LT	6.97	13.28	17.16	3.13	Yes	No	Yes	No
(NE 6)616	616	N246E136	LT	6.45	23.35	15.57	1.85	Yes	Yes	No	No
(NE 6)617	617	N246E136	LT	4.74	26.99	20	3.28	Yes	Yes	No	No
(NE 6)618	618	N246E136	LT	6.9	21.7	21.47	3.36	Yes	Yes	Yes	No
(NE 6)619	619	N246E136	LT	7.43	16.67	16.36	4.29	Yes	No	Yes	Yes
(NE 6)620	620	N246E136	LT	2.66	19.26	20.1	3.15	Yes	Yes	No	No
(NE 6)621	621	N246E136	LT	9.96	24.22	15.18	3.06	Yes	Yes	No	No

Table A.1 - Continued

(NE 6)622	622	N246E136	LT	4.84	17.66	23.15	4.16	Yes	Yes	Yes	No
(NE 6)623	623	N246E136	LT	9.17	12.58	17.01	4.5	Yes	Yes	Yes	No
(NE 6)624	624	N246E136	LT	7.34	20.51	14.63	4.07	Yes	Yes	No	No
(NE 6)625	625	N246E136	LT	7.79	21.11	19.23	2.73	Yes	No	No	No
(NE 6)626	626	N246E136	LT		26.33	18.57	4.02	No	No	Yes	Yes
(NE 6)627	627	N246E136	LT	8.81	19.66	22.75	3.59	Yes	Yes	No	No
(NE 6)628	628	N246E136	LT	5.31	20.98	21.85	2.49	Yes	No	Yes	Yes
(NE 6)629	629	N246E136	LT		22.81	23.91	3.16	No	Yes	No	No
(NE 6)630	630	N246E136	LT	9.4	15.39	22.7	2.55	Yes	No	Yes	No
(NE 7)631	631	N246E136	LT	5.49	27.07	14.98	2.91	Yes	No	Yes	No
(NE 7)632	632	N246E136	LT	10.83	26.15	36.21	7.12	Yes	No	Yes	Yes
(NE 7)633	633	N246E136	LT	10.13	22.22	15.74	3.86	Yes	Yes	Yes	Yes
(NE 7)634	634	N246E136	LT	5.38	48.12	19.26	4.92	Yes	No	No	No
(NE 7)635	635	N246E136	LT	7.86	23.87	33.62	6	Yes	No	Yes	No
(NE 7)636	636	N246E136	LT		32.5	25.34	9.03	No	No	No	Yes
(NE 7)637	637	N246E136	LT	8.45	34.19	17.22	5.68	Yes	Yes	Yes	No
(NE 7)638	638	N246E136	LT	5.15	27.5	17.35	3.97	Yes	No	Yes	No
(NE 7)639	639	N246E136	LT	5.05	18.2	33.37	5.26	Yes	Yes	Yes	No
(NE 7)640	640	N246E136	LT	10.34	20.16	26.92	2.95	Yes	Yes	Yes	No
(NE 7)641	641	N246E136	LT	10.67	18.68	18.54	4.61	Yes	No	Yes	Yes
(NE 7)642	642	N246E136	LT	10.62	23.35	24.7	2.9	Yes	Yes	Yes	No
(NE 7)643	643	N246E136	LT	8.43	23.91	17.22	3.27	Yes	Yes	Yes	No
(NE 7)644	644	N246E136	LT	6.47	26.54	18.89	3.19	Yes	No	No	Yes
(NE 7)645	645	N246E136	LT	8.87	35.67	20.85	4.86	Yes	Yes	Yes	No
(NE 7)646	646	N246E136	LT	4.23	24.44	16.44	5.12	Yes	Yes	No	No
(NE 7)647	647	N246E136	LT	8.5	22.97	22.93	5.7	Yes	No	Yes	No

Table A.1 - Continued

(NE 7)648	648	N246E136	LT		22.54	15.22	3.37	No	Yes	No	No
(NE 7)649	649	N246E136	LT	8.98	24.92	19.74	3.74	Yes	No	No	No
(NE 7)650	650	N246E136	LT	8.27	29.25	23.52	5.31	Yes	Yes	Yes	No
(NE 7)651	651	N246E136	LT	7.25	21.68	24.35	3.64	Yes	Yes	Yes	No
(NE 7)652	652	N246E136	LT	9.3	31.71	25.33	4.05	Yes	No	Yes	Yes
(NE 7)653	653	N246E136	LT		21.84	15.52	3.28	No	Yes	No	No
(NE 7)654	654	N246E136	LT	5.44	21.21	22.87	4.56	Yes	No	Yes	No
(NE 7)655	655	N246E136	LT	4.11	19.7	24.57	2.81	Yes	Yes	Yes	No
(NE 7)656	656	N246E136	LT	5.02	25.63	18.32	3.61	Yes	Yes	No	No
(NE 7)657	657	N246E136	LT	6.63	27.43	14.45	2.6	Yes	Yes	Yes	No
(NE 7)658	658	N246E136	LT	3.8	17.47	18.44	2.16	Yes	Yes	No	No
(NE 7)659	659	N246E136	LT	7.21	19.74	17.29	2.93	Yes	Yes	Yes	No
(NE 7)660	660	N246E136	LT	11.06	14.78	19.89	4.44	Yes	No	Yes	No
(NE 7)661	661	N246E136	LT	7.79	28	16.37	2.91	Yes	No	Yes	No
(NE 7)662	662	N246E136	LT	6.34	18.37	15.53	3.15	Yes	No	Yes	No
(NE 7)663	663	N246E136	LT	4.9	23.09	15.4	3.43	Yes	Yes	Yes	No
(NE 7)664	664	N246E136	LT	63.8	13.58	13.67	3.55	Yes	No	Yes	No
(NE 7)665	665	N246E136	LT	9.29	17.25	21.88	2.13	Yes	Yes	Yes	No
(NE 7)666	666	N246E136	LT	15.2	18	16.19	4.65	Yes	No	No	No
(NE 7)667	667	N246E136	LT	13.13	17.87	15.15	2.8	Yes	Yes	Yes	Yes
(NE 7)668	668	N246E136	LT	8.55	19.08	16.54	1.89	Yes	Yes	Yes	Yes
(NE 7)669	669	N246E136	LT	9.75	16.38	21.64	2.13	Yes	Yes	Yes	No
(NE 7)670	670	N246E136	LT		16.96	19.81	3.26	No	No	No	No
(NE 7)671	671	N246E136	LT	11.83	24.01	14.19	3.37	Yes	No	Yes	No
(NE 7)672	672	N246E136	LT	4.54	17.85	15.59	2.13	Yes	Yes	Yes	No
(NE 7)673	673	N246E136	LT	4.25	15.25	21.53	3.11	Yes	No	Yes	No

Table A.1 - Continued

(NE 7)674	674	N246E136	LT		18.19	18.89	3.32	No	No	Yes	No
(NE 7)675	675	N246E136	LT	6.77	13.64	22.41	3.02	Yes	No	Yes	No
(NE8)676	676	N246E136	LT	29.67	51.2	43.04	16.42	Yes	No	Yes	No
(NE8)677	677	N246E136	LT	5.96	29.85	25.08	7.09	Yes	a	Yes	No
(NE8)678	678	N246E136	LT	8.21	23.71	20.52	5.89	Yes	No	Yes	Yes
(NE8)679	679	N246E136	LT	9.66	24.14	21.17	6.39	Yes	No	Yes	No
(NE8)680	680	N246E136	LT	13.49	17.39	18.31	5.09	Yes	No	Yes	No
(NE8)681	681	N246E136	LT	10.47	16	17.88	3.69	Yes	No	Yes	No
(NE8)682	682	N246E136	LT	6.58	29.28	24.85	5.69	Yes	No	Yes	Yes
(NE8)683	683	N246E136	LT	11.87	22.93	18.71	6.11	Yes	Yes	Yes	No
(NE8)684	684	N246E136	LT	1.95	28.23	17.51	4.61	Yes	No	Yes	No
(NE8)685	685	N246E136	LT	15.01	19.02	17.61	3.75	Yes	No	Yes	No
(NE8)686	686	N246E136	LT		19.09	14.94	2.9	No	Yes	Yes	No
(NE8)687	687	N246E136	LT	4.73	25.12	21.92	4.55	Yes	Yes	Yes	No
(NE8)688	688	N246E136	LT	3.19	16.67	15.02	2.2	Yes	Yes	No	No
(NE8)689	689	N246E136	LT	3.02	3.02	15.9	2.19	Yes	No	No	No
(NE 9) 690	690	N246E136	LT	6.42	31.08	19.95	4.09	Yes	Yes	Yes	No
(NE 9) 691	691	N246E136	LT		38.97	58.12	10.76	No	No	No	Yes
(NE 9) 692	692	N246E136	LT	13.33	43.38	54.02	9.51	Yes	No	Yes	Yes
(NE10 693	693	N246E136	LT	5.65	20.57	24.21	4.8	Yes	No	No	No
(NE 20) 1	1	N246E136	PS	14.07	22.31	27.09	10.84	Yes	No	No	No
(NE 21) 2	2	N246E138	PS	9.96	31.74	22.13	5.66	Yes	No	Yes	No
NW 1 694	1	N246E138	LT	7.16	39.29	28.81	8.47	Yes	No	Yes	Yes
NW 1 695	2	N246E138	LT	3.79	20.09	15.03	1.93	Yes	No	No	No
NW 1 696	3	N246E138	LT	14.44	18.58	17.88	4.18	Yes	No	Yes	No
NW 1 697	4	N246E138	LT	11.37	28.5	23.74	5	Yes	Yes	Yes	No

Table A.1 - Continued

NW 1 698	5	N246E138	LT	8.69	21.96	16.89	4.03	Yes	Yes	Yes	No
NW 10 1297	6	N246E138	LT	18.61	75.9	27.84	13.31	Yes	No	Yes	Yes
NW 10 1298	7	N246E138	LT		24.17	17	2.94	No	No	No	Yes
NW 10 1299	8	N246E138	LT	6.45	29.36	25.59	4.15	Yes	Yes	Yes	No
NW 10 1300	9	N246E138	LT	7.21	18.44	11.71	2.86	Yes	Yes	Yes	No
NW 11 1301	10	N246E138	LT		39.85	47.11	27.91	No	No	Yes	No
NW 11 1302	11	N246E138	LT	8.87	22.36	19.7	3.86	Yes	Yes	No	No
NW 11 1303	12	N246E138	LT	8.95	24.89	15.52	4.15	Yes	No	Yes	No
NW 12 1304	13	N246E138	LT		16.32	20.11	2.76	No	No	Yes	Yes
NW 12 1305	14	N246E138	LT	3.1	14.63	14.3	2.27	Yes	Yes	Yes	No
NW 13 1306	15	N246E138	LT	6.55	24.39	23.91	5.74	Yes	No	Yes	Yes
NW 13 1307	16	N246E138	LT	4.91	26.69	18.61	4.72	Yes	No	Yes	Yes
NW 14 1308	17	N246E138	LT	7.76	15.21	14.28	2.79	Yes	No	Yes	No
NW 14 1309	18	N246E138	LT	8.51	20.56	15	2.36	Yes	Yes	No	Yes
NW 14 1310	19	N246E138	LT		18.61	19.04	2.65	No	No	Yes	Yes
NW 14 1311	20	N246E138	LT	10.1	12.92	11.01	2.59	Yes	No	Yes	No
NW 2 699	21	N246E138	LT	4.16	30.52	19.19	8.65	Yes	No	Yes	No
NW 2 700	22	N246E138	LT	5.54	33.09	18.36	5.4	Yes	Yes	Yes	No
NW 2 701	23	N246E138	LT	6.76	38.83	25.52	7.64	Yes	Yes	Yes	No
NW 2 702	24	N246E138	LT	8.08	17.98	22.73	5.47	Yes	No	Yes	No
NW 2 703	25	N246E138	LT	5.83	23.71	20.64	4.31	Yes	Yes	Yes	Yes
NW 2 704	26	N246E138	LT	12.78	33.84	46.48	12.28	Yes	No	Yes	No
NW 2 705	27	N246E138	LT	12.95	20.26	24.26	4.24	Yes	Yes	No	Yes
NW 2 706	28	N246E138	LT	8.93	32.79	28.04	14.19	Yes	No	Yes	No
NW 2 707	29	N246E138	LT	4.1	29.42	22.89	6.57	Yes	No	No	Yes
NW 2 708	30	N246E138	LT	11.64	21.57	24.21	7.92	Yes	No	No	Yes

Table A.1 - Continued

NW 2 709	31	N246E138	LT	19.57	26.98	23.38	2.31	Yes	Yes	Yes	No
NW 2 710	32	N246E138	LT	17.57	17.59	28.11	3.38	Yes	Yes	Yes	No
NW 2 711	33	N246E138	LT	6.22	32.7	31.76	4.04	Yes	No	Yes	No
NW 2 712	34	N246E138	LT	13.55	32.13	20.02	5.27	Yes	No	No	No
NW 2 713	35	N246E138	LT	7.52	24.46	18.17	2.66	Yes	No	No	No
NW 2 714	36	N246E138	LT	7.1	21.02	15.59	2.92	Yes	No	Yes	No
NW 2 715	37	N246E138	LT		21.3	17.86	5.38	No	No	No	Yes
NW 2 716	38	N246E138	LT	6.75	17.98	17.92	2.56	Yes	No	No	No
NW 2 717	39	N246E138	LT		20.88	17.27	3.25	No	Yes	No	No
NW 2 718	40	N246E138	LT	7.84	19.92	16.77	2.78	Yes	Yes	No	No
NW 2 719	41	N246E138	LT	7.02	22.9	14.6	2.5	Yes	Yes	No	No
NW 3 720	42	N246E138	LT	5.96	28.5	22.04	6.11	Yes	No	Yes	Yes
NW 3 721	43	N246E138	LT	6.09	29.61	21.53	9.05	Yes	No	No	Yes
NW 3 722	44	N246E138	LT	10.72	21.89	25.53	3.02	Yes	No	No	Yes
NW 3 723	45	N246E138	LT	8.48	23.42	25.79	6.41	Yes	No	Yes	No
NW 3 724	46	N246E138	LT	7.04	31.06	22.06	2.89	Yes	No	Yes	No
NW 3 725	47	N246E138	LT	9.38	24.27	17.07	2.88	Yes	Yes	Yes	No
NW 3 726	48	N246E138	LT	7.92	22.59	26.8	5.39	Yes	No	Yes	Yes
NW 3 727	49	N246E138	LT	14.42	27	28.16	6.11	Yes	Yes	Yes	No
NW 3 728	50	N246E138	LT	4.14	35.46	20.68	5.9	Yes	Yes	Yes	No
NW 3 729	51	N246E138	LT	10.54	15.75	27.95	4.58	Yes	No	Yes	No
NW 3 730	52	N246E138	LT	9.2	22.34	28.01	8.6	Yes	No	Yes	Yes
NW 3 731	53	N246E138	LT	9.23	21.14	21.76	7.39	Yes	Yes	Yes	No
NW 3 732	54	N246E138	LT	4.84	19.69	23.31	3.22	Yes	Yes	Yes	No
NW 3 733	55	N246E138	LT		14.29	30.55	6.23	No	Yes	Yes	No
NW 3 734	56	N246E138	LT	11.6	23.19	16.59	4.28	Yes	No	Yes	No

Table A.1 - Continued

NW 3 735	57	N246E138	LT	8.25	26.76	20.21	3.95	Yes	Yes	Yes	No
NW 3 736	58	N246E138	LT	15.13	34.56	27.32	5.97	Yes	Yes	Yes	No
NW 3 737	59	N246E138	LT	3.82	25.04	21.26	4.36	Yes	Yes	Yes	No
NW 3 738	60	N246E138	LT	12.67	16.76	28.32	3.44	Yes	No	Yes	No
NW 3 739	61	N246E138	LT	7.29	19.85	24.37	5.34	Yes	No	No	No
NW 3 740	62	N246E138	LT	10.03	15.76	16.61	3.96	No	No	Yes	No
NW 3 741	63	N246E138	LT		18.26	18.95	2.02	No	Yes	Yes	No
NW 3 742	64	N246E138	LT		18.59	20.08	2.2	Yes	No	No	No
NW 3 743	65	N246E138	LT	8.76	21.32	18.09	4.6	Yes	No	No	No
NW 3 744	66	N246E138	LT	7.63	17.71	17.05	4.63	Yes	Yes	Yes	No
NW 3 745	67	N246E138	LT	3.45	18.24	21.86	2.31	Yes	No	No	Yes
NW 3 746	68	N246E138	LT	7.39	21.53	16.45	4.05	Yes	No	Yes	No
NW 3 747	69	N246E138	LT	13.77	16.44	19.77	5.28	Yes	Yes	No	No
NW 3 748	70	N246E138	LT	6.28	25.59	15.63	3.37	Yes	Yes	Yes	No
NW 3 749	71	N246E138	LT	7.96	20.64	23.88	2.44	Yes	Yes	No	No
NW 3 750	72	N246E138	LT	2.32	36.58	20.18	3.94	Yes	Yes	Yes	No
NW 3 751	73	N246E138	LT	3.54	14.09	17.35	2.8	Yes	Yes	Yes	No
NW 3 752	74	N246E138	LT	2.55	25.5	13.92	4.88	Yes	Yes	No	No
NW 3 753	75	N246E138	LT	7.45	14.73	19.26	3.07	Yes	Yes	Yes	No
NW 3 754	76	N246E138	LT		23.82	16.35	3.07	No	Yes	Yes	No
NW 3 755	77	N246E138	LT	3.26	31.6	16.02	3.45	Yes	No	Yes	No
NW 3 756	78	N246E138	LT	7.72	21.09	20.62	3.08	Yes	No	Yes	No
NW 3 757	79	N246E138	LT	2.73	20.79	18.12	3.91	Yes	No	No	No
NW 3 758	80	N246E138	LT	12.66	26.4	20.44	3.5	Yes	No	Yes	Yes
NW 3 759	81	N246E138	LT	7.28	11.44	20.46	4.87	Yes	No	Yes	No
NW 3 760	82	N246E138	LT	9.17	22.26	21.23	4.45	Yes	Yes	Yes	Yes

Table A.1 - Continued

NW 3 761	83	N246E138	LT	12.43	17.03	20.8	4.24	Yes	No	No	No
NW 3 762	84	N246E138	LT	5.59	22.46	17.07	2.66	Yes	No	Yes	No
NW 3 763	85	N246E138	LT	7.04	15.86	19.48	2.37	Yes	Yes	Yes	No
NW 3 764	86	N246E138	LT	6	28.43	20.9	4.12	Yes	Yes	Yes	Yes
NW 3 765	87	N246E138	LT	6.32	19.13	17.61	2.78	Yes	No	No	No
NW 3 766	88	N246E138	LT	7.22	23.01	18.56	3.22	Yes	Yes	No	No
NW 3 767	89	N246E138	LT	10.23	16.21	14.83	3.16	Yes	No	Yes	No
NW 3 768	90	N246E138	LT	5.43	18.24	14.4	14.4	Yes	No	Yes	No
NW 4 769	91	N246E138	LT	40.55	69.47	73.74	26.37	Yes	No	Yes	Yes
NW 4 770	92	N246E138	LT	56.19	93	75.21	24.37	Yes	No	Yes	Yes
NW 4 771	93	N246E138	LT	14.75	50.92	40	11.39	Yes	No	Yes	No
NW 4 772	94	N246E138	LT	5.16	34.39	30.84	6.83	Yes	Yes	Yes	No
NW 4 773	95	N246E138	LT	13.97	42.72	36.92	8.55	Yes	No	Yes	Yes
NW 4 774	96	N246E138	LT	7.14	35.03	31.86	6.99	Yes	Yes	Yes	Yes
NW 4 775	97	N246E138	LT		31.59	36.83	14.29	No	Yes	Yes	No
NW 4 776	98	N246E138	LT	14.79	43.55	39.66	14.04	Yes	No	Yes	No
NW 4 777	99	N246E138	LT	7.42	30.13	23.85	6.01	Yes	No	Yes	Yes
NW 4 778	100	N246E138	LT	12.18	27.19	29.91	9.92	Yes	No	Yes	No
NW 4 779	101	N246E138	LT	9.16	28.51	21.32	4.51	Yes	Yes	Yes	No
NW 4 780	102	N246E138	LT	2.92	26.51	24.57	2.67	Yes	No	Yes	No
NW 4 781	103	N246E138	LT	5.91	25.08	20.43	4.1	Yes	No	No	Yes
NW 4 782	104	N246E138	LT	4.33	31.23	25.94	3.13	Yes	Yes	Yes	No
NW 4 783	105	N246E138	LT	8.81	31.03	28.54	5.55	Yes	No	No	Yes
NW 4 784	106	N246E138	LT		32.43	36.38	7.57	No	No	No	Yes
NW 4 785	107	N246E138	LT	5.57	45.37	27.04	4.81	Yes	Yes	Yes	No
NW 4 786	108	N246E138	LT	6.79	39.69	30.43	6.92	Yes	Yes	Yes	No

Table A.1 - Continued

NW 4 787	109	N246E138	LT	9.52	26.5	28.79	5.92	Yes	Yes	No	No
NW 4 788	110	N246E138	LT	7.17	37.37	21.68	4.2	Yes	Yes	Yes	Yes
NW 4 789	111	N246E138	LT	17.71	25.52	38.43	6.67	Yes	Yes	Yes	No
NW 4 790	112	N246E138	LT	17.22	24.34	26.27	4.6	Yes	Yes	Yes	Yes
NW 4 791	113	N246E138	LT	6.28	32.78	27.98	5.31	Yes	Yes	Yes	No
NW 4 792	114	N246E138	LT	14.09	26.48	25.51	5.93	Yes	No	No	No
NW 4 793	115	N246E138	LT	6.64	24.04	40.04	5.9	Yes	Yes	Yes	No
NW 4 794	116	N246E138	LT	10.06	27.2	30.58	6.14	Yes	No	No	Yes
NW 4 795	117	N246E138	LT	12.97	15.42	25.37	5.7	Yes	Yes	Yes	Yes
NW 4 796	118	N246E138	LT	15.92	22.56	34.27	7.1	Yes	No	Yes	Yes
NW 4 797	119	N246E138	LT	8.29	25.29	33.24	7.95	Yes	Yes	Yes	Yes
NW 4 798	120	N246E138	LT	13.66	37.98	19	3.98	Yes	Yes	Yes	No
NW 4 799	121	N246E138	LT	12.3	26.67	23.52	5.87	Yes	No	Yes	Yes
NW 4 800	122	N246E138	LT	10.45	22.95	41.54	5.85	Yes	No	Yes	No
NW 4 801	123	N246E138	LT	18.11	26.04	20.59	6.34	Yes	No	No	No
NW 4 802	124	N246E138	LT	3.7	28.27	18.21	4.92	Yes	Yes	Yes	Yes
NW 4 803	125	N246E138	LT	8.5	49.89	21.54	5.16	Yes	No	Yes	No
NW 4 804	126	N246E138	LT	7.92	22.14	27.63	7.65	Yes	No	Yes	Yes
NW 4 805	127	N246E138	LT	7.29	23.35	27.01	4.49	Yes	Yes	Yes	No
NW 4 806	128	N246E138	LT	13.96	21.75	29.5	7346	Yes	No	No	No
NW 4 807	129	N246E138	LT	17.81	30.12	22.85	5.4	Yes	No	No	No
NW 4 808	130	N246E138	LT	7.43	24.98	24.78	5.03	Yes	Yes	Yes	Yes
NW 4 809	131	N246E138	LT	14.3	29.7	32.08	5.85	Yes	No	Yes	No
NW 4 810	132	N246E138	LT	9.52	28.76	29.34	7.72	Yes	No	Yes	No
NW 4 811	133	N246E138	LT		39.34	14.79	3.44	No	Yes	No	Yes
NW 4 812	134	N246E138	LT	7.47	22.62	28	4.08	Yes	Yes	Yes	No

Table A.1 - Continued

NW 4 813	135	N246E138	LT	14.85	30.13	34.94	8.02	Yes	No	Yes	No
NW 4 814	136	N246E138	LT	18.02	20.9	18.33	8.04	Yes	No	No	No
NW 4 815	137	N246E138	LT	12.12	33.76	27.36	3.74	Yes	No	No	No
NW 4 816	138	N246E138	LT	2.8	20.95	32.78	4.66	Yes	Yes	Yes	No
NW 4 817	139	N246E138	LT	6.25	18.77	26.9	4.89	Yes	Yes	No	No
NW 4 818	140	N246E138	LT	3.36	35.75	16.94	4.37	Yes	Yes	Yes	No
NW 4 819	141	N246E138	LT	5.89	20.59	19.46	2.97	Yes	Yes	No	No
NW 4 820	142	N246E138	LT		20.8	18.31	2.55	No	Yes	No	No
NW 4 821	143	N246E138	LT	11.55	30.88	21.15	4.45	Yes	Yes	No	No
NW 4 822	144	N246E138	LT	5.85	26.09	34.82	6.97	Yes	Yes	Yes	No
NW 4 823	145	N246E138	LT	5.08	27.91	17.69	4.31	Yes	Yes	Yes	No
NW 4 824	146	N246E138	LT	8.12	14.24	17.04	5.05	Yes	Yes	Yes	No
NW 4 825	147	N246E138	LT	6.16	15.82	25.57	4.33	Yes	No	Yes	No
NW 4 826	148	N246E138	LT	9.63	23.93	21.43	6.08	Yes	Yes	Yes	No
NW 4 827	149	N246E138	LT		21.12	21.03	6.36	No	No	No	No
NW 4 828	150	N246E138	LT	10.26	25.49	22	4.13	Yes	No	Yes	No
NW 4 829	151	N246E138	LT	5.83	25.28	28.93	4.62	Yes	Yes	No	Yes
NW 4 830	152	N246E138	LT	16.4	18.08	33.4	3.84	Yes	No	No	No
NW 4 831	153	N246E138	LT	14.21	34.61	24.11	6.38	Yes	Yes	No	No
NW 4 832	154	N246E138	LT	8.97	30.91	24.47	4.37	Yes	Yes	No	No
NW 4 833	155	N246E138	LT	11.35	26.86	28.24	4.82	Yes	No	Yes	Yes
NW 4 834	156	N246E138	LT		27.13	25	5.23	No	Yes	No	No
NW 4 835	157	N246E138	LT	14	26.07	18.35	6.35	Yes	Yes	Yes	No
NW 4 836	158	N246E138	LT	3.38	17.71	21.4	5.33	Yes	Yes	Yes	Yes
NW 4 837	159	N246E138	LT	15.41	17.71	27.57	3.37	Yes	No	Yes	No
NW 4 838	160	N246E138	LT	8.51	22.32	20.9	5.44	Yes	Yes	Yes	No

Table A.1 - Continued

NW 4 839	161	N246E138	LT	7.67	18.89	28.24	2.82	Yes	No	Yes	No
NW 4 840	162	N246E138	LT	5.97	19.51	19	3.59	Yes	Yes	Yes	No
NW 4 841	163	N246E138	LT	15.44	18.3	24.03	4.96	Yes	Yes	Yes	No
NW 4 842	164	N246E138	LT	6.89	24.42	17.18	2.91	Yes	Yes	No	
NW 4 843	165	N246E138	LT	4.25	20.4	15.39	1.7	Yes	Yes	No	No
NW 4 844	166	N246E138	LT	7.29	12.74	19.43	2.86	Yes	No	Yes	Yes
NW 4 845	167	N246E138	LT	7.75	32	31.31	8.47	Yes	No	Yes	No
NW 4 846	168	N246E138	LT	12.05	20.27	20.5	3.62	Yes	No	Yes	No
NW 4 847	169	N246E138	LT	7.61	26.22	25.82	3.37	Yes	Yes	No	No
NW 4 848	170	N246E138	LT	15.18	16.77	16.19	4.94	Yes	No	Yes	No
NW 4 849	171	N246E138	LT	10.22	29.87	31.2	7.62	Yes	Yes	Yes	No
NW 4 850	172	N246E138	LT	5.82	22.93	18.13	4.28	Yes	Yes	Yes	No
NW 4 851	173	N246E138	LT	9.91	20.5	20.97	3.97	Yes	Yes	No	No
NW 4 852	174	N246E138	LT	7.92	14.73	18.37	2.84	Yes	No	Yes	No
NW 4 853	175	N246E138	LT	7.83	22.54	17.18	4.85	Yes	No	Yes	Yes
NW 4 854	176	N246E138	LT	11.31	32.11	14.34	4.97	Yes	Yes	Yes	No
NW 4 855	177	N246E138	LT	4.73	22.4	13.01	5.52	Yes	No	Yes	No
NW 4 856	178	N246E138	LT	8.84	27.29	19.64	4.02	Yes	Yes	Yes	No
NW 4 857	179	N246E138	LT	6.54	16.5	20.93	3.76	Yes	No	Yes	No
NW 4 858	180	N246E138	LT	5.29	19.54	18.51	3.77	Yes	No	Yes	No
NW 4 859	181	N246E138	LT	6.78	16.31	17.57	3.68	Yes	Yes	Yes	No
NW 4 860	182	N246E138	LT	8.84	13.04	19.82	2.92	Yes	No	Yes	Yes
NW 4 861	183	N246E138	LT	18.16	16	14	1.87	Yes	Yes	No	No
NW 4 862	184	N246E138	LT	6.2	15.58	20.34	3.33	Yes	No	Yes	Yes
NW 4 863	185	N246E138	LT	4.36	17.81	19.59	2.77	Yes	Yes	Yes	No
NW 4 864	186	N246E138	LT	8.73	20.35	28.11	6.18	Yes	No	Yes	Yes

Table A.1 - Continued

NW 4 865	187	N246E138	LT	6.63	35.17	19.24	3	Yes	Yes	Yes	No
NW 4 866	188	N246E138	LT		21.26	15.85	4.88	No	Yes	No	No
NW 4 867	189	N246E138	LT	6.29	30.88	18.14	2.61	Yes	No	Yes	No
NW 4 868	190	N246E138	LT	7.6	20.5	19.79	4.16	Yes	No	No	Yes
NW 4 869	191	N246E138	LT	4.86	25.35	19.68	2.46	Yes	No	Yes	Yes
NW 4 870	192	N246E138	LT	10.12	22.8	14.57	2.45	Yes	No	Yes	Yes
NW 4 871	193	N246E138	LT	4.2	25.89	16.32	2.46	Yes	Yes	Yes	No
NW 4 872	194	N246E138	LT	7.63	18.78	16.51	3.8	Yes	No	Yes	Yes
NW 4 873	195	N246E138	LT	8.06	32.85	15.03	4.12	Yes	No	Yes	No
NW 4 874	196	N246E138	LT		20.31	16.95	2.54		No	No	No
NW 4 875	197	N246E138	LT	11.29	25.97	18.59	3.81	Yes	No	Yes	No
NW 4 876	198	N246E138	LT	9.9	26.09	22.42	9.35	Yes	Yes	Yes	No
NW 4 877	199	N246E138	LT	10.16	13.74	22.22	3.81	Yes	Yes	Yes	No
NW 4 878	200	N246E138	LT	4.2	14.5	16.05	2.87	Yes	No	No	No
NW 4 879	201	N246E138	LT	6.21	19.71	16.25	2.97	Yes	No	Yes	No
NW 4 880	202	N246E138	LT	4.74	23.36	17.52	3.34	Yes	Yes	Yes	No
NW 4 881	203	N246E138	LT	7.17	19.7	20.16	3.87	Yes	No	Yes	Yes
NW 4 882	204	N246E138	LT	7.71	21	15.93	5.53	Yes	No	Yes	Yes
NW 5 1000	205	N246E138	LT	13.3	24.26	25.18	4.83	Yes	No	No	No
NW 5 1001	206	N246E138	LT	7.91	28.53	30.66	4.94	Yes	No	Yes	No
NW 5 1002	207	N246E138	LT	12.39	29.7	16.41	5.15	Yes	No	No	No
NW 5 1003	208	N246E138	LT	8.51	28.52	18.59	2.36	Yes	Yes	No	No
NW 5 1004	209	N246E138	LT	15.47	28.05	17.61	5.49	Yes	No	No	Yes
NW 5 1005	210	N246E138	LT	18.43	18.91	21.42	8.05	Yes	No	Yes	No
NW 5 1006	211	N246E138	LT	11.18	14.67	25.01	5.97	Yes	Yes	Yes	Yes
NW 5 1007	212	N246E138	LT	9.46	19.65	24.68	3.17	Yes	No	Yes	No

Table A.1 - Continued

NW 5 1008	213	N246E138	LT	4.49	19.92	21.98	3.55	Yes	Yes	Yes	Yes
NW 5 1009	214	N246E138	LT	7.47	25.89	18.95	3.66	Yes	No	No	Yes
NW 5 1010	215	N246E138	LT	9.45	15.39	19.47	5.32	Yes	No	Yes	Yes
NW 5 1011	216	N246E138	LT	6.12	30.61	18.39	3.17	Yes	Yes	No	No
NW 5 1012	217	N246E138	LT		28.1	18.28	3.14	No	No	No	No
NW 5 1013	218	N246E138	LT	4356	28.5	14.7	2.37	Yes	No	No	No
NW 5 1014	219	N246E138	LT	5.35	23.96	17.43	2.93	Yes	Yes	Yes	Yes
NW 5 1015	220	N246E138	LT	11.05	29.93	16.58	7.14	Yes	No	Yes	Yes
NW 5 1016	221	N246E138	LT	8.92	22.5	24.08	4.67	Yes	Yes	Yes	No
NW 5 1017	222	N246E138	LT	9.02	26.24	17.79	3.33	Yes	No	No	Yes
NW 5 1018	223	N246E138	LT	5.54	18.89	28.87	3.71	Yes	No	Yes	Yes
NW 5 1019	224	N246E138	LT		19.27	17.62	3.6	No	No	Yes	No
NW 5 1020	225	N246E138	LT	10.57	15.86	24.43	5.58	Yes	No	Yes	No
NW 5 1021	226	N246E138	LT	8.67	25.73	19.06	2.33	Yes	No	Yes	No
NW 5 1022	227	N246E138	LT	14.97	20.4	17.37	2.73	Yes	No	Yes	No
NW 5 1023	228	N246E138	LT	21.11	29.11	16.54	2.65	Yes	No	Yes	Yes
NW 5 1024	229	N246E138	LT	10.76	14.97	23.25	4.85	Yes	No	Yes	No
NW 5 1025	230	N246E138	LT	8.13	17.29	18.8	4.6	Yes	Yes	Yes	No
NW 5 1026	231	N246E138	LT		32.27	15.27	3.69	No	Yes	No	Yes
NW 5 1027	232	N246E138	LT	8.46	23.73	14.58	2.58	Yes	No	Yes	No
NW 5 1028	233	N246E138	LT	6.37	16.71	16.38	2.05	Yes	Yes	No	No
NW 5 1029	234	N246E138	LT	7.64	16.52	1803	2.71	Yes	No	No	No
NW 5 1030	235	N246E138	LT	15.19	19.02	23.33	5.1	Yes	No	Yes	No
NW 5 1031	236	N246E138	LT	5.44	24.26	23.45	2.69	Yes	No	Yes	No
NW 5 1032	237	N246E138	LT	12.89	15.48	22.17	6.12	Yes	No	No	No
NW 5 1033	238	N246E138	LT	7.46	23.55	18.44	5.3	Yes	No	Yes	Yes

Table A.1 - Continued

NW 5 1034	239	N246E138	LT	9.42	17.56	22.33	4.82	Yes	Yes	Yes	No
NW 5 1035	240	N246E138	LT	9.41	16.29	13.81	5.65	Yes	Yes	No	No
NW 5 1036	241	N246E138	LT	6.32	22.08	17.22	1.95	Yes	No	No	No
NW 5 1037	242	N246E138	LT	9.84	18.87	20.34	4.66	Yes	No	Yes	No
NW 5 1038	243	N246E138	LT		18.72	28.41	3.49	No	No	Yes	No
NW 5 1039	244	N246E138	LT	6.07	23	14.18	3.66	Yes	No	Yes	No
NW 5 1040	245	N246E138	LT	3.32	20.1	14.97	2.71	Yes	Yes	Yes	No
NW 5 1041	246	N246E138	LT	4.6	15.42	20.86	3.44	Yes	No	Yes	No
NW 5 1042	247	N246E138	LT	3.91	16.32	17.64	4.53	Yes	No	No	No
NW 5 1043	248	N246E138	LT	5.55	21.74	15.41	2.3	Yes	No	No	No
NW 5 883	249	N246E138	LT	24.42	44.32	49.8	18.78	Yes	No	Yes	Yes
NW 5 884	250	N246E138	LT	9.85	31.02	27.13	5.66	Yes	Yes	No	No
NW 5 885	251	N246E138	LT	6.12	39.81	25.01	7.17	Yes	Yes	Yes	Yes
NW 5 886	252	N246E138	LT	9.65	33.07	22.23	4.92	Yes	No	No	No
NW 5 887	253	N246E138	LT	26.78	40.93	33.9	8.25	Yes	Yes	Yes	No
NW 5 888	254	N246E138	LT	9.08	26.67	28.36	4.14	Yes	Yes	Yes	No
NW 5 889	255	N246E138	LT		37.83	22.51	6.29	No	Yes	No	No
NW 5 890	256	N246E138	LT	3	41.24	23.77	3.13	Yes	Yes	No	No
NW 5 891	257	N246E138	LT	5.16	28.11	20.37	3.7	Yes	Yes	Yes	No
NW 5 892	258	N246E138	LT	7.69	30.2	21.48	2.93	Yes	No	No	No
NW 5 893	259	N246E138	LT	9.04	32.85	48.84	6.1	Yes	Yes	No	No
NW 5 894	260	N246E138	LT	6.43	31.03	21.65	4.49	Yes	No	Yes	No
NW 5 895	261	N246E138	LT	23.56	26.78	27.21	6.64	Yes	Yes	Yes	No
NW 5 896	262	N246E138	LT	6.36	30.82	24.6	5.25	Yes	No	Yes	No
NW 5 897	263	N246E138	LT	10.97	30.29	24.03	6.14	Yes	Yes	Yes	Yes
NW 5 898	264	N246E138	LT	8.91	37.76	28.5	7.35	Yes	Yes	No	No

Table A.1 - Continued

NW 5 899	265	N246E138	LT	8.35	35.53	34.35	4.64	Yes	Yes	Yes	No
NW 5 900	266	N246E138	LT	19.11	28.23	32.61	5.51	Yes	Yes	Yes	No
NW 5 901	267	N246E138	LT	8.66	40.15	31.28	7.6	Yes	Yes	Yes	No
NW 5 902	268	N246E138	LT	13.35	22.23	18.88	6.5	Yes	Yes	Yes	No
NW 5 903	269	N246E138	LT	12.25	22.94	24.94	4.82	Yes	Yes	Yes	No
NW 5 904	270	N246E138	LT		24.82	19.57	5.25	No	Yes	No	No
NW 5 905	271	N246E138	LT	9.74	37.5	17.03	5.85	Yes	Yes	No	No
NW 5 906	272	N246E138	LT	12.72	36.77	30.01	7.76	Yes	Yes	Yes	No
NW 5 907	273	N246E138	LT	15.86	24.36	29.15	5.5	Yes	Yes	Yes	No
NW 5 908	274	N246E138	LT	16.37	22.1	25.62	7.31	Yes	Yes	Yes	No
NW 5 909	275	N246E138	LT		29.25	26.06	7.84	No	No	No	No
NW 5 910	276	N246E138	LT	7.29	33.28	42.37	5.83	Yes	Yes	Yes	No
NW 5 911	277	N246E138	LT	7.79	29.49	26.17	10.1	Yes	Yes	No	No
NW 5 912	278	N246E138	LT	2.44	22.15	16.03	2.16	Yes	Yes	No	No
NW 5 913	279	N246E138	LT	4.49	22.12	17.11	2.76	Yes	Yes	Yes	No
NW 5 914	280	N246E138	LT	12.59	28.38	28.38	5.73	Yes	No	Yes	Yes
NW 5 915	281	N246E138	LT	15.8	235.76	35.82	8.28	Yes	No	Yes	No
NW 5 916	282	N246E138	LT	11.32	30.8	44.82	8.63	Yes	No	Yes	No
NW 5 917	283	N246E138	LT	13.01	53.64	33.02	10.7	Yes	No	Yes	No
NW 5 918	284	N246E138	LT	6.38	19.43	25.17	4.62	Yes	No	No	No
NW 5 919	285	N246E138	LT	8.3	33.92	26.58	6.74	Yes	No	Yes	No
NW 5 920	286	N246E138	LT	12.75	34.12	26.27	6.47	Yes	No	Yes	No
NW 5 921	287	N246E138	LT	10.95	23.05	18.3	5.36	Yes	Yes	Yes	No
NW 5 922	288	N246E138	LT	14.72	26.41	19.15	5.08	Yes	Yes	Yes	Yes
NW 5 923	289	N246E138	LT	8.41	8.77	15.54	5.03	Yes	Yes	Yes	Yes
NW 5 924	290	N246E138	LT	6.57	34.41	32.51	7.53	Yes	No	Yes	No

Table A.1 - Continued

NW 5 925	291	N246E138	LT	12.69	31.26	26.17	3.94	Yes	Yes	No	Yes
NW 5 926	292	N246E138	LT	4.66	30.82	29.86	5.51	Yes	No	Yes	No
NW 5 927	293	N246E138	LT	7.21	26.69	27.45	7.12	Yes	No	Yes	No
NW 5 928	294	N246E138	LT	15.34	19.63	29.45	6.08	Yes	No	No	No
NW 5 929	295	N246E138	LT		29.9	18.39	4.36	No	No	Yes	No
NW 5 930	296	N246E138	LT		27.02	28.82	4.29	No	Yes	No	Yes
NW 5 931	297	N246E138	LT	4.07	27.83	15.87	3.03	Yes	Yes	No	No
NW 5 932	298	N246E138	LT	6.69	28.36	17	4.19	Yes	No	Yes	No
NW 5 933	299	N246E138	LT	26.56	23.53	27.42	7.25	Yes	No	Yes	No
NW 5 934	300	N246E138	LT	17.46	26.29	29.02	6.73	Yes	Yes	Yes	No
NW 5 935	301	N246E138	LT	7.88	32.08	15.5	4.06	Yes	No	Yes	No
NW 5 936	302	N246E138	LT	9.54	31.72	44.88	7.44	Yes	No	Yes	Yes
NW 5 937	303	N246E138	LT		14.95	24.61	2.98	No	No	No	No
NW 5 938	304	N246E138	LT	12.88	22.26	29.39	7.18	Yes	Yes	Yes	No
NW 5 939	305	N246E138	LT	16.87	22.19	25.56	6.82	Yes	No	Yes	No
NW 5 940	306	N246E138	LT	7.86	32.68	22.56	6.02	Yes	No	Yes	No
NW 5 941	307	N246E138	LT	6.69	19.95	23.22	3.98	Yes	Yes	Yes	Yes
NW 5 942	308	N246E138	LT	6.19	26.04	15.27	2.52	Yes	No	Yes	No
NW 5 943	309	N246E138	LT	8.05	28.11	18.24	6.17	Yes	Yes	Yes	No
NW 5 944	310	N246E138	LT	10.07	29.51	33.18	5.95	Yes	Yes	No	No
NW 5 945	311	N246E138	LT	5.69	25.26	18	2.8	Yes	Yes	Yes	No
NW 5 946	312	N246E138	LT	6.32	25.45	27.57	4.94	Yes	No	No	Yes
NW 5 947	313	N246E138	LT	9.5	16.63	18.42	2.88	Yes	Yes	Yes	No
NW 5 948	314	N246E138	LT	12.9	27.17	15.45	5.06	Yes	Yes	Yes	No
NW 5 949	315	N246E138	LT	6.76	14.57	18.45	2.36	Yes	Yes	No	No
NW 5 950	316	N246E138	LT		24.58	13.9	5.66	No	Yes	No	No

Table A.1 - Continued

NW 5 951	317	N246E138	LT	7.84	17.07	24.66	2.6	Yes	No	Yes	No
NW 5 952	318	N246E138	LT	6.76	31.05	26.54	6.6	Yes	No	Yes	Yes
NW 5 953	319	N246E138	LT	8.39	20.01	23.13	3.9	Yes	No	Yes	No
NW 5 954	320	N246E138	LT	7.42	31.9	25.02	10.12	Yes	No	Yes	No
NW 5 955	321	N246E138	LT	6.87	21.74	21.52	3.68	Yes	Yes	No	Yes
NW 5 956	322	N246E138	LT	2.84	28.46	24.46	3.38	Yes	No	Yes	No
NW 5 957	323	N246E138	LT	9.22	16.03	22.11	5.39	Yes	Yes	Yes	No
NW 5 958	324	N246E138	LT	23.93	23.9	43.1	7.76	Yes	No	Yes	Yes
NW 5 959	325	N246E138	LT	12.95	26.62	23.21	4.85	Yes	No	No	Yes
NW 5 960	326	N246E138	LT	10.54	30.96	17.4	4.25	Yes	No	No	No
NW 5 961	327	N246E138	LT	3.84	27.72	25.48	4.84	Yes	No	Yes	Yes
NW 5 962	328	N246E138	LT	8.78	29.55	19.53	4.35	Yes	No	Yes	Yes
NW 5 963	329	N246E138	LT	4.16	30.9	20.7	2.62	Yes	No	Yes	No
NW 5 964	330	N246E138	LT	11.87	54.23	31.07	9.31	Yes	No	No	No
NW 5 965	331	N246E138	LT	6.95	37.01	27.83	6.48	Yes	No	Yes	Yes
NW 5 966	332	N246E138	LT	7.21	33.54	25.3	4.66	Yes	No	Yes	No
NW 5 967	333	N246E138	LT	6.84	26.65	24.02	5.31	Yes	No	Yes	No
NW 5 968	334	N246E138	LT	7.22	20.89	28.73	5.77	Yes	Yes	No	No
NW 5 969	335	N246E138	LT	9.62	24.1	26.34	3.58	Yes	No	Yes	No
NW 5 970	336	N246E138	LT	6.32	20.52	21.16	5.17	Yes	No	Yes	Yes
NW 5 971	337	N246E138	LT	4.05	19.55	22.37	1.58	Yes	Yes	No	No
NW 5 972	338	N246E138	LT	15.67	30.51	42.3	9.11	Yes	No	Yes	Yes
NW 5 973	339	N246E138	LT	10.5	27.33	38.95	6.14	Yes	No	Yes	No
NW 5 974	340	N246E138	LT	16.57	28.93	25.95	5.13	Yes	Yes	No	No
NW 5 975	341	N246E138	LT	5.58	34.08	22.85	5.03	Yes	Yes	No	No
NW 5 976	342	N246E138	LT	5.68	37.72	23.81	4.88	Yes	No	No	Yes

Table A.1 - Continued

NW 5 977	343	N246E138	LT	7.44	15.65	26.6	3.24	Yes	No	Yes	No
NW 5 978	344	N246E138	LT	6.51	22.61	16.75	3.55	Yes	No	No	No
NW 5 979	345	N246E138	LT	4.18	30.22	25.56	5.52	Yes	No	Yes	No
NW 5 980	346	N246E138	LT	8.03	27.97	19	2.89	Yes	Yes	No	No
NW 5 981	347	N246E138	LT	11.5	37.09	23.26	6.28	Yes	No	Yes	No
NW 5 982	348	N246E138	LT	6.78	46.04	17.4	6.28	Yes	No	Yes	Yes
NW 5 983	349	N246E138	LT	9.93	42.03	21.29	6.07	Yes	No	Yes	No
NW 5 984	350	N246E138	LT		24.77	22.13	6.56	No	No	No	Yes
NW 5 985	351	N246E138	LT	15.68	23.46	19.8	5.33	Yes	No	No	No
NW 5 986	352	N246E138	LT	9.33	31.35	24.38	5.68	Yes	Yes	Yes	No
NW 5 987	353	N246E138	LT	6.02	29.75	21.45	3.64	Yes	No	Yes	No
NW 5 988	354	N246E138	LT	5.02	33.93	24.09	3.24	Yes	No	No	No
NW 5 989	355	N246E138	LT	7.81	21.18	25.19	3.53	Yes	Yes	No	No
NW 5 990	356	N246E138	LT	7.91	27.28	14.94	3.49	Yes	Yes	No	No
NW 5 991	357	N246E138	LT	5.8	37.89	27.51	2.66	Yes	Yes	No	No
NW 5 992	358	N246E138	LT	13.89	25.57	25.6	7.62	Yes	No	Yes	No
NW 5 993	359	N246E138	LT	8.9	30.01	28.84	5.05	Yes	Yes	No	No
NW 5 994	360	N246E138	LT	7.23	37.23	32.07	3.64	Yes	No	Yes	Yes
NW 5 995	361	N246E138	LT	7.37	38.57	27.82	4.47	Yes	No	No	No
NW 5 996	362	N246E138	LT	5.97	32.63	33.76	5.54	Yes	No	Yes	Yes
NW 5 997	363	N246E138	LT	15.73	32.1	31.05	7.83	Yes	Yes	No	Yes
NW 5 998	364	N246E138	LT	4.31	29.22	24.24	8.21	Yes	No	No	No
NW 5 999	365	N246E138	LT	8.3	19.61	16.93	5.5	Yes	Yes	Yes	No
NW 6 1044	366	N246E138	LT	11.52	32.02	41.9	9.09	Yes	No	Yes	Yes
NW 6 1045	367	N246E138	LT	32.02	27.14	22.31	7.43	Yes	No	No	No
NW 6 1046	368	N246E138	LT	27.14	24.97	26.56	3.87	Yes	No	No	Yes

Table A.1 - Continued

NW 6 1047	369	N246E138	LT	24.97	35.95	24.06	3.82	Yes	No	Yes	No
NW 6 1048	370	N246E138	LT	35.95	34.2	42.57	22.49	Yes	No	Yes	Yes
NW 6 1049	371	N246E138	LT	38.92	71.37	52.69	16.67	Yes	No	Yes	No
NW 6 1050	372	N246E138	LT	7.79	40	33	6.55	Yes	No	Yes	Yes
NW 6 1051	373	N246E138	LT	9.66	35.33	30.12	5.77	Yes	No	Yes	Yes
NW 6 1052	374	N246E138	LT	12.5	24.47	36.63	8.97	Yes	No	No	No
NW 6 1053	375	N246E138	LT	10.72	31.76	25.53	6.71	Yes	No	No	No
NW 6 1054	376	N246E138	LT	18.43	57.42	24.19	9.36	Yes	No	No	Yes
NW 6 1055	377	N246E138	LT	13.22	31.5	25.95	8.82	Yes	No	Yes	No
NW 6 1056	378	N246E138	LT	10.7	38.62	64.65	5.82	Yes	No	Yes	No
NW 6 1057	379	N246E138	LT	26.03	45.3	30	11.19	Yes	No	Yes	No
NW 6 1058	380	N246E138	LT	8.8	44.06	24.69	6.75	Yes	No	No	No
NW 6 1059	381	N246E138	LT	17.64	23.92	23.94	3.96	Yes	No	No	No
NW 6 1060	382	N246E138	LT	9.8	40.37	23.13	6.54	Yes	No	Yes	No
NW 6 1061	383	N246E138	LT	10.82	27.87	40.62	7.5	Yes	No	Yes	Yes
NW 6 1062	384	N246E138	LT	10.91	42.16	26.35	6.53	Yes	No	Yes	Yes
NW 6 1063	385	N246E138	LT	14.38	30.57	26.21	10.56	Yes	No	Yes	Yes
NW 6 1064	386	N246E138	LT	12.71	29.78	40.09	7.13	Yes	No	No	Yes
NW 6 1065	387	N246E138	LT	15.06	21.72	26.45	4.58	Yes	No	Yes	No
NW 6 1066	388	N246E138	LT	12.62	31.72	27.61	8.03	Yes	No	No	No
NW 6 1067	389	N246E138	LT	3.8	30.11	27.93	5.78	Yes	No	Yes	Yes
NW 6 1068	390	N246E138	LT	28.15	41.36	34.68	9.87	Yes	No	Yes	No
NW 6 1069	391	N246E138	LT	5.87	42.52	23.67	4.61	Yes	No	Yes	No
NW 6 1070	392	N246E138	LT	14.66	40.89	17.45	7.54	Yes	No	Yes	Yes
NW 6 1071	393	N246E138	LT	13.37	26.9	22.3	5.21	Yes	No	Yes	Yes
NW 6 1072	394	N246E138	LT	8.18	16.47	23.14	9.67	Yes	No	Yes	No

Table A.1 - Continued

NW 6 1073	395	N246E138	LT	11.1	41.87	37.19	6.03	Yes	No	Yes	No
NW 6 1074	396	N246E138	LT	8.87	39.81	21.62	6.03	Yes	No	Yes	No
NW 6 1075	397	N246E138	LT	8.27	27.22	18.91	3.19	Yes	No	No	No
NW 6 1076	398	N246E138	LT	11.73	21.39	22.2	5.8	Yes	No	No	Yes
NW 6 1077	399	N246E138	LT	8.67	22.52	22.79	4.49	Yes	No	Yes	No
NW 6 1078	400	N246E138	LT	5.44	37.8	17.48	5.54	Yes	No	No	Yes
NW 6 1079	401	N246E138	LT	5.35	40.33	21.05	3.85	Yes	No	No	No
NW 6 1080	402	N246E138	LT	4.57	35.02	18.16	4.06	Yes	No	No	No
NW 6 1081	403	N246E138	LT	11.67	26.38	24	6.57	Yes	Yes	Yes	No
NW 6 1082	404	N246E138	LT	8.5	30.29	23.07	4.5	Yes	No	Yes	No
NW 6 1083	405	N246E138	LT	6.09	29.07	21.82	3.41	Yes	No	Yes	No
NW 6 1084	406	N246E138	LT	10.6	27.21	30.9	3.91	Yes	Yes	Yes	Yes
NW 6 1085	407	N246E138	LT	7.6	22	34.76	7.8	Yes	Yes	No	No
NW 6 1086	408	N246E138	LT	11.47	31.62	40.63	7.73	Yes	Yes	Yes	No
NW 6 1087	409	N246E138	LT	10.09	32.68	28.15	5.67	Yes	Yes	Yes	No
NW 6 1088	410	N246E138	LT		23.61	29.52	7.38	No	No	Yes	No
NW 6 1089	411	N246E138	LT	12.95	26.57	33.83	7.66	Yes	Yes	Yes	No
NW 6 1090	412	N246E138	LT	10.45	40.38	30.87	5.59	Yes	Yes	Yes	Yes
NW 6 1091	413	N246E138	LT	8.04	34.09	24.66	5.02	Yes	Yes	No	Yes
NW 6 1092	414	N246E138	LT	10.34	26.5	26.4	5.25	Yes	No	Yes	No
NW 6 1093	415	N246E138	LT	11.9	32.41	22.05	3.88	Yes	Yes	Yes	Yes
NW 6 1094	416	N246E138	LT	8.43	17.42	27.96	4.94	Yes	No	Yes	No
NW 6 1095	417	N246E138	LT	12.53	17.42	20.97	4.15	Yes	Yes	Yes	No
NW 6 1096	418	N246E138	LT	8.75	25.26	19.34	4.46	Yes	Yes	Yes	No
NW 6 1097	419	N246E138	LT	7.03	33.6	25.52	5.68	Yes	Yes	Yes	No
NW 6 1098	420	N246E138	LT	9.53	35.77	28.61	6.41	Yes	Yes	Yes	Yes

Table A.1 - Continued

NW 6 1099	421	N246E138	LT	8.93	37.87	26.71	7.03	Yes	No	Yes	No
NW 6 1100	422	N246E138	LT	10.9	26.47	21.07	5.11	Yes	Yes	Yes	No
NW 6 1101	423	N246E138	LT	12.47	30.35	22.34	5.81	Yes	Yes	Yes	No
NW 6 1102	424	N246E138	LT	13.08	38.35	33.9	4.32	Yes	Yes	Yes	No
NW 6 1103	425	N246E138	LT	11.96	25.88	41.06	6.52	Yes	Yes	Yes	No
NW 6 1104	426	N246E138	LT	9.32	30.47	27.2	4.49	Yes	Yes	Yes	Yes
NW 6 1105	427	N246E138	LT	17.47	40.31	27.43	14.1	Yes	Yes	Yes	Yes
NW 6 1106	428	N246E138	LT	7.27	38.49	22.92	6.11	Yes	Yes	Yes	No
NW 6 1107	429	N246E138	LT		28.92	27.41	5.36	No	No	No	No
NW 6 1108	430	N246E138	LT	6.2	26.57	21.6	4.92	Yes	Yes	No	Yes
NW 6 1109	431	N246E138	LT	12.37	28.35	21.74	6.34	Yes	No	Yes	No
NW 6 1110	432	N246E138	LT	11.09	31.35	17.77	5.14	Yes	Yes	Yes	No
NW 6 1111	433	N246E138	LT	15.9	24.88	17.54	3.74	Yes	Yes	Yes	No
NW 6 1112	434	N246E138	LT		21.52	17.17	3.93	No	No	No	No
NW 6 1113	435	N246E138	LT	11.01	23.37	28.31	7.88	Yes	No	Yes	Yes
NW 6 1114	436	N246E138	LT	6.56	30.46	30.14	6.43	Yes	No	No	Yes
NW 6 1115	437	N246E138	LT	10.7	32.45	21.6	4.05	Yes	No	No	No
NW 6 1116	438	N246E138	LT	7	32.06	22.63	4.68	Yes	Yes	Yes	No
NW 6 1117	439	N246E138	LT	6.56	27.95	33.2	3.24	Yes	Yes	No	No
NW 6 1118	440	N246E138	LT	9.83	28.12	27.4	3.41	Yes	Yes	No	No
NW 6 1119	441	N246E138	LT	11.58	33.34	22.68	4.72	Yes	No	Yes	No
NW 6 1120	442	N246E138	LT	5.43	26.87	27.23	6.42	Yes	Yes	Yes	No
NW 6 1121	443	N246E138	LT	6.2	22.12	26.17	5.67	Yes	No	Yes	No
NW 6 1122	444	N246E138	LT	9.31	26.64	19.14	8.45	Yes	Yes	Yes	No
NW 6 1123	445	N246E138	LT		30.56	24.92	5.21	No	Yes	No	No
NW 6 1124	446	N246E138	LT	6.77	33.68	23.53	7.58	Yes	Yes	Yes	No

Table A.1 - Continued

NW 6 1125	447	N246E138	LT		34.83	20.35	5.08	No	Yes	No	No
NW 6 1126	448	N246E138	LT	2.89	26.81	19.17	4.12	Yes	Yes	Yes	Yes
NW 6 1127	449	N246E138	LT	8.27	44.53	37.08	5.9	Yes	Yes	No	No
NW 6 1128	450	N246E138	LT	5.58	20.4	21.57	4.4	Yes	Yes	Yes	No
NW 6 1129	451	N246E138	LT	6.67	22.48	20.71	4.76	Yes	No	No	No
NW 6 1130	452	N246E138	LT	11.93	24.06	25.95	5.7	Yes	No	Yes	Yes
NW 6 1131	453	N246E138	LT	5.86	27.56	21.87	4.2	Yes	No	Yes	Yes
NW 6 1132	454	N246E138	LT	11.72	41.49	28.12	6.2	Yes	Yes	Yes	No
NW 6 1133	455	N246E138	LT	12.72	22.43	17.4	5.77	Yes	No	No	Yes
NW 6 1134	456	N246E138	LT	12.96	33.05	33.25	6.38	Yes	Yes	Yes	Yes
NW 6 1135	457	N246E138	LT	12.08	29.25	25.93	5.96	Yes	Yes	No	No
NW 6 1136	458	N246E138	LT	10.79	33.22	18.54	4.87	Yes	Yes	Yes	No
NW 6 1137	459	N246E138	LT	9.55	22.92	17.09	3.1	Yes	No	Yes	No
NW 6 1138	460	N246E138	LT	7.36	24.69	18.97	4.44	Yes	Yes	Yes	No
NW 6 1139	461	N246E138	LT	9.86	24.04	30.6	6.62	Yes	Yes	Yes	No
NW 6 1140	462	N246E138	LT	7.36	20.1	27.4	2.69	Yes	Yes	No	Yes
NW 6 1141	463	N246E138	LT	8.89	26.28	20.96	5.07	Yes	Yes	Yes	No
NW 6 1142	464	N246E138	LT	12.72	25.16	34.46	6.25	Yes	Yes	Yes	No
NW 6 1143	465	N246E138	LT		24.03	26.68	4.18	No	Yes	No	No
NW 6 1144	466	N246E138	LT	6.24	27.04	24.87	5.36	Yes	Yes	Yes	No
NW 6 1145	467	N246E138	LT	4.31	23.11	23.59	3.73	Yes	Yes	Yes	No
NW 6 1146	468	N246E138	LT	10.56	20.5	23.6	5.26	Yes	No	Yes	Yes
NW 6 1147	469	N246E138	LT	16.52	26.18	27.73	3.48	Yes	Yes	Yes	No
NW 6 1148	470	N246E138	LT	2.87	31.68	20.07	4.02	Yes	No	No	No
NW 6 1149	471	N246E138	LT	3.47	23.84	20.25	3.89	Yes	Yes	No	No
NW 6 1150	472	N246E138	LT	10.74	22.86	14.8	3.21	Yes	Yes	No	Yes

Table A.1 - Continued

NW 6 1151	473	N246E138	LT	8.01	33.16	21.85	3.9	Yes	No	Yes	No
NW 6 1152	474	N246E138	LT	18.15	27.67	22.87	4.83	Yes	No	Yes	Yes
NW 6 1153	475	N246E138	LT	4.69	31.11	20.78	3	Yes	Yes	Yes	No
NW 6 1154	476	N246E138	LT	6.87	43.04	26.3	6.77	Yes	Yes	Yes	Yes
NW 6 1155	477	N246E138	LT	9.89	30.19	34.44	9.91	Yes	Yes	Yes	Yes
NW 6 1156	478	N246E138	LT	7.78	20.19	23.88	4.93	Yes	No	Yes	No
NW 6 1157	479	N246E138	LT	6.43	21.3	25	5.1	Yes	Yes	Yes	Yes
NW 6 1158	480	N246E138	LT	8.43	19.24	19.89	4.47	Yes	No	No	No
NW 6 1159	481	N246E138	LT	11.69	23.94	17.48	4.59	Yes	Yes	Yes	No
NW 6 1160	482	N246E138	LT	12.42	23.03	15.78	3.98	Yes	No	Yes	Yes
NW 6 1161	483	N246E138	LT	12.44	26.91	23.42	4.66	Yes	No	Yes	Yes
NW 6 1162	484	N246E138	LT	7.96	25.55	16.63	4.97	Yes	Yes	Yes	No
NW 6 1163	485	N246E138	LT	15.25	26.79	22.75	3.96	Yes	Yes	Yes	No
NW 6 1164	486	N246E138	LT	11.79	19.96	20.51	4.08	Yes	No	Yes	No
NW 6 1165	487	N246E138	LT	6.28	32.92	20.47	3.97	Yes	Yes	No	No
NW 6 1166	488	N246E138	LT	11.45	40.03	17.69	5.87	Yes	Yes	Yes	No
NW 6 1167	489	N246E138	LT	8.19	23.95	22.94	3.6	Yes	Yes	Yes	No
NW 6 1168	490	N246E138	LT	16.92	17.96	25.22	6	Yes	Yes	No	No
NW 6 1169	491	N246E138	LT	6.24	25.88	18.48	3.15	Yes	Yes	Yes	No
NW 6 1170	492	N246E138	LT	8.7	13.03	20.66	4.07	Yes	Yes	Yes	No
NW 6 1171	493	N246E138	LT	3.88	16.71	19.53	3.58	Yes	No	Yes	No
NW 6 1172	494	N246E138	LT	5.42	16.75	16.66	2.68	Yes	No	Yes	Yes
NW 6 1173	495	N246E138	LT	10.09	15.34	24.45	5.43	Yes	Yes	No	No
NW 6 1174	496	N246E138	LT	6.65	23.75	22.45	2.12	Yes	No	Yes	No
NW 6 1175	497	N246E138	LT	8.22	19.88	22.52	2.38	Yes	Yes	No	No
NW 6 1176	498	N246E138	LT	11.68	17.74	20.89	3.42	Yes	No	No	Yes

Table A.1 - Continued

NW 6 1177	499	N246E138	LT	11.36	20.92	18.2	5.12	Yes	Yes	Yes	No
NW 6 1178	500	N246E138	LT	14.87	16.07	14.88	3.64	Yes	Yes	Yes	No
NW 6 1179	501	N246E138	LT		23.52	22.29	3.65	No	No	No	Yes
NW 6 1180	502	N246E138	LT		27.6	15.43	2.6	No	No	No	Yes
NW 6 1181	503	N246E138	LT	6.71	18.87	16.73	4.34	Yes	No	No	No
NW 6 1182	504	N246E138	LT	7.58	21.52	23.27	4.56	Yes	Yes	Yes	Yes
NW 6 1183	505	N246E138	LT	5.1	23.49	20	3.7	Yes	Yes	Yes	No
NW 6 1184	506	N246E138	LT	13.8	24.8	16.14	5.29	Yes	Yes	Yes	Yes
NW 6 1185	507	N246E138	LT	7.71	20.67	19.53	3.24	Yes	Yes	Yes	No
NW 6 1186	508	N246E138	LT	12.83	12.82	20.31	3.72	Yes	No	Yes	No
NW 6 1187	509	N246E138	LT	6.03	18.7	17.14	2.86	Yes	No	No	No
NW 6 1188	510	N246E138	LT	5.64	23.41	19.95	3.54	Yes	No	Yes	No
NW 6 1189	511	N246E138	LT	5.89	22.3	22.67	3.16	Yes	No	Yes	No
NW 6 1190	512	N246E138	LT		25.64	18.6	3.62	No	Yes	No	No
NW 6 1191	513	N246E138	LT	7.45	13.01	20.8	5.84	Yes	Yes	Yes	No
NW 6 1192	514	N246E138	LT	7.6	26.07	18.17	3.88	Yes	No	Yes	No
NW 6 1193	515	N246E138	LT	7.68	15.48	21.32	4.16	Yes	No	Yes	No
NW 6 1194	516	N246E138	LT	6.26	16.15	18.23	3.17	Yes	Yes	Yes	No
NW 6 1195	517	N246E138	LT	12.35	17.81	15.67	3.14	Yes	No	No	Yes
NW 6 1196	518	N246E138	LT	10.56	22.24	20.25	4	Yes	Yes	Yes	No
NW 6 1197	519	N246E138	LT	7.77	22.85	22.85	4.28	Yes	No	Yes	No
NW 6 1198	520	N246E138	LT	8.85	17.84	17.84	4.31	Yes	No	Yes	No
NW 6 1199	521	N246E138	LT		21.24	15.79	5.31	No	Yes	Yes	No
NW 6 1200	522	N246E138	LT	8.76	26.77	18.74	4.77	Yes	No	Yes	No
NW 6 1201	523	N246E138	LT	7.73	32.97	22.3	5.22	Yes	Yes	Yes	No
NW 6 1202	524	N246E138	LT	6.88	19.64	20.07	2.65	Yes	Yes	Yes	No

Table A.1 - Continued

NW 6 1203	525	N246E138	LT	7.32	21.79	17.32	3.26	Yes	Yes	No	No
NW 6 1204	526	N246E138	LT	9.61	37.4	21.77	5.71	Yes	Yes	Yes	No
NW 6 1205	527	N246E138	LT	12.32	25.71	20.42	4	Yes	Yes	Yes	No
NW 6 1206	528	N246E138	LT	14.39	17.88	21.85	2.24	Yes	Yes	Yes	No
NW 6 1207	529	N246E138	LT	11.87	20.24	24.13	3.34	Yes	Yes	Yes	No
NW 6 1208	530	N246E138	LT	8.41	25.19	18.81	3.57	Yes	Yes	Yes	No
NW 6 1209	531	N246E138	LT	7.1	27.31	17.66	2.7	Yes	Yes	No	No
NW 6 1210	532	N246E138	LT		21.86	21.6	3.49	No	Yes	Yes	No
NW 6 1211	533	N246E138	LT	5.74	30.22	14.07	4.17	Yes	No	Yes	No
NW 6 1212	534	N246E138	LT	6.11	22.17	17.29	2.59	Yes	Yes	Yes	No
NW 6 1213	535	N246E138	LT	8.5	19.72	22.25	2.49	Yes	Yes	Yes	No
NW 6 1214	536	N246E138	LT	10.38	15.33	18	3.32	Yes	No	Yes	No
NW 6 1215	537	N246E138	LT	3.87	26.16	18	2.27	Yes	Yes	Yes	Yes
NW 6 1216	538	N246E138	LT		22.37	17.04	3.88	No	Yes	Yes	No
NW 6 1217	539	N246E138	LT	6.27	20.52	18.47	2.5	Yes	Yes	Yes	No
NW 6 1218	540	N246E138	LT	12.86	22	17.14	4.61	Yes	No	Yes	No
NW 6 1219	541	N246E138	LT	5.95	29.83	16.32	3.04	Yes	Yes	Yes	Yes
NW 6 1220	542	N246E138	LT	10.31	24.69	14.67	4.93	Yes	No	Yes	No
NW 6 1221	543	N246E138	LT	20.14	18.9	20.19	5.1	Yes	Yes	No	Yes
NW 6 1222	544	N246E138	LT	6.57	20.92	20.03	3.89	Yes	No	Yes	Yes
NW 6 1223	545	N246E138	LT		17.17	15.4	3.35	No	No	Yes	Yes
NW 6 1224	546	N246E138	LT	7.29	28.18	15.92	2.21	Yes	Yes	Yes	No
NW 6 1225	547	N246E138	LT	7.8	21.38	14.96	4.25	Yes	No	Yes	Yes
NW 6 1226	548	N246E138	LT	5.06	17.13	20.28	3.02	Yes	No	Yes	No
NW 6 1227	549	N246E138	LT		24.67	17.45	2.71	No	No	Yes	Yes
NW 6 1228	550	N246E138	LT	6.67	18.3	19.51	3.97	Yes	No	Yes	No

Table A.1 - Continued

NW 6 1229	551	N246E138	LT	9.9	21.3	17.38	6.09	Yes	No	Yes	No
NW 6 1230	552	N246E138	LT	12.71	19.7	15.18	2.56	Yes	No	Yes	No
NW 6 1231	553	N246E138	LT	5.57	19.06	19.57	2.71	Yes	Yes	Yes	No
NW 6 1232	554	N246E138	LT	7.24	22.88	14.54	3.14	Yes	No	Yes	Yes
NW 6 1233	555	N246E138	LT	4.36	22.9	13.8	2.45	Yes	Yes	Yes	No
NW 6 1234	556	N246E138	LT	5.01	17.84	17.78	3.68	Yes	Yes	Yes	No
NW 6 1235	557	N246E138	LT	7.67	19.04	15.11	4.73	Yes	No	Yes	Yes
NW 6 1236	558	N246E138	LT	7.82	18.39	21.53	5.08	Yes	Yes	Yes	No
NW 6 1237	559	N246E138	LT	4.89	16.55	17.39	2.48	Yes	No	Yes	Yes
NW 6 1238	560	N246E138	LT	5.29	14.91	18.89	4	Yes	Yes	Yes	No
NW 6 1239	561	N246E138	LT	10.53	20.46	15.73	2.83	Yes	No	Yes	Yes
NW 6 1240	562	N246E138	LT	11	19.82	15.39	3.21	Yes	Yes	Yes	Yes
NW 6 1241	563	N246E138	LT	8.56	15.77	23.33	4.55	Yes	No	Yes	No
NW 6 1242	564	N246E138	LT	6.76	18.68	15.11	2.94	Yes	Yes	Yes	No
NW 6 1243	565	N246E138	LT	6.89	13.52	17.68	4	Yes	Yes	Yes	No
NW 6 1244	566	N246E138	LT	6.09	17.96	21.52	4.22	Yes	No	Yes	Yes
NW 6 1245	567	N246E138	LT	5.06	18.31	21.01	1.95	Yes	Yes	Yes	No
NW 6 1246	568	N246E138	LT	8.78	16.78	17.08	2.59	Yes	No	Yes	Yes
NW 6 1247	569	N246E138	LT	8.46	12.9	16.97	2.88	Yes	No	No	No
NW 6 1248	570	N246E138	LT	4.76	14.74	15.95	2.12	Yes	No	Yes	No
NW 6 1249	571	N246E138	LT	4.78	14.78	16.97	2.7	Yes	Yes	Yes	No
NW 6 1250	572	N246E138	LT	7.73	18.15	18.26	4.15	Yes	No	Yes	No
NW 6 1251	573	N246E138	LT	9.4	15.42	17.35	4.18	Yes	No	Yes	No
NW 7 1252	574	N246E138	LT	26.74	48.61	55.45	11.12	Yes	No	Yes	No
NW 7 1253	575	N246E138	LT	11.24	37.13	29.51	5.25	Yes	Yes	Yes	No
NW 7 1254	576	N246E138	LT	8.72	33.98	29.97	6.34	Yes	No	Yes	Yes

Table A.1 - Continued

NW 7 1255	577	N246E138	LT	19.64	32.47	31.17	5.33	Yes	No	Yes	Yes
NW 7 1256	578	N246E138	LT	5.62	35.1	31.01	10.12	Yes	No	No	No
NW 7 1257	579	N246E138	LT	11.24	26	23.41	3.36	Yes	Yes	Yes	No
NW 7 1258	580	N246E138	LT	4.14	30.71	21.36	4.43	Yes	Yes	Yes	No
NW 7 1259	581	N246E138	LT	7.15	18.7	21.96	4.36	Yes	No	Yes	No
NW 7 1260	582	N246E138	LT	8.83	18.78	16.86	7	Yes	No	Yes	No
NW 7 1261	583	N246E138	LT	3.71	21.18	15.63	2.74	Yes	Yes	Yes	No
NW 7 1262	584	N246E138	LT		23.34	18.03	6.14	No	No	Yes	Yes
NW 7 1263	585	N246E138	LT	4.03	34.09	20.1	4.5	Yes	No	Yes	Yes
NW 7 1264	586	N246E138	LT	6.33	25.75	21.1	3.14	Yes	Yes	Yes	Yes
NW 7 1265	587	N246E138	LT	3.76	30.25	15.73	2.29	Yes	Yes	Yes	No
NW 7 1266	588	N246E138	LT	3.82	28.87	15.14	3.47	Yes	No	Yes	No
NW 7 1267	589	N246E138	LT	5.83	22.33	17.18	2.62	Yes	No	Yes	No
NW 7 1268	590	N246E138	LT	7.83	14.84	19.45	2.94	Yes	No	Yes	No
NW 7 1269	591	N246E138	LT	8.73	14.83	17.27	3.15	Yes	No	Yes	No
NW 7 1270	592	N246E138	LT	6.35	15.61	14.5	2.41	Yes	Yes	Yes	No
NW 7 1271	593	N246E138	LT	11.07	15.33	15.42	3.36	Yes	No	Yes	No
NW 7 1272	594	N246E138	LT	9.46	14.59	18.63	4.14	Yes	Yes	Yes	No
NW 7 1273	595	N246E138	LT	12.09	15.25	13.87	4.12	Yes	Yes	Yes	No
NW 7 1274	596	N246E138	LT	7.68	17.93	13.76	3.22	Yes	Yes	Yes	No
NW 8 1275	597	N246E138	LT	11.98	24.39	29.96	4.62	Yes	No	Yes	No
NW 8 1276	598	N246E138	LT	6.94	31.34	16.18	3.3	Yes	Yes	Yes	No
NW 8 1277	599	N246E138	LT	11.46	22.49	17.24	5.49	Yes	No	No	Yes
NW 8 1278	600	N246E138	LT	4.47	13.61	19.43	2.79	Yes	Yes	Yes	No
NW 8 1279	601	N246E138	LT	14.44	23.06	15.55	4.07	Yes	No	No	No
NW 8 1280	602	N246E138	LT	3.35	25.54	16.14	3.85	Yes	Yes	Yes	No

Table A.1 - Continued

NW 8 1281	603	N246E138	LT	4.61	23.15	16.08	2.46	Yes	Yes	Yes	No
NW 8 1282	604	N246E138	LT	9.03	12.76	16.64	3.04	Yes	No	Yes	Yes
NW 9 1283	605	N246E138	LT		57.17	26.3	6.5	No	No	Yes	No
NW 9 1284	606	N246E138	LT	14.44	38.9	35.33	6.73	Yes	No	No	Yes
NW 9 1285	607	N246E138	LT	7.94	38.34	33.85	8.03	Yes	No	Yes	Yes
NW 9 1286	608	N246E138	LT	16.2	31.05	39.27	7.5	Yes	Yes	Yes	No
NW 9 1287	609	N246E138	LT	5.51	34.79	21.8	5.84	Yes	Yes	No	No
NW 9 1288	610	N246E138	LT		21.72	22.1	4.03	No	No	Yes	No
NW 9 1289	611	N246E138	LT	10.53	22.93	28.1	4.01	Yes	No	Yes	Yes
NW 9 1290	612	N246E138	LT	3.4	37.97	27.63	4.72	Yes	No	No	Yes
NW 9 1291	613	N246E138	LT		46.38	100.11	13.8	No	No	Yes	Yes
NW 9 1292	614	N246E138	LT	32.62	23.35	37.71	9.79	Yes	No	Yes	No
NW 9 1293	615	N246E138	LT	11.01	25.86	18.25	3.11	Yes	No	No	Yes
NW 9 1294	616	N246E138	LT	6.77	17.7	15.78	3.96	Yes	Yes	Yes	No
NW 9 1295	617	N246E138	LT	7.36	20.54	11.8	2.92	Yes	Yes	Yes	No
NW 9 1296	618	N246E138	LT	13.78	13.69	16.2	3.51	Yes	No	Yes	No
(NW 10) 13	1	N246E138	PS	9.23	11.3	9.36	2.49	Yes	No	No	No
(NW 10) 14	2	N246E138	PS	6.1	23.75	12.61	2.71	Yes	Yes	No	No
(NW 10) 15	3	N246E138	PS	11.95	13.18	18.02	3.74	Yes	No	Yes	No
(NW 11) 16	4	N246E138	PS	6.33	15.68	15.36	5.8	Yes	No	Yes	Yes
(NW 11) 17	5	N246E138	PS	9.6	13.69	17.94	3	Yes	No	Yes	Yes
(NW 11) 18	6	N246E138	PS	12.09	15.79	15.77	4.19	Yes	No	No	Yes
(NW 12) 19	7	N246E138	PS	3.89	12.07	9.95	1.91	Yes	No	Yes	No
(NW 15) 20	8	N246E138	PS	7.01	13.04	12.12	5.27	Yes	No	No	Yes
(NW 15) 21	9	N246E138	PS		11.49	14.33	2.47	No	No	Yes	No
(NW 6) 1	10	N246E138	PS	8.61	28.98	23.87	5.58	Yes	No	Yes	No

Table A.1 - Continued

(NW 6) 2	11	N246E138	PS	7.4	12.92	18.29	2.75	Yes	No	Yes	No
(NW 6) 3	12	N246E138	PS	3	12.88	14.32	3.5	Yes	No	Yes	No
(NW 6) 4	13	N246E138	PS	0	22.74	25.16	5.44	No	Yes	No	No
(NW 6) 5	14	N246E138	PS	7.92	26.44	12.42	3.97	Yes	Yes	Yes	Yes
(NW 6) 6	15	N246E138	PS	7.7	14.28	9.96	2.38	Yes	Yes	No	No
(NW 7) 7	16	N246E138	PS	8.57	24.61	15.14	4.59	Yes	No	Yes	Yes
(NW 7) 8	17	N246E138	PS	9.91	18.25	17.17	3.09	Yes	Yes	Yes	No
(NW 7) 9	18	N246E138	PS	5.63	9.57	10.85	1.77	Yes	No	Yes	No
(NW 8) 10	19	N246E138	PS	5.72	13.7	18.66	3.73	Yes	Yes	Yes	No
(NW 9) 11	20	N246E138	PS	3.33	19.83	9.64	1.43	Yes	Yes	Yes	No
(NW 9) 12	21	N246E138	PS	7.33	11.31	12.28	2.03	Yes	No	Yes	Yes
(NE 1) 1	1	N246E138	LT		20.29	32.18	4.18	No	Yes	No	Yes
(NE 1) 10	2	N246E138	LT	6.91	19.85	13.93	3.41	Yes	Yes	No	No
(NE 1) 2	3	N246E138	LT		26.75	21.2	5.2	No	No	No	No
(NE 1) 3	4	N246E138	LT	6.46	28.14	31.83	4.3	Yes	No	Yes	No
(NE 1) 4	5	N246E138	LT	12.94	20.82	20.66	4.56	Yes	No	Yes	Yes
(NE 1) 5	6	N246E138	LT	7.61	23.3	22.53	8.02	Yes	Yes	No	No
(NE 1) 6	7	N246E138	LT		29.53	18.54	3.31	No	No	Yes	No
(NE 1) 7	8	N246E138	LT	6.8	18.41	14.95	3.53	Yes	Yes	Yes	No
(NE 1) 8	9	N246E138	LT		14.41	15.1	3.54	No	Yes	Yes	No
(NE 1) 9	10	N246E138	LT	6.88	21.53	20.1	3.4	Yes	No	Yes	No
(NE 10) 242	11	N246E138	LT	20.8	49.25	45.83	13.42	Yes	No	Yes	Yes
(NE 11) 243	12	N246E138	LT	16.98	18.93	16.98	4.95	Yes	No	No	Yes
(NE 11) 244	13	N246E138	LT	11.21	15.02	16.33	4.08	Yes	No	No	No
(NE 11) 245	14	N246E138	LT	7.48	17.96	21.68	3.55	Yes	No	Yes	Yes
(NE 11) 246	15	N246E138	LT	10.86	16.25	15.02	3.66	Yes	No	Yes	Yes

Table A.1 - Continued

(NE 11) 247	16	N246E138	LT	4.76	24.34	15.04	3.54	Yes	Yes	Yes	No
(NE 12) 248	17	N246E138	LT	8.01	18.07	15.26	3.5	Yes	No	No	No
(NE 12) 249	18	N246E138	LT	4.92	14.55	14.76	4.14	Yes	No	Yes	No
(NE 12) 250	19	N246E138	LT		23.94	12	1.61	No	Yes	No	No
(NE 13) 251	20	N246E138	LT	8.46	36.24	15.03	3.8	Yes	Yes	Yes	No
(NE 13) 252	21	N246E138	LT	11.95	23.69	19.67	3.66	Yes	No	No	Yes
(NE 14) 253	22	N246E138	LT	5.55	19.27	31.22	5.13	Yes	Yes	No	No
(NE 14) 254	23	N246E138	LT		24.61	20.75	6.05	No	No	Yes	No
(NE 2) 11	24	N246E138	LT	10.92	29.92	19.77	6.82	Yes	No	Yes	Yes
(NE 2) 12	25	N246E138	LT		32.54	26.19	4.51	No	No	Yes	Yes
(NE 2) 13	26	N246E138	LT	11.35	27.71	33.49	11.05	Yes	No	Yes	No
(NE 2) 14	27	N246E138	LT	8.12	33.88	29.92	7.61	Yes	No	Yes	Yes
(NE 2) 15	28	N246E138	LT	14.06	22.03	20.66	4.05	Yes	No	Yes	Yes
(NE 2) 16	29	N246E138	LT	9.13	30.82	17	5.57	Yes	No	Yes	No
(NE 2) 17	30	N246E138	LT	10.75	23.64	27.72	5.31	Yes	No	Yes	Yes
(NE 2) 18	31	N246E138	LT		26.1	24.38	6.33	No	Yes	Yes	No
(NE 2) 19	32	N246E138	LT	9.97	23.29	34.95	9.51	Yes	Yes	No	Yes
(NE 2) 20	33	N246E138	LT	9.88	21.71	17.45	2.85	Yes	Yes	Yes	No
(NE 2) 21	34	N246E138	LT	9.31	28.68	16.61	4.49	Yes	Yes	No	No
(NE 2) 22	35	N246E138	LT	6.14	20.85	27.99	6.16	Yes	Yes	Yes	Yes
(NE 2) 23	36	N246E138	LT	10.01	24.99	36.29	5.81	Yes	No	Yes	No
(NE 2) 24	37	N246E138	LT	6.54	25.75	16.56	3.03	Yes	Yes	Yes	No
(NE 2) 25	38	N246E138	LT	9.32	23.07	20.72	4.39	Yes	No	Yes	No
(NE 2) 26	39	N246E138	LT	8.5	18.48	20.27	2.62	Yes	No	No	No
(NE 2) 27	40	N246E138	LT	7.25	18.59	15.32	3.46	Yes	No	Yes	Yes
(NE 2) 28	41	N246E138	LT	5.92	20.05	12.84	2.57	Yes	No	No	No

Table A.1 - Continued

(NE 2) 29	42	N246E138	LT	3.84	26.53	13.22	3.64	Yes	No	Yes	No
(NE 2) 30	43	N246E138	LT	10.04	25.52	19.77	3.94	Yes	No	Yes	No
(NE 2) 31	44	N246E138	LT	10.25	14.26	22.78	1.77	Yes	No	Yes	No
(NE 2) 32	45	N246E138	LT	6.33	16.07	17.41	2.79	Yes	No	No	No
(NE 2) 33	46	N246E138	LT	2.82	14.41	16.69	2.39	Yes	Yes	Yes	No
(NE 3) 34	47	N246E138	LT		63.05	42.56	14.12	No	No	No	Yes
(NE 3) 35	48	N246E138	LT		48.93	39.9	8.63	No	No	No	Yes
(NE 3) 36	49	N246E138	LT		33.01	41.82	4.5	No	Yes	No	No
(NE 3) 37	50	N246E138	LT	11.69	28.31	24.37	6.64	Yes	No	Yes	No
(NE 3) 38	51	N246E138	LT	5.26	24.4	21.52	4.01	Yes	Yes	Yes	No
(NE 3) 39	52	N246E138	LT	14.08	27.61	25.64	5.96	Yes	No	Yes	Yes
(NE 3) 40	53	N246E138	LT	9.55	20	24.01	3.71	Yes	No	Yes	No
(NE 3) 41	54	N246E138	LT	3.28	19.97	22.48	4.2	Yes	Yes	Yes	No
(NE 3) 42	55	N246E138	LT	11.46	18.54	16.86	4.27	Yes	Yes	No	No
(NE 3) 43	56	N246E138	LT	5.68	25.24	19.53	2.44	Yes	Yes	Yes	No
(NE 3) 44	57	N246E138	LT	15.39	19.09	25.26	3.74	Yes	Yes	Yes	No
(NE 3) 45	58	N246E138	LT	3.1	19.11	27	4.03	Yes	Yes	Yes	Yes
(NE 3) 46	59	N246E138	LT	6.43	21.19	14.43	3.59	Yes	No	No	No
(NE 3) 47	60	N246E138	LT		20.54	22.91	3.16	No	Yes	No	No
(NE 3) 48	61	N246E138	LT	9.68	17.98	15.19	3.32	Yes	Yes	Yes	No
(NE 3) 49	62	N246E138	LT	8.33	16.98	19.32	3.96	Yes	No	Yes	Yes
(NE 3) 50	63	N246E138	LT		20.29	23.88	3.56	No	Yes	Yes	No
(NE 3) 51	64	N246E138	LT		14.64	20.21	3.94	No	Yes	No	No
(NE 4) 100	65	N246E138	LT	7.05	14.86	19.01	5.49	Yes	No	No	No
(NE 4) 101	66	N246E138	LT	6.52	14.78	20.28	2.88	Yes	No	Yes	No
(NE 4) 102	67	N246E138	LT	15.38	15.22	17.44	4.51	Yes	No	Yes	No

Table A.1 - Continued

(NE 4) 103	68	N246E138	LT		19.58	20.97	2.86	No	No	No	No
(NE 4) 104	69	N246E138	LT	8.83	19.26	22.36	1.88	Yes	Yes	No	No
(NE 4) 105	70	N246E138	LT	3.94	22.93	20.31	1.93	Yes	No	Yes	No
(NE 4) 106	71	N246E138	LT	7.24	16.35	18.39	3.34	Yes	No	No	No
(NE 4) 107	72	N246E138	LT	6.87	14.56	19.92	3.61	Yes	No	Yes	No
(NE 4) 108	73	N246E138	LT	5.1	22.86	18.29	1.93	Yes	Yes	Yes	Yes
(NE 4) 109	74	N246E138	LT	11	18.82	16.33	3.54	Yes	No	Yes	No
(NE 4) 110	75	N246E138	LT		14.68	18.81	1.98	No	No	Yes	No
(NE 4) 111	76	N246E138	LT		13.49	14.04	1.88	No	No	No	No
(NE 4) 52	77	N246E138	LT	16.98	53.14	60.11	16.17	Yes	No	Yes	Yes
(NE 4) 53	78	N246E138	LT	8.72	34.43	28.15	4.56	Yes	Yes	Yes	No
(NE 4) 54	79	N246E138	LT		36.82	64.98	8.32	No	No	Yes	Yes
(NE 4) 55	80	N246E138	LT	9.64	26.86	37.21	6.03	Yes	Yes	Yes	No
(NE 4) 56	81	N246E138	LT		23.72	24.3	3.78	No	Yes	No	No
(NE 4) 57	82	N246E138	LT	6.58	29.71	32.68	4.83	Yes	Yes	Yes	No
(NE 4) 58	83	N246E138	LT	12.4	25.96	29.84	4.21	Yes	No	No	No
(NE 4) 59	84	N246E138	LT	13.82	28.25	37.47	5.75	Yes	Yes	Yes	No
(NE 4) 60	85	N246E138	LT	7.03	35.52	30.34	4.77	Yes	No	Yes	No
(NE 4) 61	86	N246E138	LT	18.98	22.71	32.98	5.85	Yes	No	Yes	No
(NE 4) 62	87	N246E138	LT	20.9	21.66	28.95	6.22	Yes	Yes	Yes	No
(NE 4) 63	88	N246E138	LT	8.05	30.22	25.1	6.4	Yes	No	Yes	No
(NE 4) 64	89	N246E138	LT	13.34	43.28	23.8	9.37	Yes	Yes	No	No
(NE 4) 65	90	N246E138	LT		35.37	20.27	7.07	No	No	Yes	No
(NE 4) 66	91	N246E138	LT	7.42	29.56	25.85	5.42	Yes	No	Yes	No
(NE 4) 67	92	N246E138	LT	8.41	25.15	27.14	4.53	Yes	No	Yes	No
(NE 4) 68	93	N246E138	LT	5.36	21.22	28.83	5.14	Yes	No	Yes	No

Table A.1 - Continued

(NE 4) 69	94	N246E138	LT	4.97	29.71	13.32	5.5	Yes	No	No	No
(NE 4) 70	95	N246E138	LT	5.45	32.68	15.76	3.86	Yes	No	No	Yes
(NE 4) 71	96	N246E138	LT		23.09	19.82	5.13	No	No	Yes	Yes
(NE 4) 72	97	N246E138	LT	11.23	24.03	23.62	5.84	Yes	No	No	Yes
(NE 4) 73	98	N246E138	LT	4.68	21.63	23.27	3.35	Yes	No	Yes	Yes
(NE 4) 74	99	N246E138	LT	9.95	18.44	17.22	2.2	Yes	Yes	No	No
(NE 4) 75	100	N246E138	LT	11.39	33.56	28.58	7.35	Yes	Yes	No	No
(NE 4) 76	101	N246E138	LT	13.17	25.9	17.31	4.74	Yes	No	Yes	No
(NE 4) 77	102	N246E138	LT	13.1	20	18.36	2.52	Yes	Yes	Yes	No
(NE 4) 78	103	N246E138	LT	11.54	19.91	30.67	4.57	Yes	No	Yes	No
(NE 4) 79	104	N246E138	LT	8.51	21.87	19.71	4.89	Yes	No	No	No
(NE 4) 80	105	N246E138	LT	11.76	19.19	22.73	7.09	Yes	No	No	No
(NE 4) 81	106	N246E138	LT	8.73	23.7	22.47	4.46	Yes	No	Yes	Yes
(NE 4) 82	107	N246E138	LT	6.44	20.05	24.59	4.96	Yes	No	Yes	Yes
(NE 4) 83	108	N246E138	LT	7.29	31.32	24.13	6.23	Yes	No	No	No
(NE 4) 84	109	N246E138	LT		27.75	22.49	3.52	No	No	Yes	Yes
(NE 4) 85	110	N246E138	LT	7.12	21.77	24.73	4.34	Yes	Yes	No	No
(NE 4) 86	111	N246E138	LT	2.75	21.93	18.63	4.85	Yes	No	Yes	No
(NE 4) 87	112	N246E138	LT	11.62	22	18.7	5.18	Yes	No	No	Yes
(NE 4) 88	113	N246E138	LT	7.37	23.8	17.55	3.97	Yes	Yes	Yes	No
(NE 4) 89	114	N246E138	LT	8.14	20.78	17.07	2.58	Yes	Yes	Yes	No
(NE 4) 90	115	N246E138	LT		26.34	26.33	4.06	No	Yes	No	No
(NE 4) 91	116	N246E138	LT	8.29	19.14	28.46	4.75	Yes	Yes	Yes	No
(NE 4) 92	117	N246E138	LT	10.83	24.08	19.86	3.39	Yes	Yes	Yes	No
(NE 4) 93	118	N246E138	LT	4.25	27.66	17.78	3.13	Yes	Yes	Yes	No
(NE 4) 94	119	N246E138	LT		17.35	20.47	3.69	No	No	Yes	No

Table A.1 - Continued

(NE 4) 95	120	N246E138	LT	6.16	21.94	19.34	5.45	Yes	Yes	Yes	No
(NE 4) 96	121	N246E138	LT	5.59	26.16	15.98	2.94	Yes	No	Yes	No
(NE 4) 97	122	N246E138	LT	6.23	22.13	24.62	4.92	Yes	No	Yes	Yes
(NE 4) 98	123	N246E138	LT		22.27	17.33	2.92	No	No	No	No
(NE 4) 99	124	N246E138	LT	5.69	20.39	17.04	3.22	Yes	Yes	Yes	No
(NE 5) 112	125	N246E138	LT	24.53	32.61	54.54	10.94	Yes	No	Yes	Yes
(NE 5) 113	126	N246E138	LT	34.56	24.13	36.83	12.32	Yes	No	Yes	No
(NE 5) 114	127	N246E138	LT		24.86	33.79	12.06	No	No	No	Yes
(NE 5) 115	128	N246E138	LT		61.25	62.05	21.54	No	No	Yes	Yes
(NE 5) 116	129	N246E138	LT	15.97	55.02	36.72	7.25	Yes	No	Yes	No
(NE 5) 117	130	N246E138	LT	11.28	37.06	29.24	7.21	Yes	No	Yes	Yes
(NE 5) 118	131	N246E138	LT	6.08	40.75	19.57	9.96	Yes	Yes	Yes	No
(NE 5) 119	132	N246E138	LT	21.52	40.42	32.4	9.84	Yes	Yes	Yes	No
(NE 5) 120	133	N246E138	LT	6.75	39.48	22.37	6	Yes	No	Yes	No
(NE 5) 121	134	N246E138	LT		30.1	29.47	7.26	No	No	No	No
(NE 5) 122	135	N246E138	LT	12.3	37.94	31.82	9.08	Yes	No	No	Yes
(NE 5) 123	136	N246E138	LT	6	37.84	24	3.76	Yes	Yes	Yes	No
(NE 5) 124	137	N246E138	LT	9.97	20.48	31.6	4.66	Yes	No	No	Yes
(NE 5) 125	138	N246E138	LT	13.97	29.76	20.4	6.77	Yes	No	No	No
(NE 5) 126	139	N246E138	LT	4.11	29.36	24.36	5.63	Yes	Yes	Yes	No
(NE 5) 127	140	N246E138	LT	24.38	34.13	31.44	8.94	Yes	No	Yes	No
(NE 5) 128	141	N246E138	LT	9.02	32.12	31.5	7.8	Yes	Yes	Yes	Yes
(NE 5) 129	142	N246E138	LT	9.4	42.78	26.8	5.18	Yes	No	Yes	No
(NE 5) 130	143	N246E138	LT	9	24.09	27.29	4.52	Yes	Yes	Yes	Yes
(NE 5) 131	144	N246E138	LT	4.87	27.18	23.64	3.73	Yes	Yes	No	No
(NE 5) 132	145	N246E138	LT		26.82	23.54	6.4	No	No	No	No

Table A.1 - Continued

(NE 5) 133	146	N246E138	LT	7.53	26.19	23.88	4.74	Yes	Yes	Yes	No
(NE 5) 134	147	N246E138	LT	4.08	28.34	23.47	5.09	Yes	No	No	Yes
(NE 5) 135	148	N246E138	LT	7.88	21.79	17.7	4.21	Yes	Yes	Yes	No
(NE 5) 136	149	N246E138	LT	6.88	23.61	29.11	5.36	Yes	Yes	Yes	Yes
(NE 5) 137	150	N246E138	LT	10.05	25.54	24.83	3.29	Yes	Yes	Yes	No
(NE 5) 138	151	N246E138	LT	14.15	26.93	28.44	7.72	Yes	Yes	Yes	Yes
(NE 5) 139	152	N246E138	LT	12.64	18.4	28.54	7.2	Yes	Yes	No	No
(NE 5) 140	153	N246E138	LT	8.01	35.87	30.48	7.65	Yes	No	Yes	No
(NE 5) 141	154	N246E138	LT	12.32	30.84	18.94	4.32	Yes	No	Yes	Yes
(NE 5) 142	155	N246E138	LT	7.26	22.68	21.62	5.33	Yes	No	No	Yes
(NE 5) 143	156	N246E138	LT	12.09	28.46	16.89	3.58	Yes	Yes	No	No
(NE 5) 144	157	N246E138	LT	9.64	21.62	24.34	4.14	Yes	No	Yes	Yes
(NE 5) 145	158	N246E138	LT	11.28	26.47	18.67	4.15	Yes	No	Yes	Yes
(NE 5) 146	159	N246E138	LT	11.73	22.68	23.44	3.37	Yes	Yes	Yes	No
(NE 5) 147	160	N246E138	LT	7.65	30.45	23.42	5.36	Yes	No	Yes	Yes
(NE 5) 148	161	N246E138	LT	5.08	21.51	18.47	2.65	Yes	Yes	Yes	No
(NE 5) 149	162	N246E138	LT		24.13	22.36	5.08	No	No	No	Yes
(NE 5) 150	163	N246E138	LT	11.77	25.71	20.41	4.34	Yes	No	Yes	No
(NE 5) 151	164	N246E138	LT		17.69	26.92	2.55	No	Yes	Yes	No
(NE 5) 152	165	N246E138	LT		30.75	22.82	3.92	No	Yes	No	No
(NE 5) 153	166	N246E138	LT	7.04	17.15	23.04	3.13	Yes	Yes	Yes	Yes
(NE 5) 154	167	N246E138	LT	10.46	24.67	17.7	3.94	Yes	No	Yes	No
(NE 5) 155	168	N246E138	LT	12.14	21.93	13.7	4.05	Yes	No	Yes	No
(NE 5) 156	169	N246E138	LT	13.69	18.42	17.12	6.78	Yes	Yes	Yes	No
(NE 5) 157	170	N246E138	LT		18.06	17.07	3.62	No	No	No	Yes
(NE 5) 158	171	N246E138	LT	4.82	17.22	19.21	2.85	Yes	No	Yes	Yes

Table A.1 - Continued

(NE 5) 159	172	N246E138	LT	7.61	15.67	19.22	4.23	Yes	No	Yes	Yes
(NE 5) 160	173	N246E138	LT	4.95	13.23	25.03	5.08	Yes	No	Yes	No
(NE 5) 161	174	N246E138	LT	4.73	13.34	16.38	2.77	Yes	Yes	Yes	No
(NE 5) 162	175	N246E138	LT	9.95	24.01	18.71	3.57	Yes	No	Yes	Yes
(NE 5) 163	176	N246E138	LT	7.91	29.14	15.1	5	Yes	No	Yes	No
(NE 5) 164	177	N246E138	LT	6.23	31.47	18.85	6.3	Yes	No	Yes	No
(NE 5) 165	178	N246E138	LT		22.27	16	2.89	No	Yes	No	No
(NE 5) 166	179	N246E138	LT	6.14	16.08	18.01	3.48	Yes	Yes	Yes	No
(NE 5) 167	180	N246E138	LT	13.84	25.36	22.83	6.76	Yes	No	Yes	Yes
(NE 5) 168	181	N246E138	LT	7.25	17.64	20.03	4.64	Yes	Yes	Yes	No
(NE 5) 169	182	N246E138	LT	6.98	22.44	16.66	2.78	Yes	No	No	Yes
(NE 5) 170	183	N246E138	LT	9.61	22.64	21.41	3.39	Yes	No	No	No
(NE 5) 171	184	N246E138	LT	4.16	22.43	18.38	2.51	Yes	No	No	No
(NE 5) 172	185	N246E138	LT	8.19	20.58	24.43	5.37	Yes	Yes	Yes	No
(NE 5) 173	186	N246E138	LT	7.46	25.1	18.5	4	Yes	Yes	Yes	Yes
(NE 5) 174	187	N246E138	LT	8.4	16.2	25.72	4.43	Yes	No	Yes	Yes
(NE 5) 175	188	N246E138	LT	3.43	15.29	18.52	4.49	Yes	Yes	Yes	No
(NE 5) 176	189	N246E138	LT	5.56	20.84	16.55	2.68	Yes	No	Yes	Yes
(NE 5) 177	190	N246E138	LT	5.48	16.77	14.92	3.2	Yes	No	No	No
(NE 5) 178	191	N246E138	LT	5.73	14.9	18.37	2.91	Yes	No	Yes	Yes
(NE 5) 179	192	N246E138	LT	3.78	21.53	22.46	5.21	Yes	No	Yes	Yes
(NE 5) 180	193	N246E138	LT	5.84	22.46	20.74	2.76	Yes	Yes	Yes	No
(NE 5) 181	194	N246E138	LT	7.35	19.2	19.15	3.63	Yes	No	Yes	No
(NE 5) 182	195	N246E138	LT	4.16	14.81	16.49	2.59	Yes	No	Yes	No
(NE 5) 183	196	N246E138	LT	10.42	19.53	18.56	5.49	Yes	No	Yes	No
(NE 5) 184	197	N246E138	LT	10.08	16.65	18.14	2.63	Yes	Yes	No	No

Table A.1 - Continued

(NE 5) 185	198	N246E138	LT	5.41	17.89	17.68	2.98	Yes	Yes	Yes	No
(NE 5) 186	199	N246E138	LT	6.29	22.63	17.66	3.49	Yes	Yes	Yes	No
(NE 5) 187	200	N246E138	LT	8.55	23.11	17.25	2.61	Yes	Yes	Yes	No
(NE 5) 188	201	N246E138	LT	6.69	14.33	17.02	3.41	Yes	No	Yes	No
(NE 5) 189	202	N246E138	LT	5.41	17.13	14.7	2.13	Yes	No	Yes	Yes
(NE 5) 190	203	N246E138	LT	4.21	17.96	15.57	2.59	Yes	Yes	Yes	No
(NE 6) 191	204	N246E138	LT	12.55	49.01	27.33	7.51	Yes	No	Yes	No
(NE 6) 192	205	N246E138	LT	11.24	28.58	33.04	5.79	Yes	Yes	Yes	Yes
(NE 6) 193	206	N246E138	LT	12.74	21.05	30.89	6.89	Yes	Yes	No	No
(NE 6) 194	207	N246E138	LT	10.87	19.93	22.51	6.06	Yes	Yes	Yes	Yes
(NE 6) 195	208	N246E138	LT	5.48	24.49	23.46	3.31	Yes	No	Yes	No
(NE 6) 196	209	N246E138	LT	5.52	18.5	28.06	6.14	Yes	No	No	No
(NE 6) 197	210	N246E138	LT	10.13	19.2	25.85	2.81	Yes	No	Yes	No
(NE 6) 198	211	N246E138	LT	4.72	28.31	21.74	3.26	Yes	Yes	Yes	No
(NE 6) 199	212	N246E138	LT	12.53	28.48	29.22	5.15	Yes	Yes	Yes	No
(NE 6) 200	213	N246E138	LT	5.13	22.59	24.6	9.69	Yes	Yes	Yes	No
(NE 6) 201	214	N246E138	LT	7.55	24.6	33.61	4.87	Yes	No	Yes	No
(NE 6) 202	215	N246E138	LT	6.89	30.93	24.01	5.09	Yes	Yes	No	No
(NE 6) 203	216	N246E138	LT	8.3	46.59	22.4	3.32	Yes	No	Yes	No
(NE 6) 204	217	N246E138	LT	8.95	29.66	23.49	3.66	Yes	No	Yes	Yes
(NE 6) 205	218	N246E138	LT	17.09	22.69	23.82	7.74	Yes	No	No	Yes
(NE 6) 206	219	N246E138	LT	9.66	29.31	24.2	4.77	Yes	No	Yes	Yes
(NE 6) 207	220	N246E138	LT	11.07	18.77	23.5	4	Yes	Yes	No	No
(NE 6) 208	221	N246E138	LT	9.07	22.44	25.15	9.55	Yes	No	No	Yes
(NE 6) 209	222	N246E138	LT	6.7	25.7	15.05	4.67	Yes	No	No	No
(NE 6) 210	223	N246E138	LT	4.84	19.71	21.78	4.31	Yes	Yes	Yes	Yes

Table A.1 - Continued

(NE 6) 211	224	N246E138	LT	5.37	23.22	15.81	3.07	Yes	No	Yes	Yes
(NE 6) 212	225	N246E138	LT		46.46	15.91	4.28	No	Yes	No	No
(NE 6) 213	226	N246E138	LT	8.83	24.48	16.73	4.48	Yes	No	No	No
(NE 6) 214	227	N246E138	LT	8.42	23.41	23.84	4.27	Yes	No	No	No
(NE 6) 215	228	N246E138	LT	4.27	20.98	26.57	5.47	Yes	No	Yes	No
(NE 6) 216	229	N246E138	LT	3.8	26.7	24.02	4.5	Yes	Yes	Yes	No
(NE 6) 217	230	N246E138	LT		23.17	17.68	2.76	No	Yes	Yes	No
(NE 6) 218	231	N246E138	LT		21.84	15.43	4.75	No	Yes	Yes	No
(NE 6) 219	232	N246E138	LT		25.88	23.82	3.15	No	Yes	Yes	No
(NE 6) 220	233	N246E138	LT	10.35	19.3	23.16	2.24	Yes	Yes	Yes	No
(NE 6) 221	234	N246E138	LT	8.18	23.21	15.48	2.7	Yes	Yes	Yes	No
(NE 6) 222	235	N246E138	LT	5.78	17.14	20	4.01	Yes	Yes	Yes	No
(NE 6) 223	236	N246E138	LT	7.73	15.73	22.26	3.78	Yes	No	No	Yes
(NE 6) 224	237	N246E138	LT	4.36	16.95	18.25	2.25	Yes	No	No	No
(NE 6) 225	238	N246E138	LT	8.25	20.64	16.93	2.81	Yes	Yes	Yes	No
(NE 6) 226	239	N246E138	LT	10.05	13.25	16.77	4.77	Yes	No	Yes	No
(NE 6) 227	240	N246E138	LT	6.42	23.93	15.33	2.39	Yes	Yes	Yes	No
(NE 7) 228	241	N246E138	LT	6.23	12.37	15.47	4.07	Yes	No	No	No
(NE 7) 229	242	N246E138	LT	10.77	18.57	12.69	8.4	Yes	No	Yes	Yes
(NE 7) 230	243	N246E138	LT	7.12	28.3	19.23	3.46	Yes	Yes	Yes	No
(NE 7) 231	244	N246E138	LT	6.68	22.87	20.33	3.78	Yes	Yes	Yes	Yes
(NE 7) 232	245	N246E138	LT	3.5	14.65	20.71	2.03	Yes	No	Yes	No
(NE 8) 233	246	N246E138	LT	12.02	34.71	32.65	12.55	Yes	No	No	Yes
(NE 8) 234	247	N246E138	LT	16.68	44.65	30.98	9.35	Yes	No	No	Yes
(NE 8) 235	248	N246E138	LT	11.08	28.44	22.22	14.62	Yes	No	Yes	Yes
(NE 8) 236	249	N246E138	LT	3.81	25.02	27.21	7.95	Yes	Yes	Yes	No

Table A.1 - Continued

(NE 9) 237	250	N246E138	LT	24.66	54.11	24.6	8.9	Yes	No	No	Yes
(NE 9) 238	251	N246E138	LT	5.91	31.03	13.15	4.7	Yes	No	Yes	Yes
(NE 9) 239	252	N246E138	LT	9.2	22.48	17.21	4.35	Yes	Yes	Yes	No
(NE 9) 240	253	N246E138	LT		24.51	21.3	2.35	No	No	No	Yes
(NE 9) 241	254	N246E138	LT		16.95	15.96	2.76	No	No	Yes	No
(NE 11) 11	1	N246E136	PS	8.56	14.12	9.12	3.1	Yes	No	No	No
(NE 10) 6	2	N246E136	PS	4.12	18.63	12.43	2.31	Yes	No	Yes	Yes
(NE 10) 7	3	N246E136	PS		12.52	14.93	3.29	No	No	No	No
(NE 10) 8	4	N246E136	PS	9.27	21.71	10.21	2.05	Yes	Yes	Yes	No
(NE 11) 9	5	N246E136	PS	4.08	11.36	15.69	1.42	Yes	Yes	Yes	No
(NE 11) 10	6	N246E136	PS	6.28	10.91	6.91	2.21	Yes	Yes	Yes	Yes
(NE 13) 12	7	N246E136	PS	25.21	29.31	42.28	24.79	Yes	No	Yes	No
(NE 13) 13	8	N246E136	PS		31.93	22.35	9.65	No	No	No	Yes
(NE 13) 15	9	N246E136	PS	10.46	18.34	28.51	10.54	Yes	No	No	Yes
(NE 13) 16	10	N246E136	PS		22.44	13.1	6.86	No	No	Yes	Yes
(NE 13) 17	11	N246E136	PS	5.71	11.91	13.98	1.78	Yes	Yes	Yes	No
(NE 13) 18	12	N246E136	PS		12.47	12.27	4.4	No	No	Yes	Yes
(NE 13) 19	13	N246E136	PS	7.67	10.67	15.67	1.43	Yes	Yes	Yes	No
(NW 13) 1	14	N246E138	PS		17.85	29.36	5.21	No	No	Yes	No
(NW 14) 2	15	N246E138	PS	6.7	12.6	11.17	3.16	Yes	No	Yes	No
(NE 15) 3	16	N246E138	PS	8.57	10.06	13.3	1.79	Yes	No	Yes	No
(NE 16) 4	17	N246E138	PS	4.58	13.34	20.17	9.29	Yes	Yes	Yes	Yes
(NE 17) 5	18	N246E138	PS		12.55	15.28	2.42	No	Yes	Yes	No
(NE 7) 1	19	N246E138	PS		20.17	15.84	6.15	No	No	Yes	Yes
(NE 7) 2	20	N246E138	PS	8.52	15.74	9.17	5.4	Yes	No	Yes	No
(NE 8) 3	21	N246E138	PS	14.51	16.71	15.18	4.6	Yes	No	No	Yes

Table A.1 - Continued

(NE 8) 4	22	N246E138	PS	5.59	13.59	8.37	3.44	Yes	No	Yes	Yes
(NE 9) 5	23	N246E138	PS	8.92	22.75	21.94	4.97	Yes	Yes	No	Yes

VITA

Megan King was born June 10th, 1984 in Buffalo New York. She was raised in Hamburg, New York where she graduated from Frontier High School in 2002. From there she attended Buffalo State College where she received her B.A. in Anthropology in 2006. Megan pursued a Masters degree in Anthropology at the University of Tennessee, Knoxville and graduated in 2012. She is currently pursuing her doctorate in Anthropology at the University of Tennessee.