Stone Tool Raw Material Distribution Network and Predictability Study in Southern Illinois

By

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Abstract

Stone tools and their waste products, due to their durability and their importance to everyday prehistoric life, are key elements found in archeological sites. By knowing the locations of the stone outcrops and the distribution of the stones deposited in archaeological sites, researchers will attain a clearer understanding of prehistoric people's daily lives. In this study four stone materials, Burlington chert, Mill Creek chert, Cobden/Dongola chert, and Kaolin chert, are tracked from their outcrop location in southern Illinois to the archeological sites where prehistoric peoples deposited them. The raw material taken from these outcrop areas has been found as much as 100 miles away even when other sources of chert are closer. This is evidence of the choices made by prehistoric peoples for one chert type over another.

This research was conducted in order to understand the stone material selection process, the distance prehistoric people will go to obtain a specific chert type, and the temporal affiliation of these choices. Included in this study is an endeavor to find the most probable outcrop areas for each chert type. The outcrop prediction model broke down the landscape characteristics including slope, waterways, and geology and identified the areas of highest probability of finding these cherts. The research also sought to identify the distance chert was transported from its outcrop location. By using archaeological site chert data, the distance that the outcrop material was transported in the study area was identified. Additionally, a distribution pattern of the material across the landscape shows areas where each chert type was more heavily concentrated. Finally, by researching the distances and distribution of chert during specific cultural components, inferences made by archeologists concerning the distribution of these specific cherts are proven.

Chapter 1 Introduction

The answers sought by this thesis are relatively simple ones, but ones that have implications throughout the field of archeology. Where did our prehistoric ancestors obtaining the raw material to make stone tools? How far away from the stone outcrop was the raw material dispersed by prehistoric persons individually transporting the material or trading for the material? In addition, how and why did the dispersal change through time? As these questions relate to geographical extents, spatial distribution, and changing distributions through time, GIS applications are key to finding the answers.

1.1 Significance of Stone Selected

The raw material is identified by archaeologists in documents by the term lithic when it is made into stone tools, when it becomes waste material discarded during the tool making process, or when it is modified by humans in any way. The importance of lithics on an archeological site cannot be understated, since lithics are one of the few artifacts left to find due to their durability. As a predominate prehistoric tool making raw material, chert, plays a vital role in the economics and distribution network in areas now known as Southern Illinois.

Chert is sedimentary rocks composed primarily of microcrystalline quartz (Luedtke, 1992). Prehistoric people moved chert from the source locations to their final destinations, the archeological sites found today. At some point in the transportation or deposition processes, these cherts were modified by humans, making them lithics. During this process, specific chert types were chosen over others. As each specific chert type moved across the landscape and was transformed into lithics made out of chert, they created distribution patterns. The distribution of each specific type changed as the selection process and desirability changed over time.

By analyzing chert outcrop areas and distribution patterns, this research identifies regions with higher and lower concentrations of a particular chert type made into lithics during a specific cultural component. Components in the state of Illinois include Paleoindian (prior to 10,000 years ago), Archaic (10,000-3,000 years ago), Woodland (3,000-1,250 years ago), Mississippian (1,100-550 years ago) and Late Prehistoric (550 years ago to European contact) (Illinois State Museum 2000). This study only includes archeological sites with Archaic, Woodland, or Mississippian cultural materials. Paleoindian and Late Prehistoric components are not included here due to their limited appearance in the study area. The study area was chosen because of its natural boundaries consisting of the Mississippi River on the west and the Ohio River on the east. The northern extent was determined in order to limit the study area to the southern part of the state while keeping in mind the Archaeological site reports are filed by county.

Each time component included in this study had distinctive cultural components and hunting tools as shown in Figure 1. The Archaic component is distinguished by its hunter gatherer population who use atlatls to kill their prey. Atlatls are dart throwers with darts that are typically smaller in size and require less raw material to produce than the previously utilized spears.

The Woodland component was a transition period from hunter gatherers to farmers. In this time period, the first bow and arrows were used along with the first ceramic containers to store goods. As with the transition from Paleoindian to Archaic, the hunting tool size was generally reduced although farming tools required larger raw material pieces than hunting tools. Additionally, long distance trade and trade networks were established. The final component included in this study is the Mississippian. The Mississippian time period saw a greater reliance

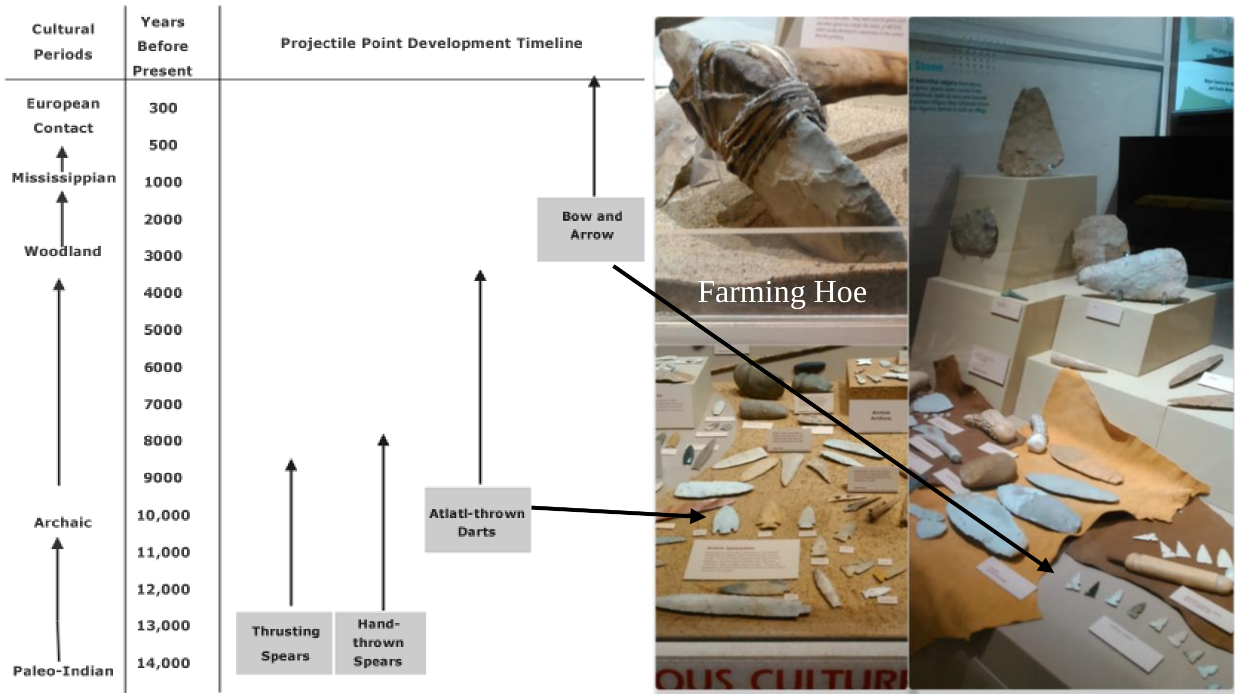


Figure 1 Stone tool types per cultural component (Illinois State Museum 2006)

on farming, mound building on an expansive scale, the building of earthworks, the formation of cities, and the creation of very finely crafted artifacts some of which are made from chert.

Given the aforementioned temporal needs for stone tools, a general trend in size of raw material needed to make each tool is established. Hunting tools were gradually reduced in size from the spear point to the dart point and eventually to the arrow point (Figure 1). Therefore, a smaller piece of raw material was utilized to produce an arrow point than a spear point. With this in mind if the population remained the same, prehistoric peoples would use less raw material as time progressed for hunting tools.

Raw material used for farming, on the other hand, increased from no tools used in the Archaic component to numerous tools used in the Mississippian component. These farming tools are significantly larger than the hunting tools and their production requires larger non-fractured pieces of chert (Figure 1). Raw material with large size and consistency of composition was of high importance for prehistoric farming and was transported long distances. Two chert types that consistently contain these attributes are included in this study.

1.2 Regional Geology and Selected Raw Material

In Illinois, the geology is heavily dependent on the extent of glaciation. Most of the state is in the Central Lowlands physiographic region, identified in Figure 2. The Central Lowlands were formed by till plains of seven distinctive glacial extents. These till plains consist of material washed out from the glaciers as the glaciers melted. The material, consisting of rock and sediment, formed thick layers on top of the bedrock. The buildup of material makes accessing native raw material difficult in glaciated areas. Additionally, rock in the glacial till is almost impossible to identify since it has been transported over long distances from unknown geographic origins. The remainder of the state was unglaciated. In the south, there are two large unglaciated regions, the Interior Highlands and the Gulf Coast Plains. The last small physiographic region in the state is made up of the Ozark Plateau, which occurs in three small sections that border the Mississippi River.

The four types of raw material selected for this study were Kaolin (Figure 2a), Cobden/Dongola (Figure 2b), Burlington chert (Figure 2c), and Mill Creek (Figure 2d), which are representative of both the glaciated and unglaciated regions. Kaolin, Cobden/Dongola, and Mill creek chert are exposed in the unglaciated portions of Illinois, the Gulf Coast Plains, Interior Highlands, and the Ozark Plateau. Burlington chert is the only type in this study that outcrops in both the glaciated, Central Lowlands, and unglaciated, Ozark Plateau, regions. This chert type is found in unglaciated areas due to the scouring of the Mississippi river down though the glacial till exposing bedrock at the edge of the floodplain (Figure 2).

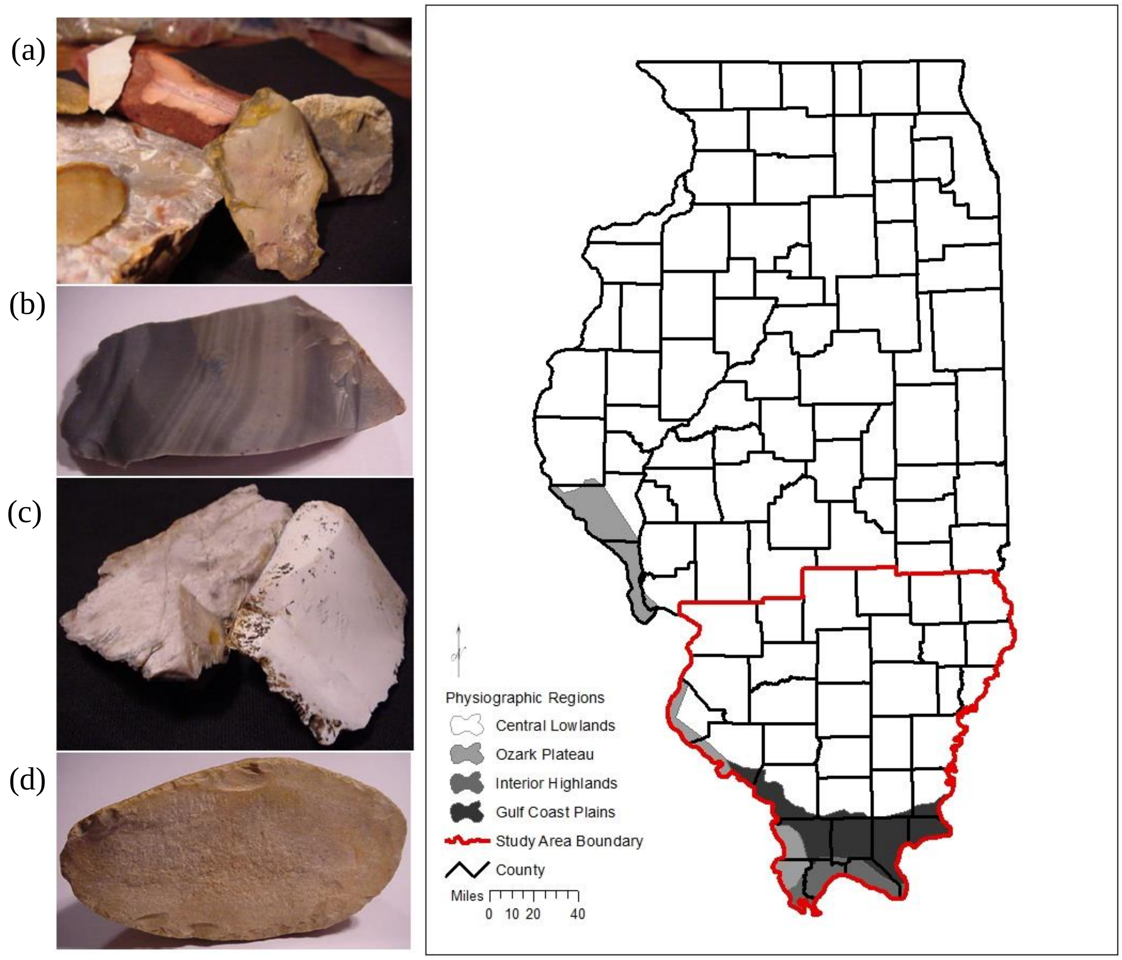


Figure 2 Chert types, study area, and physiographic regions

The Cobden/Dongola and Mill Creek chert source areas are limited to a few watersheds in the southern part of the state (Figure 3). Kaolin chert outcrops occur in one partial tributary and one small geologic feature in Union county, IL. Burlington chert, on the other hand, is quite expansive and can be found along the Mississippi river to the north and well into the central part of the study area (Figure 4). As some of the chert types have small source areas and others are quite large, this study will limit the extent of the distribution analysis to the southern part of the state of Illinois. Further delineation of the chert source areas is discussed in Section 2.2. Watersheds and relevant geologic formations for all the chert types included in this study are shown in Figures 3 and 4.

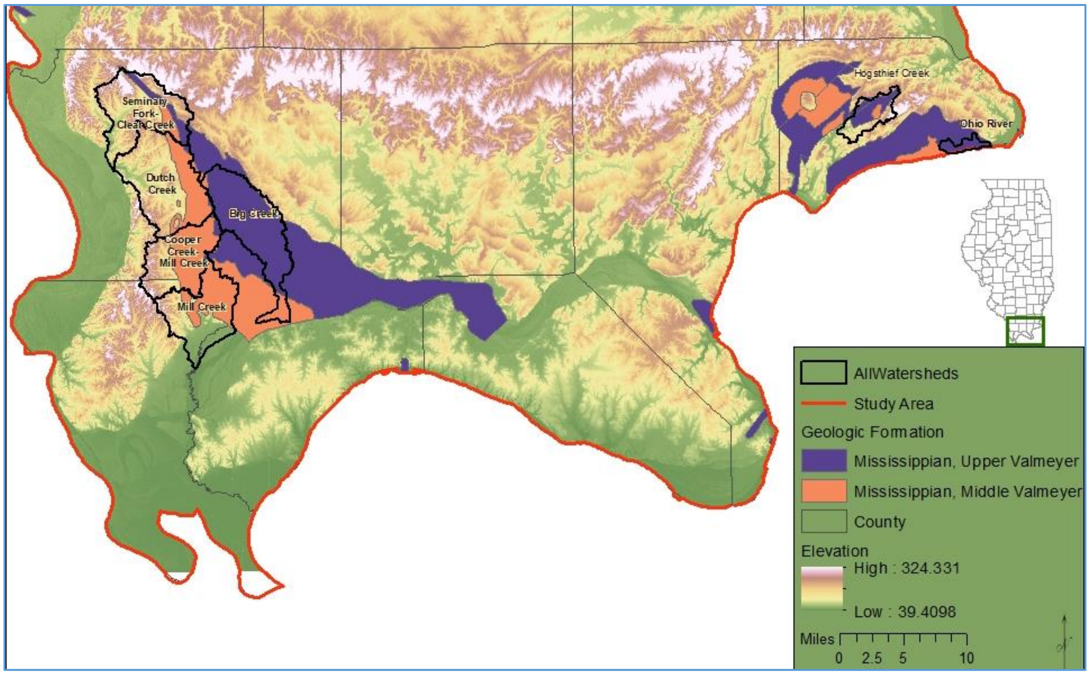


Figure 3 Relevant watersheds and geologic formations in the southern half of the study area

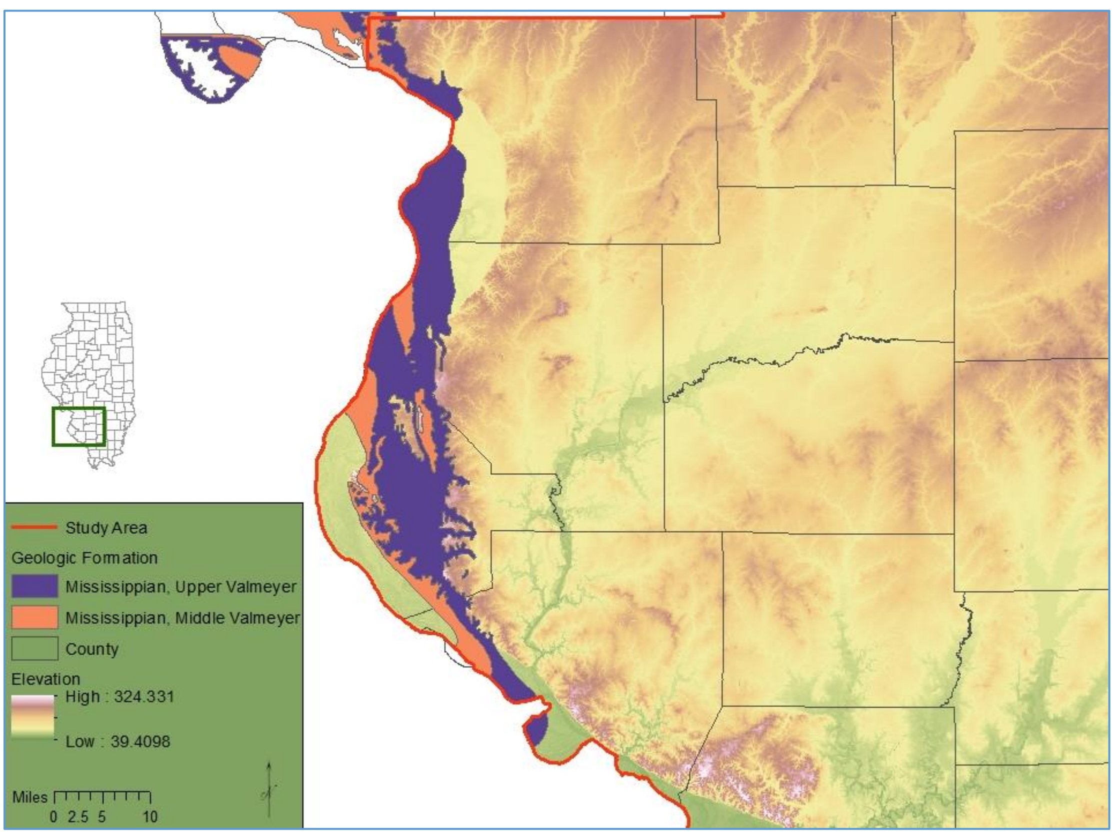


Figure 4 Relevant geologic formations in the northern half of the study area

1.3 Research Motivation and Goals

There are two main problems plaguing current research methods, which this research attempts to overcome by producing a viable study on raw material outcrops and lithic distributions. First, most previous research identifies only general area information on outcrops without attempting to identify the most probable place chert outcrops occur (see Section 3.2 for previously conducted research). Second, state and federal regulations dictate which projects require archaeological assessment, testing, and mitigation. This leaves large areas unsurveyed, untested, and open for destruction by any project not fitting the regulatory guidelines. By using the methods employed in this study, a more complete picture of chert outcrop areas and lithic distribution patterns over three distinct cultural components were produced for the southern part of Illinois.

This research in essence has two parts: (1) a chert outcrop prediction study; and (2) distribution analysis of lithic made from chert. The distribution analysis utilizes archaeological site's lithics data to determine the extent and volume of specific chert types found in archaeological sites distributed across the landscape in the Archaic, Woodland, and Mississippian cultural components (Sections 1.3.1, 2.3, and 3.2). Next, a prediction study was employed using geographic features in order to identify the most probable locations where chert outcrops occur (Sections 1.3.2, 2.1, 2.2, and 3.1). Both parts of this study are integral to determining the way prehistoric humans utilized their landscape and the choices they made when selecting lithic raw material.

To limit the confusion in this document, from this point forward chert and lithics made out of chert will be identified using the term chert. Additionally, the combination of descriptors is not a significant change since the material in both cases is the same as just the shape of the material changed.

1.3.1 Chert Distribution

Archeological site data was used to determine the distance a piece of chert was moved from its outcrop location. Additionally, the spread of each type of chert was obtained by analyzing the distribution pattern from data recorded at archaeological sites. Areas where chert is heavily deposited in archaeological sites or areas where chert is absent was revealed by studying the distribution patterns of each chert type from different components.

As a part of the distribution analysis, chert counts and weights were collected from reports found in the CRM Report Archive (ISAS 2017). These data were collected for specific chert types from Phase II and III archaeological reports for the Archaic, Woodland, and Mississippian cultural components (Appendices A and B). Multiple reports were used in this study for sites located inside the area outlined in red in Figure 2 and recorded in the reference section at the end of this report.

A less biased picture of the chert migration was obtained by using Phase III site reports which are known as mitigation phase reports and Phase II reports which are known as testing phase reports. Both phases encompass subsurface excavation, which reveals and includes subsurface artifacts in the context of the archaeological feature. Phase I reports include only surface collection and limited shovel testing with no known association with specific feature attributes or fully entailed artifact assemblages.

Imagery was created from the plotted archeological site data to show the dispersal of chert in the Archaic, Woodland, and Mississippian cultural components. Additionally, this imagery data was segregated by the individual chert types included in this study. All imagery from the same chert type was analyzed to reveal how chert distributions varied over time as well as space. From this, inferences made by other archeologists and explored in Sections 2.2.2 through 2.2.4 were proven.

1.3.2 Chert Types and Quarry Sites

During this research, numerous periodicals were identified which discussed chert types from across the Midwest. Most of this information is tucked into archaeological site reports and geologic studies, although some researchers made a concerted effort to limit their discussions to chert types. One thesis written by Koldehoff (1985) has been identified as one of the best studies on lithic raw materials in Southern Illinois for its time. This is in part due to limited compiled research on the subject. This research does contain information on chert types but like so many others, it does not identify anything beyond a general area where the raw material can be found. Unlike other studies, this thesis study pared down the larger general area of occurrence identified by previous researchers into the most probable area where a specific type of chert can be found.

By producing a prediction map for the most probable raw material locations, future researchers can conduct field reconnaissance with the intent of finding new prehistoric chert quarry sites. After locating and studying a sufficient number of quarry sites, questions can be answered pertaining to the process prehistoric people used to reduce the raw material into a transportable form. Based on the material left at the quarry site, assumptions can be made about the potential volume of material transported out of the quarries.

Since the author performed limited previous field reconnaissance pertaining to chert sample collection in the state of Illinois, this reconnaissance was put to good use (Borgic 1999, 2000). As identified in the previous paragraph, this step would normally be taken after the predictability study is completed. In so doing, the area of reconnaissance is limited and the field research in essence validates the prediction study. Since the author's reconnaissance work has already been performed on a limited scale, it was used to validate the prediction study.

The following chapters will include information on related works, the research design for this thesis, the results of this work, and the conclusions. The related works section, Chapter 2, outlines the previous research on the four chert types in this study and will give detail on the chert type's physical and geospatial attributes. Additionally, Chapter 2 discusses distribution inferences made by archaeologist for each chert type. The methods used to produce the final outcrop prediction surface and chert distribution analysis are discussed in Chapter 3.A detailed account of all the parameters and tools are included. Next the results of this work are presented in Chapter 4. Maps are presented for each chert types distribution analysis per component along with the prediction model for all chert types. Finally, Chapter 5 gives a brief summary and describes the limitations of this study and the potential for future work.

Chapter 2 **Related Work**

As the following sections will show, this research includes parts of many previous works. Previous studies on chert exploitation include research on chert identification, geologic outcrop locations, and archaeological site and chert quarry site prediction studies. This research combines some of the elements from the works presented below along with original research on the topic of stone tool raw material outcrops and distribution in Southern Illinois.

2.1 **Lithic Prediction Studies**

Few relevant articles were found concerning lithic predictability models. Two articles, Barriento et al. (2016) and the Clarkson and Bellas (2014), use interpolation models based on lithic raw material found at cultural resource sites. After producing the models, Barriento et al. (2016) used known lithic outcrop areas to check their interpolation models. Clarkson and Bellas (2014) utilized their model to check known outcrops, and used an interpolation model to perform field reconnaissance to find unknown resource areas.

Following the lead of previous lithic predictions models, this prediction study was validated by comparing it to a reconnaissance study. The author utilized her reconnaissance study collecting raw material samples at specific geographic locations. Data from two separate reconnaissance studies recorded 22 total chert types found in Illinois. Borgic (1999) presented 10 chert types, while Borgic (2000) presented 12 different types along with the chert geologic formation data.

One prediction study, which is not only relevant in terms of factors used in the predictability study but also for the chert outcrops investigated, was written by Chad Goings (2013). This article employs distance from riverine networks, formerly identified outcrop areas, slope, relief, and depth to bedrock. All of these factors except depth to bedrock were used in the current study to determine the most probable chert outcrop location. Riverine networks are one of the key components used to identify lithic resource outcrops in the central portion of the U.S. due to waterways cutting through the soils and exposing the bedrock underneath. Slope is the second significant factor since steep slopes specifically next to creeks and rivers usually indicate potential rock outcrops.

Goings (2013) breaks down the raw material outcrop areas in his study into subtypes in order to identify specific raw material outcrops. He uses well logs with geologic formation information to assists in his prediction study of specific raw material outcrops. Barriento et al. (2016) and Clarkson and Bellas (2014), who were only interested in outcrops not specific types of stone tool raw material outcrops, did not include geologic formation information recoded in well logs. As there are several good sources, which identify the general areas of specific raw material outcrops, there was no need to utilize well cores for this research.

The following section will identify the four chert types included in this study. Discussions will include not only the physical description of each chert type but also the general consensus of where these chert types outcrop. Additionally, information is conveyed as to which cultural components are thought to exploit the raw material more heavily.

2.2 Raw Material

The four distinct chert types, Burlington, Cobden/Dongola, Kaolin, and Mill Creek chert, are the basis for this study. All of these types have distinctive physical features, abundance, desirability, and source location areas. The Cobden/Dongola and Mill Creek chert source areas are limited to a few watersheds in the southern part of the state. Kaolin chert outcrops in two very limited areas in the southernmost part of Illinois. Burlington chert, on the other hand, is quite expansive and can be found along the Mississippi river in several states. Since Burlington chert outcrop areas are quite extensive, the chert predictability study for Burlington chert will be limited to outcrop locations within the study area.

As can be seen in the paragraphs below, the chert types are not only different between types but also have a variety of differences from one chert specimen to another within a single type. This may cause confusion when the lithics are cataloged. Given these limitations, it is important to understand that these specific chert types were selected for this study because they are exceedingly well known by archeologists in the area and they have a low likelihood of being identified as originating from another raw material source. Additionally, the geographic extent and location of each chert type described below for the most part is well established even if the geographic formations in which they occur are not.

Emerson and McElrath (2000) discuss extensively the implications of misidentified chert sources, misidentified geologic formations of origin, and the effects of each on the archaeological record. They specifically convey the importance of the location of origin over the formation of origin in relation to the archaeological record. In essence, this means that the location where an outcrop occurs is more important than what geologic formation the chert originates from.

As it should be noted here, color and texture are both subjective qualities. Two people looking at the same piece of chert can identify it using a different color and textural description. The important thing to remember is that the professional archeologist, despite the color or texture description, can identify the chert as a specific type coming from a specific source location. The following is an amalgamated description from other archeologists concerning the outcrop and use of each chert type included in this study.

2.2.1 Burlington chert

The geologic formation in which Burlington chert is found is an early Mississippian aged limestone called Burlington Limestone. In Illinois, this formation is exposed along the Mississippi river from Quincy, Adams County, to near Alton, Madison County and also in Monroe county (Willman et al., 1975). Within Burlington limestone two types of chert are prehistorically known to be quarried in Illinois: Burlington chert and Grime Hills chert. Burlington chert can be found in nodular, tabular, or bedded form in creeks and bluff lines along the Mississippi river (Figure 5). It comes in a variety of colors, and has been described as being "white to light grey...yellowish and blackish" (Morrow, 1988) "light gray to bluish grey...pale brown to white" (Odell, 1984) and "white to tanish" (Emerson, Milner, and Jackson, 1983). Crinoid Fossils, Brachiopods, and Bryozoa are found in some Burlington cherts giving it a coarse texture. Because of the inclusion or exclusion of fossils, Burlington's texture ranges from fine-to coarse-grained. The non-fossiliferous fine grained chert was sought after for tool production. This is due to fossils in chert causing unpredictable fractures in the material during the tool making process.

Burlington chert has previously been included in a quarry site prediction study in Iowa by Chad Goings (Goings, 2013). He identified probable Burlington chert quarry sites in the counties of Henry, Jefferson, Van Buren, Lee, and Des Moines counties, IA. In addition to the outcrop locations identified in Goings (2013) study and the outcrop locations identified previously in this section, Burlington chert can be found in Missouri and other locations in Iowa along the Mississippi river. As Burlington chert is quite extensive with a wide range of quality no assumptions were made about its changing distribution across the landscape or its presence in each cultural component.

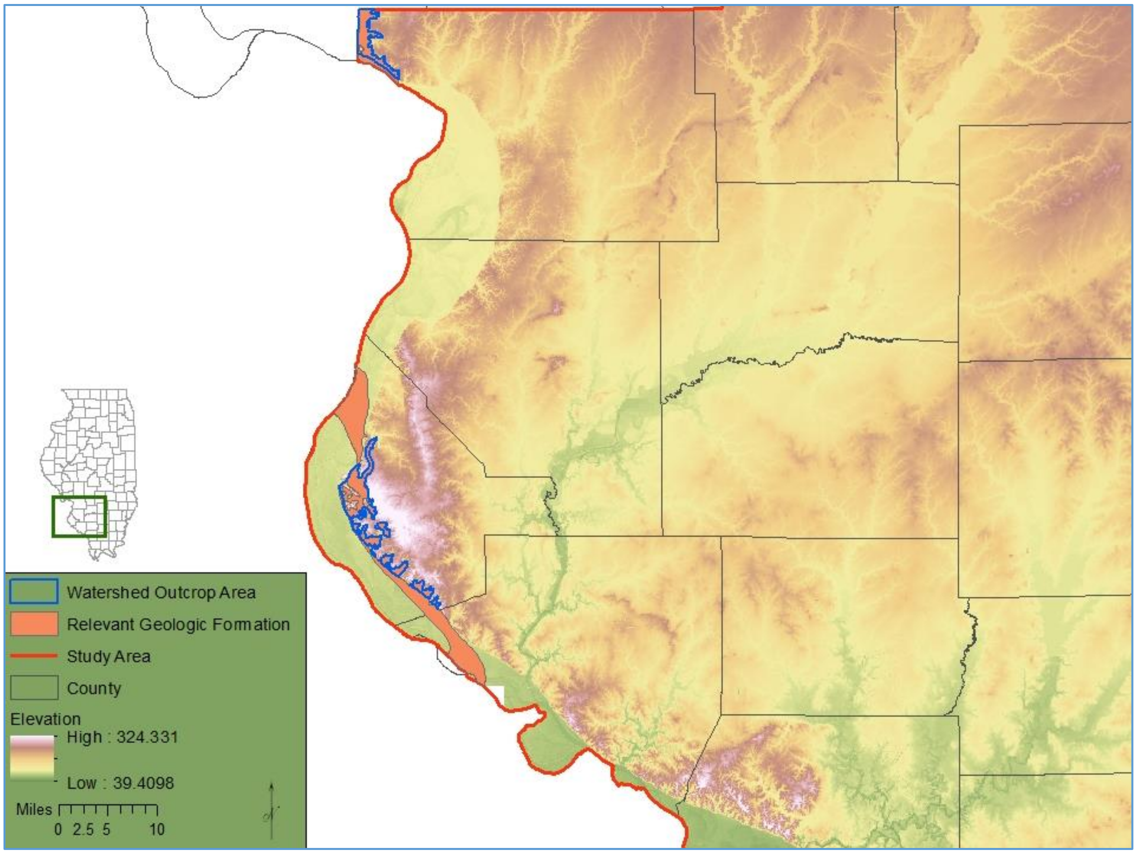


Figure 5 Burlington chert watershed area and geologic formation

2.2.2 Mill Creek chert

Recent studies suggest that Mill Creek chert is formed in the Warsaw-Salem Formation; formerly it was thought to originate from Keokuk limestone (Spielbauer, 1984). The Warsaw-Salem formation is of Mississippian age. It is exposed along Mill Creek, Lingle Creek, and Cooper Creek in Union and Alexander counties (Morrow, 1988) (Figure 6).

Mill Creek chert has a rough and weathered exterior, which is generally a rusty brown. The exterior can also be grey or brown, but these colors are not as common as the rusty brown color. The interior of Mill Creek chert comes in a variety of colors and is described as “Grayish tan to brown” (Spielbauer, 1984) and “blue beige, grey, yellow, pink or reddish brown” (Morrow, 1988). A typical banded pattern occurs in Mill Creek chert. The bands run parallel to the outer surface of the lenticular nodule. The interior of the nodule is coarse in texture, but the knapping characteristics are favorable.

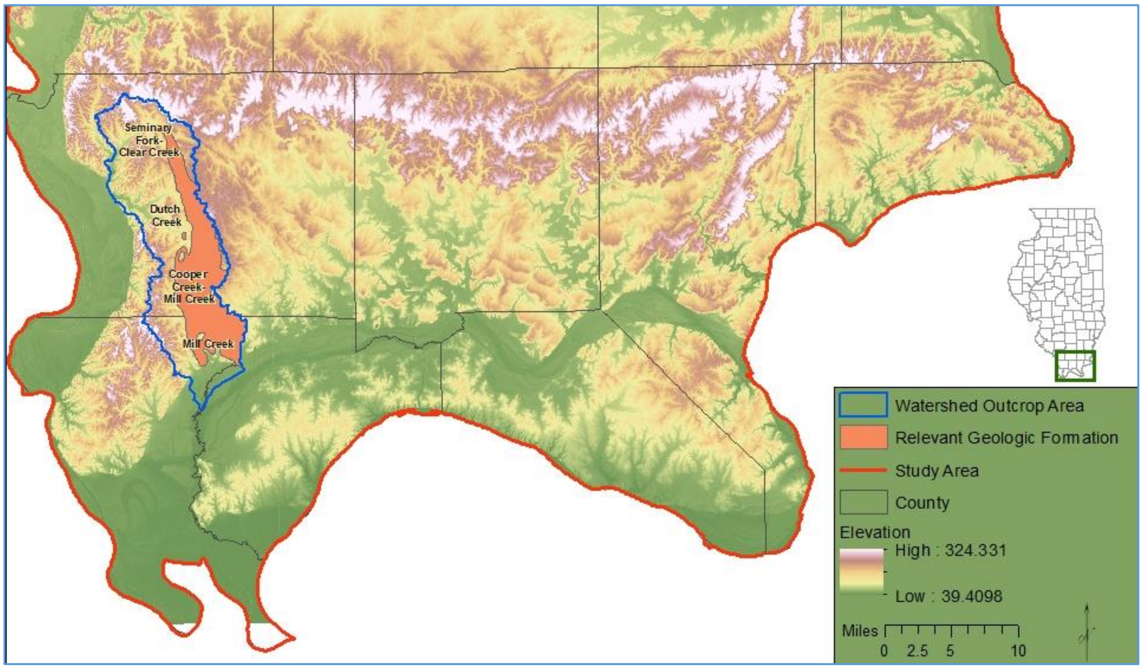


Figure 6 Mill Creek chert watershed area and geologic formation

Archaeologists have identified an increase in the occurrence of Mill Creek chert in archaeological sites where evidence of farming is present (Cobb, 1989). Chert requirements for stone farming hoes include a shape that is two to three times larger in terms of length than width, and large enough in terms of size to produce a chipped stone implement with a length roughly 30 cm or more, limited fractures, and roughed structure. As Mill Creek chert is one of the few types that consistently have these attributes, it was widely selected for, transported, and deposited in archaeological sites during the Woodland and Mississippian components. Mill Creek chert was spread across the landscape for long distances to include appearing in the lithic assemblage at Aztalan State Park approximately 630 miles to the north of the outcrop area (Hollon, 2011). As part of this research, the increase of Mill Creek chert in archaeological sites that practice farming was proven by analyzing the distribution patterns.

In their study the practicality of Mill Creek hoes for farming in prairie soil, Hammerstedt and Hughes (2015) performed experiments using these hoes to break up an unplowed plot of land. The results showed that the Mill Creek chert hoes were very effective in cultivation thus proving the durability of the chert and reason why prehistoric people used Mill Creek chert so heavily during times when farming was initiated.

2.2.3 Cobden/Dongola chert

The St. Louis limestone is a Mississippian aged limestone (Willman et al., 1975). Two Illinois chert types outcrop in St. Louis limestone: St. Louis chert and Cobden/Dongola chert. Cobden/Dongola has historically been called Dongola, Dongola series, Anna, Hornstone, St. Louis Ball chert, and Cobden (Morrow, 1988; Hofman and Morrow, 1989). In Indiana, similar chert outcrops are still known as Hornstone or Wyandott chert. Cobden/Dongola usually has a weathered buff colored cortex with a smooth fine-grained interior. The interior generally is a blue-grey color, but it can also be found as Blue-black (Speilbauer, 1984) and tan (Morrow, 1988). Cobden/Dongola chert can be found as nodules or as bedded chert. The round nodular chert frequently is banded with alternating dark and light bands. Historically the term Dongola was used to describe the banded chert, while Cobden was used for the unbanded chert. Since the two types were found to be from the same outcrop, they are now lumped together (Spielbauer, 1984). Cobden/Dongola outcrops in this study area near Dongola Illinois downstream from Big Creek, along Clear Creek near Cobden IL, and in the eastern Shawnee Hills (Koldehoff, 1985; Morrow, 1988) (Figure 7).

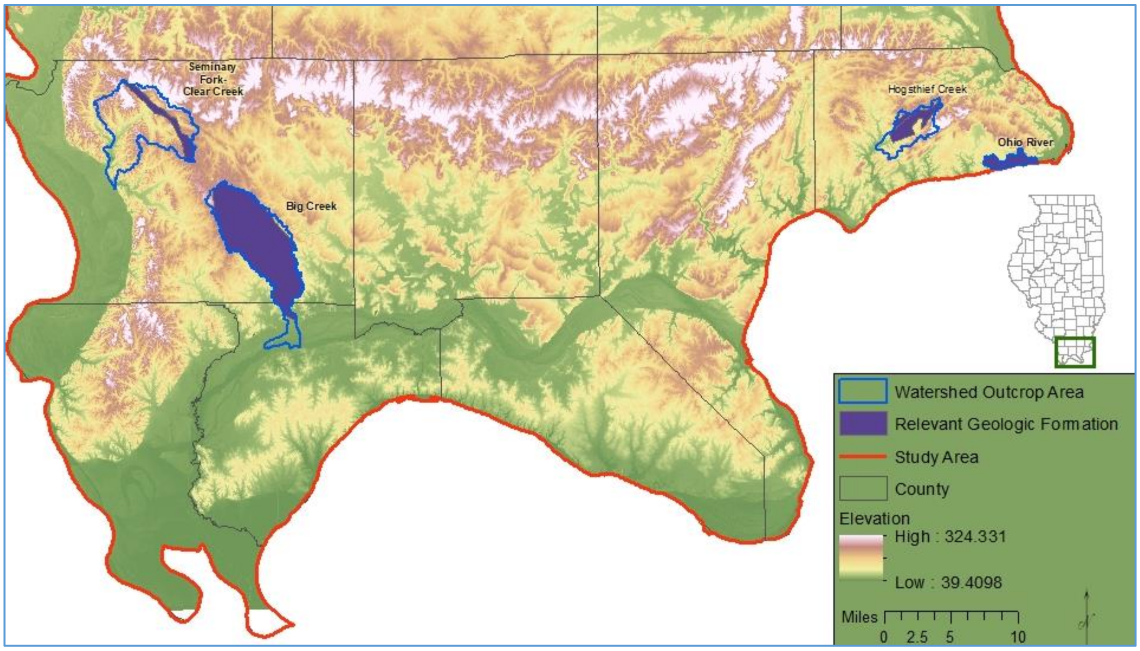


Figure 7 Cobden/Dongola chert watershed area and geologic formation

Cobden/Dongola was utilized by all of the cultural components in this study. Although, it has been assumed that this blue grey chert was a preferred chert type during the Middle Woodland time period. Morrow, Elan, and Glascock (1992) disagree with this due to the lack of testing. The current study proves that Woodland peoples in southern Illinois did use blue grey chert more heavily than Archaic or Mississippian peoples.

2.2.4 Kaolin chert

The Vienna Limestone formation and a secondary geologic deposit of unknown origin have been noted as the origin of Kaolin chert. The uncertainty of the formation's origin arises from the degraded nature of the formation. The Vienna limestone formation is the earlier derived origin of Kaolin chert (Spielbauer, 1984).

The known Kaolin outcrop areas are at Iron Mountain, a ridge that runs north and south found approximately 4 miles west of Cobden, IL and on a tributary of Big Creek in Union County (Figure 8). Some Kaolin chert has been called noviculite and chalcedony because of its high quality (Hofman and Morrow, 1989). Kaolin can be semi-translucent with color ranges of reds, pinks, tans, creams, buffs, yellows, purple, brown, orange, black, and white. A web like pattern of banding occurs because of light refracting off of fractured edges or because of a more porous area being stained. The texture of Kaolin chert is coarse-to fine-grained. Kaolin's cortex has a pitted texture with a yellow, white, or black color (Spielbauer, 1984). Nodules of Kaolin chert are lenticular or discoidal (Morrow, 1988; Hofman and Morrow, 1989).

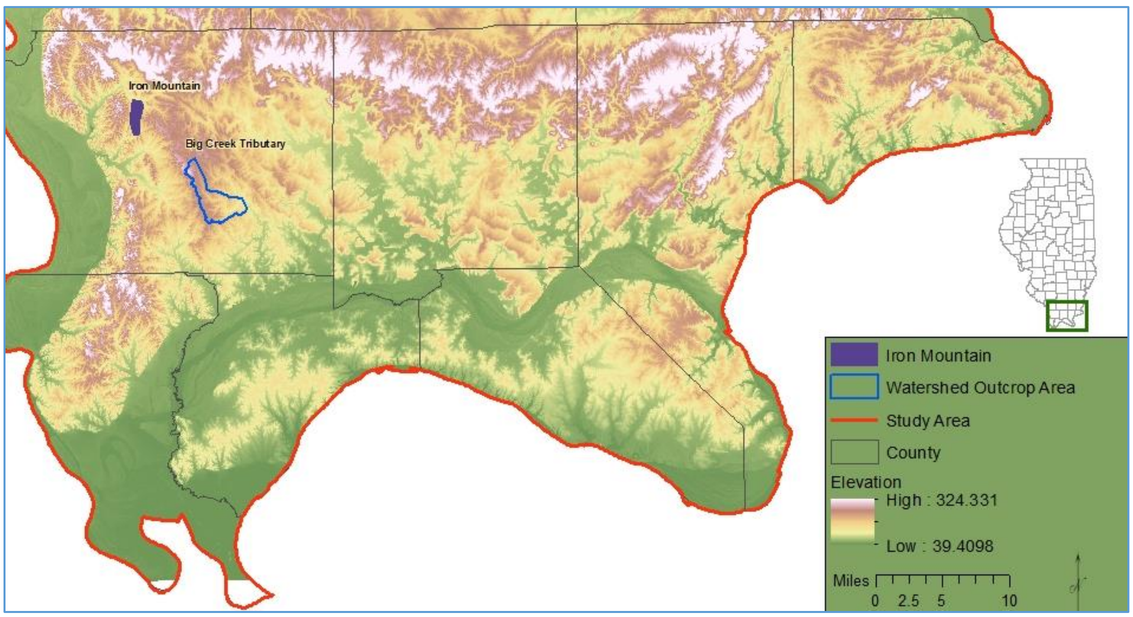


Figure 8 Kaolin chert watershed area and geologic surface feature

Kaolin chert was heavily utilized during the middle Woodland and Mississippian components. This is due in part to the large raw material size, good workability, and range of striking colors. An archaeological investigation of the Iron Mountain quarry site revealed the true nature of how the chert was obtained. Prehistoric peoples predominantly dug large pits to unearth the Kaolin chert instead of collecting it from outcrops or streambeds (Billings, 1984). This would entail significantly more effort to obtain the chert. As with Mill Creek chert, the implication is that Kaolin chert due to its inherent attributes was utilized for farming. In addition, Kaolin chert was made into large decorative items because of its striking colors and patterns. Through analysis of the distribution of Kaolin chert over time, it is proven in this study that Woodland and Mississippian peoples in southern Illinois used this chert more than their predecessors.

2.3 Distribution Network

Models pertaining to the procurement of raw materials have been applied to archaeological sites and chert exploitation in the past. The Neutral model executed by Brantingham (2003) utilizes an idealized spatial analysis where all materials are equally spaced on the landscape. Brantingham's (2003) study indicates that the selection of lithics found at an archaeological site is not a product of selection. Instead, it is a product of random selection of raw materials from random wanderings of prehistoric peoples across the landscape. This model may have some validity but given the choice between two sources of material, humans will always have a preference for one over another. A paper concerning the selection for blue-grey chert by Morrow, Elam, and Glascock (1992) was prompted by the choice of prehistoric peoples choosing one chert type over another. Additionally, this research shows the results of the choices made by a collective group of people in three distinct cultural components.

Geospatial models proposed by Beck (2008) and Wilson (2007) assist in calculating the selection process of raw materials by prehistoric peoples. Beck (2008) uses a distance transport model to prove that in areas with larger selections of raw materials a smaller raw material acquisition range is used than in areas with limited raw materials. Wilson (2007) uses a gravity model to determine which source of material should be utilized more than others. Both studies are uniquely pertinent to the mode of transport and the selection of materials to be transported. However, they leave a gap in the information as to why some raw materials are transported significantly longer distances given an equal amount of resources and closer raw material outcrops.

This thesis sheds light on the outcrops and distribution of four chert types described in Section 3.2 as the populations in the study area transition from hunter-gatherers to farmers. Table 1 shows the basic attributes of each chert type and the assumed preferences for each chert type by peoples in specific cultural components.

Table 1. Chert Type Overview

Chert Type	Formation	Formation Shape	Distribution	Component Preference
Burlington	Mississippian	Nodular, Tabular, Bedded	Along the Mississippi river in Iowa, Illinois, and Missouri	No temporal preference
Mill Creek	Warsaw-Salem	Lenticular nodules	In Mill Creek, Lingle Creek, and Cooper Creek drainages and Tributaries in Union, Alexander and Pulaski Counties	Woodland and Mississippian
Cobden/Dongola	St. Louis	Nodular, Bedded	near Dongola Illinois downstream from Big Creek, along Clear Creek near Cobden Illinois, and in the eastern Shawnee Hills in Hardin County	Woodland
Kaolin	Unknown	Nodular	Iron Mountain and a tributary of Big Creek in Union County	Woodland and Mississippian

The following chapter describes the steps taken to produce the outcrop prediction study for each chert type and the distribution analysis for each chert type in the Archaic, Woodland and Mississippian components. This process was developed in order to understand the procurement and distribution of chert over time as well as providing evidence for assumptions made by archaeologists concerning the selection of specific chert types in each component.

Chapter 3 **Research Design**

This research has two distinctive parts: (1) the development of the chert outcrop prediction model; and (2) the chert distribution analysis over time. The chert outcrop prediction model delineates the most probable locations to find the four distinctive chert types presented in this thesis study. The chert distribution analysis determines the spread and deposition of chert in archaeological sites during the Archaic, Woodland and Mississippian components. As both parts of this study are spatially independent, there was no need to complete one before the other. The correlation of each part becomes apparent when the analysis is completed and the outcrop location is spatially correlated with the distribution of chert across the landscape. By completing this overlay, a relationship is shown between the raw material quarried locations and the spread of chert.

The process used to arrive at the final prediction and analysis is outlined in the following sections. All data used for this study was either downloaded or transformed into the NAD 1983 Illinois State Plane West coordinate system. This coordinate system was chosen because the majority of the chert outcrops and site data occur in the western part of the state. By choosing this coordinate system, the amount of distortion was minimized for the majority of the data.

3.1 **Chert Outcrop Prediction Model**

Previously, researchers have written about specific chert outcrop areas, as seen in Sections 2.2.1. through 2.2.4. Unfortunately, these previous reports only include the general area of chert outcrop. Usually this generalization identified a creek watershed, geographic feature, or linear extent. By not identifying the most probable area of outcrop, analysis potential is limited. In contrast, this research identifies the most probable locations to find the specific chert types within the general areas identified by previous researchers.

3.1.1 Prediction Study Parameters

Historically, chert outcrop area descriptions have been vague. A significant portion of the previous researchers chert outcrop locations are identified by written descriptions and/or small-scale maps with hazy placement of chert outcrop indicators. Given this limitation, more weight was given to the written description of chert outcrops when imagery was poor.

Care was taken in the process of predicting chert outcrop locations to define not only the general areas of outcrop but also the mode of outcrop. For chert identified as occurring along a landform only, creek data were eliminated from the potential outcrop paths. For locations where water erosion was determined to be the source of the outcrop, slope data was weighted in preference for high slopes close to surfaces eroded by water. High slope areas within the geologic formation's extent were determined to have the highest potential for outcrop locations. This is in part due to the higher likelihood of soils to fall down a steeper slope exposing the bedrock underneath. Additionally, in Illinois, the landform is generally flat or gently rolling. As such, any abrupt change in the slope and elevation is a good indicator of exposed bedrock or creeks potentially cutting into the landform. Finally, since water can carry material downstream during flooding events the portion of the watershed downstream from the geologic outcrop was identified as potentially containing chert.

In this study, all land with slopes less than 15 percent was determined to have very limited outcrop potential due to the thick layer of sedimentary and glacial till deposits in Illinois. Additionally, according to the Illinois State Geological Survey the majority of the state has an average slope by county of less than 4.25 percent with a maximum elevation difference by county of 680 ft. Given this low terrain and elevation married with the thick deposits of sediment and glacial till, areas with less than 15 percent slope were determined to have very limited potential for chert outcrops.

Since the data used for this study were collected in the last several decades some surfaces are not the same as they appeared during prehistoric time periods. In order to create the most accurate prediction model, modern construction influences when feasible were removed from the source data. Any locations with a high probability of outcrop next to roadways were evaluated to determine the nature of the outcrop. Additionally, any areas where obviously modern channelization occurred were removed from the prediction surface.

3D Elevation Program (3DEP) LiDAR based 1/3 arc second Digital Elevation Model (DEM) data layers were used to locate areas of greatest slope and those most likely to be eroded by water. Surface exposed areas of key geologic members used in this study and identified in Section 2.2 were delineated by the USGS Mineral Resources Division and obtained from the Illinois Geospatial Database Clearinghouse. The watershed boundaries, identified in Section 2.2 as containing chert outcrops, were obtained from the National Hydrographic Dataset. All data manipulation was conducted in ArcGIS.

3.1.2 General Area Outcrop Boundary

As the initial step in identifying the most probable outcrop areas, a shapefile was created for each of the generalized chert outcrop areas based on previous researcher's descriptions, geologic formation surface extent outcrop boundaries, and watershed boundaries (Figures 3-6). Since no existing shapefiles containing singular formations was available, the smallest grouping of formations in the USGS shapefile was used. The cherts identified in this study originate from the Mississippian system in the Valmeyeran series, with the exception of Kaolin chert's unknown origin. It was found that two geologic shapes contain these formations in the USGS shapefile. The geologic formation groups were identified as the Middle Valmeyeran (Salem, Warsaw, Borden, Springville Series; includes thin Mvl and Mk to the south and east) and Upper Valmeyeran (Aux Vases, Ste. Genevieve, St. Louis Series) (USGS 2005). The extent of the two Valmeyeran groups in the study area is shown in Figure 9. The formations included in these two groupings are shown in Figure 10 with the chert bearing formations identified within the group.

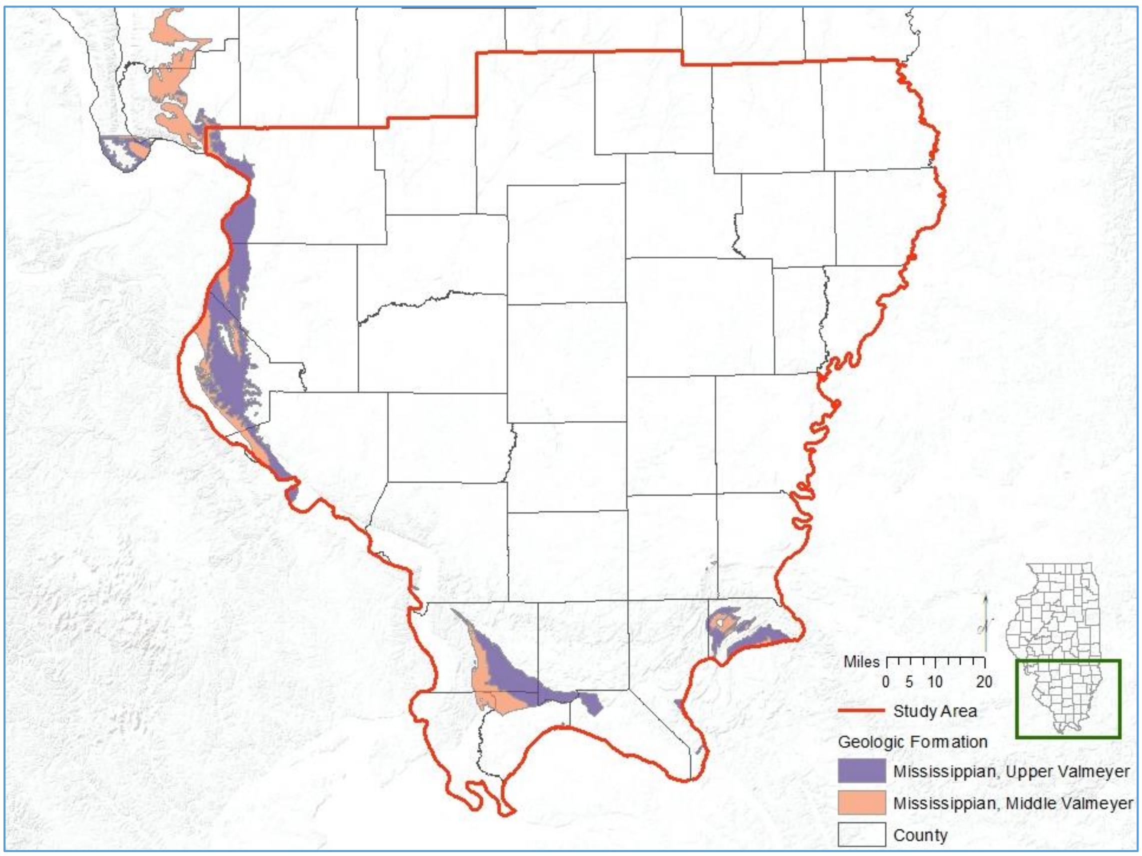


Figure 9 Surface exposure extent of upper and middle Valmeyeran formations

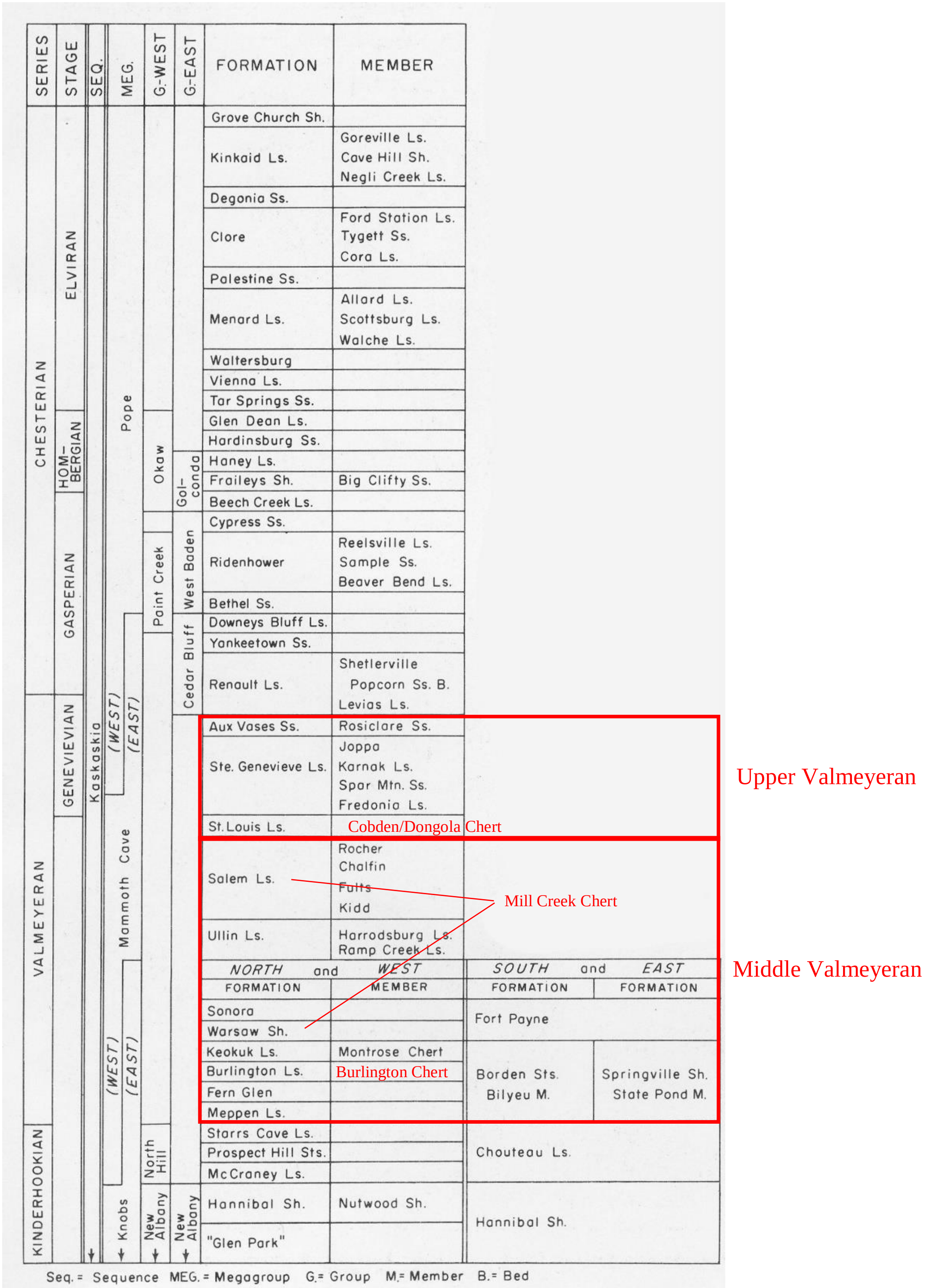


Figure 10 Relevant geologic formations within the Mississippian age geology (Willman et al. 1975, annotations added by author)

Watersheds were a delineator for Kaolin, Cobden/Dongola and Mill Creek chert outcrop locations. The level 6 sub-watershed was used from the Watershed Boundary Dataset contained in the National Hydrographic Dataset. By choosing the level 6 watershed boundary almost all of the watersheds were delineated by creeks containing chert outcrops in this study. Only the Cobden/Dongola chert watershed area in Hardin county and the Kaolin chert watershed area in Union county required modification. Additionally, since the Burlington chert outcrop area did not include the name of a watershed when delineating its outcrop area, a watershed boundary area was created for it.

The Hogthief Creek watershed seen in Figure 7 was initially one branch of the larger Y shaped Big Creek watershed. In order to use only the smaller section of the watershed identified as containing Cobden/Dongola chert all parts of the watershed not drained by Hogthief Creek were removed from the shapefiles. In addition to these changes a vague location along the Ohio River was identified as containing Cobden/Dongola chert by Koldehoff (1985). A shape for this outcrop area was determined by enclosing the two small unnamed tributaries of the Ohio River in the area identified by Koldehoff (1985) which contain the relevant geologic member. Both of the Cobden/Dongola watershed area modifications can be seen in Figure 11.

Burlington chert outcrops in a geologic feature created by the scouring of the landscape by the Mississippi River. Since the Mississippi River watershed is too large to be useful in the delineation of Burlington chert outcrop areas, a smaller watershed area needed to be delineated to encompass the effects of water on the geologic formation. A National Hydrographic Dataset waterway shapefile was evaluated in the area of the Burlington chert geologic formation. Any waterway within the geologic formation surface exposure area was included in the Burlington waterway shapefile along with any area in which a watershed crossed an adjacent geologic formation and reenters the same Burlington geologic formation area. In addition, all waterways in the Mississippi river floodplain were eliminated from the Burlington chert watershed area due to the exceedingly large percentage of channelized waterways. A finalized Burlington chert watershed can be seen in Figure 12.

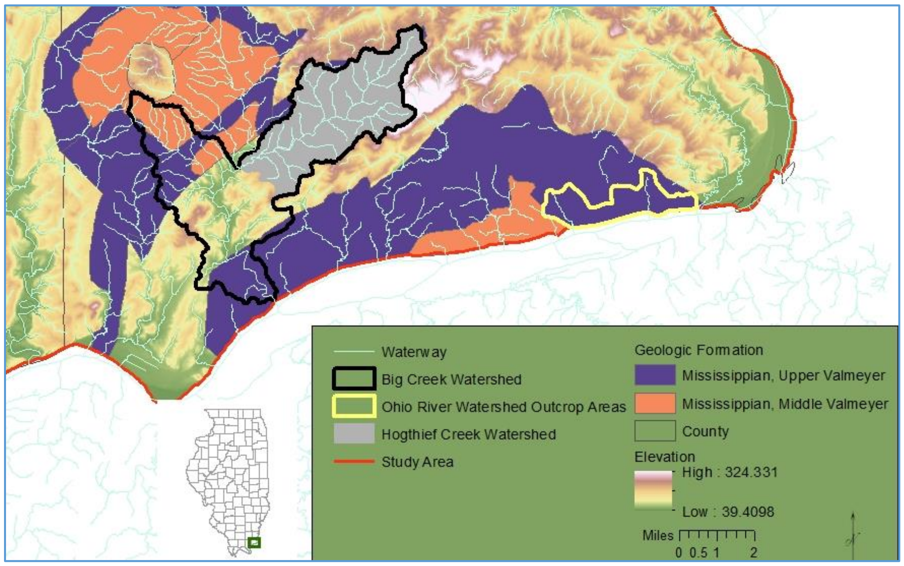


Figure 11 Cobden/Dongola watershed area modifications

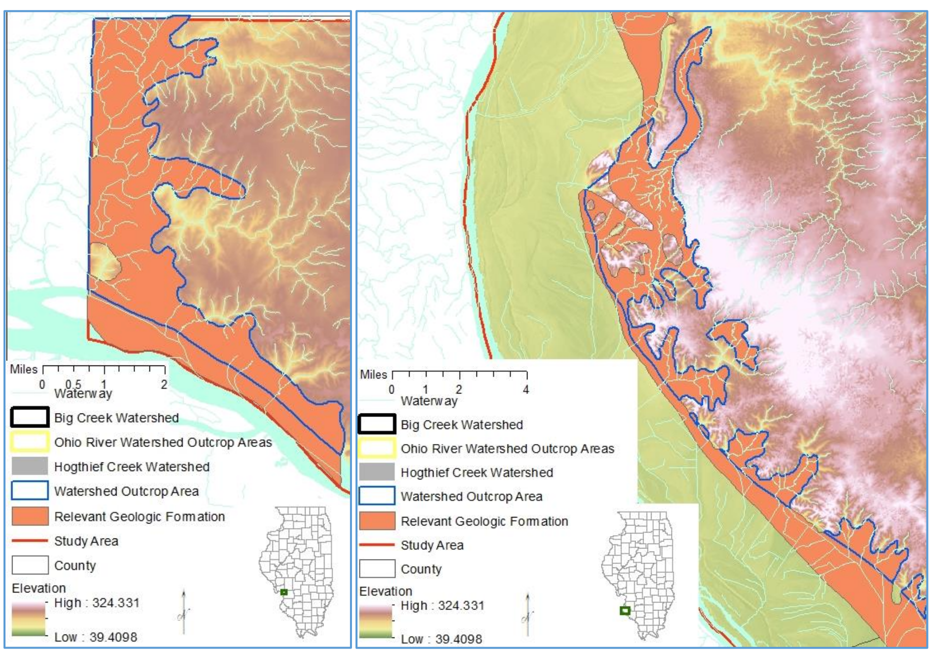


Figure 12 Burlington chert watershed delineation

The final two shapes created for the completion of the chert outcrop area was the landform called Iron Mountain and the delineation of a tributary of Big Creek containing Kaolin chert. Iron Mountain, which is the main outcrop area of Kaolin chert, was plotted using the Esri aerial topographic map and the Cobden/Kaolin Chert Source Zone National Register of Historic Places Inventory-Nomination Form (Pulcher 1975). The edge for Iron Mountain was determined predominately by identifying the approximate base of the mountain. The tributary of Big Creek was identified in the Kaolin outcrop figure from Koldehoff (1985). Both Kaolin outcrop areas are shown in Figure 13.

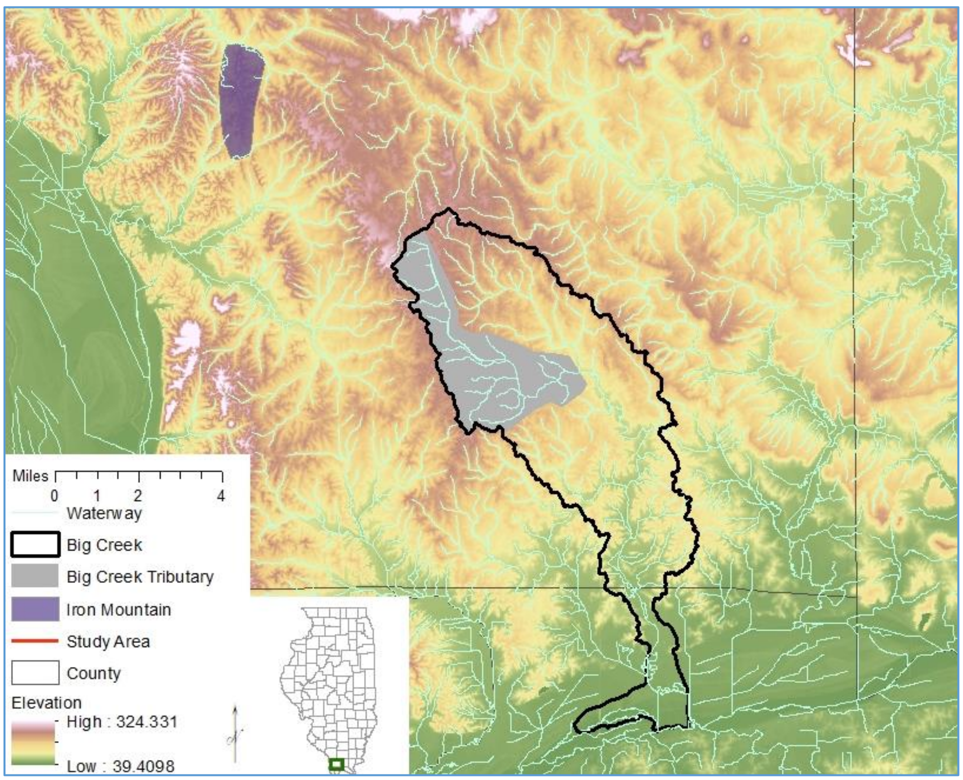


Figure 13 Delineation of Iron Mountain outcrop area

3.1.3 Outcrop Predictor Delineation

The next step taken towards the completion of a final prediction surface was the production of a slope shapefile using three 1/3 arc second DEMs as the base layers. By first clipping the DEMs to the counties it enabled faster processing time of the slope tool while eliminating large unnecessary areas in the final slope raster. Percent grade was chosen as the measure of slope with categories of slope steepness delineated using the slope steepness index created by the Barcelona Field Study Center (2017) (Table 2).

Table 2 Barcelona Field Study Slope Index and Raster Cell Reclassification Values

Slope type	Percent Slope Classifications	Slope Reclassification Values
Very Steep Slope	>100	400
Steep Slope	70-100	400
Extreme Slope	45-70	300
Very Strong Slope	30-45	200
Strong Slope	15-30	100
Moderate Slope	9-15	No Data
Gentle Slope	5-9	No Data
Very Gentle Slope	2-5	No Data
Near Level	0.5-2	No Data
Level	0-0.5	No Data

In order to identify all slopes with potential for chert outcrops the slope raster was reclassified using the classification scheme summarized in Table 2. All area with a slope less than 15 percent was deemed extremely unlikely to produce chert outcrop, therefore, these areas were given a no data cell value. The highest weight was assigned to cells with a greater than 70 percent slope value since these areas are the most likely to contain outcrops.

Areas where water eroded the landscape were obtained by using the Spatial Analysis Hydrologic tool set in ArcGIS Version 10.4. First, the original 1/3 arc second DEM data layers were merged together using the mosaic tool with default input parameters. This combined raster was entered into the fill tool to remove imperfections in the raster. Flow direction and flow accumulation tools produced the first estimates of water accumulation points in the study area. When performing the flow accumulation, a float data output type was selected.

The flow accumulation ranged from 0 to 6,584,680 m^2. This prompted the use of the raster calculator to narrow the range of data for better display. A new raster was created by taking the Log10 of the flow accumulation raster which limited the raster cell range from zero to just less than eight. Several different methods of classification of the data were attempted to produce the optimum results, including several different methods of classified symbol and stretch types. After consideration of all symbiology attempted only one appeared to show a sufficient number of water denuded areas without limiting the raster to large rivers or including a significant number of small fragmented segments. The selected classification type was the natural breaks classified method with five classes.

From the five classes in the classification scheme the range of data from the top two classes was sufficient to show the area of water accumulation. The two classes were selected for using the raster calculation of Con("FlowAccumulationLog10",1,0,"Value >=2.082510914"). The numerical value used in this calculation is the lowest number included in the two selected natural break classes. Finally, the raster was reclassified to only include data values above 2.082510914 leaving all other cells with no data.

After completion of this water accumulation raster, it was transformed into a polygon using the raster to polygon tool. The simplify polygon tab was left unchecked in order to keep the exact shape of the accumulation raster. By transforming the raster to polygon, it enabled the removal of water accumulation points caused by modern influences. The water accumulation polygon was then clipped to the maximum extent of all chert outcrop areas and overlaid on a Esri aerial and Esri Topographic base map. Areas were removed from the shapefile where the water accumulation polygon was aligned with modern ditches, overlaid on top of modern strip mines, or run through buildings. An example of these modern influences can be seen in Figure 14.

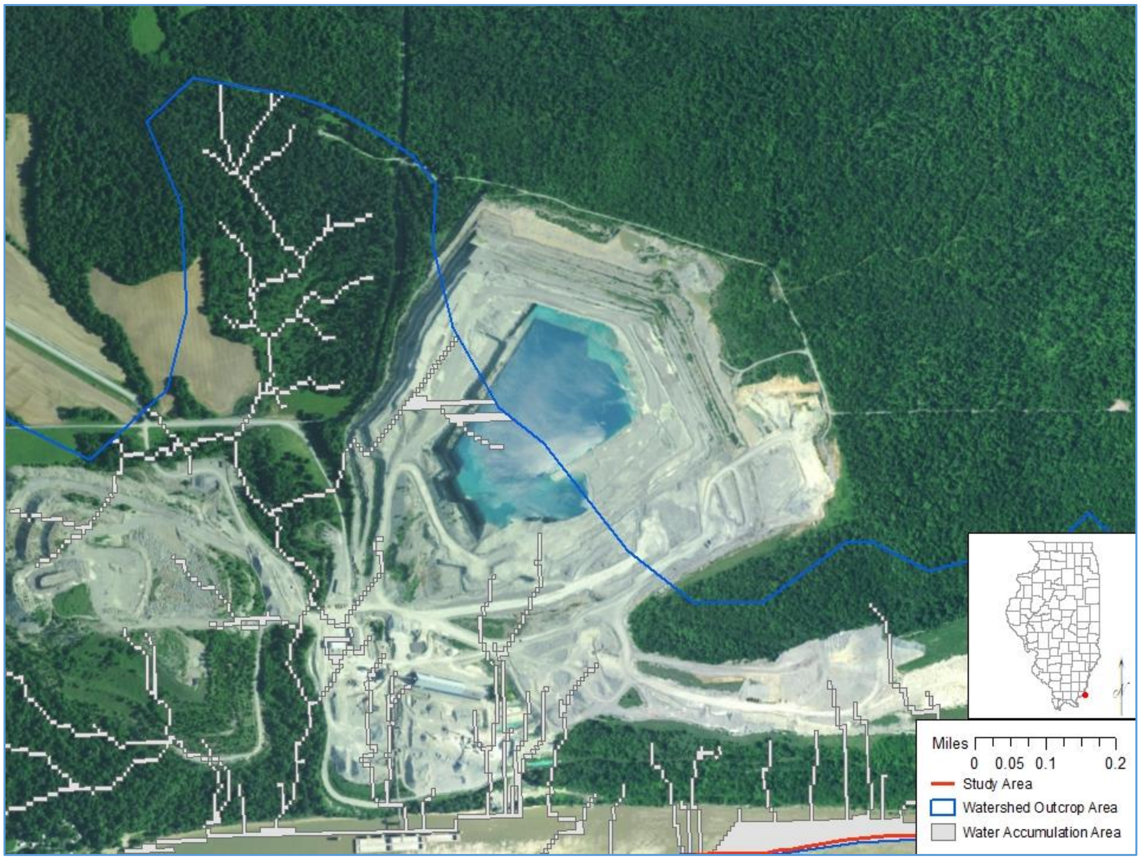


Figure 14 Water accumulation polygon overlay with modern influences

When all obviously modern parts of the water accumulation polygon were removed, the polygon was subjected to the Euclidean Distance tool with a cell size of 8.2. By using the Euclidean Distance from the accumulation areas, the influence water has on erosion of the landscape materials and the remaining landscape material could be predicted. The closer the very steep slopes and steep slopes are to water the more likely these slopes are made up of bedrock outcrops. This is due to the more impermeable nature of rock vs. the surrounding soil. To map these influences, first, the Euclidean distance raster needed to be reclassified (Table 3).

After the reclassification, the Euclidean Distance raster was added to the slope raster using the Cell Statistics tool with an overlay statistic of Sum while ignoring the no data cells in

Table 3 Euclidean Distance Reclassification Values

Distance from Creek in Meters	Reclassification Values	Distance from Creek in Meters	Reclassification Values
0-10	25	130-140	12
10-20	24	140-150	11
20-30	23	150-160	10
30-40	22	160-170	9
40-50	21	170-180	8
50-60	20	180-190	7
60-70	19	190-200	6
70-80	18	200-210	5
80-90	17	210-220	4
90-100	16	220-230	3
100-110	15	230-240	2
110-120	14	240-250	1
120-130	13	>250	0

Table 4 Combined Raster Classification Break Values

Classification Break Values			
24	124	299	404
25	199	304	409
99	204	309	414
104	209	314	419
109	214	319	424
114	219	324	
119	224	399	

the source datasets. The combined raster was finalized by classifying the range of cell data identified in Table 4. All cells with values less than 24 were excluded from the dataset.

The final combined raster was used to produce the four chert types prediction model. The use of the final raster was dependent on the availability of data on the outcrop areas for each chert type. Mill Creek and Cobden/Dongola chert were clipped to the geologic formations extent inside the predetermined watersheds. Then polygons were constructed to encompass only those streams inside the watershed downstream of the geologic areas Figure 15. The Euclidean distance raster was clipped to the downstream boundary polygons with only the closet two raster values included in the output clipped raster. A most probable outcome can be seen by using the final combined raster only in areas where the geologic formation is known to outcrop while using the Euclidean distance for the creeks downstream of the geologic formation.

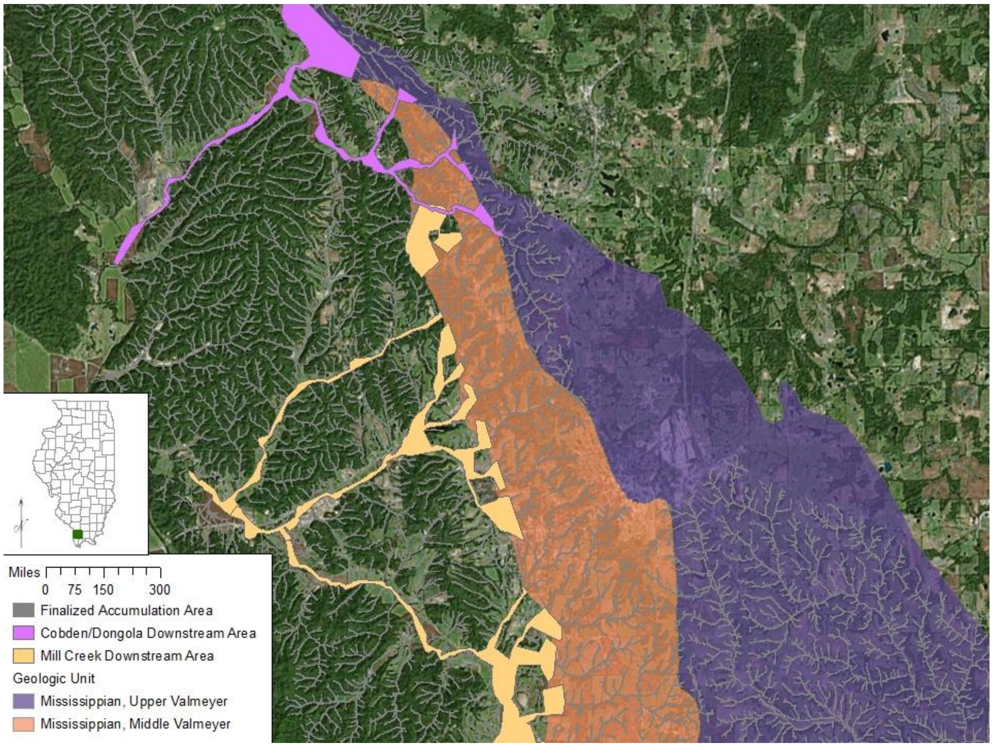


Figure 15 Downstream creek identification

The entire watershed area and geologic feature identified as containing Kaolin chert was used to delineate the final combined raster. This was done because there is no known geologic formation. Therefore, there is no known geologic formation extent and the geologic formation has an unknown probability of being found anywhere in the watershed and geologic feature area.

The final combined raster was delineated for Burlington chert using the watershed shapefile shown in Figure 12. Areas included in the watershed shapefile from another geologic unit were determined to potentially contain Burlington chert outcrops. These included areas are small and from the overlying geologic formation. There is potential for the overlying geologic formation to be eroded away to reveal the Burlington formation underneath. Additionally, the geologic formation in the Mississippi floodplain did not produce slope in the range used for this probability study except for banks of modern waterways. Therefore, the floodplain was eliminated as a potential source of Burlington chert in this study.

3.1.4 Validation of Outcrop Prediction Study

The chert samples collected and recorded during the author's previous work were used to validate the prediction study (Borgic 1999, 2000). All of the chert collected from these previously conducted reconnaissance surveys was collected from road right-of-way's or areas where the landowner gave permission to collect the samples. Other outcrop locations were recorded where no samples were collected. The 11 recorded locations in this previous study were recorded on paper. For this study, the recorded locations were plotted as a point shapefile for the chert types included in the study. The plotted locations for the previous reconnaissance survey were overlaid onto the prediction surface to determine if the predictions accurately depicted the real-world outcrops.

3.2 **Chert Distribution Analysis**

The chert distribution analysis was heavily dependent on the available site reports containing usable chert analysis data. Archaeological reports reviewed from before the 1970s did not include chert analysis. Chert analysis was competed for some sites reported upon in the 1970s but it was typically limited to the number of chert pieces found per chert type and/or percent of each chert type found on individual sites. The early 1980s reports saw the beginnings of weight data included in cultural resource reports. By analyzing weight data along with the number of pieces of chert found it was possible to analyze chert across sites.

The two following subsections describe the methods of data collection and data analysis employed in this thesis. The outcome of this distribution analysis may differ somewhat from similar distribution analyses for the same area due to the availability of reports. This analysis is intended to be a general overview of chert distribution in Southern Illinois in areas where data were available.

3.2.1 Archaeological Site Data Collection and Tabulation

Archaeological site data is reported in site reports prepared with input from the Illinois State Historic Preservation Office. Access to these reports was gained through the Illinois CRM Reports Archive from the Illinois State Archaeological Survey. In this archive, PDFs of archaeological site reports are searchable by a variety of variables including county, major component, and CRM phase (Figure 16).

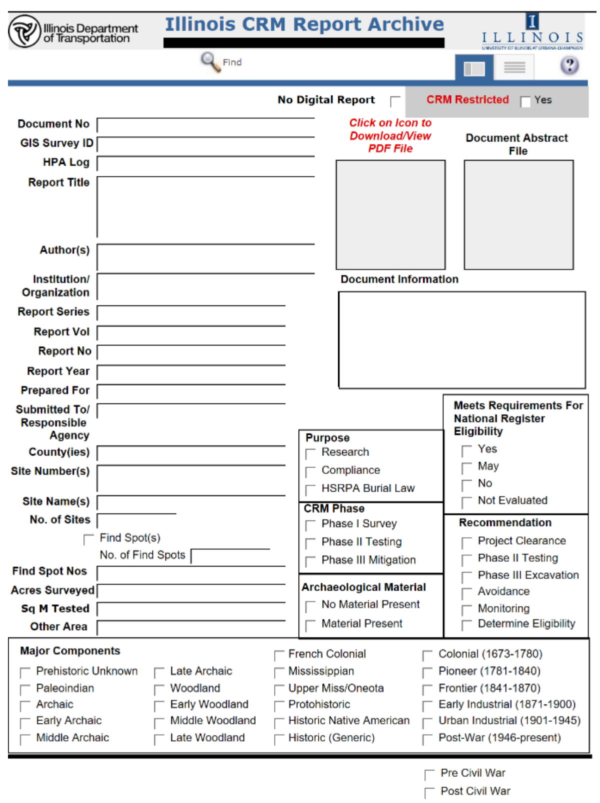


Figure 16 Search criteria available in the Illinois CRM Report Archive

To search systematically through the reports, it was determined necessary to search by county. As the CRM Reports Archive is in essence a professional crowd sourced repository for site reports with what appears to be little review of entries, all report entries identified with relevant county origin were reviewed in addition to 340 reports without county affiliation. The number of available reports in the study area per county is shown in Table 5.

Records were identified with Phase II and III archaeological data for the Archaic, Woodland, and Mississippian components within the study area. Archaic and Woodland components identified in the CRM Reports Archive were in some cases identified by sub-periods of time indicated by the terms early, middle, and late. These sub-periods were identified in the Appendix A sub-period columns to facilitate further study on this subject. Two Mississippian sub-periods not identified in the CRM Reports Archive search criteria but identified in the PDF reports and recorded in Appendix A are Emergent and Late. For this study, all Archaic sub-period data for each site was combined to show a broad picture of changing chert utilization over time. The same applied for the Woodland and Mississippian components.

The PDF from each CRM Reports Archive record, whose recorded entry appeared to identify the sought-after criteria, was opened in windows. Additionally, reports with a title of potential interest with limited data entered on the CRM Reports Archive record were also viewed for potentially usable data. To determine if the sought-after data were present, a quick scan of the document was completed. If the document was found to contain the desired chert data, it was saved for further examination.

After all the report records were viewed and the relevant PDFs were collected, the data was entered into an excel spreadsheet as each PDF received a thorough examination (Appendices

Table 5 Reports Reviewed for Relevant Data from the CRM Reports Archive

County	Total Records identified for each County	Identified in database as Phase II Reports	Identified in database as Phase III Reports	Usable Reports
Alexander	147	10	4	yes
Pulaski	92	8	0	yes
Massac	135	11	3	yes
Union	175	8	0	yes
Johnson	104	9	0	yes
Pope	126	14	0	yes
Hardin	89	4	0	no
Jackson	357	42	10	yes
Williamson	328	7	0	yes
Saline	202	10	1	yes
Gallatin	124	13	5	yes
Randolph	278	13	0	yes
Perry	131	19	6	yes
Franklin	212	10	1	yes
Hamilton	84	1	3	yes
Monroe	376	79	12	yes
St. Clair	1,369	142	12	yes
Washington	119	2	0	yes
Clinton	209	10	3	yes
Jefferson	225	14	5	yes
White	127	1	0	no
Wayne	88	0	0	no
Marion	174	17	2	no
Fayette	159	4	4	yes
Bond	117	7	1	yes
Madison	1,632	284	39	yes
Edwards	37	1	0	no
Wabash	77	0	0	no
Clay	75	1	0	no
Richland	40	0	0	no
Lawrence	69	2	0	no
Effingham	150	4	0	no
Jasper	52	2	1	no
Crawford	59	0	2	no
No County affiliation	340	6	0	yes

A and B). Site reports were deemed usable if the number of chert pieces found and the weight in grams of the chert by type was available. Data was used for a limited number of sites that only identified chert type, count, and weight for recognizable tools and in some cases another subset of the entire chert collection. This decision was made because the portion of the collection not identified by count and weight were predominately debitage, the waste material left over from tool production. The tools were deemed representative of the entire collections because the debitage was removed in the process of creating the tools.

When recording chert types and weights, the data were recorded from the available site reports for the entire site or for specific cultural components. Multicomponent site data was recorded as the data were represented in the report. For reports that presented data by individual cultural component, the chert data were recorded by individual component and then summed for the entire report. Individually tabulated cultural component data for components not included in this study were not tabulated into the total report chert counts. When reports included data delineated by cultural component and data where no temporal affiliation was known, the unaffiliated data were recorded with the total site chert data. Where site data were recorded for all components collectively only the site total was recorded with no attempt to delineate chert by component. Both the individual component data when available and the total site data were recorded in order to perform geospatial queries selecting for specific cultural components or total site data. The site type column in Appendix A contains numeric indicators to differentiate the data recording methods, as shown in Table 6.

In many cases each chert type's counts and weights were not totaled per site, per cultural component, or per artifact type. Data was presented in raw data format with individual artifact attributes, in tables by geographic location, or in tables delineated by artifact types. In all these cases where total chert counts and weights were not recorded, the counts and weights were tabulated from the multiple tables presented in the reports.

Table 6 Appendix A Site Type Identifiers

Appendix A Site Type Identifier	Explanation of Identifier
1	The data recorded in the available report is from only one cultural component from a single component site or a multicomponent site with only data recoded in the report for one component
2	The data recorded in the available report is from only one cultural component from a multicomponent site
3	The data recorded in the available report is documented for all cultural components from a multicomponent site
4	The data is calculated for all identifier two entries for each site
5	The data is calculated for all identifier two entries for each site plus additional component data and/or indeterminate component data recorded for the site

After thorough review of the available reports in the study area, only a small portion contained the appropriate data to include in this study. A total of 179 reports were utilized from a total of 24,093 reports entered into the CRM Reports Archive as of July 7th, 2017. From these reports 317 sites were entered into Appendices A and B.

Subsequently, after collecting the raw data, calculations were performed on each row of data to obtain the average weight of each chert type and total weight for all the chert per entry (Appendix B). The total chert weight per chert type and component was calculated to compare chert types. Additional tabulations were conducted from this core data set to support the research questions identified in Sections 2.2.1 through 2.2.4. These results are presented in Chapter 4.

3.2.2 Archaeological Site Map

All the reports included in this study contain PDF map imagery. These maps are in varying degrees of detail, scale, and correlation to today's geospatial imagery. Generally, each report contained a small and a large-scale image of the site or sites contained in the report and surrounding geospatial features in simple line and point shapes. Some reports contained the location of surrounding archaeological sites. These multi-site maps were generally limited to sites excavated for the same project but reported on separately.

It was necessary to plot all sites individually into a point shapefile using Esri topographic and imagery base maps as a guide for site placement. Additional sources used to correctly place each site include the National Hydrology Dataset overlaid on the Esri base map and Google Map searches for geospatial elements identified on the PDF maps. Cemeteries were the most often depicted feature on the PDF imagery that could be searched for via Google Maps. These searches gave the author a general area to focus on when looking for the exact location of each site. When determining the exact location of each site's center, topo lines, roadways, and creeks were of the most help. The center of each site was visually estimated from the PDF imager. As most sites are not circular the author used best judgement when determining the center of each site.

Since the majority of the sites were investigated, excavated, and recorded as the result of modern construction, the sites tended to center around roadways, damns, lakes, borrow pits, or pipelines. Site dispersal across the study area was heavily dependent on the time each site was recorded, the construction needs of the area, and the availability of reports in the CRM Reports Archive. Rural areas contained less available site data than metropolitan areas due to less state and federally funded construction. Given the above-mentioned restrictions it is not surprising that the rural eastern section of the study area did not contain any usable site information and the western portion of the study area known as St. Louis Metro East contained the greatest number of usable site data.

In addition to these modern data imbalance factors, prehistoric preferences for site locations were also at play. St. Louis Metro East contains the largest existing prehistoric mound group in the U.S. along with numerous outlier villages and towns. This prehistoric preference is due to the prime transportation location at the junction of three major rivers. Given the restrictions and preferences of the aforementioned prehistoric and modern human activities the distribution analysis area is significantly smaller than originally planned (Figure 17).

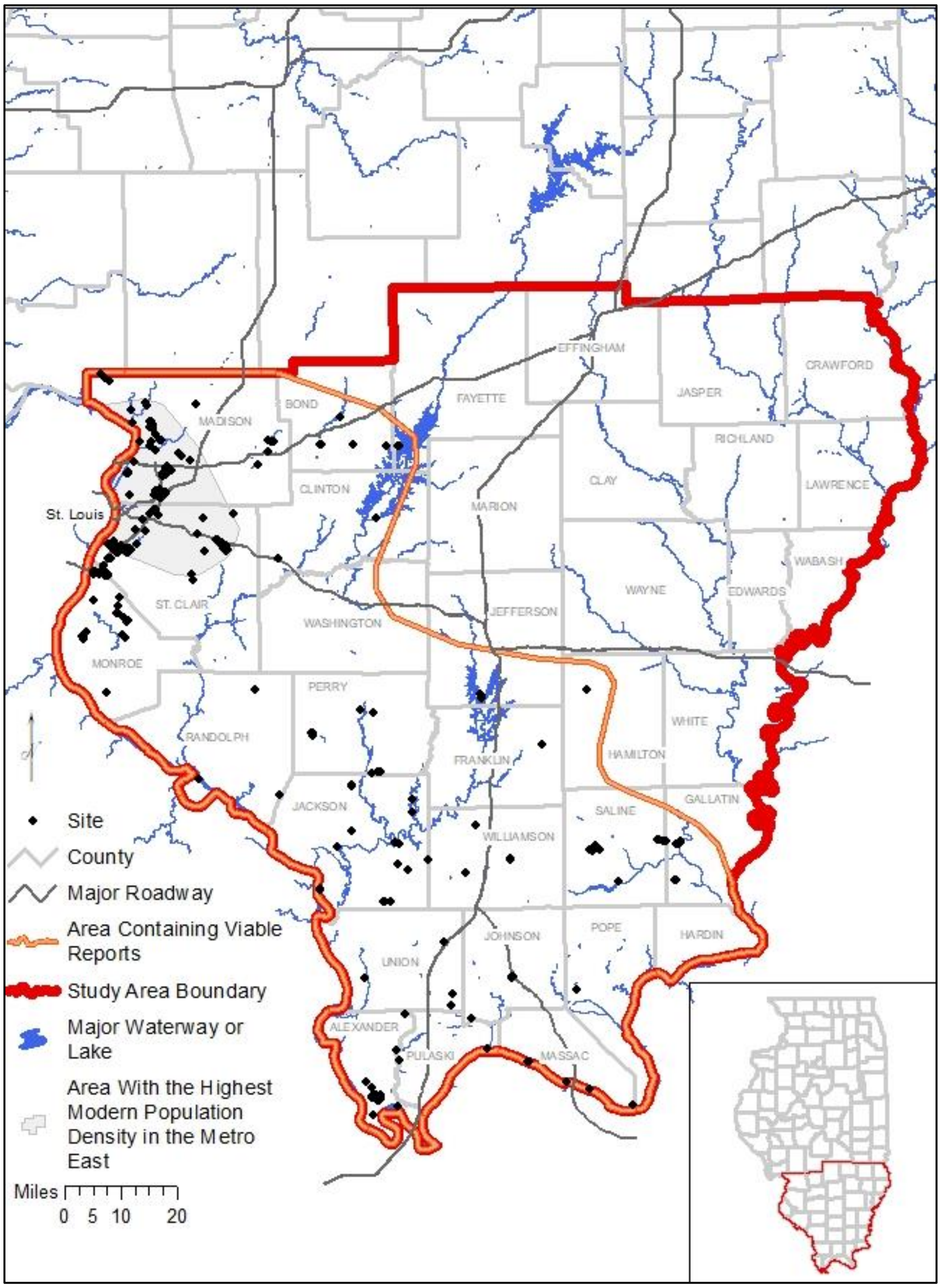


Figure 17 Site locations and modern influences on archaeological sites

3.2.3 Distribution Analysis

The initial setup for the distribution analysis started by creating a comma separated value (CSV) file from the sites data excel spreadsheet. The CSV was added to ArcMap along with the sites shapefile. Two fields were added to the sites shapefile for X and Y coordinates. The coordinates were calculated using the Calculate Geometry tool with parameters set for the X or Y coordinates of each point and using the NAD 1983 State Plane Illinois West FIPS 1202 coordinate system in meters. The sites shapefile was joined to the CSV site data file. The joined CSV file was subsequently displayed in ArcMap using the X and Y coordinates imported from the sites shapefile. In order to facilitate reproduction and manipulation of the joined CSV file, the data from the joined CSV file was exported into a data shapefile.

The compiled shapefile was copied numerous times to accommodate all of the different parameters this study included. The comparative analysis was visualized by utilizing the graduated symbol break values listed in Table 7. Break values were determined in order to show all site weight data at the same scale across all parameters and to visualize the weight classes where the highest concentration of site data was accumulated. The median weights for each chert type were used to determine appropriate break values. In order to not bias the data, the median weights were calculated without zero weight entries. This produced medians between 1.8 and 86 g. Since the median weights were all very small compared to the total range of weights, smaller intervals were used for lower total weight and larger intervals for larger total weights to show a visual change in the data while not including an exorbitant number of break values and classes.

Table 7 Graduated Symbol Break Values for Chert Weight

Symbol Break Values						
10	120	800	9000	19000	29000	39000
20	140	900	10000	20000	30000	40000
30	160	1000	11000	21000	31000	41000
40	180	2000	12000	22000	32000	42000
50	200	3000	13000	23000	33000	43000
60	300	4000	14000	24000	34000	44000
70	400	5000	15000	25000	35000	
80	500	6000	16000	26000	36000	
90	600	7000	17000	27000	37000	
100	700	8000	18000	28000	38000	

By using the expression queries in Table 6 and selecting for the appropriate chert weight from Appendix B as the value field for the graduated symbol, comparable data layer files by chert weight for each component in this study were created. Additionally, each chert used in the analysis for total chert weight for all components. In all imagery where the data entered was zero for a given parameter at a site, the site was not displayed on the image. This was accomplished by using the data exclusion tool to remove any site from the dataset with zero weight as the data value. Finally, to give an informative view of the component's distribution across all sites, layer files were created using the expression queries in Table 8 to show distribution of each individual component site and multicomponent sites across the landscape. A total of 20 layer files were created and are displayed in 17 comparative images in Chapter 4.

The final comparative analysis completed on the site distribution data included comparisons between kernel density imagery of the total weight of each chert type by site and the average weight of each chert type by site. Kernel density input parameters were the same for all chert types and weight category to facilitate comparison. The kernel density analysis was performed on the data found in Appendix B with either the total weight or average weight column selected for each chert type and using the distribution of total weight per chert type definition query from Table 8. The output cell size used was 692.1 which is the width of the output extent divided by 250. Since the site locations are spread across a large area with clusters of sites around modern construction areas, several trials were attempted on different search radii in order to find an appropriate radius for this study. A radius of 4,828.032 m or 3 mi was found to be sufficient to show the spread of chert across the landscape. The final input parameter for the kernel density analysis included area units in square meters, the use of density output values and a planar distance in meters.

Table 8 Expression Queries for Chert Types

Component	Distribution of Sites by Component only	Distribution of Sites by individual Chert type Total Weight and Component	Distribution of Total Weight per Chert Type
Multicomponent	[Sitetype] > 2		
Archaic	[Sitetype] < 3 AND [Period] LIKE 'Archaic'	[Sitetype] < 3 AND [Period] LIKE 'Archaic'	
Woodland	[Sitetype] < 3 AND [Period] LIKE 'Woodland'	[Sitetype] < 3 AND [Period] LIKE 'Woodland'	
Mississippian	[Sitetype] < 3 AND [Period] LIKE 'Mississippian'	[Sitetype] < 3 AND [Period] LIKE 'Mississippian'	
All Component			[Sitetype] = 1 OR [Sitetype] > 2

Each output density shapefile was modified to show the best possible view of the kernel density data. Since all the density values were very low it was necessary to change the classification scheme to geometrical interval. This allowed for the density map to show the data in multiple categories instead of containing most of the data in the lowest interval. As an added visual enhancement, data with a zero data value were excluded from the final density image. The completed density images included eight shapefiles representing the total and average weights of the four chert types. The results and implications of these density images are discussed in Chapter 4.

Chapter 4 **Results**

The resulting imagery included in this section proves theories presented in Section 2.2. in addition to raising a few more questions. The following section demonstrates where data is sufficient and where improvements can be made in future research. Imagery presented here uses the best possible input data at the time this report was created (i.e. 2017). New geospatial data may become available in the future which may add to the outcomes of this thesis project.

4.1 **Outcrop Prediction**

The outcrop prediction proved to be a larger undertaking than originally anticipated. The many transformations to the data to obtain one workable prediction range took careful planning and numerous attempts at different methods to finally produce a workable and viable prediction model. The method outlined in Section 3.1 and presented here in final imagery is the result of many hours of diligent work.

4.1.1 Prediction Model Results

The following series of maps show the outcrop prediction surfaces for Burlington, Cobden/Dongola, Kaolin, and Mill Creek chert. The most probable locations to find chert are in the red spectrum of cells with yellow to blue/grey cells having a decreasing likelihood of chert outcrops. The dark blue end of the predictability range with cell counts of 24 and 25 represent the area's most likely to contain secondary deposits of chert. The 24 and 25 count cells are 20 m or less from the flow accumulation points.

As with all predictability studies testing of the prediction only increases the validity of the prediction model itself. As stated in Section 3.1.4, locations identified during previous chert reconnaissance are used to test the model. At least one reconnaissance location exists for all of the chert types examined in this study. Reconnaissance locations in areas disturbed by modern construction were not included in this study.

The Burlington chert outcrop area included several locations along the bluff line of the Mississippi River (Figures 18 and 19). The Mississippi river exposed the bluff lines when a large magnitude of water rushed through the area during the Ice Age and cut into the bedrock. The outcrop locations along this bluff line are severed and generally enclose parts of smaller tributaries to the Mississippi River waterways but not entire watershed systems. The smaller watersheds included in the Burlington chert prediction area have a significantly smaller influence on the locations of outcrops but their influence is still important. These smaller waterways are responsible for exposing additional areas of Burlington chert after the Ice age.

Burlington waterway influences are significantly different from the other chert types in this study. The other chert types include descriptive areas along creeks as outcrop areas and contain waterways with much less scouring potential than the Mississippi River. Cobden/Dongola chert outcrop in three distinctive watersheds and in a small nondescript area along the Ohio River. Mill Creek chert is identified as outcropping along three distinctive but geographically large creek areas. Kaolin chert has significantly less waterway exposure with only one partial watershed. Kaolin, Cobden/Dongola, and Mill Creek chert do not outcrop on the same massive scale as Burlington chert.

Cobden/Dongola chert has the most geographically expansive outcrop area in this study. The outcrop area includes locations on the east and west sides of the state. The prediction study shows several locations with high potential for Cobden/Dongola chert as can be seen in

(a)

(b)

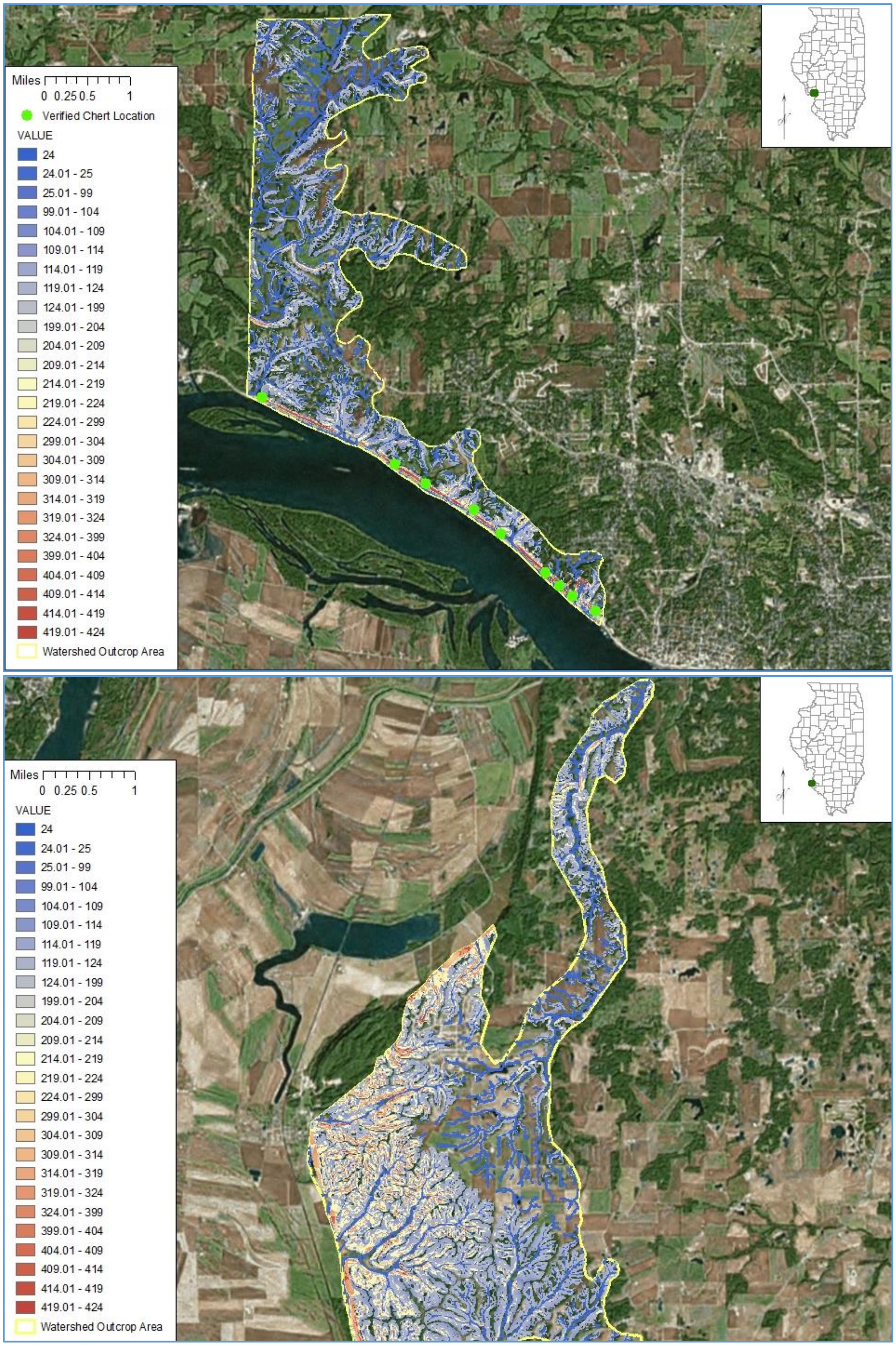
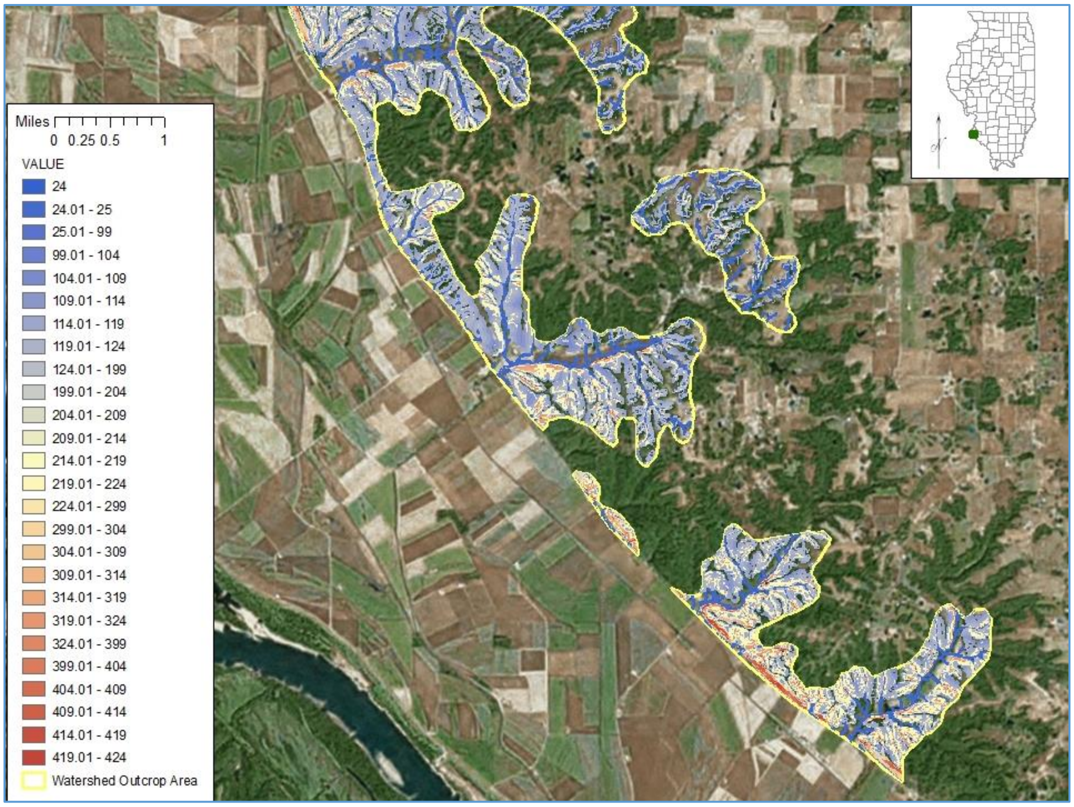


Figure 18 Burlington chert predicted outcrop areas: (a) in Madison County; and (b) in northwestern Monroe County

(a)



(b)

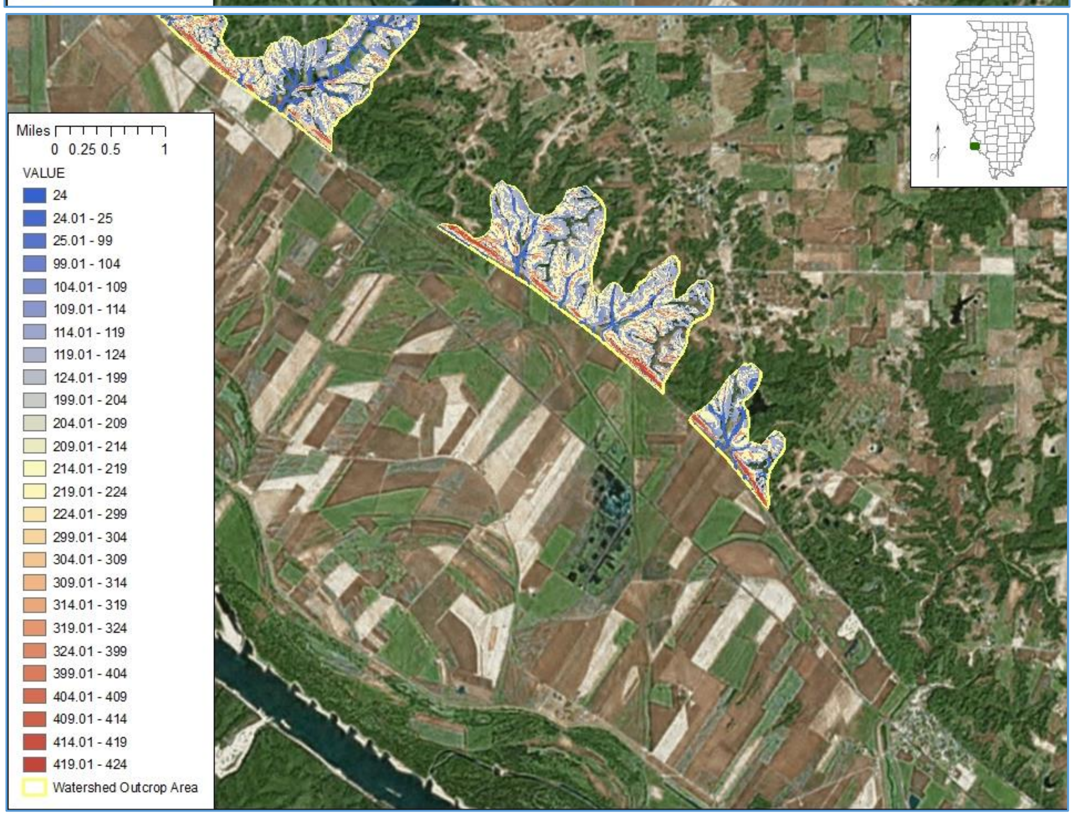


Figure 19 Burlington chert predicted outcrop area: (a) in west central Monroe County; and (b) in southwestern Monroe County

Figures 20 and 21. The high prediction areas can be seen in along the Ohio river (Figure 21b) and in the Clear Creek watershed area (Figure 20a). The remainder of the prediction study shows a mid-range of potential prediction surfaces.

There are several areas where the Cobden/Dongola prediction study is lacking due to the removal of modern waterway systems and the construction of a large modern stone quarry (Figures 14, 20 and 21). When these areas were removed from the prediction study, no information was available at the time of this study to replace them with prehistoric landscape features. Therefore, holes appear in the prediction surface where modern influence occurs. Noticeable are the large area of removal where the modern quarry exists (Figure 21b) and areas occupied by farm fields (Figure 20b). The farmed areas contained a significantly large number of modern influences on waterways. Water was diverted in channelized fashion around the edges of property lines to maximize the amount of tillable land. This channelization is beneficial to modern farmers but it leaves gaps in the prehistoric surficial geologic record of the area.

Kaolin chert by far contains the smallest outcrop area of all the chert types in this study (Figure 22). This is consistent with the small Kaolin chert distribution in comparison to the other chert types included in this study noted in section 4.1. The small distribution amounts can also be attributed to the methods employed by prehistoric peoples to obtain Kaolin chert. In reality, the author is confident that a combination of both small outcrop areas and more labor-intensive methods to obtain Kaolin chert influences not only the distribution but also the areas of known outcrop locations.

The lack of known geologic formations changed the way the outcrop prediction model was used to identified outcrop areas of Kaolin chert. The entire watershed area was assumed to contain potential Kaolin outcrops along with the entire geologic feature know as Iron Mountain

(a)

(b)

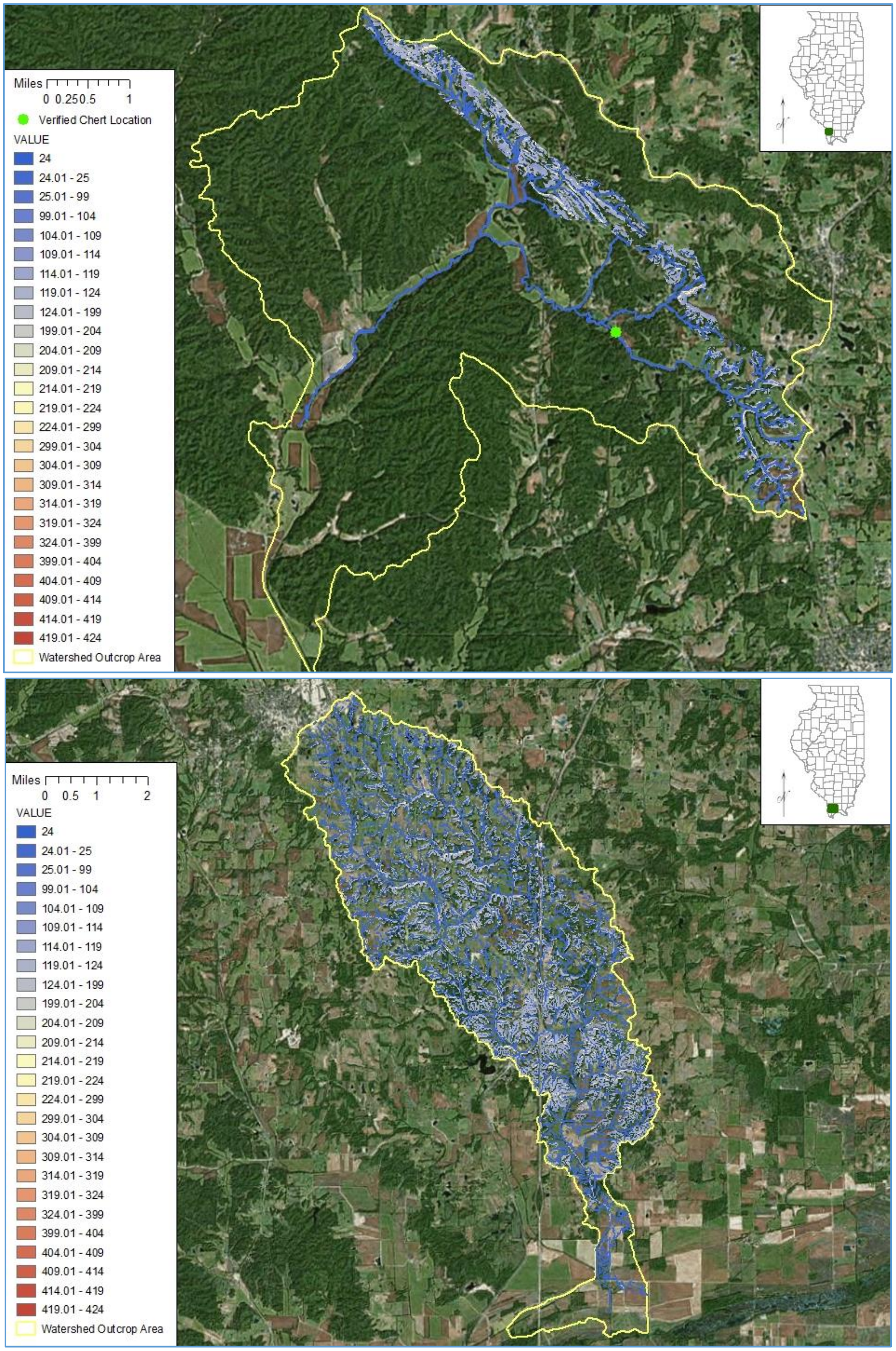


Figure 20 Cobden/Dongola predicted outcrop areas: (a) in the Seminary Fork Clear Creek watershed; and (b) in Big Creek watershed

(a)

(b)

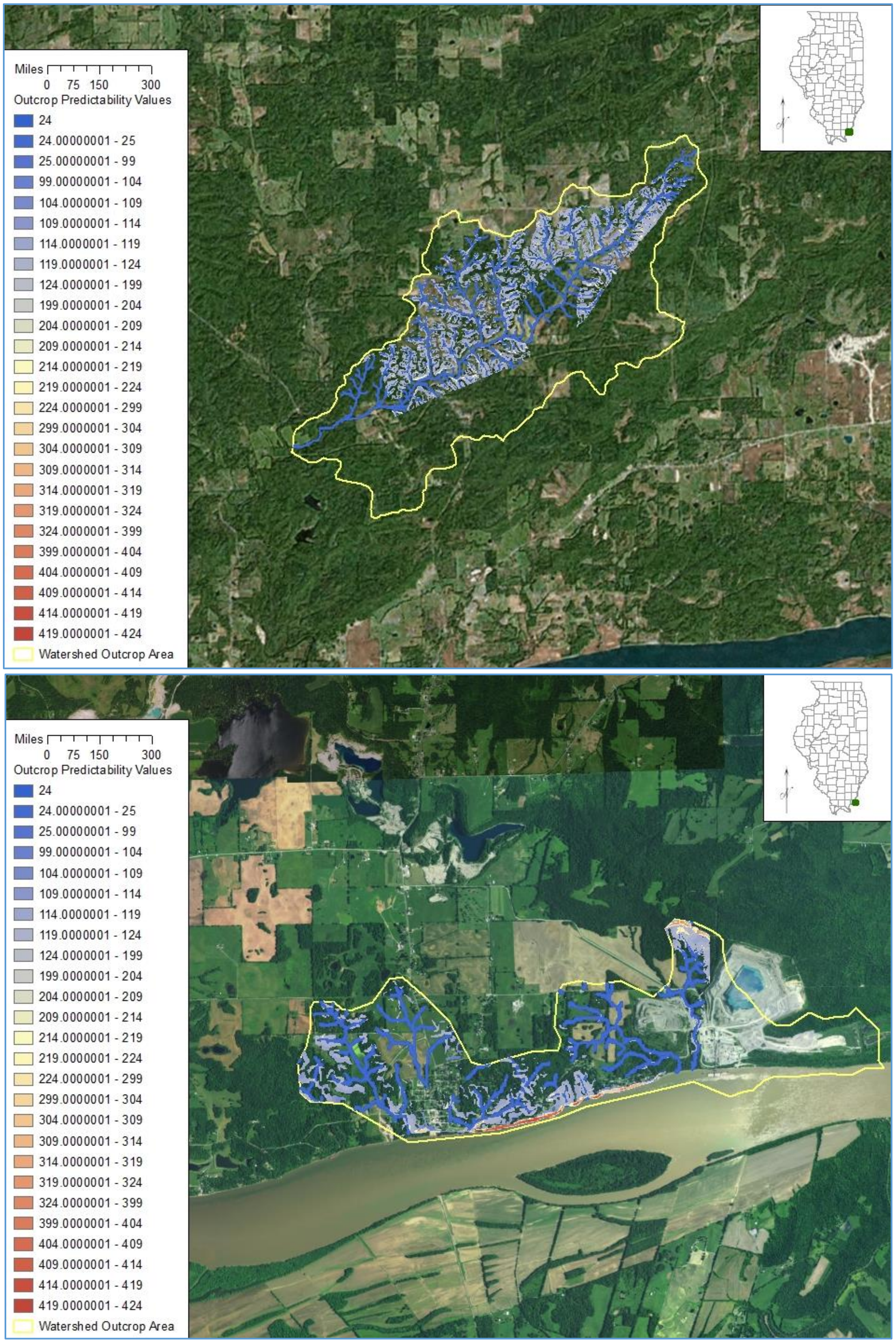


Figure 21 Cobden/Dongola predicted outcrop area: (a) in Hogthief Creek watershed; and (b) adjacent to the Ohio River

(a)

(b)

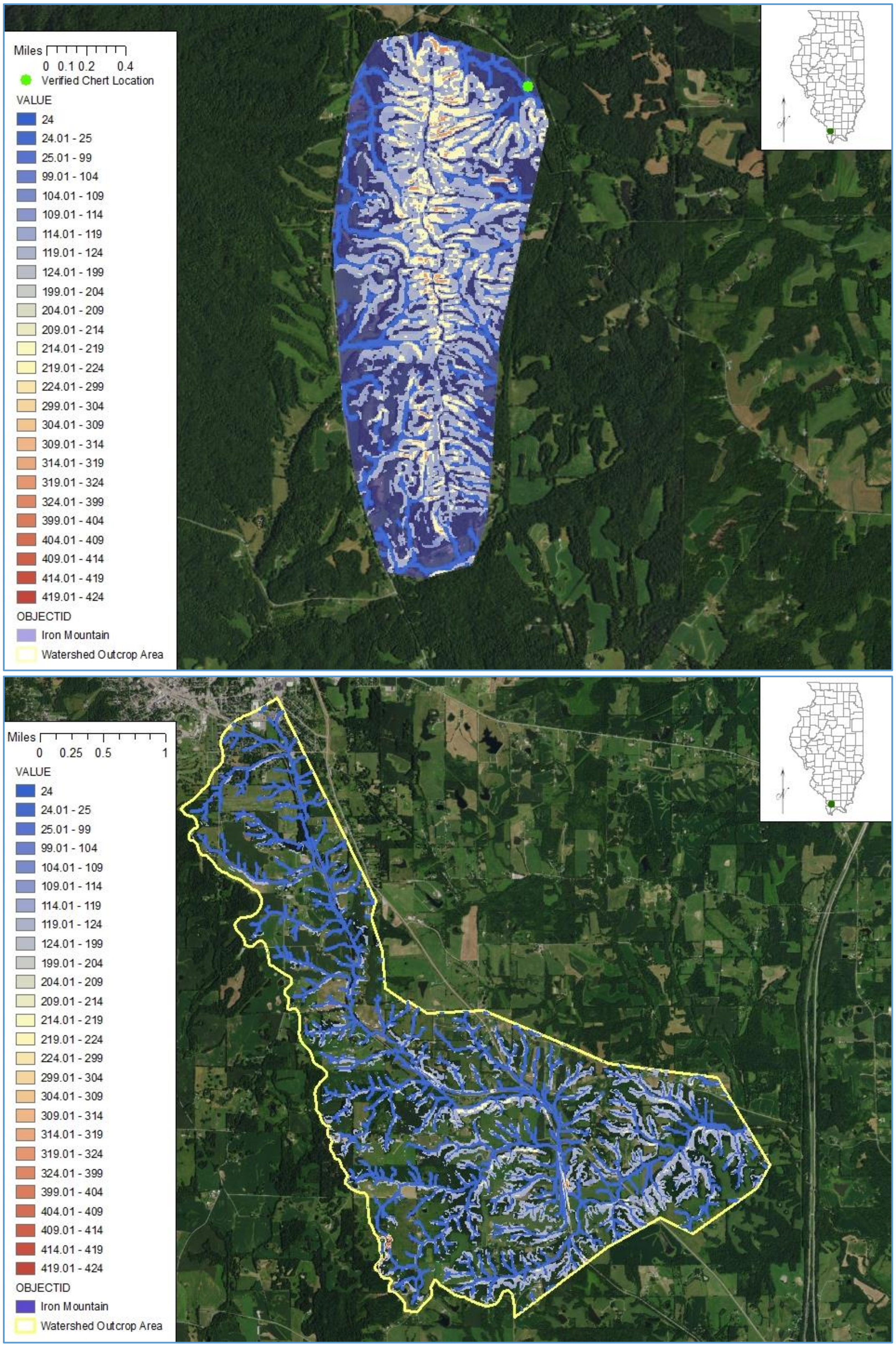


Figure 22 Kaolin chert predicted outcrop area: (a) on Iron Mountain: and (b) in the watershed of a tributary to Big Creek

(Figure 22). By including both areas in their entirety, it is very possible locations are identified as potentially containing outcrops when none exist.

Iron Mountain (Figure 22a) contains the most probable locations to find Kaolin chert in this study. Large areas with the highest prediction surfaces are located within this surficial geologic formation. Outside of the Burlington Chert outcrop areas, no other chert outcrop area in this study contains as much surface area with the highest probable chert outcrop locations. In part, this is attributed to the high percent slope found in both the Burlington chert outcrop area and Iron Mountain.

The Mill Creek chert outcrop locations includes the largest contiguous area of potential outcrop in this study (Figures 23 and 24). Most of the potential outcrop areas have mid-range outcrop probability except for the southern portion of the outcrop area (Figure 24). In this area, there are scattered high range outcrop locations. The high range outcrop areas are a factor of the larger percent slope in the area.

As with Cobden/Dongola chert, the Mill Creek chert outcrop prediction surface contains areas where modern channelization was removed. Again, farming practices played a large part in the relocation and channelization of waterways which is seen predominately in Figure 24. Channelization also played a part in the production of Figure 23a where accumulation points downstream of the geologic surface exposure area appear to end where farm fields occur on the landscape.

The Cobden/Dongola and Mill Creek chert watersheds contain large areas downstream of the relevant geologic surficial exposure areas. As stated in Section 3.1.1 and identified in Figure 15 these downstream accumulation points were included as part of the potential outcrop areas.

(a)

(b)

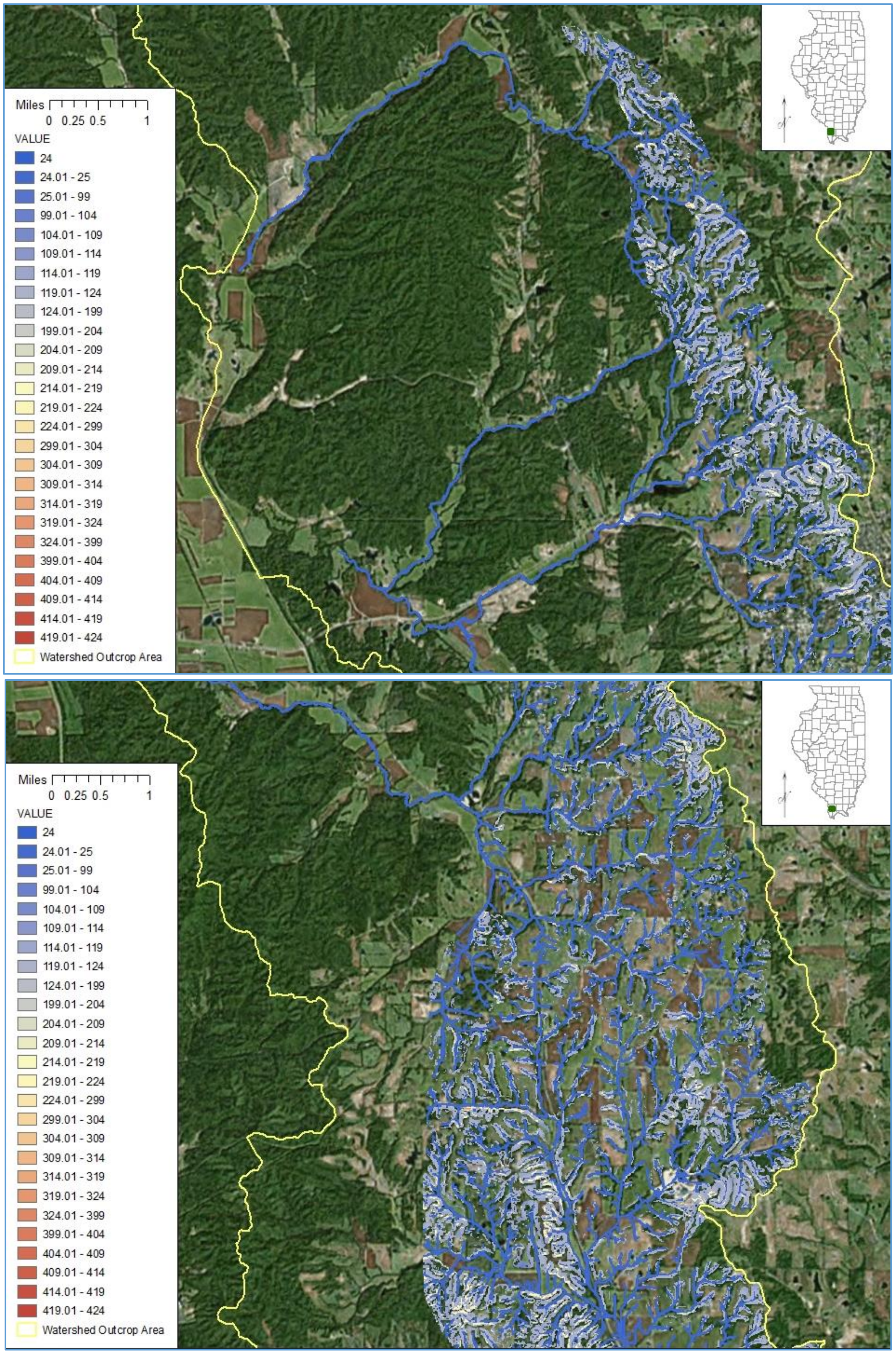


Figure 23 Mill Creek chert predicted outcrop area: (a) in the Seminary Fork Clear Creek and northern Dutch Creek watershed; and (b) in the Dutch Creek and Cooper Creek watershed

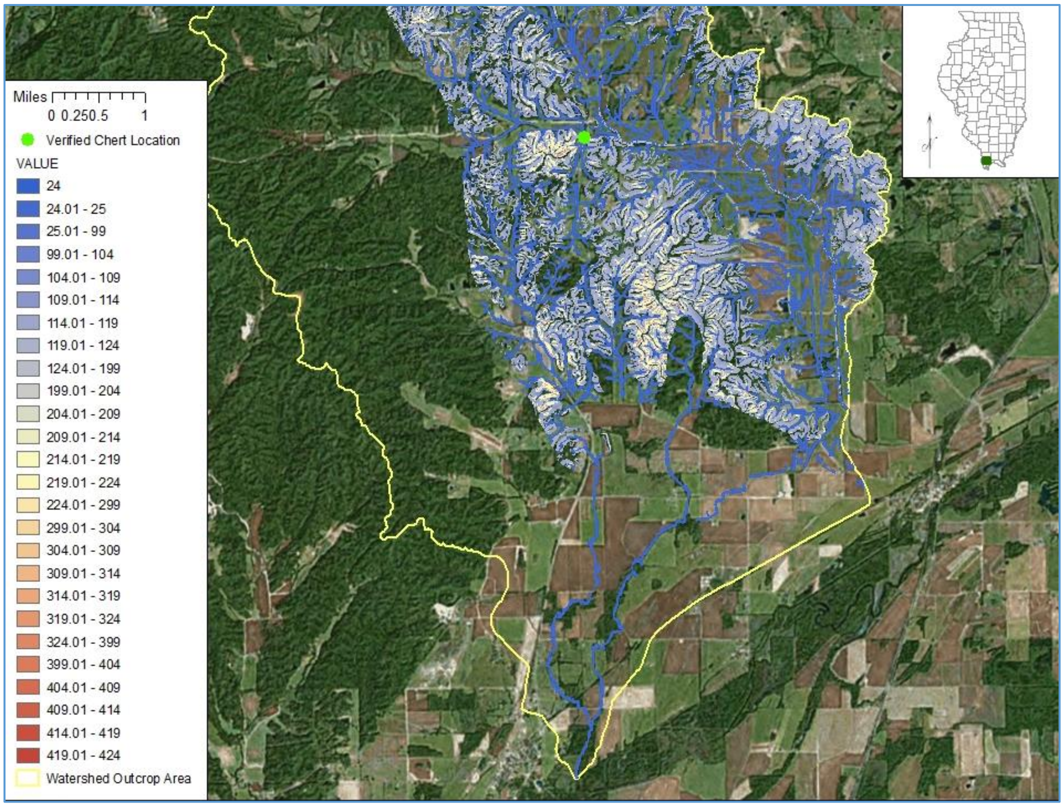


Figure 24 Mill Creek chert predicted outcrop area in the Cooper Creek and Mill Creek watersheds

All other accumulation point locations upstream or not originating inside the surficial geologic exposure area were not included as potential outcrop locations. This process lead to the exclusion of large portions of the chert bearing creeks identified in Sections 2.2.2 and 2.2.3. With the exclusion of these areas the resulting images are believed to contain a more accurate prediction model.

4.1.2 Validation of the Model

The chert outcrop reconnaissance performed by the author was in unison with the outcrop prediction model. Figures 18a, 20a, 22a, and 30 show the location of the reconnaissance locations on the prediction surface. All of the reconnaissance locations are located in areas identified as containing probable outcrop locations.

The Burlington chert reconnaissance locations are located on some of the highest probable locations in the prediction surface. The Mill Creek chert reconnaissance location is in an accumulation point location adjacent to one of the highest probable areas in the outcrop area. As the author was limited in terms of road access in the Mill Creek prediction area, it is extremely probable that the chert found at the Mill Creek reconnaissance location originated from the high probability area upslope from the reconnaissance area.

The Cobden/Dongola and Kaolin reconnaissance location are the same. In both prediction models the point is located in an accumulation area. In the Cobden/Dongola prediction model, the reconnaissance location is significantly downstream from the surficial geologic exposure area. With this in mind, it may be prudent in future studies to include more downstream accumulation points or perform reconnaissance downstream of the outcrop location to determine the distance chert can travel.

4.2 **Distribution Analysis**

There are a few things, if they were made available, that would advance the distribution analysis. The analysis of the chert distribution patterns across the landscape would be greatly improved with additional data points or separated data by component for all of the included multicomponent sites. As can be seen in Table 9 there are 109 multicomponent sites in which the chert data is combined for the entire site and not split up by component. This data proved to be important when analyzing the overall pattern of each chert types distribution but could not be used when showing the distribution analysis of chert types by component. In addition, there were 48 sites with unknown components which could only be used to show the overall distribution pattern (Table 10).

Table 9 Combined Multicomponent Site Component Types

Component	Total	Percent of multicomponent sites
Archaic	67	0.61
Woodland	107	0.98
Mississippian	70	0.64
Total Combined Multicomponent Sites	109	

Table 10 Total Sites by Components

Component	Single Component Sites	Separated Multicomponent Sites	Combined Multicomponent Sites	Total
Archaic	34	4	67	105
Woodland	67	13	107	187
Mississippian	40	12	70	122
Unknown	48			48

From the data presented in Tables 9 and 10, it is clear that Woodland sites are the most prevalent in this study. It is unknown at this time whether the study area as a hole contains more Woodland sites or if the data available is skewed. As the data in this study was limited to the available sites with chert identification statistics, it could just simply be a matter of the practices at the time of excavation and the researcher's knowledge of chert in the area or the much larger time frame in which the Woodland culture was practiced. In addition, the population increasing from the Archaic through the Mississippian time period certainly had an effect on the amount of sites created by indigenous peoples.

Given the above limitations in the data set, chert distribution can clearly be seen across the landscape. The following sections present the analysis completed from the available reports in the study area. Section 4.1.1 compares the total chert weight distribution of each chert type.

Section 4.1.2 compare each chert types total weight for all components to the average size of the chert distributed.

4.2.1 Chert Total Weight Distribution

Each chert type's total weight distribution is displayed in Figures 25-32. The total weight for all sites is used as a general distribution of chert throughout time (Figures 25a, 27a, 29a and 31a). By knowing the general area where the majority of the chert is distributed, assumptions were made on the total distribution of chert from the Archaic to the Mississippian time period.

The majority of the chert types were distributed most heavily around the area of outcrop with lesser concentrations along major waterways outside of the outcrop area. Chert was found less often farther away from the major waterways outside the outcrop area. An exception to this is Mill Creek chert. The distribution of Mill Creek chert is relatively uniform across the study area. This is due to the large pieces of Mill Creek chert used for farming hoes weighing several hundred grams.

Burlington chert use increased from the Archaic to the Mississippian time periods (Figures 25-26) (Table 11). This is most likely due to an increase in population living at the archaeological sites. The general area of deposition in archaeological sites seems to hold true to the total Burlington distribution. The closer to the outcrop the more chert was deposited in archaeological sites. Additionally, archaeological sites along the major waterway have higher concentrations of Burlington chert than the surrounding landscape.

Cobden/Dongola chert was most significantly used during the Woodland component. This supports the aforementioned claims by archaeologists that the blue grey chert was preferred during the Woodland Period (Section 2.2.3). Morrow, Elan, and Glascock (1992) disagreed with

(a)

(b)

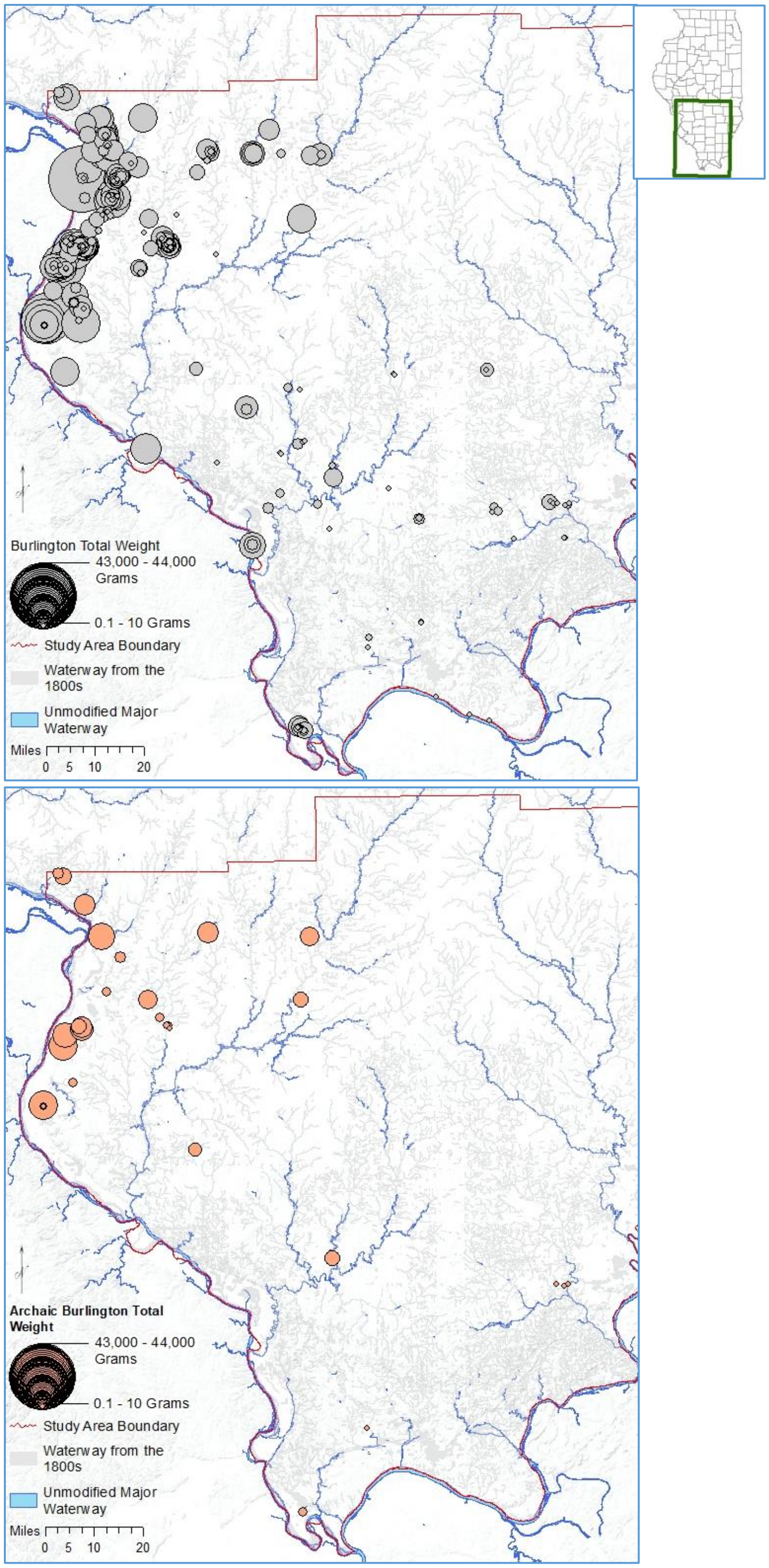


Figure 25 Burlington chert total weight distribution: (a) all components; and (b) Archaic component

(a)

(b)

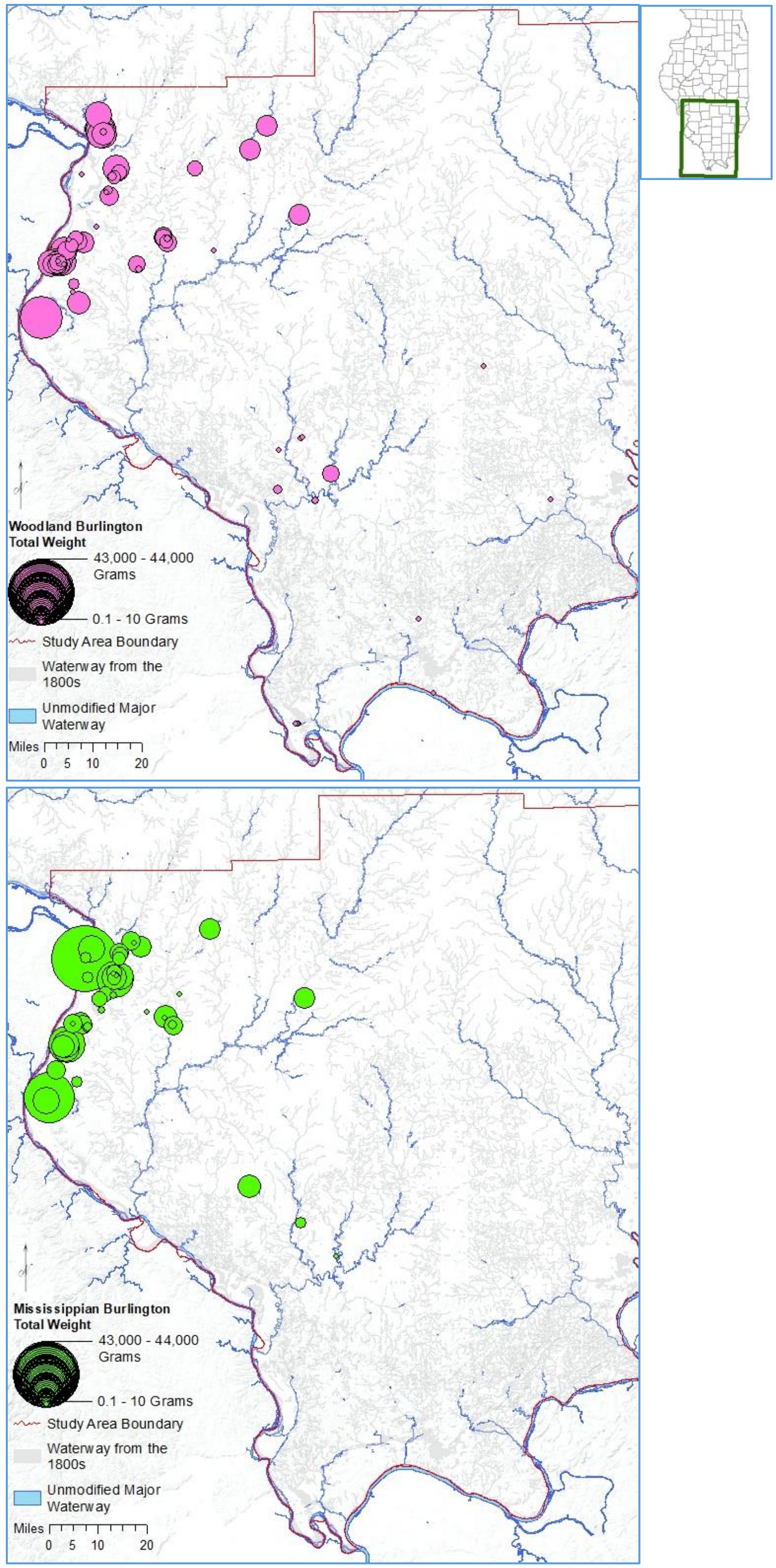


Figure 26 Burlington chert total weight distribution: (a) Woodland Component; and (b) Mississippian Component

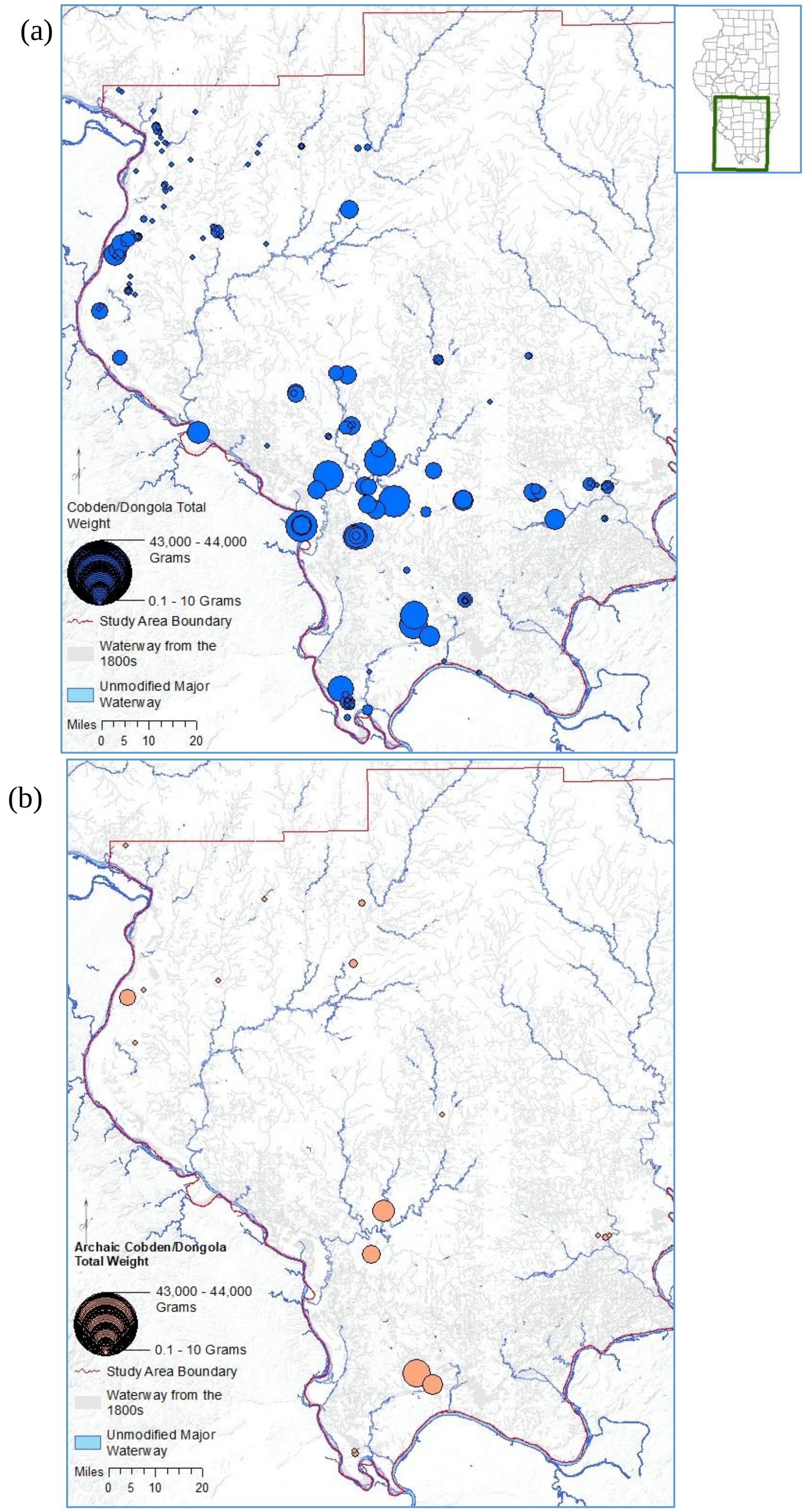


Figure 27 Cobden/Dongola total weight distribution: (a) all components; (b) and Archaic component

(a)

(b)

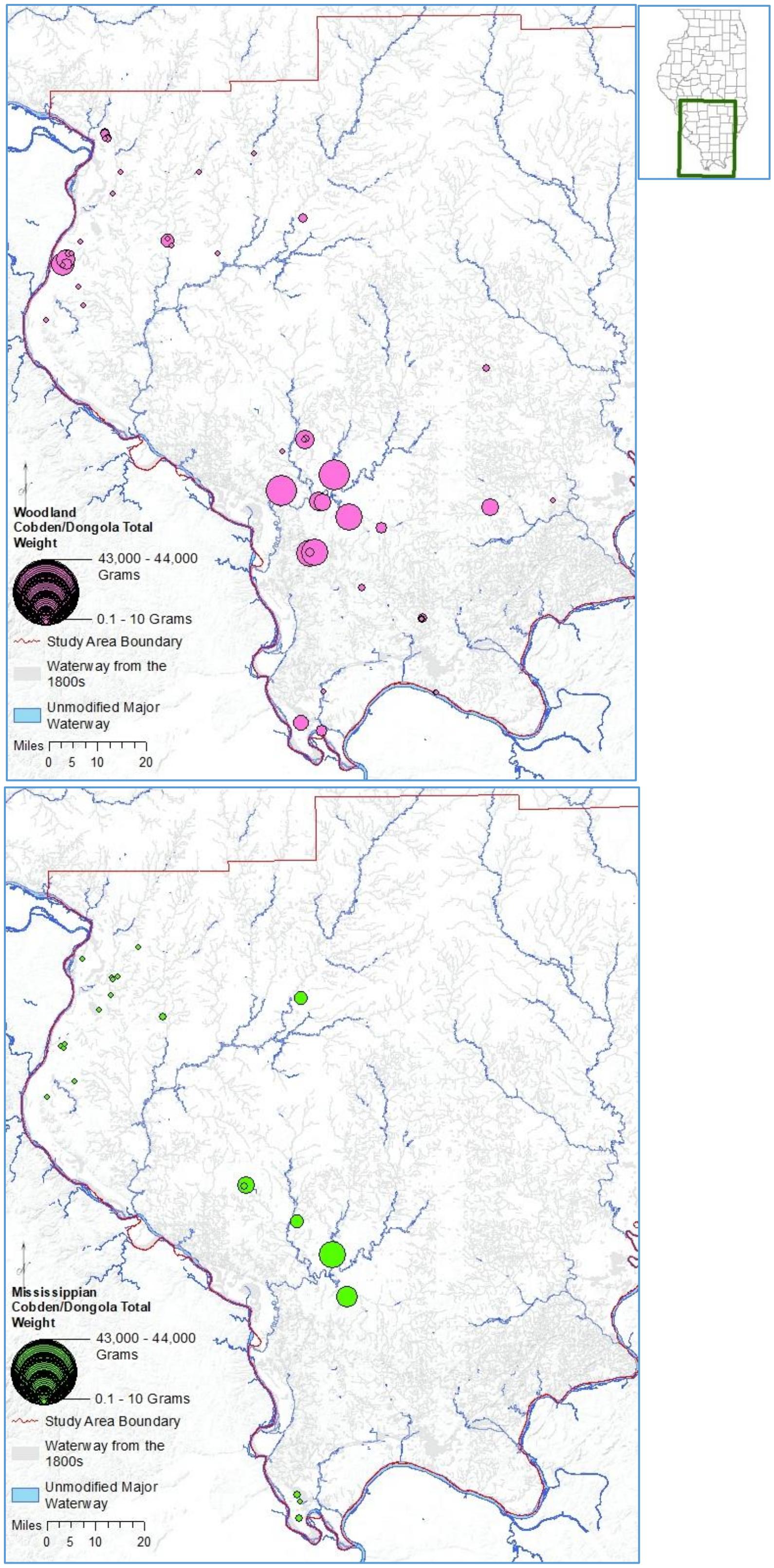


Figure 28 Cobden/Dongola total weight distribution: (c) Woodland Component; and (d) Mississippian Component

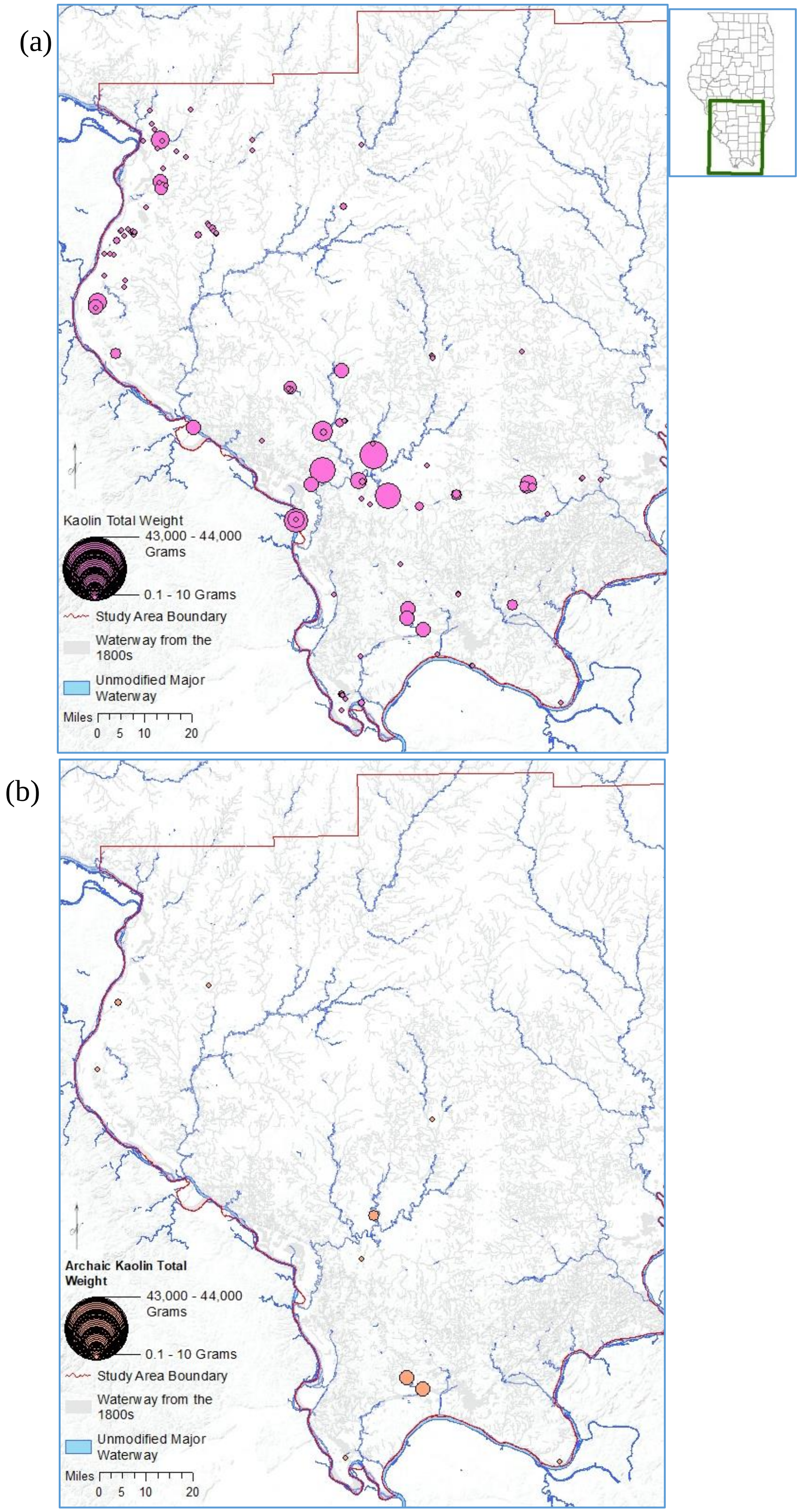
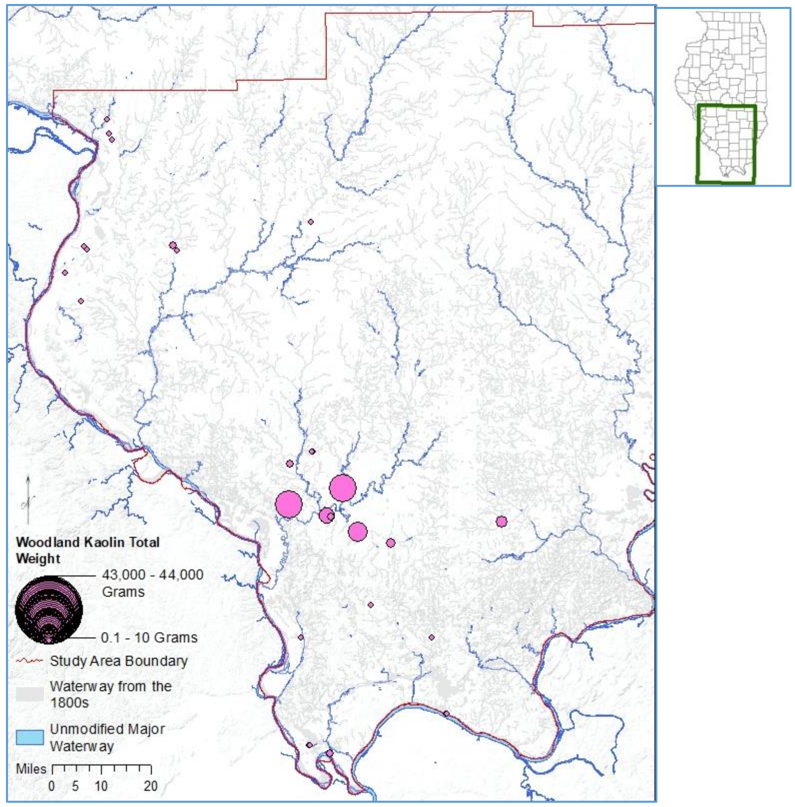


Figure 29 Kaolin total weight distribution: (a) all components; and (b) Archaic component

(a)



(b)

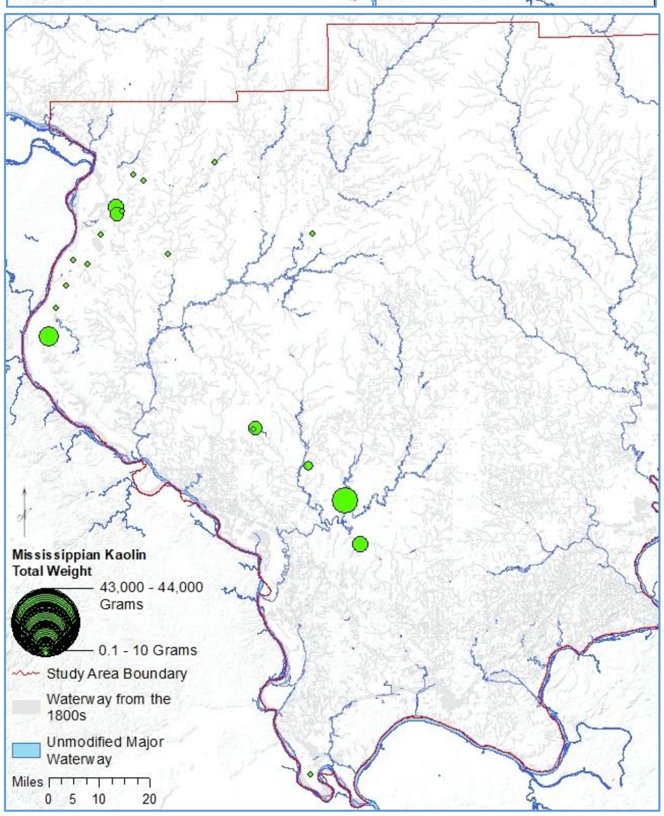


Figure 30 Kaolin total weight distribution: (a) Woodland Component; and (b) Mississippian Component

(a)

(b)

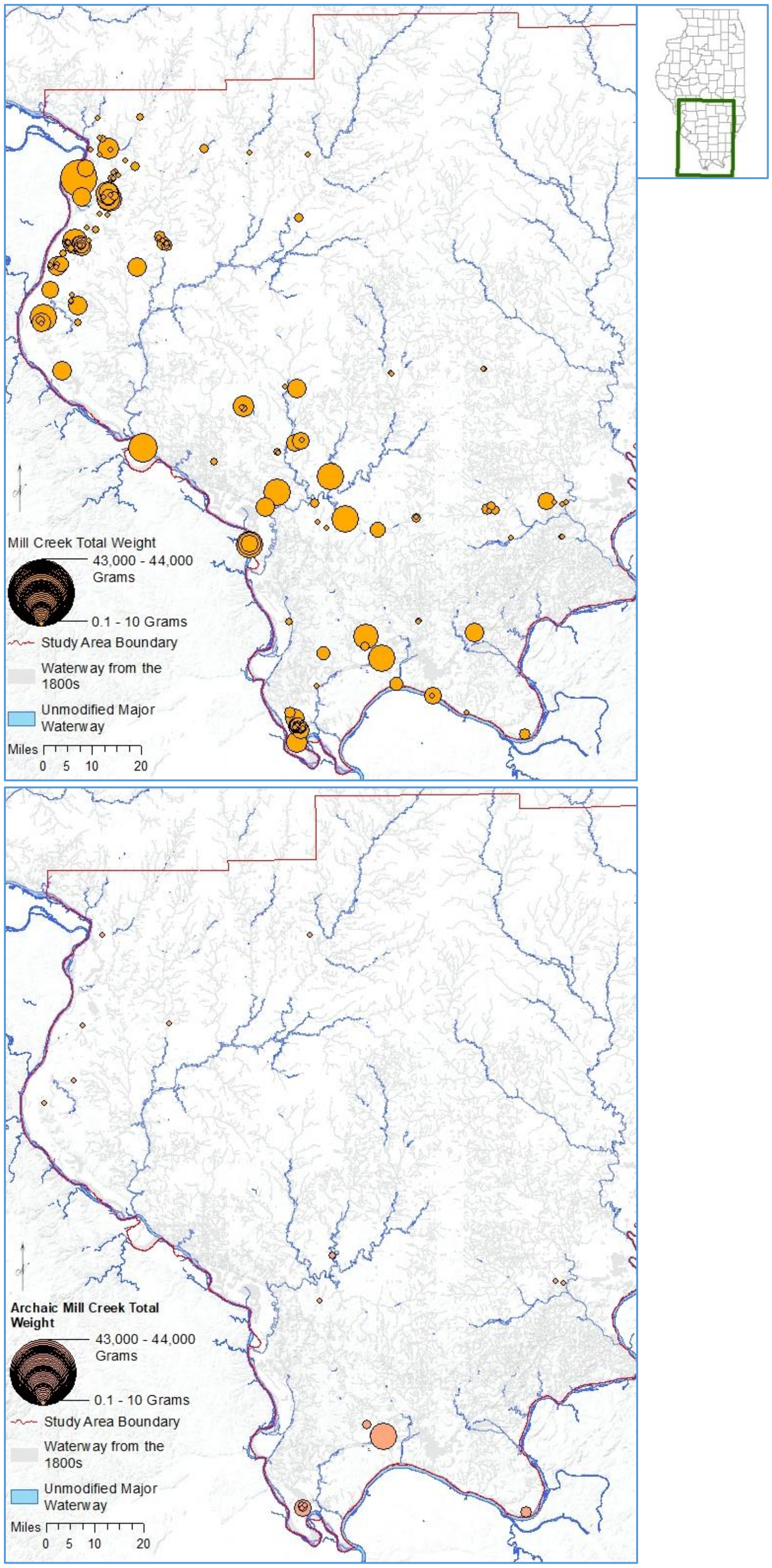
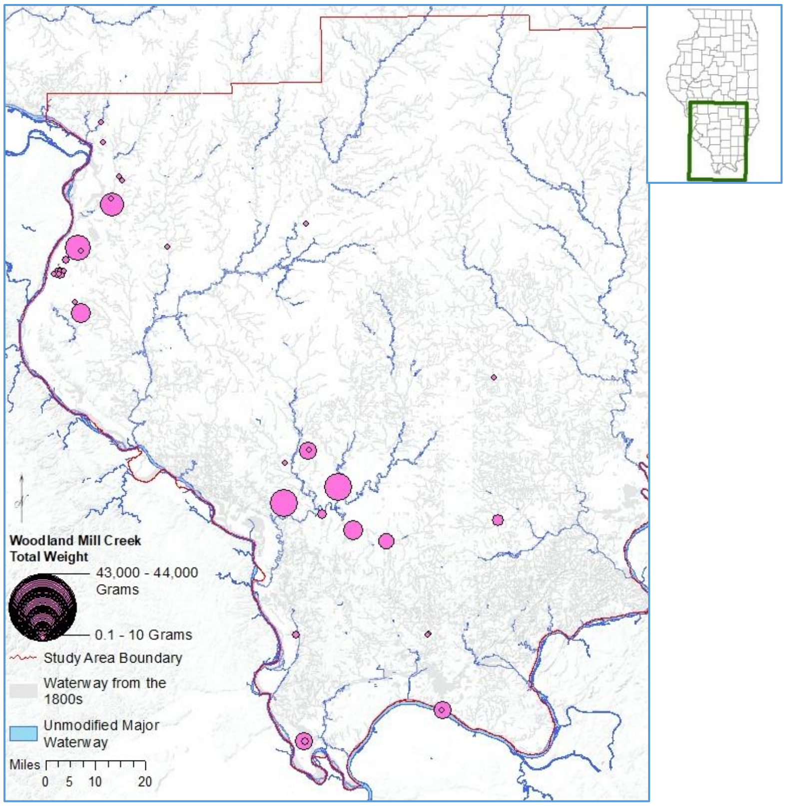


Figure 31 Mill Creek total weight distribution: (a) all components; and (b) Archaic component

(a)



(b)

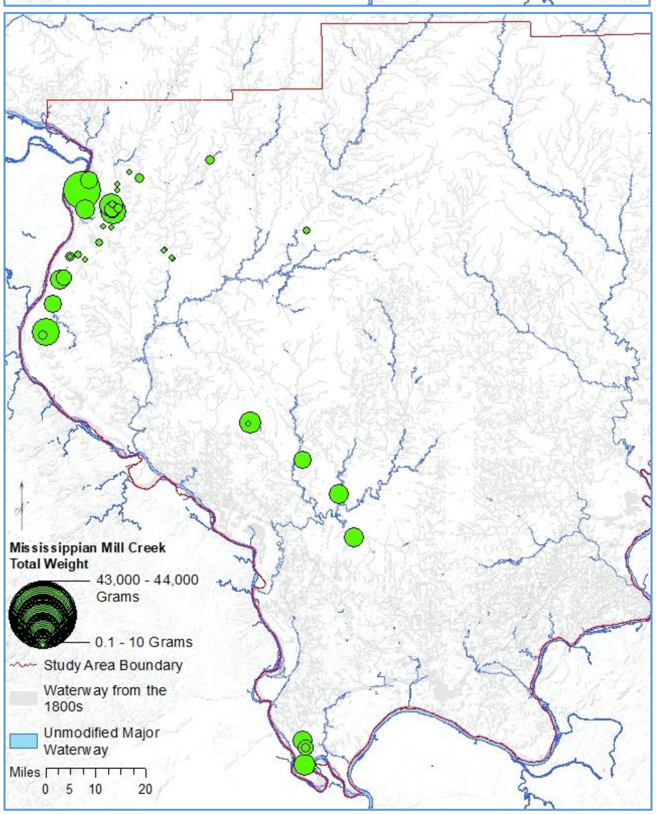


Figure 32 Mill Creek total weight distribution: (a) Woodland Component; and (b) Mississippian Component

Table 11 Burlington Chert Total Weight in Grams

Component	Single Component Sites	Separated Multi Component Sites	Total Weight Burlington
Archaic	8,909.2	4,798.2	13,707.4
Woodland	29,738.4	27,549.2	57,287.6
Mississippian	95,907.6	20,199.1	116,106.7
Unknown			2,891.2
Added to Separated Multi Component			6,074.1
Multicomponent			90,082.3
Total			286,149.3

these claims based on the lack of evidence. By use of this study, there is now evidence to support the Woodland people's preference for blue grey chert over people of adjacent time periods (Figures 27-28) (Table 12). Significantly more sites containing Cobden/Dongola chert were Woodland with a larger amount of chert overall deposited in the Woodland sites. Like Burlington chert, Cobden/Dongola chert appeared more often in sites surrounding the outcrop area and along major drainage pathways.

Table 12 Cobden/Dongola Total Weight in Grams

Component	Single Component Sites	Separated Multi Component Sites	Total Weight Cobden/Dongola
Archaic	5,013.6	804.9	5,818.5
Woodland	11,542.5	7,569.3	19,111.8
Mississippian	421.2	1,728.0	2,149.2
Unknown			1,282.1
Added to Separated Multi Component			5425.4
Multicomponent			19,869.3
Total			53,656.3

Kaolin chert was less often used than the other cherts in this study. Due to the difficulty of acquiring Kaolin chert it is not surprising that Archaic peoples did not use Kaolin very much when other more accessible cherts were available in the appropriate size (Figures 29-30). The Archaic peoples did not routinely make large stone tools therefore mining for large pieces of chert was not necessary. Woodland and Mississippian people were anticipated to use the most Kaolin chert due to the large raw material pieces needed to produce farming hoes. Before performing this analysis, the author anticipated that the most kaolin would appear in Mississippian sites. However, this proved not to be the case. The Woodland people used Kaolin chert almost four times as much as the Mississippians (Table 13). This may be a factor of small sample size in this study since Kaolin chert only appeared in 115 sites. The distribution of Kaolin chert was similar to Burlington and Cobden/Dongola and concentrated near the outcrop area and along major waterways.

Table 13 Kaolin Total Weight in Grams

Component	Single Component Sites	Separated Multi Component Sites	Total Weight Kaolin
Archaic	243.8	95.8	339.6
Woodland	2,917.2	2,589.9	5,507.1
Mississippian	523.8	1,088.3	1,612.1
Unknown			8.0
Added to Separated Multi Component			777.9
Multicomponent			3,066.1
Total			11,310.8

Mill Creek chert was the most dissimilar to the distribution pattern of the other cherts. As was expected, the Archaic peoples used very little Mill Creek chert compared to the Woodland or Mississippian (Figure 31-32) (Table 14). The Mississippian and Woodland components saw a relatively equal amount of chert in the outcrop area and along major waterways. This even distribution is due to the large size needed to make farming hoes. As anticipated the Mississippian people, who were high intensity farmers, used more Mill Creek chert than the

Woodland people, who were in the transitioning from hunter gather to farmers. The amount of Mill Creek chert in this study reflects the difference in food acquisition type with almost four times as much Mill Creek chert used by the Mississippians.

The distribution of chert not only varies between the chert type but also between components. Burlington chert is the most frequent chert type in all components, making Burlington chert the most widespread chert type in this study. Kaolin is the least distributed chert type per component. Cobden/Dongola is found at more Woodland sites while Mill Creek is found at more Mississippian sites. Table 15 shows the distribution of chert by site per components.

Table 14 Mill Creek Total Weight in Grams

Component	Single Component Sites	Separated Multi Component Sites	Total Weight Mill Creek
Archaic	1,789.9	32.0	1,821.9
Woodland	2,979.8	2,512.4	5,492.2
Mississippian	18,146.3	1,685.3	19,831.6
Unknown			339.0
Added to Separated Multi Component			1,063.5
Multicomponent			11,165.1
Total			39,713.3

Table 15 Number of Sites by Chert Type and Component

Component	Burlington	Cobden/Dongola	Kaolin	Mill Creek
Archaic	30	18	10	18
Woodland	66	49	28	36
Mississippian	46	22	20	40
Unknown	34	10	3	14
Multicomponent	120	70	54	93
Total	296	169	115	201

4.2.2 Chert Average Weight Distribution

The Kernel Density tool was used to show the difference between the total weight and the average weight of chert per site. The average weight will display the average size of chert deposited in archaeological sites. Assumptions made at the beginning of this research about the size of chert deposited in archaeological sites include the farther away from the outcrop the smaller the average chert size with the exception of Mill Creek chert. Given the large size of Mill Creek tools, this chert type average size would vary across the landscape.

As can be seen in Figures 33 and 34 distances from the outcrop source has variable influence on the average size of the chert. Burlington chert does appear to have larger average weight close to the outcrop area, although the average weight of some outlier site locations is equivalent to those in the outcrop area. Cobden/Dongola, on the other hand, has little average weight correlation between the outcrop and the distance from the outcrop (Figures 33c, d). Kaolin average weight is relatively equal across the landscape despite the closeness to the outcrop area. Finally, Mill Creek average weight tends to correlate relatively well with the Kernel Density of the total weight.

From the comparison of the chert weight and average weight Kernel Density, it is clear that distance from the source does not have direct correlations with the two weight metrics. It may be more prudent to compare the size of similar tools made of the same kind of chert. Additionally, if the data was available, using the average weight of all projectile points for the same chert type instead of the average weight of all the chert found at the site might produce a better comparison. Comparing debitage from sites may also prove useful. For this study, the data and time were not available for a more intensive investigation of this matter.

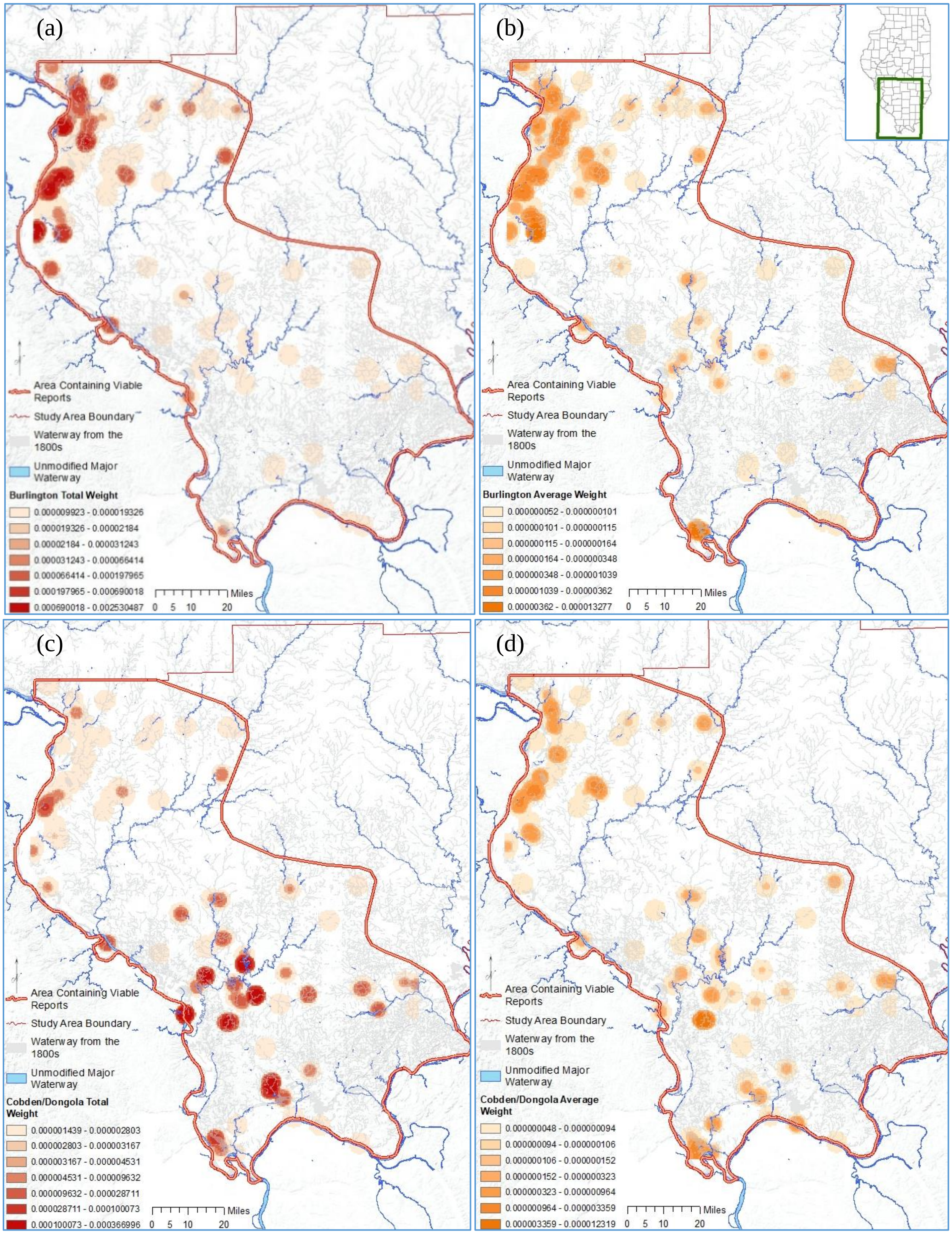


Figure 33 Kernel density: (a) Burlington total weight; (b) Burlington average weight; (c) Cobden/Dongola total weight; and (d) Cobden/Dongola average weight

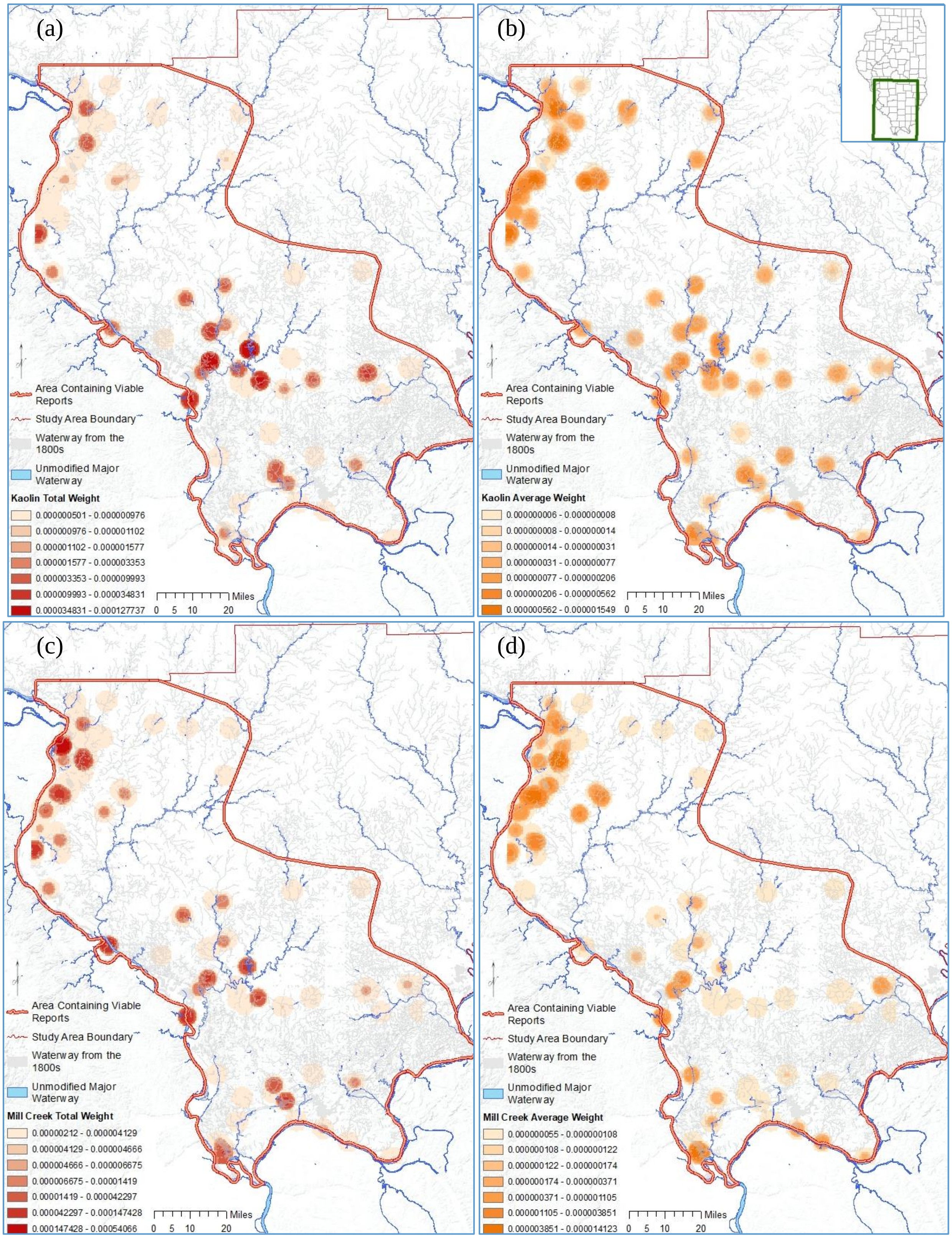


Figure 34 Kernel density: (a) Kaolin total weight; (b) Kaolin average weight; (c) Mill Creek total weight; and (d) Mill Creek average weight

Chapter 5 Discussion and Conclusions

This project was undertaken to better understand the movement of chert from the outcrop location to the final depositional location, the archaeological site. By studying the distribution pattern of the stone tool raw material, prehistoric people's preference for chert raw material types has been shown over geographical space. The preferences for one chert type over another in many cases appeared to be dependent on proximity to the outcrop area. In other cases, it is heavily dependent on the inherent properties of the chert type itself. Color, size, and shape are the three physical properties of the chert types that influence the preferential selection.

The outcrop prediction study portion of this research was implemented to identify the most probable locations to find Burlington, Cobden/Dongola, Kaolin, and Mill Creek chert. Each chert type contained within it a unique set of outcrop parameters. Because of this, the aforementioned method encompassed all of the outcrop parameters while allowing for individual manipulation of the method to customize the outcrop predictions for each chert type.

5.1 Limitations

During this study, several things limited potential avenues leading to the production of more accurate and thorough results. Initially, obtaining the archaeological site data was a daunting task with so many of the reviewed site reports containing no usable data. As no additional avenues to obtain large numbers of site reports were available, the study was limited to only those reports contained on the CRM Reports Archive and the few reports in the author's small personal collection. The final distribution of site report data lacked information for a large portion of the originally defined study area. If data was available for this portion of the study area a defined end of distribution may have been available for each chert type.

As stated in Section 3.1 the nature of archaeological excavation and testing is in itself a limitation. Archaeological studies are only completed where modern construction and government regulations dictate studies are needed. From this uneven and biased distribution of archaeological data the distribution pattern of past lives must be interpreted to produce study area wide results. This is one of the biggest limitations to any study of archaeological site distribution analysis. Although interpretation of the current data is valid, there will always be unknown or outlier data unexcavated or unresearched.

The second limitation for this study was in the available geospatial data. Geographic formation data was only available for groupings of geologic formations. The group of formations, although encompassing the sought-after formation, also included areas not containing the specific chert bearing formation. Therefore, the final prediction surface is assumed to be larger than it should be. Another geospatial data set which affects the outcrop prediction surface is the DEM. The DEM size selected for this study was the smallest possible cell size which encompassed the entire study area. The 3 m cell size, although good, was not the ideal DEM cell size to derive a slope layer. A smaller cell size would have shown a more detailed picture of the study area and potentially revealed additional high probability locations.

The final limitation to this study is the unknown changes which have occurred on the landscape between the prehistoric component in this study and today. Creeks and rivers may have changed courses. The slopes and bedrock could be more denuded than in prehistoric times. Outcrop areas may be long forgotten and never rediscovered. Prehistoric peoples may have relocated artifacts from a previous time period. All of these things may have an impact on this study’s outcome, none of which can be known without further study in each of these areas.

5.2 Future Work

To build on the distribution analysis, initially it would be important to increase the number of sites included in the study, as more data points will show a more complete picture of the chert distribution analysis. It would also be important for future studies to increase the geographical extent of the study to the natural limit of each chert's distribution. In some cases, this may be hundreds of miles, but this would document the desirability of each chert type by the entire prehistoric population.

Another avenue to pursue would be to include all the chert types from these reports and others in the study area. This will show a full picture of the prehistoric people's preference for all chert types available to them. Additionally, localized preferences will become apparent for each component.

Potential future work concerning the outcrop areas include geographically delineating the individual formations, performing reconnaissance surveys in areas of high probability, and following creeks downstream of the geologic surficial exposure area to determine approximately how far chert travels. Reconnaissance surveys to validate chert outcrop areas and tracking chert downstream from the source would prove to be the most feasible. Determining the distance a piece of chert travels downstream can greatly affect the distance a prehistoric person must travel to obtain the chert. As seen with this study, chert is most likely to be used when the archaeological site is close to the outcrop area. Therefore, if the chert travels downstream a significant distance the location of obtaining a specific chert type may be closer due to water transport than an adjacent chert outcrop. The proximity to one chert type over another may be the determining factor in the makeup of the deposits at individual archaeological sites. Until the water transport of chert types is known, no definitive answer can be obtained.

5.3 Conclusions

The completed outcrop prediction model and distribution analysis contained a few surprises. Initially, the author expected Kaolin chert would be most used in the Mississippian time period due to its large size and its intense color. As can be seen in Figures 29-30 and Table 13 this is not the case. It would appear that the Woodland peoples valued these two attributes and used Kaolin chert almost four times as much.

As reported in Section 2.2.3, Cobden/Dongola was indicated to be preferred by the Woodland people's due to its blue grey color. The significance of this preference was drastically understated. Cobden/Dongola chert was not only used more, its total weight for the Woodland component was four times more than the Archaic component and nine times more than the Mississippian times.

The expectations for average weight of chert distributed over the study area was for archaeological sites closer to the outcrop to contain larger pieces of chert than archaeological sites farther away from the outcrop location. In all cases of chert average weight was not influenced significantly by distance from the outcrop locations. Therefore, the average weight must be influenced more directly by some other factors. Most probably the factor determining the average weight of the chert is the need for a specific size tool and the generally equivalent chert debitage size.

Anticipated factors in this study include the correlation between predicted outcrop and reconnaissance locations. During both studies, waterways and a high degree of slope were determined to be indicators of potential chert outcrop locations. Since the input parameters were relatively simple for the outcrop prediction model and these parameters are the same ones sought after in the reconnaissance survey, it is not surprising that the reconnaissance locations coincide with the outcrop prediction surface. Other factors predicted and validated include the large quantity of Burlington chert found in archaeological sites of all components, the small amount of Kaolin chert distributed over all components, and the large amount of Mill Creek chert utilized in the Mississippian component.

This study aids in the understanding of chert distribution over Southern Illinois. By understanding the way chert is distributed insight can be gained into the prehistoric people's preferences and cultural needs. Outcrop prediction helps researchers obtain a baseline for reconnaissance surveys and aids in understanding the distances chert traveled to the final depositional locations. The archaeological site and the outcrop location are two key components in a prehistoric person's daily life. This research was an attempt to better understand the correlation between them both.

References

Abbott, Larry, 1989. *Archaeological Investigations at the Wooded Site (11MS587) Madison County, Illinois*. Resource investigation Program.

Aberle, Gabrielle, Cally Lence, and Monica Shah, 2002. *A Phase II Investigation of Sites 11G361 and 11G365 within Black Beauty Coal Company's Cottage Grove Mine, DNR Permit #348 Gallatin and Saline Counties, Illinois*. American Resources Group, Ltd.

Aberle, Gabrielle, Monica Shah Lomas, and Cally Lence, 2006. *Phase II and III Archaeological Investigations at Sites 11SA510 and 11SA526 within Black Beauty Coal Company's Wildcat Hills Mine, Cottage Grove Pit, Saline County, Illinois*. American Resources Group, Ltd.

Adams, Brian, Gregory Walz, Paul Kreisa, Kevin McGowan, Jacqueline McDowell, Cynthia Balek, 1997. *Archaeological Investigations for the Relocation of Valmeyer, Monroe County, Illinois: Volume 2: The Strong Site*. Public Service Archaeology Program Department of Anthropology University of Illinois at Urbana-Champaign.

Avery, George, Everett, Bassett, Jonathan Bloom, Peter Bobrowsky, Emanuel Breitburg, Brian Butler, Michael Hargrave, Richard Jefferies, Neal Lopinot, B. Mark Lynch, Ernest May, James Merritt, Carol Morrow, Gerald Oetelaar, and William Woods, 1982. *The Carrier Mills Archaeological Project Human Adaptation in the Saline Valley, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Barcelona Field Study Center. 2000-2016. "Measuring Slope Steepness". Accessed July 2017, http://geographyfieldwork.com/SlopeSteepnessIndex.htm

Barr, Kenneth, Mary McCorvie, Mark Wagner, Brad Koldehoff, William Cremin, 1993. *The Black Snake Site: A Mississippian Stone Box Cemetery in the Upper Galum Creek Valley Perry County, Illinois*. American Resources Group, Ltd.

Barriento, Gustava, Juan Bautista Belardi, Luciana Catalla, Flavia Carvallo Marina, and Fernando Oliva. 2016. Continuous spatial models as an aid for sourcing lithic raw materials: Examples from the Argentine Pampas and Patagonia. *Journal of Archaeological Science: Reports*.

Beck, Kelly, 2008. Transport Distance and Debitage Assemblage Diversity: An Application of the Field Processing Model to Southern Utah Toolstone Procurement Sites. *American Antiquity*. Vol. 73, No. 4, 759-780.

Bentz, Charles, Lucy Whalley, 1985. *The Leingang Site A Late Woodland Occupations*. Department of Anthropology University of Illinois at Urbana-Champaign.

Bentz, Charles, Dale McElrath, Fred Finney, and Richard Lacampagne, 1988. *Late Woodland Sites in the American Bottom Uplands.* Illinois Archaeological Survey.

Berres, Thomas, 1985. *Archaeological Investigations at the Komondor Site (11-J-79) Jackson County, Illinois.* Illinois Archaeology Survey.

Betzenhauser, Alleen, and Jennifer Howe, 2008, *Archaeological Investigations at Site 11J1196 (Halloween Site) for the Southern Illinois Airport Project*. Illinois Transportation Archaeological Research Program.

Betzenhauser, Alleen, 2012. Archaeological Investigations at 11MS2300 (Auburn Sky Site) for the Robbins Road (Hartford), IL 3 to IL111, Addendum A Project. Archaeological Testing Short Report No. 366. Illinois State Archaeological Survey, University of Illinois at Urbana-Champaign.

Betzenhauser, Alleen, Robert Marzim, and Mark Branstner, 2013. *Archaeological Investigations at Site 11PY198 (Perrackson Site) for the FAP 42, IL 13/127 Project. Archaeological Testing Short Report No. 416. Illinois State* Archaeological Survey, Prairie Research Institute.

Betzenhauser, Alleen, Brad Koldehoff, Kathryn Parker, Steven Kuehn, Mera Hertel, 2013. *The Prehistory of Turkey Hill: Archaeological Investigations along Illinois Route 13/15 (FAP-103) Belleville to Freeburg, St. Clair County, Illinois*. Illinois State Archaeological Survey Prairie Research Institute.

Bevitt, Todd, 1997.*Phase II Archaeological Investigations at Sites 11MO636 and 11MO672 Monroe County, Illinois*. American Resource Group, Ltd.

Billings, Deborah, 1984. An Analysis of Lithic Workshop Debris from Iron Mountain, Union County, Illinois. *Center for Archaeological Investigations, Southern Illinois University at Carbondale.*

Blanton, Dennis, Lucretia Kelly, and Katherine Parker, 1989. *Archaeological Mitigation at 11-Wm-99: A Multicomponent Site in the Crab Orchard Creek Basin*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Blodgett, Daniel, Craig Kitchen, and Patrick Durst, 2016. *Phase II Archaeological Investigations at Site 11MS2248 (McCoy Site) for the FAP 310 Project. Archaeological Testing Short Report No. 467*. Illinois State Archaeological Survey at the University of Illinois at Urbana-Champaign.

Boles, Steve, and Patrick Durst, 2011. *Archaeological Investigations at Site 11MS1614 (Meeks Farm Site) for the FAP 310 Project. Archaeological Testing Short Report No. 329*. Illinois State Archaeological Survey at the University of Illinois at Urbana-Champaign.

Boles, Steven, Joseph Galloy, 2012. *Additional Archaeological Investigations at Dugan Airfield Site (11MO718) Archaeological Testing Short Report No. 446*. Illinois State Archaeological Survey Prairie Research Institute.

Boles, Steve, Patrick Durst, 2012. *Archaeological Investigations at 11MS2317 (Herter Site) for the FAP310 Four-lane Expressway, Godfrey to Jerseyville Project. Archaeological Testing Short Report No. 368*. Illinois Archaeological Survey, University of Illinois at Urbana-Champaign.

Booth, Donald, Brad Koldehoff, Michael Kolb, Eric Roselle, 1999.*The EWP Project Archaeological Investigations for the 1998 Metro East Ditch Cleanout Project in Madison and St. Clair County, Illinois*. Illinois Transportation Archaeological Research Program.

Booth, Donald, Matthew Bivens, Kathryn Warner, Steve Dasovich, Edwin Hajic, 2006. *Phase One Cultural Resource Survey and Phase Two National Register of Historic Places Eligibility Testing Sites 11MO598, 11MO599, 11MO725, and 11MO1068*. SCI Engineering, Inc.

Booth, Don. 2012. *Phase Two National Register Eligibility Testing of Sites 11S1637, Halloran 50-acre Tract St. Clair County, Illinois*. SCI Engineering, Inc.

Booth, Don, Michele Lorenzini, Kellie DeFosset, Rob Verheggan, Marjorie Schroeder, Lucretia Kelly, 2012. *Limited Phase III Investigations Schmid Site 11MS109 Wood River Illinois*. SCI Engineering, Inc.

Borgic, Quentina, 1999. *Chert Types Found In Illinois* A Presentation Presented in Fulfillment of a Senior Assignment for a Bachelor of Arts in Anthropology, Southern Illinois University Edwardsville, Illinois.

Borgic, Quentina, 2000. *Geologic Descriptions of Some Illinois Chert Types*. A Research Paper Submitted in Fulfillment of a Senior Assignment for a Bachelor of Arts in Geography, Southern Illinois University Edwardsville, Illinois.

Butler, Brian, Brian DelCastello, and Mark Wagner, 2000. *Archaeological Investigations at Site 11J1145 Jackson County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Brantingham, Jeffery. 2003. A Neutral Model of Stone Raw Material Procurement. *American Antiquity*. Vol. 68, No. 3, 487-509.

Butler, Brian, and Anne Cobry DiCosola, 2008. *Archaeological Investigations at Four Stone Forts in the Shawnee National Forest*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Butler, Brian, and Rosanna Crow, 2013. Archaic Period Occupation at Kincaid Mounds. Illinois Archaeological Survey, Inc., *Illinois Archaeology*, Vol 25, pp 106-140.

Cobb, Charles, and Richard Jefferies, 1983. *Archaeological Investigations at the Milar Site, Alexander County Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Cobb, Charles, 1989. An Appraisal of the Role of Mill Creek Chert Hoes in Mississippian Exchange System. *Southeastern Archaeology.* Vol. 8, No. 2. 79-92.

Clarkson, Chris, and Angelo Bellas. 2014. Mapping stone: using GIS spatial modeling to predict lithic source zones. *Journal of Archaeological Science*.

Craig, Joseph, Joseph Galloy, 1994.*Phase III Archaeological Investigations at Site GCS #1 (11-MS-1380) A Mississippian Farmstead Near Horseshoe Lake, Madison County, Illinois*. Hanson Engineers, Inc.

Craig, Joseph, Susan Vorreyer, Rachael Baskett, Terrance Martin, Kathryn Parker, Jason Rein, 2007. *The Lange Site An Early Mississippian Upland Civic and Ceremonial Center in Southwestern Illinois.* Environmental Compliance Consultants, Inc.

De Mott, Rodney, George Holley, 1991. *Archaeological Investigations at the Style Site (11-MS-1350)*. Contract Archaeology Program Southern Illinois University Edwardsville.

DelCastello, Brian, and Brian Butler, 2000. *Archaeological Investigations at 11Js-321 Cache River Scenic Natural Area Visitor Center, Johnson County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

DelCastello, Brian, Jennifer Faberson, Trent Spurlock, 2007. *An Archaeological Survey of a 100 Acre Parcel for the Proposed Sugarcamp No. 1 Coal Mine Operation, Franklin County, Illinois*. Cultural Resource Analysts, Inc.

Emerson, Thomas, Douglas Jackson, 1980. *The Marcus Site (11-S-631) A Late Bluff and Early Mississippian Occupation in the American Bottom*. Department of Anthropology University of Illinois Urbana-Champaign.

Emerson, Tom, Douglas Jackson, Sissel Johannessen, Lise Marx, George Milner, Alison Towers, Lucy Walley, 1982. *The BBB Motor Site (11-Ms-598): An early Mississippian Site in the American Bottom*. Department of Anthropology University of Illinois at Urbana-Champaign.

Emerson, Thomas, George R. Milner, and Douglas K. Jackson. 1983. *The Florence Street Site.* Urbana & Chicago: University of Illinois Press.

Emerson, Thomas, and Dale McElrath, 2000. Toward an "Intrinsic Characteristics" Approach to Chert Raw Material Classification: An American Bottom Example. *Midcontinental Journal of Archaeology*, Vol. 25, No. 2.

Ensor, H. Blaine, Steve Titus, 2004. *Phase II Archaeological Investigations at the Booster Station Site (11MO768) Monroe County, Illinois*. American Resource Group, Ltd.

Ensor, Blaine, Kathryn Parker, Jessica Allgood, Jeff Anderson, Mike McNerney, Steve Titus, 2009. *Phase II Archaeological Investigations at the Fults Site (11MO1075) Monroe County, Illinois*. American Resource Group, Ltd.

Evans, Bryant, 1995. *FAP-310 Project/Borrow Pit FA310-9a*. Illinois Transportation Archaeological Research Program.

Evans, Bryant, 1995. *FAP-310 Project/Borrow Pit FA310-9b*. Illinois Transportation Archaeological Research Program.

Evans, J. Bryant, Madeleine Evans, Thomas Berres, Edwin Hajic, Sheena Beaverson, Andrea Freeman, Mary Simon, 2000. *Ringering: A Multicomponent Site in the American Bottom*. Illinois Transportation Archaeological Research Program.

Evans, Bryant, Madeleine Evans, Kathryn Parker, 2001. *The Floyd Site: A Terminal Archaic Habitiation in the Northern American Bottom*. Illinois Transportation Archaeological Research Program.

Evans, Madeleine, 2010. *Archaeological Investigations at Site 11MS1435 (Refinery View Site) for the FAP 310 Highway Project*. Illinois State Archaeological Survey University of Illinois at Urbana-Champaign.

Evans, Madeleine, 2011 *Archaeological Investigations at Site 11MS627 (Shell Oil Site) for the FAP-310 Highway Project. Archaeological Testing Short Report No. 304*. Illinois State Archaeological Survey at the University of Illinois at Urbana-Champaign.

Finney, Fred, Sissel Johannessen, 1981. *The Carbon Dioxide Site: Late Woodland and Early Mississippian Occupations on the American Bottom*. Department of Anthropology University of Illinois at Urbana-Champaign.

Fortier, Andrew, Fred Finney, 1979. *Preliminary Report of Phase III Archaeological Investigations at the Carbon Dioxide Site (11-Mo-594)*. Department of Anthropology University of Illinois.

Fortier, Andrew, 1980. *Final Report on Phase II Excavations at the Fiege Site (11-Mo-609)*. Department of Anthropology University of Illinois Urbana-Champaign.

Fortier, Andrew, Sissel Johannessen, 1981. *Archaeological Investigations of the Middle Woodland Occupation at the Truck #7 and Go-Kart South Sites*. Department of Anthropology University of Illinois at Urbana-Champaign.

Fortier, Andrew, 1981. *The Carbon Monoxide (11-Mo-593) Site: An Early and Middle Woodland Occupation in the American Bottom*. Department of Anthropology University of Illinois at Urbana-Champaign.

Fortier, Andrew, Fred Finney, Richard Lacampagne, 1983. *The Mund Site.* Illinois Archaeological Survey.

Fortier, Andrew, Richard Lacampagne, Fred Finney, 1984. *The Fish Lake Site.* Illinois Archaeological Survey.

Fortier, Andrew, Fred Finney, Sissel Johannessen, 1984. *The Robert Schneider Site (11-Ms-1177)*. Department of Anthropology University of Illinois at Urbana-Champaign.

Fortier, Andrew, Douglas Jackson, 1988.*Investigations at the Nochta Mainline Site (11Ms-128)*. Department of Anthropology University of Illinois at Urbana-Champaign.

Fortier, Andrew, Madeleine Evans, Andrew Fortier, Michael Gornick, Steven Kuehn, Kathryn Parker, Alexey Zelin, 2014. *A Late Woodland Ceremonial and Extractive Campsite at the Husted Site in the Northern American Bottoms Upland*. Illinois State Archaeological Survey Prairie Research Institute.

Fortier, Andrew, Brenda Beck, Madeleine Evans, Steven Kuehn, Kathryn Parker, Alexey Zelin, 2015. *A Multi-Component Late Woodland Complex at the Vasey Site in the Northern American Bottom Uplands*. Illinois State Archaeological Survey Prairie Research Institute.

Fortier, Andrew, Brenda Beck, Amanda Butler, Madeleine Evans, Michael Gornick, Kristin Hedman, Seven Kuehn, Kathryn Parker, Alexey Zelin, 2015(2). *A Late Woodland Procurement and Ceremonial Complex at the Reilley and Husted Sites in the Northern American Bottom*. Illinois State Archaeological Survey Prairie Research Institute.

Fortier, Andrew, Madeleine Evans, Andrew Fortier, Michael Gornick, Steven Kuehn, Kathryn Parker, Adam Tufano, Alexey Zelin, 2016. *Late Woodland Extractive Camps at the Ray's Bluff Site in the Northern American Bottom Upland*. Illinois State Archaeological Survey Prairie Research Institute.

Fortier, Andrew, Julie Bukowski, Melinda Carter, Madeleine Evans, Matthew Fort, Michael Gornick, Eve Hargrave, Kristin Hedman, Steven Kuehn, Kathryn Parker, Adam Tufano, Alexey Zelin, 2016(2). *A Late Woodland Extractive Campsite and Designated Mortuary Location at the Lillie Site in the Northern American Bottom Uplands*. Illinois State Archaeological Survey Prairie Research Institute.

Galloy, Joseph, Kathryn Parker, Nathan Babcook, 2000. *Phase Three Archaeological Data Recovery at the Bivouac Site (11MS1665) Madison County, Illinois*. SCI Engineering, Inc.

Galloy, Joseph, 2001. *Site 11B111 Mitigation Bond County, Illinois*. SCI Engineering, Inc.

Galloy, Joseph, Brad Koldehoff, 2002. *Illinois Route 3 Expansion and Realignment (FAP-14)*. Illinois Transportation Archaeological Research Program.

Galloy, Joseph, 2003. *CH 75/Governor's Parkway; IL157 to IL143 (Edwardsville)*. Illinois Transportation Archaeological Research Program.

Galloy, Joseph, 2005. *Archaeological Investigations at Site 11CT225 (Harry Billhartz Site #1) for the FAS 783/CH 8, Borrow 1/1 Project. Archaeological Testing Short Report No. 185*. Illinois Transportation Archaeological Research Program.

Galloy, Joseph, Steve Boles, Lenna Nash, and Charles O. Witty, 2013. *Archaeological Investigations at Site 11WM80 (Broglio Site) for the FAU 903/FAU 9588, Herrin to Johnston City Blacktop Project*. Illinois State Archaeological Survey.

Galloy, Joseph, Steven Boles, Mary Simon, Lucas Leady, 2015. *FAP 312, IL Route 3 Waterloo Bypass. IDOT Seq.# 11865A, 11869B. ISAS log # 11102*. Illinois State Archaeological Survey Prairie Research Institute.

Gaydos, Zack, Madeleine Evens, Adam Tuffano, Robert McCullough, 2016. *Archaeological Investigations at Site 11MS1956 (Long Haul Site) for the FAP-31-0 Highway Project. Archaeological Testing Short Report No. 384*. Illinois State Archaeological Survey at the University of Illinois at Urbana-Champaign.

Goings, Chad A. 2003 A predictive model for lithic raw material in Iowa. *Plains Anthropology*, Volume 48, No. 184.

Hammerstedt, Scott, and Erin Hughes, 2015. Mill Creek Chert Hoes and Prairie Soils: Implications for Cahokian Production and Expansion. *Midcontinental Journal of Archaeology*, Vol. 40 No. 2, 149–165

Hanenberger, Ned, Kathryn Parker, 1987. *The Karol Kekas Site (11-Ms-1255): A Mississippian Stirling Phase Occupation on the Bluffs above the American Bottoms*. Department of Anthropology University of Illinois at Urbana-Champaign.

Hargrave, Michael, Neal Lopinot, M. Michele Seme, 1982. *Archaeological Investigations at the Bluff Shadow Site Monroe County, Illinois*. Center for Archeological Investigations Southern Illinois University at Carbondale.

Hargrave, Michael, Brian Butler, Neal Lopinot, and Timothy Pugh, 1992. *Mollie Baker (11-J-964) A Woodland Period Site in the Kinkaid Creek Drainage, Jackson County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Hargrave, Michael, 1992. *Archaeological Investigations at the Old Sawmill No. 2 Site (11-Jn-108) Jefferson County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Hargrave, Michael, 1993. *Archaeological Investigations at the Doll Head III Site (11-Jn-257) Jefferson County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Harl, Joe, Robin Machiran, 2012. *Phase II Archaeological Testing of Sites 11MS1049, 11MS1245, and 11MS1246 Granite City, Illinois*. Archaeological Research Center of St. Louis, Inc.

Hofman, Jack, and Carol Morrow. 1989. Chipped Stone Technologies at Twenhafel: A multicomponent site in Southern Illinois. *Lithic Resource Procurement: Proceeding From The Second Conference on Prehistoric Chert Exploitation*. United States. Southern Illinois University.

Holley, George, Alan Brown, Neal Lopinot, 1989. *Archaeological Investigations Relating to the Glen Carbon Interceptor Sewer Line, Devision 3 through 7, Madison County, Illinois*. Contract Archaeology Program Southern Illinois University at Edwardsville.

Holley, George, 1993(1). *Scott Joint-Use Airport, Jens Site S-784*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(2). *Scott Joint-Use Airport, Vesta Lembke Site S-782*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(3). *Scott Joint-Use Airport, E.J.Pfeifer Site #2 S-742*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(4). *Scott Joint-Use Airport, Site S-85 and S-781*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(5). *Scott Joint-Use Airport, Lembke Site #3 S-87*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(6). *Scott Joint-Use Airport, William Lembke Junior Site #1 S-234*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(7). *Scott Joint-Use Airport, Site S-889*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(8). *Scott Joint-Use Airport, J. Ernest Site S-793*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(9). *Scott Joint-Use Airport, Bill Schobert Site S-786*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(10). *Scott Joint-Use Airport, R.Hughes Site S-794*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(11). *Scott Joint-Use Airport, Crooked Creek Site #2 S-795*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(12). *Scott Joint-Use Airport, Site S-882*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(13). *Scott Joint-Use Airport, Richard Sprague Site S-764*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(14). *Scott Joint-Use Airport, Hess Site S-775*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(15). *Scott Joint-Use Airport, John H. Faust Site #1 S-237*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(16). *Scott Joint-Use Airport, William Lembke Jr Site #3 S-236*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George, 1993(17). *Scott Joint-Use Airport, William Lembke Jr. Site #2 S-235*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Holley, George 1995(18). *Cardinal Creek Residential Relocation in Association with Scott Joint-Use Airport*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Hollon, Debra, 2011. *GIS and the Prehistoric Landscape: An Examination of Applicability*. M.S. Thesis, Ball State University, Indiana.

Howe, W. Gordon, Jim Snyder, and David McConkey, 1994. *Phase I Survey of Six Tracts within the Cypress Creek National Wildlife Refuge, Alexander, Pulaski, and Union Counties Illinois and Phase II Testing at Site 11-U-682, Union County, Illinois*. American Resources Group, Ltd.

Hoxie, R. David, Kurt Moore, Wes Neal, William Woods, William Cremin, Leonard Blake, Carl Falk, Lynn Snyder, Colleen Hamilton, 1993. *Phase III Archaeological Investigations at Site 21D3-67, A Multicomponent Site on White Walnut Creek in Consolidation Coal Company's Burning Star Mine #2, Deep Strip #3 Perry County, Illinois*. American Resource Group, Ldt.

ISAS (Illinois State Archaeological Survey) 2017. CRM Report Archive, Accessed July 2017. https://isas.illinois.edu/collections/crm_report_archive

Illinois State Museum, 2000. "Native American: Prehistoric Native American Cultures. Accessed July 2017. http://www.museum.state.il.us/muslink/nat_amer/pre/

Illinois State Museum, 2006. "Projectile Point Type Collection". Accessed July 2017. http://www.museum.state.il.us/ismdepts/anthro/proj_point/points_timeline.html

Jackson, Douglas, Sandra Dunavan, 1987.*Middle Woodland and Mississippian Short-Term Occupations at the Willoughby Site (11-Ms-610)*. Department of Anthropology University of Illinois at Urbana-Champaign.

Jackson, Douglas, Sandra Dunavan, 1988. *Mississippian Occupation at the Esterlein Site (11-Ms-598)*. Department of Anthropology University of Illinois at Urbana-Champaign.

Jackson, Douglas, Alexey Zelin, Madeleine Evans, 2011. *Archaeological Investigations at Site 11MS637 (Barnhill's Farmstead Site) for the FAP-310 Highway Project. Archaeological Testing Short Report No. 306*. Illinois State Archaeological Survey at the University of Illinois at Urbana-Champaign.

Jackson, Douglas, Mary Simon, Lucretia Kelly, Eve Hargrave, 2014.*Hawkins Hollow: A Late Mississippian Household in the Southern American Bottom*. Illinois State Archaeological Survey Prairie Research Institute.

Kelly, John, Andrew Fortier, Seven Ozuk, Joyce Williams, Lucretia Kelly, Sissel Johannessen, Paula Cross, George Milner, 1987. *The Range Site: Archaic through Late Woodland Occupation.* Illinois Archaeological Survey.

Kelly, John, Kathryn Parker, 1997. *Metro East Emergency Project: Phase I, II, and III Archaeological Investigations of the Drainage Ditch Cleanout in Madison and St. Clair Counties, Illinois*. Illinois Transportation Archaeological Research Program.

Knight, Frances, Terrance Martin, J. Chris Richmond, Marjorie Schroeder, and Kenneth Tankersley, 1992. *Archaeological Investigations at the Swimming Snake Site Horseshoe Lake Conservation Area, Alexander County, Illinois*. Illinois State Museum.

Knight, Frances, and Brian Butler, 1995.*Archaeological Survey on the Mississippi River Floodplain, Union County Conservation Area, Illinois: Results of the 1994 Southern Illinois University at Carbondale Field School Survey*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Koeppel, Christopher, 2001. *CRM 1109 Phase II on 3 Sites for Construction of Transloading Facility in Massoc County Illinois*. Archaeological Survey Short Report.

Koeppel, Christopher, 2001(2). *CRM 1110, Phase II on 4 sites for Shawnee Survey and Consulting, Inc., Vienna, Illinois*. Illinois Archaeological Short Report.

Koldenhoff, Brad, 1985. Southern Illinois Cherts: A Guide to Silicious Materials Exploited by Prehistoric Populations in Southern Illinois. *Center for Archaeological Investigations*.

Koldehoff, Brad, and Mark Wagner, 1998. *Archaeology and History of Horseshoe Lake Alexander County, Illinois*. Center for Archaeological Investigations.

Koldehoff, Brad, 2000. *FAS 850, Ch2, Rogers Road Extension*. Illinois Transportation Archaeological Research Program.

Koldehoff, Brad, Kathryn Parker, Gregory Wilson, John Penman, 2001. *The Woodland Ridge Site: Archaeological Investigations on Salt Lick Point for the Expansion of Valmeyer, Monroe County, Illinois*. Illinois Transportation Archaeological Research Program.

Kruchten, Jeffery, S. Vanderford, E. Hargrave, C. Witty, 2004. *Archaeological Investigations at Site 11MS54 (St. Thomas Site) for the I-270, IL 111 to Mississippi River Project*. Illinois Transportation Archaeological Research Program.

Kruchten, Jeffery, K. Shane Vanderford, Eve Hargrave, Charles Witty, 2005. *The St. Thomas Site (11MS54) Madison County, Illinois*. Illinois Transportation Archaeological Research Program.

Kruchten, Jeffery, Mark Branstner, 2007. *Archaeological Investigations at Site 11S69 (Faust Site) for the FAI Route 64 St. Clair County Resurfacing and Bridge Rehabilitation Project. Archaeological Testing Short Report No. 256*. Illinois Transportation Archaeological Research Program.

Kruchten, Jeffery, 2008. *Archaeological Investigations at Site 11S71 (Knoebel Site) for the FAI Route 64 St. Clair County Resurfacing and Bridge Rehabilitation Project. Archaeological Testing Short Report No. 273*. Illinois Transportation Archaeological Research Program.

Kullen, Douglas, 2000. *Phase II National Register Evaluation of Sites 11U779 and 11U781 in Cypress Creek National Wildlife Refuge Union County, Illinois*. Allied Archaeology.

Lopinot, Neal, Alan Brown, George Holley, 1989, *Archaeological Investigations of the Proposed Sanitary Sewer Collection System, Eastern Portion of the Village of Fairmont, St. Clair and Madison Counties, Illinois*. Archaeology Program Southern Illinois University at Edwardsville.

Lopinot, Neal, 1991.*The Diana Site (11-R-331) Randolph County, Illinois*. Contract Archaeology Program Southern Illinois University Edwardsville, Illinois.

Lomas, Monica Shah, Steve Titus, John Schwegman, 2011. *Phase II Testing at Sites 11H2 and 11H27 Two Prehistoric Sites Located within the White Oak Resources Mine No. 1. Permit Area in Hamilton County, Illinois*. American Resource Group, Ltd.

Luedtke, Barbara. 1992. *An Archeologist's Guide to Chert and Flint*. Los Angeles, California. University of California.

Machiran, Robin, Susanna Bailey, John Kelly, 2005. *Valmeyer KPR Development-Bluff Meadows Subdivision, IAS No. 11MO475*. CMVARI.

Machiran, Robin, Susanna Bailey, John Kelly, 2005(2). *Valmeyer KPR Development-Bluff Meadows Subdivision, IAS No. 11MO1032*. CMVARI.

Machiran, Robin, Susanna Bailey, John Kelly, 2005(3). *Valmeyer KPR Development-Bluff Meadows Subdivision, IAS No. 11MO1033*. CMVARI.

Machiran, Robin, Joe Harl, 2009. *Phase II Testing of Site 11S446 on the Proposed Knollwood Retirement Center Tract St. Clair County, Illinois*. Archaeological Research Center of St. Louis, Inc.

Machiran, Robin, John Klein, Joe Harl, Marge Schroeder, 2010. *Data Recovery Investigations at the Alexander Jacob Site. (11MS2288) in Granite City, Illinois*. Archaeological Research Center of St. Louis, Inc.

McCullough, Robert, Steven Kuehn, Robert McCullough, Kathryn Parker, Adam Tufano, Alexey Zelin, 2015. *Late Woodland Occupation at the Bland Site in the Northern American Bottom*. Illinois State Archaeological Survey Prairie Research Institute.

McCullough, Robert, Steven Kuehn, Kathryn Parker, Adam Tufano, Alexey Zelin, 2015(2). *Redwood, Cunningham, and Sponemann Occupations at the Tena Deye Site in the Northern American Bottom*. Illinois State Archaeological Survey Prairie Research Institute.

McElrath, Dale, 1986. *The McLean Site*. Illinois Archaeological Survey.

McElrath, Dale, Fred Finney, Marlene Moshage, Sissel Johannessen, Paula Cross, 1987. *The George Reeves Site.* Illinois Archaeological Survey.

McElrath, Dale, Joyce Williams, Thomas Maher, Michael Meinkoth, Kathryn Parker, Maria Mercer Hajic, Lucretia Kelly, 1987(2). *Emergent Mississippian and Mississippian Communities at the Radic Site (11-Ms-584)*. Illinois Archaeological Survey.

McNerney, Michael, William Cremin, William Folan, Fredrick Hill, Barry Konneker, and Jeanette Stephens, 1975. *Archaeological Investigations in the Cedar Creek Reservoir Jackson County, Illinois*. Southern Illinois University Carbondale.

McNerney, Michael, Jim Snyder, Wes Neal, David McCorkey, Paul Strader, Bonita Rubach, Elizabeth Scott, 1996. *Phase III Salvage Investigation at Site 11-R-604 After the Flood of 1993, Kaskaskia Island, Randolph County, Illinois.* American Resource Group.Ltd.

MCNerney, Michael, Wes Neal, 1998.*Phase II Cultural Resource Investigation at Sites 11G326 and 11G329 within Black Beauty Coal Company's Wildcat Hills Mine of the Gallatin County Mine Permit Area, Gallatin County Illinois, Permit ILDNR LDR No 294*.American Resource Group, Ltd.

McNerney, Michael, Keith Keeney, Monica Shah, Cynthia Baer, 1999. *A Phase II Investigation of Sites 11G178, 11G188, 11G188, 11G190, and 11G200 within Black Beauty Coal Company's Cottage Grove Mine Permit Area, Gallatin County, Illinois.* American Resources Group, Ltd.

McNerney, Michael Gregory Wolff, Keith Keeney, 1999. *Phase II Testing at Sites 11PY179, 11PY180, and 11PY216 within Freeman United Coal Company's Fidelity Walkers Creek Mine Permit Area, Perry County, Illinois*. American Resource Group, Ltd.

Meinholz, Norm, 1986. *Archaeological Investigations at the Spring Branch Site Bond County, Illinois*. Department of Anthropology University of Illinois Urbana-Champaign.

Milner, George, Kelly Cox, Michael Meinkoth, Paula Cross, Sissel Johannessen, 1982. *The Robinson's Lake Site (11-Ms-582) A Small Late Bluff Settlement*. Department of Anthropology University of Illinois at Urbana-Champaign.

Moffet, Charles, Brad Koldehof, William Cremin, Terrance Martin, Mary Carol Masulis, and Mary McCorvie, 1992. *The Little Muddy Rock Shelter: A Deep Stratified Prehistoric Site in the Southern Till Plains of Illinois*. American Cultural Resources Group, Ltd.

Moffat, Charles, Tamira Brennan, Brad Koldehoff, Shane Vanderford, Patti Wright, 2008. Archaeological *Investigations at the Quicksilver Site (11MS1992): A Mississippian Homestead in the Silver Creek Headwaters, Madison County, Illinois*. Illinois Transportation Archaeological Research Program.

Moffat, Charles, Kathryn Parker, Terrance Martin, 2016. *Phase III Data Recovery at Site 11MO1005, a Single-Component, Emergent Mississippian Site Located in the D & A Builders Brellinger Subdivision Monroe County, Illinois*. American Resource Group, Ltd.

Moffat, Charles, Brad Koldehoff, Mary Simon, K. Shane Vanderford, Alexey Zelin, 2016. *The Kane Village Site: A Terminal Late Woodland Habitation in Madison County, Illinois*. Illinois State Archaeological Survey Prairie Research Institute.

Moore, Kurt, and Michael McNerney, 1983. *Phase II Investigations at the Westfield, Burning Star Mine #5, Jackson County, Illinois*. American Resource Group, Ltd.

Moore, Kurt, 1984. *Cultural Resource Assessment of the Pitts Site (24B4-381) Shawnee National Forest 43-51A8-3-586*. American Resources Group, Ltd.

Morrow, Carol Ann. 1988. *Chert Exploitation and Social Interaction in the Prehistoric Midwest, 200 B.C.-A.D.600*. Ann Arbor, Michigan: A Bell And Howell Company.

Morrow, Carol, J. Michael Elam, and Michael Glascock, 1992. The Use of Blue-Grey Chert in Midwestern Prehistory. *Midcontinental Journal of Archaeology*. Vol. 17, No. 2, 166-197.

Naglich, Dennis, 2002. *Site 11MS2020 Phase II Testing Silver Creek Meadows*. Archaeological Research Center of St. Louis.

Neal, W. 1994. *Phase II Cultural Resource Testing of sites 11MO797, 798, and 799 Located in an Addition to Sterrit's Run Subdivision in Waterloo, Illinois*. American Resource Group, Ltd.

Odell, George. 1984. Chert Resource Availability in the Lower Illinois Valley: A Transect Sample. *Prehistoric Chert Exploitation: Studies from the Midcontinent.* United States. Southern Illinois University.

Parker, Katherine, 2002. *Phase II and Phase III Archaeological Investigation at the Ameren 1 (11J1148), Ameren 2 (11J1149), and Hileman (11J1150) Sites, Ameren Grand Tower Power Plant Jackson County, Illinois*. American Resource Group, Ltd.

Penny, Jr, James, 1987.*Archaeological Investigations for the Hard Times Timber Sale, Union County, Illinois.* Center for Archaeological Investigations Southern Illinois University at Carbondale.

Pulcher, Ronald, 1975. Cobden-Kaolin Chert Source area: National Register of Historic Places Inventory-Nomination Form. *U.S. Department of Interior, National Park Service.*

Pauketat, Timothy, Jeffery Kruchten, Susan Alt, 2015.*Archaeological Test Excavations into Mound 3 at the Emerald Site (11S1).* Submitted to the Illinois Historic Preservation Agency In fulfillment of HSRPA #2015-014.

Sant, Mark, Brad Koldehoff, and Kathryn Koldehoff, 1986. *Archaeological Test Excavations at Four Site Locations in Fort Massac State Park, Massac County, Illinois*. Southern Illinois University at Carbondale.

Santeford, Lawrence, and Neal Lopinot, 1979. *Final Report on Archaeological Investigations at Frog City and Red Light: Two Middle Woodland Period Sites in Alexander County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Scheid, Dwayne, Charles Witty, 2012. *Archaeological Investigations at Site 11S71 (Knoebel) for the I-64 Interchange a Rieder Road Project. Archaeological Testing Short Report No. 397*. Illinois State Archaeological Survey Prairie Research Institute.

Scheid, Dwayne, Steve Boles, Charles Witty, 2012. *Archaeological Investigations at Site 11S816 (Knoebel South) for the I-64 Interchange a Rieder Road Project. Archaeological Testing Short Report No. 397*. Illinois State Archaeological Survey Prairie Research Institute.

Scheid, Dwayne, Mark Branstner, Charles Witty, 2012. *Archaeological Investigations at Site 11S814 (George Perchbacher) for the I-64 Interchange a Rieder Road Project. Archaeological Testing Short Report No. 398*. Illinois State Archaeological Survey Prairie Research Institute.

Scheid, Dwayne,Mark Branstner, Charles Witty, 2012. *Archaeological Investigations at Site 11S1098 (John Knoebel Site) for the I-64 Interchange a Rieder Road Project. Archaeological Testing Short Report No. 413*. Illinois State Archaeological Survey Prairie Research Institute.

Schwegman, John, 2006. *Phase II Archaeological Investigations at Site 11SA463 Archaeological Survey Short Report.*

Schwegman, John, Jeff Myers, Gabrielle Aberle, Steve Titus, Cally Lence, Jennifer Williams, Margaret Fink, 2007. *Phase II Archaeological Investigations at Sites 11MS2018, 11MS2278, 11MS2277, 11MS2276, 11MS2275, 11B165, 11B164, 11B159, 11B155, 11FY204, and 11FY205 within the Keystone Pipeline Project Corridor, Madison, Bond, and Fayette Counties, Illinois.* American Resource Group, Ltd.

Schwegman, John, Monica Shah Lomas, H. Blaine Ensor, 2009. *Phase II Archaeological Investigations at Sites 11MS17 and 11MS619 within the Keystone Pipeline Project Corridor, Madison County, Illinois*. American Resource Group, Ltd.

Shah, Monica, Cally Lence, Kathryn Parker, Steve Titus, and Brad Williams, 2003. *Phase II and Phase III Archaeological Investigations at Sites 11J1115: A Mid-Nineteenth Century Squatter Occupation in Jackson County, Illinois*. American Resources Group, Ltd.

Snyder, David, 1991. *Archaeological Test Excavations at Site 11-U-276, Union County Conservation Area Road Realignment, Union County, Illinois*. Archaeological Survey Short Report.

Snyder, Jim, and Steve Titus, 1999. *Phase II Testing at Site 11J129 within the Knight Hawk Mine Permit Area, Jackson County, Illinois*. American Resource Group, Ltd.

Snyder, Jim, Steve Titus, Chris Koeppel, Jeff Anderson, Blaine Ensor, Elizabeth Scott, and Witty, C. 2002. *Archaeological Survey Short Report Document Number 13487*. Illinois Transportation Archaeological Research Program.

Snyder, Jim, Cally Lence, and Steve Titus, 2002. *Phase II Testing at 11MX269 at Cellular Tower Site in Brookport; ARG CRM 1239*. Archaeological Survey Short Report.

Spielbauer, Ronald. 1984. Potentialities for Trace Element Analyses in Southern Illinois Cherts. *Prehistoric Chert Exploitation: Studies from the Midcontinent*. United States. Southern Illinois University.

Stahl, Ann, James Porter, Charles Baries, Sissel Johannessen, Paul Cross, George Milner, 1985. *The Dohack Site.* Illinois Archaeological Survey.

Stephens, Jeanette, and Lee Newsom, 1996.*Archaeological Mitigation at the Dogtooth Bend Site (11-Ax-31), Alexander County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Tankersley, Kenneth, Marjorie Schroeder, Terrance Martin, and J. Chris Richmond, 1991. *Early Mississippian Subsistence Activities on the Northern Fringes of the Gulf Coastal Plain*. Illinois State Museum.

Titus, Steve, Jim Snyder, Todd Ogier, Gordon Howe, and Michael McNerney, 1992. *Phase II Archaeological Investigations, at Sites 11-Sa-101, 11-Sa-217, and 11-Sa-234 Located within Amax Coal Company's Delta Mine Expansion, Saline County, Illinois*. American Resources Group, Ltd.

Titus, Steve, and Gordon Howe, 1993. *Phase II Archaeological Investigations at Site 11-Sa-221 Located within the AMAX Coal Company's Delta Mine Expansion, Saline County, Illinois*. American Resources Group, Ltd.

Titus, Steve, Cynthia Baer, and Greg Wolff, 2000. *Phase II Archaeological Investigations at Site 11J967, City of Carbondale, Jackson County, Illinois*. American Resource Group, Ltd.

Titus, Steve, 2002. *Phase II Archaeological Investigations at Sites 11MO997, 11MO998, and 11S1520, D & A Builders Subdivision, Monroe and St. Clair County, Illinois*. American Resources Group, Ltd.

Titus, Steve, Chris Koeppel, Kathryn Parker, Lucretia Kelly, 2002. *Phase II Archaeological Investigations at Site 11MO1005, D & A Builders Subdivision, Monroe and St. Clair Counties, Illinois*. American Resource Group, Ltd.

Titus, Steve, Kevin Lomas, and Kathryn Parker, 2008. *Phase II Archaeological Investigations at Site 11WM355 and 11WM357 City of Marion Industrial Park, Williamson County, Illinois*. American Resource Group, Ltd.

Titus, Steve, H. Blaine Ensor, Karen Mayo, Kathryn Parker, 2010. *Phase III Archaeological Investigations at Site 11MS17 within the Illinois Segment of the Keystone Pipeline Project Corridor, Madison County, Illinois*. American Resource Group, Ltd.

USGS, 2005. "State Geologic Maps" Shapefile. *USGS Mineral Resources.*

Wagner, Mark, Mary McCorvie, Charles Foor, Kathryn Parker, 1992. *Phase III Archaeological Investigations at the Thanksgiving Site (21D3-242) in the Consolidation Coal Mine #2 Pinckneyville Pit #3 Extension Perry County, Illinois*. American Resource Group, Ltd.

Wagner, Mark, Brad Koldehoff, William Cremin, Mary McCorvie, Leonard Blake, Jonathan Bloom, 1994. *The Bonnie Creek Site: A late Mississippian Homestead in the Upper Galum Creek Valley, Perry County, Illinois.* American Resource Group, Ltd.

Wagner, Mark, 1995. *Cultural Resource Investigations at Site 11-Jn-291, Jefferson County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Wagner, Mark, 1995(2). *Cultural Resources Investigations at the Heron Flats Site (11-Mw-279), Williamson County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Wagner, Mark, 1998. *The Archaeology and Rock Art of the Piney Creek Ravine Nature Preserve, Jackson and Randolph Counties, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Wagner, Mark, and Brian Butler, 1999. *Archaeological Investigations of Three Sites at the Southern Illinois Airport, Jackson County Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Wagner, Mark, Brain Butler, Brian DelCastello, Richard Herndon, Lucretia Kelly, and Kathryn Parker, 2000. *Archaeological Investigations at Dixon Springs State Park: The Hills Branch Rock Shelter, Pope County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Wagner, Mark, 2005. *Historical and Archaeological Investigations of Cantonment Wilkinson (11Pu-281), An 1801-1802 U.S. Army Post in Pulaski County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Wagner, Mark, Brad Koldehoff, Candace Lutzow, Mary McCorvie, Johnathan Bloom, 2005.*The Lightfoot Site: An Early Late Woodland and Mississippian Occupation in the Upper Galum Creek Valley, Perry County, Illinois: Phase III Excavations at the Consolidation Coal Company, Northfield, Burning Star Mine #4.* American Resource Group, Ltd.

Wagner, Mark, Brian Butler, Sarah Montieth, and Kathryn Parker. 2007, *Archaeological Investigations of the Julius and Maud Marlin Site, 11Sa-513, Saline County, Illinois*. Center for Archaeological Investigations Southern Illinois University at Carbondale.

Waltz, Gregory, Brian Adams, Jacqueline McDowell, Paul Kreisa, Kevin McGowan, Kirstin Hedman, Cynthia Balek, 1997. *Archeological Investigations for the Relocation of Valmeyer, Monroe County, Illinois: Volume 3: The Stemler Bluff Site*. Public Service Archaeological Program Department of Anthropology University of Illinois at Urbana-Champaign.

Wells, Christy, 1992. *Phase II Testing, Fohne Site, Thornbury Hill Subdivision*. Contract Archaeology Program, Southern Illinois University at Edwardsville.

Willman, H. B.,Elwood Atherton, T. C. Buschback, Charles Collinson, John Frye, M. E. Hopkins, Jerry Lineback, and Jack Simon. 1975. *Handbook of Illinois Stratigraphy*. Urbana, Il. Illinois State Geological Survey.

Wilson, Lucy, 2007. Understanding Prehistoric Lithic Raw Material Selection: Application of a Gravity Model. *Journal of Archaeological Method and Theory*. Vol. 14. No. 4, 388-411.

Witty, Charles, Brad Koldehoff, 2005. *Archaeological Investigations at Site 11S709 (Leprechaun Site) for the East Bank Pointe Development Project. Archaeological Testing Short Report No. 200*. Illinois Transportation Archaeological Research Program.

Zimmermann Holt, Julie, Miranda Yancey, Erin Marks, 2009.*SIUE Field School Investigations in the Locale of the D. Hitchins Site (11MS1124)*. Southern Illinois University Edwardsville.

Appendix A Chert Outcrop Site Component Data

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
24D3-172	Frog City	1	Woodland	Middle				
11-AX-27	Milar	3	Unknown					
11-AX-255	Swimm-ing Snake	1	Mississippian	Emergent				
11-AX-31	Dogtooth Bend	1	Mississippian					
11-AX-560		3	Unknown					
11-AX-3	Peith-man	1	Woodland					
11-AX-108		1	Woodland	Middle				
11-AX-127		3	Woodland	Late	Mississippian	Emergent		
11-AX-128		3	Archaic		Woodland			
11-AX-256		1	Mississippian	Emergent				
11-AX-257		3	Woodland	Late	Mississippian	Emergent		
11-AX-258		1	Archaic	Middle to late				
11-AX-259		3	Woodland	Late	Mississippian	Emergent		
11-AX-452		3	Unknown					
11-AX-454		3	Woodland	Late	Mississippian	Emergent		
11-AX-455		1	Woodland	Middle				
11-AX-456		1	Mississippian					
11-AX-457		3	Woodland	Middle and Late	Mississippian	Emergent		
11-AX-458		1	Archaic	Late				
11-AX-459		3	Unknown					
11-AX-460		1	Archaic	Late				

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-AX-461		3	Unknown					
11-AX-462		3	Unknown					
11-AX-463		1	Archaic	Late				
11-AX-465		3	Unknown					
11-AX-467		3	Unknown					
11-AX-468		1	Archaic	Late				
11-AX-469		3	Unknown					
11-AX-472		3	Unknown					
11-AX-474		3	Woodland	Late	Mississippian	Emergent		
11-AX-475		3	Woodland	Middle and Late	Mississippian	Emergent		
11-AX-476		3	Woodland	Late	Mississippian	Emergent		
11-AX-477		3	Unknown					
11-AX-478		3	Unknown					
11-AX-481		3	Unknown					
11-AX-483		3	Woodland	Late	Mississippian	Emergent		
11-AX-485		3	Woodland	Late	Mississippian	Emergent		
11-AX-486		3	Unknown					
11-PU-282		3	Woodland	Late	Mississippian			
11-MX-238		3	Unknown					
11-MX-208		3	Unknown					
11-MX-278		3	Unknown					
11-MX-279		1	Woodland	Middle to late				
11-MX-280		1	Woodland	Middle to late				
11-MX-269		3	Unknown					

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MX-1	Kinkaid mound	1	Archaic					
11-U-682		3	Archaic	Late	Woodland	Early to Middle		
11-PU-161F		1	Woodland	Middle				
11-AX-339	William-son	3	Unknown					
24B4-381	Pitts	1	Woodland	Late				
11-U-779		1	Archaic					
11-U-276		1	Woodland	Late				
11-JS-321		1	Archaic	Early to late				
11-JS-325		3	Archaic	Late	Woodland	Early		
11-JS-326		1	Woodland	Early				
11-JS-328		1	Woodland	Early				
11-JS-329		1	Woodland	Early				
11-PP-508	Hill Branch Rock Shelter	3	Archaic	Early to late	Woodland	Early		
24B2-59		3	Archaic	Early and late	Woodland	Early to Middle	Mississippian	
24B3-99	Topping	1	Woodland	Middle				
24B3-100	Landreth #2	1	Woodland	Middle				
24B3-110	Throg-morton Dam	1	Woodland	Middle to late				
24B3-102	Beach	3	Archaic	Late	Woodland	Middle		
24B3-101	Landreth #1	3	Archaic	Late	Woodland	Early		

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-J-79	Komond-or	3	Archaic	Late	Woodland	Early		
11-J-814	Little Muddy	2	Archaic	Early to late				
11-J-814	Little Muddy	2	Woodland	Middle to late				
11-J-814	Little Muddy	2	Mississippian					
11-J-814	Little Muddy	4	Archaic	Early to late	Woodland	Middle to late	Mississippian	
11-J-964	Mollie Baker	1	Woodland	Middle				
11-J-1055		1	Woodland	Middle				
11-J-129		3	Woodland	Late	Mississippian			
11-J-1145		1	Archaic					
11-R-26	Piney Creek	3	Archaic	Late	Woodland	Early to late	Mississippian	
11-J-1115		1	Woodland	Middle to late				
11-J-967		3	Archaic	Late	Woodland	Early and middle		
11-J-1196	Hallo-ween	2	Woodland	Middle and late				
11-J-1196	Hallo-ween	5	Woodland	Middle and Late	Indeterminate			
11-J-1148	Ameren 1	3	Archaic	Late	Woodland	Late		
11-J-1149	Ameren 2	3	Archaic	Late	Woodland	Late		
11-J-1150	Hileman	3	Archaic	Middle	Woodland	Late		

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-WM-99		2	Woodland	Middle to late				
11-WM-99		2	Mississippian					
11-WM-99		5	Woodland	Middle to late	Mississippian		Indeterminate	
11-WM-279	Heron Flats	1	Woodland	Middle				
11-WM-355		3	Archaic	Early and late	Woodland	Early to late		
11-WM-357		3	Archaic	Early to late	Woodland	Early to late		
11-WM-80	Broglio	3	Archaic	Late	Woodland	Middle	Mississippian	
11-SA-101		3	Archaic	Early and late	Woodland	Early to late		
11-SA-217		3	Archaic	Early and late	Woodland	Early to late		
11-SA-234		3	Archaic	Early to middle	Woodland	Early to Middle		
11-SA-221		1	Woodland	Middle to late				
11-SA-510		3	Archaic	Early to late	Woodland	Early to late	Mississippian	
11-SA-526		3	Archaic	Early to late	Woodland	Early to late	Mississippian	
11-SA-513		1	Woodland	Middle				
11-SA-563		3	Archaic	Middle to late	Woodland	Early to Middle		
11-G-178		1	Archaic	Late				
11-G-188		1	Archaic	Early and late				
11-G-190		3	Archaic	Middle to late	Woodland	Middle to late	Mississippian	
11-G-200		3	Archaic	Middle to late	Woodland	Early to Middle		
11-G-326		3	Archaic	Middle to late	Woodland	Early to late	Mississippian	
11-G-329		3	Archaic	Middle to late	Woodland	Early to late		
11-G-361		1	Archaic	Late				
11-R-331	Diana	1	Archaic	Middle				

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-R-604	Brown	3	Woodland	Middle to late	Mississippian			
21C4-46	Bonnie Creek	1	Mississippian					
21C4-35	Lightfoot	3	Woodland	Late	Mississippian			
21D3-242	Thanks-giving	3	Archaic	Middle and Late	Woodland	Early to late		
21D3-67		3	Archaic	Late	Woodland	Middle to late	Mississippian	
11-PY-179		1	Woodland	Early to middle				
11-PY-180		1	Woodland	Early to middle				
11-PY-216		1	Woodland	Middle				
11-PY-198	Perrack-son	1	Mississippian	late				
21C4-9	Black Snake	1	Mississippian					
11-FK-228		3	Unknown					
11-H-2		3	Woodland	Early to middle	Mississippian			
11-H-27		1	Woodland	Late				
11-M0-609	Fiege	1	Woodland	Early				
11-MO-594	Carbon Dioxide	2	Woodland	Late				
11-MO-594	Carbon Dioxide	2	Mississippian	Early				
11-MO-594	Carbon Dioxide	4	Woodland	Late	Mississippian	Early		
11-MO-200	Truck #7	1	Woodland	Middle				
11-MO-522S	Go Kart South	1	Woodland	Early to middle				

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MO-562	Bluff Shadow	1	Mississippian					
11-MO-593	Carbon Monoxid e	1	Woodland	Middle				
11-M0-797		3	Archaic	Early to middle	Mississippian	Emergent		
11-M0-798		1	Archaic	Late				
11-M0-799		1	Mississippian					
11-M0-841	Strong	1	Archaic	Middle				
11-MO-891	Stemler Bluff	3	Woodland	Late	Mississippian	Emergent		
11-MO-636	Collin No. 2	3	Archaic	Early and late	Woodland	Late		
11-MO-672	Collin No. 3	3	Archaic	Early	Woodland	Late		
11-MO-973	Crooker-dale	1	Woodland	Early to middle				
11-MO-768	Booster Station	1	Woodland	Middle				
11-MO-997		3	Unknown					
11-MO-998		3	Unknown					
11-S-1520		1	Woodland	late				
11-MO-1005		1	Mississippian	Emergent				
11-MO-475		1	Archaic	Early to middle				
11-MO-1032		3	Archaic	Early and late	Woodland	Late		
11-MO-1033		1	Archaic	Early				

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MO-598	Power line	3	Woodland	Late	Mississippian			
11-MO-725	Sheepshead	1	Woodland	Late				
11-MO-1068	Deer	3	Unknown					
11-MO-599	Ramsey	3	Unknown					
11-MO-855	Hawkins Hollow	1	Mississippian	Late				
11-MO-717		3	Archaic	Early and late	Woodland	Late		
11-MO-718	Dugan Airfield	3	Archaic	Early and late	Woodland	Middle to late	Mississippian	
11-MO-880	Woodland Ridge	2	Woodland	Late				
11-MO-880	Woodland Ridge	2	Mississippian	Emergent				
11-MO-880	Woodland Ridge	4	Woodland	Late	Mississippian	Emergent		
11-MO-722	Leingang	1	Woodland	Late				
11-MO-776	Earl Kolmer	2	Woodland	Middle				
11-MO-776	Earl Kolmer	5	Archaic	Early	Woodland	Middle to late	Mississippian	
11-MO-1075	Fults	3	Woodland	Middle to late	Mississippian			
11-S-854	Fohne	1	Archaic	Early				
11-S-784	Jens	3	Archaic		Woodland	Late		
11-S-782	Vesta Lembke	1	Mississippian	Early				

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-S-242	E.J. Pheifer #2	1	Woodland	Late				
11-S-85	Lembke #1	1	Woodland	Late				
11-S-87	Lembke #3	3	Archaic	Early and late	Woodland	Early and late	Mississippian	
11-S-234	William Lembke Jr. #1	3	Archaic	Late	Woodland	Late		
11-S-889		1	Mississippian					
11-S-793	J. Ernest	1	Woodland	Early to late				
11-S-786	Bill Schobert	1	Woodland	Late				
11-S-794	Hughes	3	Archaic	Early	Woodland	Early		
11-S-795	Crooked Creek #2	1	Archaic	Early				
11-S-882		1	Archaic					
11-S-762	Richard Sprangue	1	Archaic					
11-S-775	Hess	1	Woodland	Late				
11-S-237	John H. Faust #1	3	Woodland	Middle to late	Mississippian			
11-S-236	William Lembke Jr. #3	3	Archaic		Woodland		Mississippian	
11-S-235	William Lembke Jr. #2	3	Woodland	Early to late	Mississippian			
11-S-1061	Kell	3	Archaic	Early to late	Woodland	Middle		

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-S-1148	Reach B	2	Mississippian					
11-S-1148	Reach B	2	Woodland	Late				
11-S-1148	Reach B	4	Woodland	Late	Mississippian			
11-S-19	Booker T. Washingt on	3	Woodland	Late	Mississippian	Emergent		
11-S-1033	Wessen	1	Mississippian	Emergent				
11-S-1161	Charles Hytla	1	Mississippian					
11-S-709	Lepre-chaun	3	Woodland	Early to late	Mississippian			
11-S-69	Faust	1	Woodland	Late				
11-S-1446		1	Mississippian					
11-S-1637		1	Mississippian					
11-S-71	Knoebel	5	Woodland	Late	Mississippian			
11-S-71	Knoebel	2	Mississippian					
11-S-816	Knoebel south	3	Archaic	Early to late	Woodland	Early to late	Mississippian	
11-S-814	George Perch-bacher	1	Mississippian					
11-S-1098	John Knoebel	1	Archaic	Middle				
11-S-729	Wilder-man	1	Woodland	Late				
11-S-730	Orville Seibert	3	Woodland	Late	Mississippian			
11-S-747	Classen	1	Woodland	Late				

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-S-1	Emerald mounds	1	Mississippian					
11-S-631	Marcus	2	Woodland	Late				
11-S-631	Marcus	2	Mississippian					
11-S-631	Marcus	5	Woodland	Late	Mississippian		Indeterminate	
11-CT-255	Harry Billhartz #1	1	Woodland	Late				
11-CT-466	Bluebell	2	Archaic	Late				
11-CT-466	Bluebell	2	Woodland	Middle to late				
11-CT-466	Bluebell	2	Mississippian	Emergent				
11-CT-466	Bluebell	5	Archaic	Late	Woodland	Middle to late	Mississippian	Emergent
11-JN-108	Old Saw Mill #2	3	Archaic	Late	Woodland	early to late		
11-JN-257	Doll Head #3	3	Archaic	Early and late	Woodland	Early to Middle		
11-JN-291		1	Archaic	Late				
11-MS-2018		3	Archaic	Late	Woodland	Late		
11-MS-2278		1	Archaic	Early				
11-MS-2277		3	Unknown					
11-MS-2276		3	Unknown					
11-MS-2275		3	Unknown					
11-B-165		1	Woodland	Early and late				
11-B-164		3	Archaic	Early and late	Woodland	Early and late		

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-B-159		3	Archaic	Early and late	Woodland	Late		
11-B-155		3	Unknown					
11-FY-205		3	Archaic	Middle to late	Woodland	Early to late		
11-FY-204		3	Archaic	Late	Woodland	Early		
11-B-21	Spring Branch	1	Archaic	Early to late				
11-B-111		1	Woodland	Late				
11-MS-1380	GCS #1	1	Mississippian					
11-MS-582	Robinson Lake	1	Woodland	Late				
11-MS-1177	Robert Schneider	1	Mississippian					
11-MS-1255	Karol Rekas	1	Mississippian					
11-MS-610	Will-boughby	2	Woodland	Middle				
11-MS-610	Will-boughby	2	Mississippian					
11-MS-610	Will-boughby	5	Woodland	Middle	Mississippian		Indeterminate	
11-MS-598	Esterlein	5	Archaic		Woodland		Mississippian	
11-MS-598	Esterlein	2	Mississippian					
11-MS-587	Wooded	1	Archaic					

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MS-611	Judy's Canal North	3	Woodland	Late	Mississippian	Emergent		
11-MS-612	Judy's Canal South	3	Archaic	Late	Woodland	Middle to late	Mississippian	
11-MS-1799	Pump Station East	3	Unknown					
11-MS-1800	Burroughs	3	Unknown					
11-MS-1801	Hans Meyers	1	Woodland	Early to middle				
11-MS-1802	Kate's Point	3	Woodland	Late	Mississippian			
11-MS-1803	Kellie's	1	Woodland	Late				
11-MS-1804	Craig Engeling	1	Mississippian					
11-MS-1805	Sepmeier	3	Unknown					
11-MS-1806	Lucky Strike	3	Woodland	Early and late	Mississippian			
11-MS-1807	Engeling Farm	3	Unknown					
11-MS-1809	Burdick	3	Unknown					
11-MS-80	Leveed Creek	3	Archaic		Woodland	Late	Mississippian	
11-MS-345	Eckmann Island	3	Archaic		Woodland	Late	Mississippian	

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MS-517	Spone-mann	3	Archaic	Early to late	Woodland	Middle	Mississippian	
11-MS-1330	School-house Branch South	1	Mississippian					
11-MS-1778	Nad Enoob	3	Woodland	Middle and Late	Mississippian			
11-MS-1815	Curve in the road	1	Woodland					
11-MS-1816	Burns Farm	3	Unknown					
11-MS-1817	Burns Trash	3	Unknown					
11-MS-1818	Schneide r Ditch	3	Unknown					
11-MS-1819	Spa	3	Unknown					
11-MS-1820	Diane's Place	3	Unknown					
11-S-316	Axis	3	Unknown					
11-S-460	Thereon	1	Archaic	Middle				
11-S-596	Chevy Chase	3	Woodland	Late	Mississippian	Emergent		
11-S-1234	Harding	3	Unknown					
11-S-1236	Sage	3	Unknown					
11-S-1278	Creamer House	3	Woodland	Middle to late	Mississippian	Emergent		
11-S-1279	Earl Crates	3	Woodland	Middle	Mississippian			

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-S-1280	Bevelot	1	Mississippian					
11-S-1281	Illinsky	1	Mississippian	Emergent				
11-S-1282	Lavonne Cates	1	Woodland	Late				
11-S-1283	Levee Road	3	Woodland	Late	Mississippian	Emergent		
11-S-1284	Golf Course	3	Unknown					
11-S-1285	Hidden Trail	3	Unknown					
11-S-1252	Mullins Creek	3	Woodland	Early and late	Mississippian			
11-S-1253	Morgan	3	Archaic	Late	Woodland	Late	Mississippian	
11-S-1254	Eichaker	1	Archaic					
11-S-1255	Eagle's Nest	3	Archaic	Late	Woodland	Late	Mississippian	
11-S-1256	John Hays	3	Archaic	Late	Woodland	Early and late	Mississippian	
11-S-1257	Pelanek	3	Woodland	Early and late	Mississippian	Emergent and late		
11-S-1258	Little Knob	3	Woodland	Late	Mississippian	Emergent		
11-S-1259	Cruse	1	Mississippian					
11-S-1260	Baxter	1	Woodland	Late				
11-S-1261	Hertel	1	Archaic	Late				
11-S-1262	DeFosset	3	Woodland	Early	Mississippian			
11-S-1263	Leveed Ridge	3	Unknown					
11-S-1264	Little Rise	3	Unknown					

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-S-1265	Betz	1	Archaic	Late				
11-S-1266	Rein	3	Woodland	Early and late	Mississippian	Emergent and late		
11-S-1267	Nubbin	3	Unknown					
11-S-1268	Judy Betz	1	Mississippian					
11-S-1269	Bench	3	Woodland	Early and late	Mississippian			
11-S-1270	Roadside	3	Woodland	Late	Mississippian	Emergent		
11-S-1271	Creek Side	3	Archaic	Late	Woodland	Middle to late	Mississippian	
11-S-1272	Branton	1	Mississippian					
11-S-1273	Mc Laughlin	1	Woodland	Late				
11-S-1274	Two Deer	3	Archaic	Late	Woodland	Late	Mississippian	Emergent
11-S-1275	Young	3	Woodland	Early and late	Mississippian			
11-S-1276	Bend in the Creek	3	Unknown					
11-MS-1665	Bivouac	1	Mississippian	Emergent				
11-MS-71	Ringering	3	Archaic		Woodland			
11-MS-621	Floyd	1	Archaic					
11-MS-2020		1	Woodland	Late				
11-MS-1970	Ping Pup	1	Mississippian					
11-MS-1210	Norfolk and Western	3	Archaic	Late	Woodland	Early		

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MS-1211	Chicago and North-western	1	Archaic					
11-MS-1212	Skinned Rabbit	1	Woodland	Middle				
11-MS-1273	Goshen	1	Mississippian	Emergent				
11-MS-1274	Milk and Honey	1	Mississippian	Emergent				
11-MS-2049	Lange	1	Mississippian					
11-MS-1992	Quick-silver	1	Mississippian					
11-MS-1124	D. Hitchens	3	Archaic		Woodland		Mississippian	
11-MS-17	Judge Gill	3	Archaic	Late	Woodland	Middle and Late	Mississippian	
11-MS-619		3	Woodland	Middle and Late	Mississippian			
11-MS-2288	Alex-ander Jacob	1	Mississippian					
11-MS-1049		1	Mississippian					
11-MS-1246		1	Woodland	Late				
11-MS-109	Schmid	1	Woodland					

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MS-1960	Husted	1	Woodland	Late				
11-MS-526	Ray Bluff	1	Woodland	Late				
11-MS-923	Bland	3	Archaic	Early and late	Woodland	Early to late		
11-MS-636	Vasey	1	Woodland	Late				
11-MS-769	Tena Deye	1	Woodland	Late				
11-MS-1956	Long Haul	3	Archaic	late	Woodland	Early and late		
11-MS-2248	McCoy	3	Unknown					
11-MS-662	Lillie	1	Woodland	Late				
11-MS-54	St. Thomas	1	Mississippian					
11-MS-1350	Style	3	Archaic		Woodland		Mississippian	Emergent
11-MS-584	Radic	1	Mississippian					
11-MS-595	BBB Motor	1	Mississippian	Early				
11-MS-1435		3	Archaic		Woodland	Early to late	Mississippian	
11-MS-1614	Meeks	1	Archaic	Early				
11-MS-2300	Auburn Sky	3	Woodland	Late	Mississippian			
11-MS-2317	Herter	1	Archaic	Late				
11-MS-672	Shell oil	3	Woodland	Early and late	Mississippian			

Site ID[a]	Site Name	Site Type[b]	Period	Subperiod[c]	Period 2	Subperiod 2[c]	Period3	Subperiod 3[c]
11-MS-637	Barnhill's Farm-stead	3	Archaic	Late	Woodland	Middle to late	Mississippian	
11-MS-27	Riley	1	Woodland	Late				
11-MS-52	Kane Village	1	Woodland	Late				
11-S-47	Range	2	Archaic	Late				
11-S-47	Range	2	Woodland	Early to late				
11-S-47	Range	4	Archaic	Late	Woodland	Early to late		
11-S-650	George Reeves	2	Archaic	Late				
11-S-650	George Reeves	2	Woodland	Late				
11-S-650	George Reeves	2	Mississippian					
11-S-650	George Reeves	4	Archaic	Late	Woodland	Late	Mississippian	
11-S-640	McLean	3	Archaic	Late	Mississippian			
11-S-642	Dohack	2	Woodland	Late				
11-S-642	Dohack	2	Mississippian					
11-S-642	Dohack	4	Woodland	Late	Mississippian			
11-S-629	Columbia Quarry	1	Woodland	Late				
11-S-699	Cramer #2	1	Woodland	Late				
11-MO-608	Fish Lake	1	Woodland	Late				
11-S-435	Mund	1	Woodland	Middle to late				

[a] Site IDs and names were identified in the reports and registered with the state SHPO. Site name was given to the site by the archaeologist registering the site with the state SHPO. Site ID format is determined by the state and county in which they are located. The number 11 indicates the state of Illinois. The following letters indicate the county and the final numbers specifies site identification the number.

[b] Multiple lines of data for the same site include data from the entire site when the site type is 4 or 5, when the site type is 1 or 2 only data from one period is included.

[c] Components are taken from the site reports. Cultural components that are subdivisions of Archaic, Woodland or Mississippian will be combined with the appropriate overarching component.

Appendix B Chert Outcrop Weight Data

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
24D3-172	0.0	0	0.0	77.0	6	12.8	34.1	16	2.1	0.0	0	0.0	111.1
11-AX-27	0.0	0	0.0	1250.4	294	4.3	0.0	0	0.0	74.2	30	2.5	1324.6
11-AX-255	0.0	0	0.0	34.8	0	0.0	0.0	0	0.0	181.2	0	0.0	216
11-AX-31	0.0	0	0.0	25.2	1	25.2	8.9	7	1.3	473.0	157	3.0	507.1
11-AX-560	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	99.4	13	7.6	99.4
11-AX-3	11.9	3	4.0	0.0	0	0.0	0.3	1	0.3	23.4	15	1.6	35.6
11-AX-108	1.1	1	1.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1.1
11-AX-127	1.8	1	1.8	2.3	2	1.2	0.0	0	0.0	0.0	0	0.0	4.1
11-AX-128	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	12.3	4	3.1	12.3
11-AX-256	0.0	0	0.0	9.2	1	9.2	0.0	0	0.0	56.3	1	56.3	65.5
11-AX-257	0.0	0	0.0	1.3	1	1.3	0.0	0	0.0	13.3	2	6.7	14.6
11-AX-258	0.0	0	0.0	0.9	1	0.9	0.0	0	0.0	28.3	13	2.2	29.2
11-AX-259	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	26.9	10	2.7	26.9
11-AX-452	574.9	15	38.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	574.9
11-AX-454	198.6	2	99.3	32.5	19	1.7	2.6	4	0.7	74.2	36	2.1	307.9
11-AX-455	4.1	5	0.8	102.6	6	17.1	2.2	2	1.1	160.7	13	12.4	269.6
11-AX-456	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	114.0	2	57.0	114
11-AX-457	26.0	19	1.4	74.3	33	2.3	0.0	0	0.0	78.7	38	2.1	179
11-AX-458	50.7	9	5.6	22.5	14	1.6	0.3	1	0.3	159.4	66	2.4	232.9
11-AX-459	0.0	0	0.0	7.5	1	7.5	0.0	0	0.0	0.7	1	0.7	8.2
11-AX-460	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	3.2	2	1.6	3.2
11-AX-461	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	2.8	3	0.9	2.8
11-AX-462	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	2.6	2	1.3	2.6
11-AX-463	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	50.6	2	25.3	50.6

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-AX-465	23.4	2	11.7	6.0	2	3.0	0.0	0	0.0	30.1	1	30.1	59.5
11-AX-467	147.9	1	147.9	0.6	1	0.6	0.0	0	0.0	8.7	2	4.4	157.2
11-AX-468	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	15.0	5	3.0	15
11-AX-469	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.5	1	0.5	0.5
11-AX-472	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	4.8	1	4.8	4.8
11-AX-474	0.0	0	0.0	0.7	1	0.7	2.3	2	1.2	6.6	5	1.3	9.6
11-AX-475	7.2	5	1.4	0.7	1	0.7	25.7	5	5.1	15.5	5	3.1	49.1
11-AX-476	0.0	0	0.0	16.3	5	3.3	21.5	10	2.2	126.8	12	10.6	164.6
11-AX-477	0.0	0	0.0	7.1	2	3.6	0.0	0	0.0	69.9	3	23.3	77
11-AX-478	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1.3	1	1.3	1.3
11-AX-481	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	15.3	2	7.7	15.3
11-AX-483	43.3	1	43.3	0.0	0	0.0	0.0	0	0.0	4.3	2	2.2	47.6
11-AX-485	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	17.4	2	8.7	17.4
11-AX-486	1.8	1	1.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1.8
11-PU-282	0.0	0	0.0	15.6	5	3.1	2.8	3	0.9	80.7	31	2.6	99.1
11-MX-238	2.5	1	2.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	2.5
11-MX-208	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	16.0	1	16.0	16
11-MX-278	0.0	0	0.0	5.8	1	5.8	0.0	0	0.0	0.0	0	0.0	5.8
11-MX-279	0.0	0	0.0	6.7	1	6.7	4.6	1	4.6	5.3	6	0.9	16.6
11-MX-280	0.8	1	0.8	5.8	1	5.8	0.3	1	0.3	146.4	14	10.5	153.3
11-MX-269	0.2	1	0.2	0.1	1	0.1	0.0	0	0.0	0.0	0	0.0	0.3
11-MX-1	0.0	0	0.0	0.0	0	0.0	1.3	2	0.7	67.5	12	5.6	68.8
11-U-682	20.5	23	0.9	3548.9	2683	1.3	133.8	270	0.5	819.9	834	1.0	4523.1
11-PU-161F	0.0	0	0.0	15.2	1	15.2	0.0	0	0.0	0.0	0	0.0	15.2
11-AX-339	0.0	0	0.0	0.0	0	0.0	0.7	1	0.7	12.7	2	6.4	13.4

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
24B4-381	0.0	0	0.0	21.9	41	0.5	6.0	18	0.3	0.0	0	0.0	27.9
11-U-779	0.7	2	0.4	4194.8	784	5.4	127.9	15	8.5	42.0	28	1.5	4365.4
11-U-276	0.0	0	0.0	0.0	0	0.0	1.4	1	1.4	20.3	1	20.3	21.7
11-JS-321	0.0	0	0.0	509.7	43	11.9	102.2	63	1.6	1387.0	450	3.1	1998.9
11-JS-325	7.3	10	0.7	111.6	140	0.8	10.7	13	0.8	18.1	24	0.8	147.7
11-JS-326	0.0	0	0.0	58.7	58	1.0	0.0	0	0.0	2.3	4	0.6	61
11-JS-328	0.0	0	0.0	20.8	9	2.3	4.5	1	4.5	3.0	2	1.5	28.3
11-JS-329	0.8	2	0.4	4.7	5	0.9	0.0	0	0.0	0.6	2	0.3	6.1
11-PP-508	0.0	0	0.0	0.0	0	0.0	65.0	25	2.6	219.8	145	1.5	284.8
24B2-59	29.6	10	3.0	151.7	33	4.6	14.7	2	7.4	0.0	0	0.0	196
24B3-99	0.0	0	0.0	54.0	1	54.0	0.0	0	0.0	0.0	0	0.0	54
24B3-100	0.0	0	0.0	2509.0	24	104.5	0.0	0	0.0	0.0	0	0.0	2509
24B3-110	0.0	0	0.0	1204.0	18	66.9	0.0	0	0.0	0.0	0	0.0	1204
24B3-102	0.0	0	0.0	159.0	4	39.8	0.0	0	0.0	0.0	0	0.0	159
24B3-101	0.0	0	0.0	722.0	15	48.1	0.0	0	0.0	0.0	0	0.0	722
11-J-79	76.1	15	5.1	251.2	77	3.3	115.5	38	3.0	339.4	12	28.3	782.2
11-J-814(A)	111.0	29	3.8	610.0	194	3.1	74.0	39	1.9	32.0	8	4.0	827
11-J-814(W)	175.0	54	3.2	5303.0	1431	3.7	2127.0	443	4.8	1169.0	223	5.2	8774
11-J-814(M)	11.0	6	1.8	1196.0	340	3.5	840.0	153	5.5	268.0	63	4.3	2315
11-J-814	297.0	89	3.3	7109.0	1965	3.6	3141.0	635	4.9	1469.0	294	5.0	12016
11-J-964	41.3	9	4.6	5552.0	782	7.1	2620.6	347	7.6	1270.0	34	37.4	9483.9
11-J-1055	0.0	0	0.0	150.0	108	1.4	30.0	4	7.5	0.0	0	0.0	180
11-J-129	9.1	13	0.7	21.6	30	0.7	448.6	397	1.1	33.5	22	1.5	512.8
11-J-1145	0.0	0	0.0	181.6	14	13.0	9.3	5	1.9	5.8	3	1.9	196.7
11-R-26	6.0	3	2.0	14.0	15	0.9	12.0	6	2.0	26.0	5	5.2	58

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-J-1115	2.4	2	1.2	9.5	12	0.8	23.0	7	3.3	0.7	1	0.7	35.6
11-J-967	19.3	4	4.8	331.6	294	1.1	1.1	5	0.2	6.0	9	0.7	358
11-J-1196	28.3	5	5.7	311.1	504	0.6	134.1	64	2.1	48.1	25	1.9	521.6
11-J-1196	45.6	10	4.6	324.9	517	0.6	159.3	75	2.1	49.2	27	1.8	579
11-J-1148	169.3	146	1.2	437.2	93	4.7	151.7	35	4.3	154.9	10	15.5	913.1
11-J-1149	75.6	54	1.4	233.9	318	0.7	10.7	10	1.1	698.1	26	26.9	1018.3
11-J-1150	1015.4	754	1.3	8384.7	7084	1.2	850.0	331	2.6	1686.2	255	6.6	11936.3
11-WM-99(W)	0.0	0	0.0	1774.8	1278	1.4	308.5	156	2.0	239.5	271	0.9	2322.8
11-WM-99(M)	0.0	0	0.0	402.6	313	1.3	126.5	77	1.6	282.7	96	2.9	811.8
11-WM-99	0.0	0	0.0	7532.1	2508	3.0	1186.9	459	2.6	1177.4	536	2.2	9896.4
11-WM-279	0.0	0	0.0	66.0	18	3.7	47.0	42	1.1	106.0	97	1.1	219
11-WM-355	21.8	10	2.2	323.1	183	1.8	56.5	50	1.1	11.9	21	0.6	413.3
11-WM-357	66.3	32	2.1	402.4	244	1.6	65.8	48	1.4	50.5	42	1.2	585
11-WM-80	17.8	4	4.5	159.7	53	3.0	7.6	14	0.5	0.0	0	0.0	185.1
11-SA-101	46.3	58	0.8	73.9	110	0.7	168.9	197	0.9	52.1	63	0.8	341.2
11-SA-217	40.2	32	1.3	83.3	38	2.2	52.1	100	0.5	55.7	65	0.9	231.3
11-SA-234	7.1	8	0.9	148.0	114	1.3	74.9	62	1.2	18.3	31	0.6	248.3
11-SA-221	0.0	0	0.0	143.4	275	0.5	70.5	110	0.6	72.6	102	0.7	286.5
11-SA-510	120.0	25	4.8	90.6	59	1.5	1.0	2	0.5	153.1	6	25.5	364.7
11-SA-526	15.6	9	1.7	22.1	14	1.6	0.3	1	0.3	0.0	0	0.0	38
11-SA-513	7.7	2	3.9	19.7	3	6.6	0.0	0	0.0	0.0	0	0.0	27.4
11-SA-563	8.6	13	0.7	420.4	298	1.4	8.5	9	0.9	8.8	3	2.9	446.3
11-G-178	3.7	1	3.7	26.7	5	5.3	0.0	0	0.0	1.6	1	1.6	32
11-G-188	13.0	2	6.5	4.8	5	1.0	0.0	0	0.0	0.0	0	0.0	17.8

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-G-190	22.7	14	1.6	98.5	43	2.3	0.0	0	0.0	0.0	0	0.0	121.2
11-G-200	17.3	6	2.9	42.2	56	0.8	6.3	7	0.9	0.6	4	0.2	66.4
11-G-326	1.0	4	0.3	9.9	21	0.5	0.0	0	0.0	3.1	4	0.8	14
11-G-329	10.1	9	1.1	28.0	34	0.8	0.0	0	0.0	0.6	1	0.6	38.7
11-G-361	4.2	1	4.2	1.3	1	1.3	0.0	0	0.0	2.8	1	2.8	8.3
11-R-331	94.2	29	3.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	94.2
11-R-604	5456.6	754	7.2	765.5	124	6.2	126.3	51	2.5	3189.1	738	4.3	9537.5
21C4-46	685.0	0	0.0	161.5	0	0.0	89.0	0	0.0	406.0	0	0.0	1341.5
21C4-35	77.0	0	0.0	157.5	0	0.0	30.5	0	0.0	31.0	0	0.0	296
21D3-242	48.4	5	9.7	106.1	21	5.1	0.0	0	0.0	12.9	4	3.2	167.4
21D3-67	1.0	2	0.5	268.0	66	4.1	101.0	22	4.6	321.0	50	6.4	691
11-PY-179	1.0	1	1.0	22.0	6	3.7	0.0	0	0.0	0.7	1	0.7	23.7
11-PY-180	12.3	11	1.1	366.3	215	1.7	17.8	10	1.8	140.2	56	2.5	536.6
11-PY-216	3.4	6	0.6	3.5	2	1.8	0.8	1	0.8	0.0	0	0.0	7.7
11-PY-198	65.8	35	1.9	89.3	32	2.8	58.2	25	2.3	145.1	35	4.1	358.4
21C4-9	0.0	0	0.0	27.1	13	2.1	3.0	2	1.5	13.0	4	3.3	43.1
11-FK-228	0.0	0	0.0	2.3	2	1.2	0.0	0	0.0	0.0	0	0.0	2.3
11-H-2	90.6	90	1.0	22.8	56	0.4	5.3	14	0.4	6.6	17	0.4	125.3
11-H-27	0.8	3	0.3	20.1	3	6.7	0.0	0	0.0	0.2	1	0.2	21.1
11-M0-609	195.9	1079	0.2	0.0	0	0.0	1.0	3	0.3	0.0	0	0.0	196.9
11-MO-594(W)	999.8	111	9.0	0.0	0	0.0	0.0	0	0.0	68.6	4	17.2	1068.4
11-MO-594(M)	665.9	329	2.0	7.3	10	0.7	0.0	0	0.0	183.9	67	2.7	857.1
11-MO-594	1665.7	440	3.8	7.3	10	0.7	0.0	0	0.0	252.5	71	3.6	1925.5
11-MO-200	169.4	444	0.4	6.7	3	2.2	0.0	0	0.0	0.0	0	0.0	176.1

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-MO-522S	0.6	1	0.6	607.9	31	19.6	0.0	0	0.0	13.4	1	13.4	621.9
11-MO-562	388.9	48	8.1	0.0	0	0.0	15.0	3	5.0	141.7	14	10.1	545.6
11-MO-593	444.0	240	1.9	0.0	0	0.0	0.0	0	0.0	0.1	1	0.1	444.1
11-M0-797	43.2	32	1.4	55.2	10	5.5	4.1	2	2.1	18.3	5	3.7	120.8
11-M0-798	57.9	2	29.0	11.1	5	2.2	0.0	0	0.0	5.2	3	1.7	74.2
11-M0-799	60.6	2	30.3	5.1	1	5.1	0.0	0	0.0	0.0	0	0.0	65.7
11-M0-841	3598.5	986	3.6	0.0	0	0.0	1.5	2	0.8	8.6	1	8.6	3608.6
11-MO-891	14615.0	3782	3.9	141.0	50	2.8	140.0	52	2.7	371.0	61	6.1	15267
11-MO-636	19.9	9	2.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	19.9
11-MO-672	144.9	3	48.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	144.9
11-MO-973	623.9	56	11.1	11.0	1	11.0	0.0	0	0.0	272.2	4	68.1	907.1
11-MO-768	70.6	62	1.1	0.5	1	0.5	0.0	0	0.0	0.0	0	0.0	71.1
11-MO-997	7.4	6	1.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	7.4
11-MO-998	114.4	2	57.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	114.4
11-S-1520	0.6	3	0.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.6
11-MO-1005	1891.9	529	3.6	6.7	7	1.0	2.6	1	2.6	0.0	0	0.0	1901.2
11-MO-475	23.7	11	2.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	23.7
11-MO-1032	0.3	2	0.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.3
11-MO-1033	0.5	1	0.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.5
11-MO-598	160.3	59	2.7	0.0	0	0.0	0.0	0	0.0	2.8	2	1.4	163.1
11-MO-725	399.6	20	20.0	0.0	0	0.0	0.0	0	0.0	8.0	1	8.0	407.6
11-MO-1068	52.3	29	1.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	52.3
11-MO-599	17.1	6	2.9	0.0	0	0.0	6.3	1	6.3	0.0	0	0.0	23.4
11-MO-855	26651.0	3258	8.2	7.0	4	1.8	237.0	12	19.8	1484.0	94	15.8	28379
11-MO-717	21.8	7	3.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	21.8

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-MO-718	14480.0	49	295.5	0.0	0	0.0	0.0	0	0.0	32.4	11	2.9	14512.4
11-MO-880(W)	19036.6	2636	7.2	1.3	3	0.4	0.0	0	0.0	0.0	0	0.0	19037.9
11-MO-880(M)	2602.6	688	3.8	0.0	0	0.0	0.0	0	0.0	42.6	8	5.3	2645.2
11-MO-880	21639.2	3324	6.5	1.3	3	0.4	0.0	0	0.0	42.6	8	5.3	21683.1
11-MO-722	1880.4	279	6.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1880.4
11-MO-776	9.3	9	1.0	0.0	0	0.0	2.8	2	1.4	1.1	1	1.1	13.2
11-MO-776	1029.6	249	4.1	2.0	1	2.0	2.8	2	1.4	1.1	1	1.1	1035.5
11-MO-1075	3708.5	2797	1.3	131.1	148	0.9	62.6	50	1.3	278.1	173	1.6	4180.3
11-S-854	320.9	14	22.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	320.9
11-S-784	61.3	27	2.3	5.7	3	1.9	0.0	0	0.0	0.0	0	0.0	67
11-S-782	54.9	15	3.7	0.0	0	0.0	0.0	0	0.0	6.1	3	2.0	61
11-S-242	310.7	142	2.2	93.3	9	10.4	22.8	6	3.8	0.0	0	0.0	426.8
11-S-85	96.9	25	3.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	96.9
11-S-87	790.1	548	1.4	10.4	2	5.2	5.7	1	5.7	3.5	1	3.5	809.7
11-S-234	38.9	31	1.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	38.9
11-S-889	377.8	138	2.7	0.0	0	0.0	0.0	0	0.0	19.4	2	9.7	397.2
11-S-793	195.6	161	1.2	2.3	2	1.2	0.4	1	0.4	0.0	0	0.0	198.3
11-S-786	172.3	133	1.3	0.0	0	0.0	0.0	0	0.0	1.4	2	0.7	173.7
11-S-794	8.2	13	0.6	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	8.2
11-S-795	8.0	12	0.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	8
11-S-882	30.8	17	1.8	0.0	0	0.0	0.0	0	0.0	2.7	1	2.7	33.5
11-S-762	23.0	7	3.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	23
11-S-775	22.6	12	1.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	22.6
11-S-237	1024.2	453	2.3	16.9	7	2.4	0.3	1	0.3	93.1	10	9.3	1134.5

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-S-236	138.4	59	2.3	0.0	0	0.0	0.0	0	0.0	12.2	1	12.2	150.6
11-S-235	320.2	217	1.5	20.0	2	10.0	0.1	1	0.1	61.9	13	4.8	402.2
11-S-1061	101.6	21	4.8	9.2	3	3.1	39.0	2	19.5	0.0	0	0.0	149.8
11-S-1148(M)	23.9	29	0.8	0.1	1	0.1	0.0	0	0.0	34.5	1	34.5	58.5
11-S-1148(W)	3.1	7	0.4	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	3.1
11-S-1148	27.0	36	0.8	0.1	1	0.1	0.0	0	0.0	34.5	1	34.5	61.6
11-S-19	59.9	29	2.1	0.0	0	0.0	0.0	0	0.0	0.5	5	0.1	60.4
11-S-1033	113.7	23	4.9	0.0	0	0.0	0.3	1	0.3	0.0	0	0.0	114
11-S-1161	134.0	58	2.3	0.0	0	0.0	0.0	0	0.0	18.2	23	0.8	152.2
11-S-709	227.2	40	5.7	24.5	1	24.5	0.0	0	0.0	8.4	2	4.2	260.1
11-S-69	175.1	147	1.2	3.1	3	1.0	0.0	0	0.0	0.0	0	0.0	178.2
11-S-1446	28.9	20	1.4	0.1	1	0.1	0.0	0	0.0	0.2	1	0.2	29.2
11-S-1637	14.4	4	3.6	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	14.4
11-S-71	713.5	153	4.7	23.5	1	23.5	0.0	0	0.0	67.2	5	13.4	804.2
11-S-71(M)	679.4	146	4.7	23.5	1	23.5	0.0	0	0.0	9.3	4	2.3	712.2
11-S-816	51.8	4	13.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	51.8
11-S-814	14.6	10	1.5	0.0	0	0.0	0.2	1	0.2	6.2	12	0.5	21
11-S-1098	46.1	30	1.5	0.3	1	0.3	0.3	1	0.3	0.0	0	0.0	46.7
11-S-729	147.7	91	1.6	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	147.7
11-S-730	87.9	34	2.6	0.1	1	0.1	0.0	0	0.0	216.1	7	30.9	304.1
11-S-747	31.6	18	1.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	31.6
11-S-1	17.1	5	3.4	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	17.1
11-S-631(W)	124.8	67	1.9	10.4	1	10.4	0.5	2	0.3	944.5	6	157.4	1080.2
11-S-631(M)	340.6	82	4.2	0.0	0	0.0	0.0	0	0.0	25.1	4	6.3	365.7

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-S-631	503.6	162	3.1	10.4	1	10.4	0.5	2	0.3	980.2	11	89.1	1494.7
11-CT-255	18.7	23	0.8	0.2	2	0.1	0.0	0	0.0	0.0	0	0.0	18.9
11-CT-466(A)	125.1	20	6.3	46.1	4	11.5	0.0	0	0.0	0.0	0	0.0	171.2
11-CT-466(W)	402.8	92	4.4	52.1	27	1.9	17.0	4	4.3	9.4	4	2.4	481.3
11-CT-466(M)	568.9	194	2.9	98.1	31	3.2	9.7	6	1.6	34.2	17	2.0	710.9
11-CT-466	3190.0	345	9.2	223.0	68	3.3	26.7	10	2.7	45.4	22	2.1	3485.1
11-JN-108	6.5	23	0.3	60.3	116	0.5	6.6	20	0.3	6.2	11	0.6	79.6
11-JN-257	2.0	1	2.0	54.3	32	1.7	1.3	2	0.7	2.7	2	1.4	60.3
11-JN-291	0.0	0	0.0	12.0	11	1.1	1.0	1	1.0	0.0	0	0.0	13
11-MS-2018	72.5	68	1.1	1.2	2	0.6	0.0	0	0.0	0.0	0	0.0	73.7
11-MS-2278	545.7	522	1.0	8.9	3	3.0	0.0	0	0.0	0.0	0	0.0	554.6
11-MS-2277	73.3	69	1.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	73.3
11-MS-2276	34.0	64	0.5	1.2	1	1.2	1.0	1	1.0	0.0	0	0.0	36.2
11-MS-2275	33.9	50	0.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	33.9
11-B-165	548.8	357	1.5	3.0	4	0.8	0.0	0	0.0	0.0	0	0.0	551.8
11-B-164	896.7	845	1.1	36.9	12	3.1	0.0	0	0.0	0.8	1	0.8	934.4
11-B-159	300.1	215	1.4	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	300.1
11-B-155	54.2	63	0.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	54.2
11-FY-205	697.7	384	1.8	24.8	54	0.5	16.0	14	1.1	0.0	0	0.0	738.5
11-FY-204	53.3	29	1.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	53.3
11-B-21	350.1	65	5.4	36.8	3	12.3	0.0	0	0.0	5.6	2	2.8	392.5
11-B-111	551.4	107	5.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	551.4
11-MS-1380	69.0	16	4.3	0.0	0	0.0	0.0	0	0.0	258.0	14	18.4	327

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-MS-582	216.7	613	0.4	0.0	0	0.0	0.0	0	0.0	698.6	25	27.9	915.3
11-MS-1177	84.2	66	1.3	0.0	0	0.0	0.0	0	0.0	130.1	40	3.3	214.3
11-MS-1255	2437.3	426	5.7	5.6	1	5.6	8.0	2	4.0	43.2	15	2.9	2494.1
11-MS-610(W)	58.3	85	0.7	6.6	4	1.7	0.0	0	0.0	1.1	1	1.1	66.01
11-MS-610(M)	11.0	7	1.6	0.0	0	0.0	0.0	0	0.0	645.9	1	645.9	656.9
11-MS-610	363.5	159	2.3	7.1	5	1.4	0.3	1	0.3	648.8	3	216.3	1019.7
11-MS-598	2699.9	81	33.3	27.7	15	1.8	112.6	4	28.2	372.0	63	5.9	3212.2
11-MS-598	123.1	174	0.7	0.0	0	0.0	112.1	3	37.4	36.9	55	0.7	272.1
11-MS-587	491.2	61	8.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	491.2
11-MS-611	528.8	177	3.0	0.0	0	0.0	1.1	1	1.1	33.5	5	6.7	563.4
11-MS-612	265.9	55	4.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	265.9
11-MS-1799	8.3	3	2.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	8.3
11-MS-1800	64.7	4	16.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	64.7
11-MS-1801	85.2	7	12.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	85.2
11-MS-1802	67.9	12	5.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	67.9
11-MS-1803	58.3	20	2.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	58.3
11-MS-1804	80.4	19	4.2	0.0	0	0.0	0.0	0	0.0	1.4	1	1.4	81.8
11-MS-1805	7.3	6	1.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	7.3
11-MS-1806	126.0	20	6.3	0.0	0	0.0	0.0	0	0.0	5.6	2	2.8	131.6
11-MS-1807	1.4	2	0.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1.4
11-MS-1809	89.4	23	3.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	89.4
11-MS-80	537.5	383	1.4	0.0	0	0.0	0.0	0	0.0	6.4	7	0.9	543.9
11-MS-345	142.6	56	2.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	142.6
11-MS-517	12.1	9	1.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	12.1

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-MS-1330	16.7	11	1.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	16.7
11-MS-1778	87.3	41	2.1	0.0	0	0.0	0.0	0	0.0	5.1	2	2.6	92.4
11-MS-1815	0.3	1	0.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.3
11-MS-1816	1.3	1	1.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1.3
11-MS-1817	5.2	4	1.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	5.2
11-MS-1818	37.9	3	12.6	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	37.9
11-MS-1819	4.3	2	2.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	4.3
11-MS-1820	2.4	3	0.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	2.4
11-S-316	2.1	2	1.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	2.1
11-S-460	45.8	12	3.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	45.8
11-S-596	1.1	1	1.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1.1
11-S-1234	6.7	1	6.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	6.7
11-S-1236	5.7	3	1.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	5.7
11-S-1278	46.9	17	2.8	0.0	0	0.0	0.0	0	0.0	4.4	1	4.4	51.3
11-S-1279	775.7	323	2.4	0.0	0	0.0	0.6	1	0.6	1.5	1	1.5	777.8
11-S-1280	184.4	78	2.4	0.0	0	0.0	2.1	3	0.7	4.6	3	1.5	191.1
11-S-1281	0.3	1	0.3	0.0	0	0.0	0.0	0	0.0	55.1	1	55.1	55.4
11-S-1282	2.4	3	0.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	2.4
11-S-1283	35.6	13	2.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	35.6
11-S-1284	3.1	3	1.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	3.1
11-S-1285	2.1	1	2.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	2.1
11-S-1252	1812.0	337	5.4	10.0	4	2.5	6.2	8	0.8	155.4	27	5.8	1983.6
11-S-1253	370.3	137	2.7	0.0	0	0.0	0.5	1	0.5	7.1	3	2.4	377.9
11-S-1254	452.3	146	3.1	1.2	1	1.2	0.0	0	0.0	2.4	1	2.4	455.9
11-S-1255	1125.6	400	2.8	2.1	1	2.1	3.8	2	1.9	168.5	20	8.4	1300

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-S-1256	1100.8	576	1.9	2.3	2	1.2	0.0	0	0.0	25.8	19	1.4	1128.9
11-S-1257	306.7	149	2.1	56.4	3	18.8	0.0	0	0.0	19.0	8	2.4	382.1
11-S-1258	31.3	15	2.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	31.3
11-S-1259	52.0	26	2.0	0.0	0	0.0	6.4	5	1.3	0.0	0	0.0	58.4
11-S-1260	158.5	120	1.3	0.0	0	0.0	11.3	1	11.3	10.4	2	5.2	180.2
11-S-1261	635.7	223	2.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	635.7
11-S-1262	23.0	42	0.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	23
11-S-1263	27.6	20	1.4	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	27.6
11-S-1264	0.9	1	0.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.9
11-S-1265	136.0	18	7.6	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	136
11-S-1266	32.2	32	1.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	32.2
11-S-1267	1.8	2	0.9	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1.8
11-S-1268	242.5	33	7.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	242.5
11-S-1269	2071.7	766	2.7	2.0	1	2.0	0.0	0	0.0	192.7	24	8.0	2266.4
11-S-1270	330.3	172	1.9	0.0	0	0.0	0.0	0	0.0	33.1	8	4.1	363.4
11-S-1271	4224.0	1638	2.6	23.9	4	6.0	7.1	2	3.6	108.6	20	5.4	4363.6
11-S-1272	42.4	21	2.0	0.0	0	0.0	0.0	0	0.0	5.6	1	5.6	48
11-S-1273	404.6	22	18.4	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	404.6
11-S-1274	329.5	58	5.7	0.0	0	0.0	0.5	1	0.5	53.8	1	53.8	383.8
11-S-1275	620.3	259	2.4	0.0	0	0.0	0.0	0	0.0	3.9	5	0.8	624.2
11-S-1276	28.3	9	3.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	28.3
11-MS-1665	18.9	9	2.1	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	18.9
11-MS-71	1161.1	425	2.7	16.3	1	16.3	0.7	1	0.7	0.0	0	0.0	1178.1
11-MS-621	1667.1	13811	0.1	0.0	5	0.0	0.0	0	0.0	2.2	1	2.2	1669.31
11-MS-2020	107.9	204	0.5	0.6	1	0.6	0.0	0	0.0	0.0	0	0.0	108.5

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-MS-1970	289.9	42	6.9	0.0	0	0.0	0.6	1	0.6	16.3	8	2.0	306.8
11-MS-1210	353.3	289	1.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	353.3
11-MS-1211	61.6	53	1.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	61.6
11-MS-1212	116.2	113	1.0	0.0	0	0.0	0.0	0	0.0	5.8	2	2.9	122
11-MS-1273	250.5	51	4.9	0.0	0	0.0	0.0	0	0.0	0.2	1	0.2	250.7
11-MS-1274	118.7	36	3.3	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	118.7
11-MS-2049	539.5	200	2.7	17.3	13	1.3	6.3	3	2.1	52.3	51	1.0	615.4
11-MS-1992	405.0	169	2.4	0.0	0	0.0	5.0	1	5.0	42.8	26	1.6	452.8
11-MS-1124	3929.5	5061	0.8	8.2	16	0.5	0.9	2	0.5	37.8	22	1.7	3976.4
11-MS-17	627.1	392	1.6	0.4	3	0.1	180.2	5	36.0	407.5	16	25.5	1215.2
11-MS-619	441.7	287	1.5	5.4	15	0.4	3.3	2	1.7	4.5	2	2.3	454.9
11-MS-2288	43322.4	1836	23.6	4.4	27	0.2	0.0	0	0.0	13233.8	6147	2.2	56560.61
11-MS-1049	72.7	46	1.6	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	72.7
11-MS-1246	19.3	4	4.8	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	19.3
11-MS-109	1862.5	223	8.4	9.5	4	2.4	0.0	0	0.0	0.2	3	0.1	1872.2
11-MS-1960	3740.5	2722	1.4	41.6	10	4.2	0.0	0	0.0	0.0	0	0.0	3782.1
11-MS-526	2096.0	464	4.5	30.3	17	1.8	2.3	1	2.3	0.0	0	0.0	2128.6
11-MS-923	757.3	462	1.6	4.8	1	4.8	0.0	0	0.0	0.0	0	0.0	762.1
11-MS-636	39.9	24	1.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	39.9
11-MS-769	1014.3	581	1.7	0.0	0	0.0	5.7	4	1.4	12.3	2	6.2	1032.3
11-MS-1956	94.7	13	7.3	7.0	1	7.0	0.0	0	0.0	0.0	0	0.0	101.7
11-MS-2248	1453.4	406	3.6	1.1	1	1.1	0.0	0	0.0	0.0	0	0.0	1454.5
11-MS-662	675.6	342	2.0	30.4	12	2.5	0.0	0	0.0	0.0	0	0.0	706
11-MS-54	2532.6	1104	2.3	0.0	0	0.0	0.0	0	0.0	155.6	32	4.9	2688.2
11-MS-1350	151.3	56	2.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	151.3

Site ID[a,b]	B Wt (g)	B #	B Avg Wt (g)	CD Wt (g)	CD #	CD Avg Wt (g)	K Wt (g)	K #	K Avg Wt (g)	MC Wt (g)	MC #	MC Avg Wt (g)	Total Wt per Site
11-MS-584	858.7	240	3.6	14.7	1	14.7	0.0	0	0.0	118.3	50	2.4	991.7
11-MS-595	13790.9	4506	3.1	13.2	4	3.3	81.2	44	1.8	964.6	413	2.3	14849.9
11-MS-1435	0.9	2	0.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	0.9
11-MS-1614	75.0	3	25.0	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	75
11-MS-2300	889.5	51	17.4	0.0	0	0.0	1.8	2	0.9	15.8	3	5.3	907.1
11-MS-2317	172.8	240	0.7	1.0	1	1.0	0.0	0	0.0	0.0	0	0.0	173.8
11-MS-672	54.4	27	2.0	3.2	1	3.2	0.0	0	0.0	0.0	0	0.0	57.6
11-MS-637	605.1	28	21.6	11.7	2	5.9	0.0	0	0.0	22.7	1	22.7	639.5
11-MS-27	5037.3	2395	2.1	59.3	12	4.9	10.6	3	3.5	0.0	0	0.0	5107.2
11-MS-52	1565.8	719	2.2	4.6	2	2.3	0.0	0	0.0	5.0	3	1.7	1575.4
11-S-47	824.0	85	9.7	148.8	16	9.3	21.8	2	10.9	0.0	0	0.0	994.6
11-S-47	2540.9	166	15.3	39.4	4	9.9	0.0	0	0.0	21.0	9	2.3	2601.3
11-S-47	3364.9	251	13.4	188.2	20	9.4	21.8	2	10.9	21.0	9	2.3	3595.9
11-S-650	3738.1	2471	1.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	3738.1
11-S-650	4095.1	768	5.3	70.6	18	3.9	0.0	0	0.0	10.1	2	5.1	4175.8
11-S-650	13806.1	5353	2.6	0.4	2	0.2	0.0	0	0.0	122.2	34	3.6	13928.7
11-S-650	21639.3	8592	2.5	71.0	20	3.6	0.0	0	0.0	132.3	36	3.7	21842.6
11-S-640	17214.2	1351	12.7	108.8	14	7.8	2.0	1	2.0	31.5	1	31.5	17356.5
11-S-642	75.2	52	1.4	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	75.2
11-S-642	1366.6	141	9.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1366.6
11-S-642	1441.8	193	7.5	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1441.8
11-S-629	227.8	262	0.9	12.7	2	6.4	0.0	0	0.0	0.0	0	0.0	240.5
11-S-699	86.0	52	1.7	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	86
11-MO-608	1313.1	596	2.2	0.0	0	0.0	0.0	0	0.0	0.0	0	0.0	1313.1
11-S-435	4766.2	6426	0.7	192.6	158	1.2	0.0	0	0.0	0.0	0	0.0	4958.8

[a] Site IDs and names were identified in the reports and registered with the state SHPO. Site name was given to the site by the archaeologist registering the site with the state SHPO. Site ID format is determined by the state and county in which they are located. The number 11 indicates the state of Illinois. The following letters indicate the county and the final numbers specifies site identification the number.

[b] Time period abbreviations are inserted into the Site ID column if there are more than one time period recorded for a site as: (A)=Archaic, (W)=Woodland, and (M)=Mississippian. Refer to Appendix A for the remainder of the components.

Notes: Some artifacts only weigh tenths of grams therefore, all weights are recorded in tenths of grams. Header abbreviations include: B=Burlington, CD=Cobden/Dongola, K=Kaolin, MC=Mill Creek, Wt=Weight, Avg=Average, and #=number

Citations: Abbott, 1989; Aberle et al. 2002; Aberle et al. 2006; Adams et al. 1997; Avery et al. 1982; Barr et al. 1993; Bentz and Whalley 1985; Bentz et al. 1998; Berres 1985; Betzenhauser and Howe 2008; Betzenhauser 2012; Betzenhauser, Marzim, and Branstner 2013; Betzenhauser et al. 2013; Bevitt 1997; Blanton, Kelly, and Parker 1989; Blodgett, Kitchen, and Durst 2016; Boles and Durst 2012; Booth et al. 1999; Booth et al. 2006; Booth 2012; Booth et al. 2012; Butler, DelCastello and Wagner 2000; Butler and Crow 2013; Craig and Galloy 1994; Craig et al. 2007; Cobb and Jefferies 1983; DeMott and Holley 1991; DelCastello and Butler 2000; DelCastello, Faberson, and Spurlock 2007; Emerson and Jackson 1980; Emerson et al. 1982; Ensor and Titus 2004; Ensor et al. 2009; Evans 1995; Evans et al. 2000; Evans, Evans, and Parker 2001; Evans 2010; Evans 2011; Finney and Johannessen 1981; Fortier and Finney 1979; Fortier 1980; Fortier and Johannessen 1981; Fortier 1981; Fortier, Finney, and Lacampagne 1983; Fortier, Lacampagne, and Finney 1984; Fortier, Finney, and Johannessen 1984; Fortier and Jackson 1988; Fortier et al. 2014; Fortier et al. 2015; Fortier et al. 2015(2); Fortier et al. 2016; Fortier et al. 2016(2);Galloy, Parker, Babcook 2000; Galloy 2001; Galloy and Koldehoff 2002; Galloy 2003, Galloy 2005; Galloy et al. 2013; Galloy et al. 2015; Gaydos et al. 2016; Hanenberger and Parker 1987; Hargrave, Lopinot, and Seme 1982; Hargrave et al. 1992; Hargrave 1992; Hargrave 1993; Harl and Machiran 2012; Holley, Brown, and Lopinot 1989; Holley 1993; Holley 1993(1); Holley 1993(2); Holley 1993(3); Holley 1993(4); Holley 1993(5); Holley 1993(6); Holley 1993(7); Holley 1993(8); Holley 1993(9); Holley 1993(10); Holley 1993(11); Holley 1993(12); Holley 1993(13); Holley 1993(14); Holley 1993(15); Holley 1993(16); Holley 1993(17); Holley 1993(18); Howe, Snyder and McCorkey 1994; Hoxie 1993; Jackson and Dunavan 1987, Jackson and Dunavan 1988; Jackson, Zelin, and Evans 2011; Jackson et al. 2014; Kelly et al. 1987; Kelly and Parker 1997; Knight et al. 1992; Knight and Butler 1995; Koeppel 2001; Koeppel 2001(2); Koldehoff and Wagner 1998; Koldehoff 2000; Koldehoff et al. 2001; Kruchten et al. 2004; Kruchten et al. 2005; Kruchten and Branstner 2007; Kruchten 2008; Kullen 2000; Lopinot, Brown, and Holley 1989; Lopinot 1991; Lomas, Titus, and Schwegman 2011; Machiran, Bailey, and Kelley 2005; Machiran, Bailey, and Kelley 2005(2); Machiran, Bailey, and Kelley 2005(3); Machiran and Harl 2009; Machiran et al. 2010; McCullough et al. 2015; McCullough et al. 2015(2); McElrath 1986; McElrath et al. 1987; McElrath et al. 1987(2), McNerney et al. 1975; McNerney et al. 1996; McNerney and Neal 1998; McNerney et al. 1999; McNerney, Wolff and Keeney 1999; Meinholz 1986; Milner et al. 1982;Moffet et al. 1992; Moffat et al. 2008, Moffat, Parker, and Martin 2016; Moffat et al. 2016; Moore and McNerney 1983; Moore 1984, Naglich 2002; Neal 1994; Parker 2002; Penny 1987; Pauketat, Kruchten and Alt 2015; Sant, Koldehoff, and Koldehoff 1986; Santeford and Lopoinot 1979; Scheid and Witty 2012; Scheid, Boles, and Witty 2012; Scheid, Branstner, and Witty 2012; Schwegman 2006; Schwegman et al. 2007; Schwegman Lamas, and Ensor 2009; Shah et al. 2003; Snyder 1991; Snyder and Titus 1999; Snyder et al. 2002; Snyder, Lence, and Titus 2002; Stahl et al. 1985; Stephans and Newsom 1996; Tankersly et al. 1991; Titus et. al 1992: Titus and Howe 1993; Titus, Baer, and Wolff 2000; Titus 2002; Titus et al. 2002; Titus, Lomas, and Parker 2008; Titus et al. 2010; Wagner et al. 1992; Wagner et al. 1994; Wagner 1995; Wagner 1995(2); Wagner 1998; Wagner and Butler 1999; Wagner et al. 2000; Wagner 2005; Wagner et al. 2005; Wagner et al. 2007; Waltz et al. 1997; Wells 1992; Witty and Koldehoff 2005; Zimmerman et al. 2009.