

Oneota settlement patterns in northwest Iowa:
Site catchment analysis and predictive modeling using geographic
information systems

by

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CHAPTER 1: INTRODUCTION

Introduction

The prehistory of the Upper Mississippi Valley and Prairie Peninsula has revealed dynamic and ever changing periods of human occupation and interaction for the last twelve thousand years. The presence of these past societies is manifest in the archaeological record, which has left clues to their subsistence, settlement, technology, and interaction with other groups. Some cultural manifestations are easy to identify, while others are not clearly defined within the archaeological record. Conversely, some cultural traditions are easy to identify, but the overall interpretation of their development is sometimes difficult to assess. This is the case with the Oneota tradition.

Oneota research in Iowa owes a great debt to Charles R. Keyes and Ellison Orr, two men who undertook a lifetime of research to understand the prehistory of Iowa. Both individuals spent countless hours surveying the state and recording in detail numerous archaeological sites. Ellison Orr (1914) initially defined the Oneota culture. The name Oneota was the former name of the Upper Iowa River in northeast Iowa where a number of Oneota sites were initially discovered. Both Keyes (1927) and Orr (1914) were instrumental in the beginning stages of Oneota research. Links have also been made by researchers who have tied the Oneota to historic groups of Chiwere speakers (Griffin 1937; Mott 1938).

Many researchers have expressed that Oneota material culture is immediately recognizable (Hall 1962; Henning 1970; M. Wedel 1959). However, the chronological placement of Oneota sites and regions within and between states, and ultimately how it relates to the culture history of the Upper Mississippi Valley and Prairie Peninsula still remain somewhat ambiguous.

Oneota material culture is overwhelmingly homogenous; the lithic and bone tool assemblages are virtually indistinguishable from other groups that resided in the Prairie Peninsula at one time or another. The one thing that distinguishes Oneota is their pottery, and even this is homogenous in form, temper, and paste. Decoration separates one temporal period from another, and yet the decorative motifs and design elements remained nearly the same for the entire duration of their presence. What changed is the manner in which these elements were combined through time. At one time or another the Oneota inhabited the entire area of the Midwest from southern Canada to central Missouri, and from north-central Kansas to western Indiana, and yet they lived within the same general ecological environments, irrespective of where they were.

The focus of this research and presentation is the settlement patterns of northwest Iowa Oneota groups that lived within the Little Sioux Valley. Arguably, of all the regions within Iowa that contain evidence of Oneota occupations, northwest Iowa has seen the least amount of attention. Of the known Oneota habitation sites within the Little Sioux Valley, only the Dixon (13WD8), Gillett Grove (13CY2), and Milford (13DK1) sites have seen continued research in the past few decades (Anderson 1994; Fishel 1995; Harvey 1979; Tiffany 1996; Tiffany and Anderson 1993; Titcomb 2000). These studies have increased the overall knowledge of the Oneota tradition in Iowa and across the Prairie Peninsula tremendously. Of these studies, however, only two have examined the local environment at a select number of Oneota sites in northwest Iowa with any detail (Harvey 1979; Tiffany and Anderson 1993).

The research presented in this thesis had five goals. 1) Site catchment analysis was conducted for each of the known Oneota sites situated along the Little Sioux Valley. In addition, the Blood Run site (13LO2) was also added because its general temporal and geographic location is within the parameters of protohistoric Oneota sites along the Little

Sioux Valley. The site catchment analysis was chosen as the best method to determine specific variables that were important to site location. 2) Exploratory data analysis (EDA) was performed with regard to variables thought to be significant to site location. EDA involved a variety of statistical measures to find the importance of environmental variables that may have influenced site selection. 3) A GIS-based predictive model of the Little Sioux Valley was devised utilizing the data and variables selected from the site catchment analysis and EDA. For this study, ArcView GIS 3.1 with the Spatial Analyst and 3D Analyst extensions was used. 4) An interpretation was made of the environmental or possible cultural factors that may have influenced the settlement patterns of Oneota groups in the Little Sioux Valley. While the environment would have an impact upon settlement location decisions, it is unclear as to its extent or possibly how much of an influence cultural factors may have played in Oneota settlement patterns. 5) A comparison was drawn up to consider site catchment analysis and settlement patterns of northwest Iowa Oneota sites in relationship to other regions in Iowa and the Midwest where similar studies have been performed.

The author conducted fieldwork during the summer of 1999 at the Gillett Grove site (13CY2), a post contact Oneota village. This included excavation and supervising undergraduate students in the field. Additional research was conducted at subsequent Oneota sites in northwest Iowa when the landowners granted the author permission. This supplemental work was composed of soil testing with a soil probe taken down to the sterile C horizon subsoil. The depth of these soil probes was necessary to ensure that no cultural deposits would potentially be missed. Pedestrian surveys were also conducted at each site and any surface artifacts were noted. However, no artifacts were collected during the surveys. Photographs of the surrounding landscape were also taken at each site.

Significance of Study

The importance of settlement patterns with regard to the archaeological record and overall interpretation of prehistory is well established. Gordon Willey (1956a:1) defined the settlement pattern as a starting point for the functional interpretation of archaeological cultures since the settlement system reflects the natural environment, the level of technology available, and various institutions of social interaction and control which the culture maintained. Settlements are not, for the most part, randomly scattered throughout a region, but are situated in areas that conform to a set of criteria for any one particular group (Griffin 1956; Schermer and Tiffany 1985; W. Wedel 1956). Therefore the analysis of settlement patterns integrates environmental, technological, cultural, and economic factors that were deemed important or necessary for a certain group to survive (Chang 1968; Trigger 1968, 1989; Willey 1956b, 1968). Settlement pattern studies have been conducted for prehistoric societies throughout the world, and have assisted archaeologists in examining the archaeological record with a different perspective.

In this study the analysis of settlement patterns with respect to northwest Iowa Oneota groups should assist in illuminating certain aspects of settlement behavior. First, in terms of survivability, Oneota groups would need a number of resources available to them. As a horticultural group, arable land for farming would be an important factor in site selection (Tiffany and Anderson 1993). Other important factors would have been distance to rivers and other sources of permanent water, timber for structures and fuel, game animals, chert, catlinite and other lithic resources, and clay sources for pottery (Tiffany 1982). Oneota sites are situated primarily in areas where multiple habitat areas, or ecotones, merged. This would allow them to exploit the greatest diversity of resources within a given area around the site. Therefore, the analysis of settlement patterns can shed new light on possible resource procurement patterns of northwest Iowa Oneota groups.

Another aspect pertains to theories posited for paired Oneota sites. Possible paired Oneota sites occur in southeast Iowa (Alex 1978; Tiffany 1982) and in central Iowa in the Des Moines Valley (Benn 1991). This suggests that some Oneota groups were living at a site for the summer months and another "sister" site during the winter months. While there is no evidence of this currently available for northwest Iowa Oneota sites, questions concerning paired sites and other inter-site phenomenon can be asked and possibly answered by a thorough examination of the site settlement patterns.

Third, with the research presented in this study, northwest Iowa Oneota sites can be compared regionally through the analysis of settlement patterns. With regard to the Oneota tradition, there are observed patterns of migrations in the distribution of Oneota sites through time. Oneota groups appear to have shifted their preference for site locations, although the reasons for this are not entirely clear. Currently two major Oneota settlement shifts have been postulated; one shift occurred in the fifteenth century where sites moved away from floodplains and low terraces to higher terraces and bluff bases, and the second shift occurred during the middle of the sixteenth century where sites were now located on upland areas. These shifts have been documented in Wisconsin (Boszhardt 1994, 1998), Minnesota (Dobbs 1984), and Iowa (Gibbon 1972; Henning 1995). While the probable causes of these settlement shifts may never be known, better inferences about the possible reasons for these changes can be posited and examined.

Finally, in relation to more immediate issues concerning current archaeological trends and culture resource management, the predictive model created as a component of this study will benefit future Oneota archaeological research in the Little Sioux Valley and elsewhere. Provided the predictive model is successful, it will help future researchers concentrate upon areas that contain high probabilities for Oneota sites. In addition to helping archaeologists who teach or do research in higher education, cultural resource

projects would also benefit. In particular, areas that have low probabilities for site locations could be bypassed outright, or at the very least examined less intensively by archaeologists. Further, in large areas that need to be surveyed, the predictive model could help to expedite the survey process, thereby saving companies and development firms time, personnel, and money.

Plan of Presentation

The order of presentation of this research is as follows. Chapter 2 outlines the criteria and characteristics that comprise the Oneota tradition throughout the Midwest. Chapter 3 focuses upon the northwest Iowa Oneota sites and previous archaeological investigations within the region in addition to the regional geomorphology, climate, floral, and faunal resources within the region. Chapter 4 presents an overview of site catchment analysis with examples from a variety of methods currently used, and the rationale behind those methods. The results of the site catchments and comparisons between Oneota sites in northwest Iowa comprise chapter 5. Chapter 6 describes the procedures and methods used to construct the predictive model for Oneota sites within northwest Iowa. Discussion of northwest Iowa Oneota sites in relation to other site catchment studies of Oneota sites outside of the research area constitute chapter 7. The discussion of catchment results forms the basis for discussion of settlement patterns for northwest Iowa Oneota sites and similarities and differences of these results with other Oneota sites in Iowa and throughout the Midwest, also found in chapter 7. Finally, chapter 8 provides a summation of the research, recent developments within Oneota archaeology, and suggestions for future research with regard to the Oneota tradition in northwest Iowa.

CHAPTER 2: ONEOTA ARCHAEOLOGY

Oneota Archaeology in the Midwest

Settlement and Subsistence

The Oneota tradition has a substantial geographic and temporal range. Oneota sites are all found in the Midwest and are associated with the Prairie Peninsula. Oneota sites are found in the states of Illinois, Iowa, Minnesota, Missouri, Nebraska, South Dakota, and Wisconsin (Figure 2.1) (Alex 1981; Harvey 1979; Hall 1962; Henning 1970; M. Wedel 1959). While Oneota sites are found in numerous areas, the actual locations of sites are primarily confined to the valleys or uplands adjacent to primary river systems or their major tributaries, and where zones of transition or ecotones occur between woodland and prairie. The ecotonal site setting allows for Oneota groups to maximize their potential to obtain resources without having to go too far from the main habitation area. Areas close to each site would need to have soil types that would be arable as well as easily tillable given the technology the Oneota possessed to grow and harvest crops. Easily and readily obtainable clay deposits were also important so that pottery could be produced for storage and for the cooking of food. Other resources important to Oneota groups include potable water, timber for housing, cherts, and other lithic material for tool production.

Oneota settlement patterns are relatively straightforward. Settlement studies on Oneota sites have been conducted in Illinois (Michalik 1982), Iowa (Tiffany 1982), Minnesota (Dobbs 1984; Dobbs and Shane 1982), and Wisconsin (Boszhardt 1994; Gallagher and Stevenson 1982). The majority of sites reside on terrace formations or on adjacent uplands of river systems. The peculiar thing about certain regions of Oneota

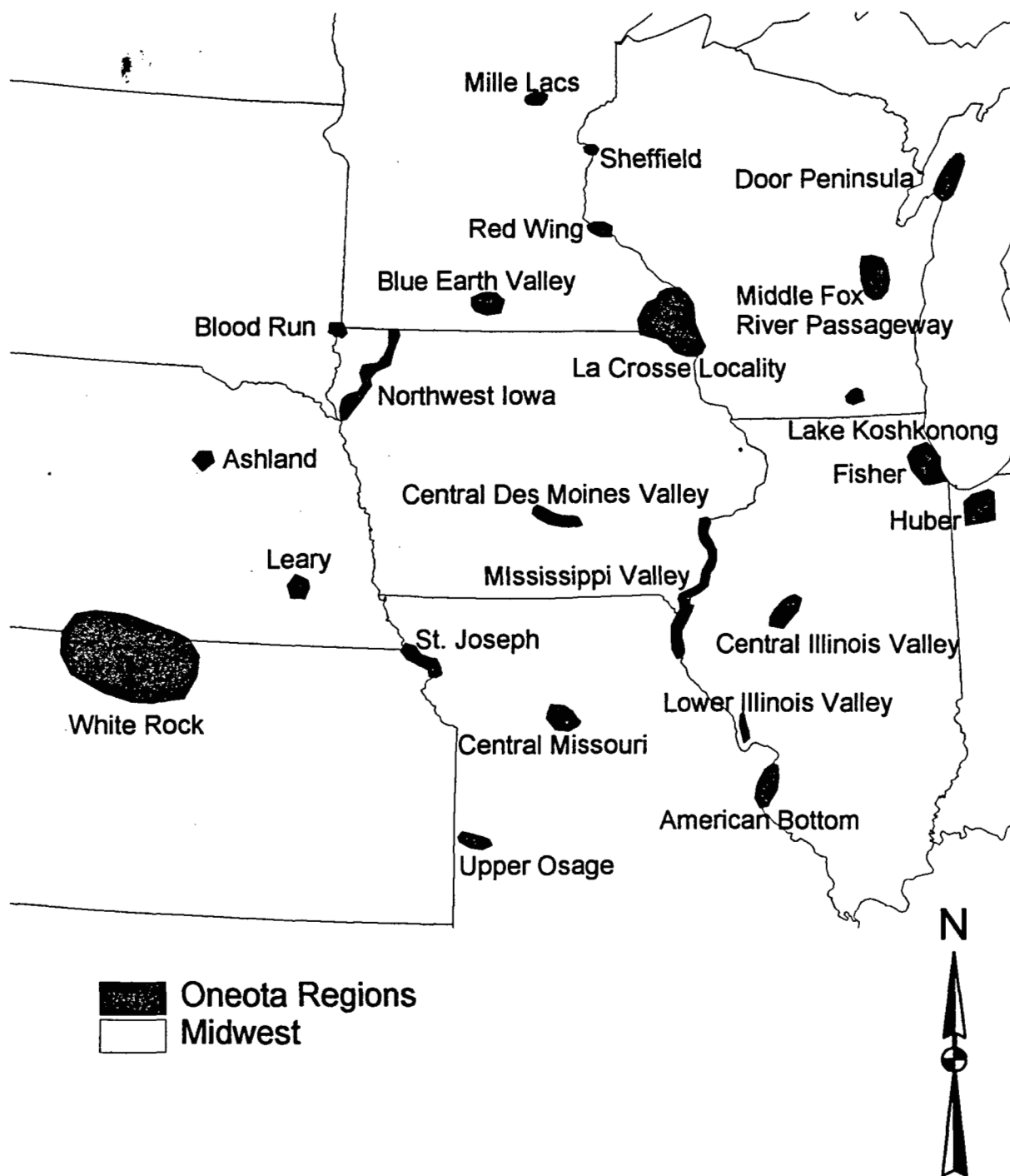


Figure 2.1. Map of the Midwest Showing Regions Where Oneota Sites are Currently Known.

occupation is that upland site location becomes more prevalent through time. This phenomenon occurs in Wisconsin and Minnesota as well as in Iowa, and as a consequence, older sites within the area will be at lower elevations on terraces than the more recent sites, which are primarily on the valley walls. Whether this occurred because of resource depletion or other environmental factors, cultural influences, or perhaps a new group moving into the region is unclear in many cases (Fishel 1999).

Oneota sites vary greatly in their overall size. Sites range from smaller temporary campsites and hunting sites, to larger village sites such as the Dixon site (13WD8) in northwest Iowa or the Utz site (23SA2) located in central Missouri. Site area varies from a few acres to several acres in size (Harvey 1979; Henning 1970). In some instances enormous sites covering hundreds of acres such as the Blood Run site (13LO2) found in northwest Iowa are also present (Harvey 1979). Cemeteries are also present in some locales, or burials are present directly on the site itself (Fishel 1995; Tiffany 1982). Some of the larger village sites also appear to have been reoccupied over periods of time, suggesting that the Oneota inhabitants left, perhaps due to resource depletion or some other cause, and returned later. Conversely, the reoccupation of a site might not necessarily have been by the same group that previously inhabited the area. A major problem with Oneota site re-use is that it is nearly impossible to associate the different occupation layers at a site with a particular group, particularly if an Oneota group left and returned in a brief period of time, or another Oneota group moved in after abandonment (Fishel 1999).

Village sites also contain numerous pits used for storage or for refuse. The shapes of these pits are predominantly bell shaped or basin shaped and may descend a meter or more into the ground (Fishel 1999; Straffin 1973). House structures are found at a number of Oneota sites and house forms appear to change through time, reflecting a shifting preference in house types. Most are ovoid structures with small, shallow posts suggesting

bark-covered lodges of early contact times (Harvey 1979). Other forms include long houses and more Mississippian like wattle and daub structures (Hall 1962; Hollinger 1995; McKusick 1973). Evidence for houses or other structures consist of post molds in the ground, or bits of wattle and daub recovered from a site (Straffin 1971).

Oneota groups can be described as semi-sedentary. They practiced a combination of hunting, horticulture, and wild plant foraging. Animals that were hunted include deer, elk and bison while the major crop cultivated was maize (Gallagher et al. 1985). Evidence for cultivation of beans has also been recovered, although they appear not to have been a substantial part of the diet based upon recent excavations of Oneota sites (Fishel 1999). Numerous wild plants and berries have also been noted at certain Oneota sites, and they seem to be a substantial part of the diet of Oneota peoples (Alex 2000; Harvey 1979; Osborn 1982). Unfortunately, floral and faunal remains have not been recovered from every Oneota site excavated, so data for some areas are sparse if nonexistent. However faunal data from some Oneota sites suggest that in the eastern prairie region white-tailed deer was the major meat source, while in the west bison appears to be the large game animal of choice (Fishel 1999; Hall 1962; Harvey 1979; Henning 1970).

Oneota Material Culture

Oneota material culture is a mixed assemblage of ceramics, stone tools, bone tools, metal and glass. Stone tools consist of small triangular projectile points, end scrapers, knives, and tools used for the processing of plants such as manos and metates. Pipes produced from catlinite or red pipestone are found at some Oneota sites. Catlinite was also used to create objects that may have had symbolic significance for some Oneota groups, such as tablets with engravings and small pendants (Tiffany 1982). Catlinite beads have also been found at some Oneota sites (Titcomb 2000). Bone tools include fishhooks, awls, antler rakes, deer and elk tine punches and bison scapula hoes among western Oneota

groups used for the cultivation of maize or other crops. Metal objects include small, decorative or spiritual items made of native copper from prehistoric Oneota sites, and various items of brass and copper recovered at historic Oneota sites. Historic Oneota sites also produce glass beads of European manufacture that were sometimes remade into other decorative items (Titcomb 2000). As the artifact assemblage shows, Oneota groups utilized the same types of tools used by other prehistoric Native American groups across the Midwest. As such, deciding whether a site is "Oneota" based upon the above artifact types is inconclusive.

The diagnostic feature of the Oneota tradition is pottery. So much dependence is put upon the identification of Oneota pottery for chronological and spatial-temporal issues, that the term "Oneota" is synonymous with pottery. In fact many archaeologists who do research on Oneota sites and Oneota material culture often refer to the Oneota tradition as a "ceramic culture" (Henning 1970; M. Wedel 1959).

Oneota pottery is characterized by its distinct shell tempering, although some recovered Oneota sherds do have grog or grit as a tempering agent (Harvey 1979; Fishel 1999). Morphologically, Oneota pottery is globular with designs primarily confined to the lip and inner lip, rim, and upper shoulder of the vessels (Hall 1962; Henning 1970). The size of Oneota vessels varies greatly; extremely small pots designated "pinch pots" are found in addition to large vessels with tremendous storage capacities. Vessel thickness varies from a couple of millimeters up to one centimeter or more in thickness (Henning 1970). Design elements primarily on the upper shoulder of Oneota vessels include trailed or incised lines, applied in parallel lines that can be at various angles and may take on the forms of chevron-like motifs. The lines are applied with a tool or by using a finger. In addition punctates may also be found in conjunction with the trailed or incised lines, and were used as filler between lines, as a border around lines, or a combination of the two. Notching of the lip is also a

common decorative feature found on Oneota pottery (Henning 1970:36-37). Curvilinear lines and motifs on vessel shoulders also occur on some of the earlier Oneota pottery found at certain Oneota sites (Gradwohl 1967; Hall 1962). Finally, handles are present. These handles may or may not be decorated. If decoration is present, it is usually in the form of parallel vertical lines that run down the length of the handle, although punctates or chevrons of parallel lines may be present. Handles were attached to the vessel using either a rivet technique of application, or applied directly to the vessel itself. Nearly all handle attachments are confined to the lip or upper exterior rim of the vessels. The location of handle attachment to the vessel is important in determining temporal placement of the vessels, and hence of the Oneota site. Early handles are attached just below the lip and are predominantly loop handles while more recent handles are strap handles attached below the lip (Gradwohl 1974; Harvey 1979; Henning 1970).

The reason the identification of pottery is so important, particularly to Oneota research, is it can be used as a temporal marker for Oneota sites when other sources of information such as stratigraphy or radiocarbon dates are not available or accurate. Another important reason that vessel decoration is useful is in making correlations between different localities in which Oneota groups resided. For example, pottery from northwest Iowa and southern Minnesota has decorative elements on them that closely resemble each other (Henning 1970; Gibbon 1983). Another example is the similarity of curvilinear motifs found on some Oneota pottery found at some of the earlier sites in central Iowa and eastern Wisconsin (Gradwohl 1974; Hall 1962). Whether or not the groups were related may never be known, however it does show a degree of cultural homogeneity, even if significant distances separate the localities.

A final and important facet of the Oneota artifact assemblage is reflected in the types and amounts of European trade goods found at some historic Oneota sites. These items

include Jesuit rings, brass kettles, glass trade beads, iron knives, points, and axes, and guns and flints. Many of these items were used as a supplement to many of the indigenous artifacts, and therefore may not have totally replaced their respective native counterparts on some protohistoric sites (Titcomb 2000).

Oneota Origins and Taxonomy

The origin of the Oneota tradition has been a perplexing, if not contested area of Oneota research for a number of years. Currently there are two theories that attempt to solve the question of Oneota origins:

The first theory postulates that the origin of the Oneota tradition was a result of Late Woodland stage groups being influenced by Middle Mississippian culture emanating from the massive Cahokia complex and its sphere of influence during the Stirling phase (Gibbon 1982; Griffin 1937; Hall 1962; Stoltman 1986; Tiffany 1998). This model is based on similarities in artifact assemblages and pottery characteristics that are believed to reflect evidence of direct contact. The theory is plausible, considering how much control the Middle Mississippian chiefdoms may have had in the Midwest during the early development of Oneota culture. Sites of Middle Mississippian affiliation do extend into extreme northern Illinois, southern Wisconsin, and southeast Minnesota. The power and influence emanating from these Middle Mississippian centers would definitely been felt in the upper Midwest.

The second theory concerning Oneota origins suggests that Oneota and Middle Mississippian evolved separately and independently of one another (Benn 1995). The assertion is that Oneota evolved from in situ Woodland antecedents (Benn 1995:91-92; Brown 1982:107-108; Henning 1995:68). Evidence for this model is based on the belief that developed Oneota societies coexisted with Middle Mississippian groups, and the apparent emergence of Oneota culture in Wisconsin in the tenth and eleventh centuries (Overstreet 1995:36). There are similarities between certain vessel decorations found on early Oneota

sites and Middle Mississippian Stirling phase wares (Hall 1962). These archaeologists do not doubt that interaction took place between Oneota groups and Middle Mississippian groups (Brown 1982:108), and was not a situation where the development of Oneota culture was dependent on the development of Middle Mississippian culture and acculturation of local groups to this lifeway. However, critical data that they use to support their claims are the radiocarbon dates obtained for many of the early Oneota sites. Unfortunately, when those dates are calibrated, the beginning of the Oneota tradition is pushed forward one to two hundred years to Stirling phase times (Boszhardt et al. 1995; Stoltman 1986).

Based upon the current available evidence, it appears that the origin of Oneota culture was the result of groups of Late Woodland people who were either directly acculturated into Middle Mississippian culture or who were indirectly influenced by sporadic contact through regional Mississippian sites such as Aztalan or Diamond Bluff. Tiffany (1998:151) expands upon this idea and suggests that Late Woodland groups who were drawn into the Middle Mississippian sphere during its height of power and influence ultimately left after the collapse of Cahokia and other regional centers and returned to areas throughout the upper Midwest possessing traits of Mississippian culture. However, those groups are not recognized as either Late Woodland or Middle Mississippian, but Oneota.

The Oneota taxonomic system is based upon an attempt to apply the temporal, spatial, and integrative terms outlined by Willey and Phillips (1958). Robert Hall (1962:106) introduced the horizon concept to delineate specific periods of time during Oneota occupation. Hall initially proposed and defined three horizons of Oneota development, the distinction of each being based primarily on stylistic attributes of ceramics, although morphological features of some stone tools, and residence structures and settlement patterns are taken as other indicators. In order they are the Emergent Horizon, Developmental Horizon, and Classic Horizon. A decade and a half later, David Overstreet

(1978) added an Historic Horizon to account for Oneota sites exhibiting evidence of European influence. Hall's horizon definitions for the Oneota are the primary method of grouping sites chronologically. However, the dates given for each of the different horizons are not calibrated and should therefore be taken as approximate values.

One very important aspect of the Historic Tradition, as defined by Overstreet, is the probable affinity of the Oneota with some of the modern historic tribes of the Great Plains. Historic tribes thought to be the descendants of Oneota groups include the Ioway, Missouri, Omaha, Osage, Oto, Ponca, and Winnebago (Hall 1962, 1995; Henning 1970; M. Mott 1938; Spector 1975; M. Wedel 1959; W. Wedel 1956). The Historic Horizon is used for Oneota sites dating after 1650 AD.

The implementation of the horizon concept to the Oneota tradition as defined by Hall and Overstreet is not without its problems, however. To begin with, the original definition of horizon as stated by Willey and Phillips (1958:33) denotes a broad geographic region among contemporaneous units such as phases that are linked together by specific traits reflected within the artifact assemblage. As such the term horizon should be used to denote geographic area; in other words, it is primarily a spatial term. The use of horizon, defined by Robert Hall, is one that does not follow the original Willey and Phillips definition. Hall uses the term horizon as a temporal taxon to delineate discrete units of time. Also implicitly stated in his use of horizon and his terminology is the idea of an evolutionary developmental sequence, and a linear transition from one horizon to the next. Now there are two usages for the same taxon used in Oneota literature, and since many other terms defined by Willey and Phillips are also used to discuss Oneota chronology, this can lead to confusion. Furthermore, the Emergent horizon is an arbitrarily defined beginning for the Oneota tradition. It is currently impossible to truly recognize when Oneota really begins in relation to an initial date since there is no true "Oneota antecedent" in Iowa *per se*. Finally,

Overstreet's use of uncalibrated, radiocarbon dates for his redefining of each Oneota horizon does not take into account the inconsistencies of radiocarbon, especially from approximately 1000 to 1200 AD where there are problems with the calibration curve.

Another model to explain Oneota development and chronology has been developed by Joseph A. Tiffany (1997). This model is based upon a temporal framework and uses three different time periods: Early, Middle, and Late. The demarcations for the different time periods are based upon Oneota artifact assemblages, and rely primarily on ceramic vessel decoration to differentiate one time period from another. The model proposed by Tiffany accomplishes two things: (1) it eliminates potential confusion of using the term horizon to denote two different concepts and (2) it eliminates the implicit proposition of developmental evolution reflected in Hall's original temporal horizon model.

Within the context of a temporal framework, the early period Oneota sites (i.e. Early, Emergent, Developmental, and Classic horizons) discovered and studied include such sites as Carcajou Point, Crabapple Point and Diamond Bluff in Wisconsin (Hall 1962; Spector 1975); Dixon, Clarkson, Grant Village, Kingston, and Schmeiser in Iowa (Harvey 1979; McKusick 1973; Osborn 1982; Straffin 1971; Tiffany 1979a); and Sheffield and Vosburg in Minnesota (Dobbs 1984; Gibbon 1983).

Middle period Oneota include such sites as Midway Village and Pammel Creek in Wisconsin (Boszhardt 1989, 1994; Gibbon 1970); Guthrey and Utz in Missouri (Henning 1970); and Bastian, Christenson, Correctionville, Kelley, the early component at McKinney, and Wever in Iowa (Benn 1991; DeVore 1990; Fishel 1999; Henning 1961, 1995; Osborn 1982; Tiffany 1979a, 1979b, 1988, 1997).

Finally, Late period and Historic horizon sites include the Valley View site in Wisconsin (Boszhardt 1994); and Blood Run, Flynn Cemetery, Gillett Grove, Lane Village,

the late component and McKinney and Milford in Iowa (Bray 1961; Harvey 1979; Tiffany 1996; Tiffany and Anderson 1993; Titcomb 2000; M. Wedel 1959).

The Oneota sites that represent the temporal periods in the preceding paragraphs are the result of associated artifacts assemblages, notably distinctive ceramic traits which serve as horizon styles that define each period within each Oneota locality such as Correctionville Trilled in Iowa or Perrot Punctate in Wisconsin for Early period (Emergent and Developmental and Classic horizon) and Middle period sites (Boszhardt 1989; Henning 1961). Late period (Historic horizon) sites are also associated with shoulder design fields on certain pottery types such as Allamakee Trilled for Iowa or Midway Incised or Koshkonong Bold for Wisconsin Oneota sites (Boszhardt 1989; M. Wedel 1959). Historic sites also have the presence of European trade goods.

Oneota in Iowa

The Oneota tradition in Iowa begins a bit later than in Wisconsin or Minnesota. Initially it was thought that Iowa may have had its own point of origin for Oneota due to some of the radiocarbon dates obtained from sites such as Dixon (13WD8). Uncalibrated radiocarbon dates put the initial occupation of the Dixon site around the late twelfth century, although dates ranged from 850 CE to 1750 CE, with a cluster of dates ranging between 1180 CE and 1400 CE (Harvey 1979:107-108). However, calibrated radiocarbon dates and their weighted means show a majority of the samples suggest an initial occupation date starting around the middle to late fourteenth century (Boszhardt et al. 1995). Compounding problems even further, radiocarbon dates taken from some sites do not correlate with the archaeological material recovered (Boszhardt et al. 1995:203). For the most part, at least in Iowa, general consensus puts the beginning of the Oneota in Iowa sometime in the thirteenth century based on a number of dates from sites located around Iowa.

The Oneota occupation in Iowa is confined to four main regions, and all four localities have a major river system close by in addition to a local environment comprising a mixture of gallery forest and prairie. The sites are located on terrace formations or upon ridges or blufftops, but all appear to be situated to maximize the availability of a broad range of resources.

Northeast Iowa

There are dozens of Oneota sites in northeast Iowa, with many located in Allamakee County. They range from village sites to burial complexes and mounds. Some of the Oneota sites in northeast Iowa include such sites as Lane Village Site and its associated enclosure (13AM200), the Lane Terrace mound group, which has intrusive Oneota burials (13AM104), the O'Regan Cemetery site (13AM21), the Grant Village (13AM201), the Flynn Cemetery site (13AM42), and Hartley Fort, which has intrusive Oneota burials (13AM103) (Alex 2000; McKusick 1973; M. Wedel 1959:8-28). These sites all exhibit an Oneota occupation at one time or another. Unfortunately, most of the data and artifacts come only from the burial sites, as these seemed to have been the focus of research. The only excavated village area was the Lane Village Site, although village components also exist, or existed prior to destruction, on the O'Regan site, Flatiron Terrace, and the New Galena Mound Group (M. Wedel 1959:35). A wide array of artifacts were recovered from the ground surface, trenching, and burial exhumations. The typical Oneota artifact assemblage was present consisting of triangular projectile points, endscrapers, and other groundstone tools for plant processing. No evidence for structures was present, although the large number of refuse and storage pits defined point to a somewhat long term occupation rather than a seasonal or repeated sequence of occupations. Subsistence evidence consists of beans and maize recovered from features along with animal bones and aquatic animal remains (Semken and Falk 1987). However, the sites were subjected to prolonged farming as well

as vandalism, which have caused some trouble in distinguishing occupation sequences (M. Wedel 1959).

The Oneota occupation in the region was termed the Orr focus initially, although it is also known now as the Orr phase (Henning 1970). The term focus was a term defined by McKern (1939) in McKern's Midwest Taxonomic System. The key attribute in distinguishing Orr phase Oneota is the characteristic pottery type, Allamakee Trilled. Allamakee Trilled pottery is identified by its globular shape with shell tempering, straight to slightly flaring rims, and decoration consisting of groups of vertical or diagonal lines with punctate filled areas in a triangular design across the shoulder of the pot (M. Wedel 1959:91-92). Decoration was applied to the lip, rim, handles, and shoulder of the vessels.

Burials were found to be an interesting dilemma, due to the nature of the burials and the locations of the bodies. Many of the Oneota burials were intrusive, with burials found in older Woodland era mounds and burial areas (M. Wedel 1959). Artifact recognition was the primary method to determine which prehistoric period the burials belonged.

Evidence for European trade and interaction is also found within the burials. Grave goods consisting of copper or brass bracelets as well as iron fragments were found in burials from the O'Regan Cemetery site (13AM21) (M. Wedel 1959). In particular, the O'Regan site had one burial with a substantial amount of glass beads, and one burial from the Hogback site had two silver bracelets with the word "Montreal" engraved on them (M. Wedel 1959; Orr 1914:237). M. Wedel's analysis of historical documentation indicates European explorers knew of Native Americans living in the area during the seventeenth century.

The Oneota occupation of northeast Iowa reflects a fairly permanent settlement, with evidence of horticultural activities and hunting of deer within the area, and is part of the Orr phase Oneota. Village locations are found along terrace formations, which would allow the

inhabitants to cultivate the rich alluvium on the terraces and bottomlands of the Upper Iowa River or its tributaries. In addition, evidence for an earlier Woodland occupation of the area is present, with burial mounds and characteristic Woodland cord marked pottery. The Oneota groups also reused burial areas, with many burials being intrusive into older Woodland components. The Oneota in northeast Iowa are also believed to be the possible protohistoric descendents of the Ioway and Oto tribes (Blaine 1979; Mott 1938; M. Wedel 1959; 1976). Northeast Iowa also shares similarities with other sites affiliated with the Orr focus in southwestern Wisconsin such as the Midway Village Site (Gibbon 1970) and at the La Crosse locality (Boszhardt 1994) and in southwest Minnesota (Dobbs 1984; Gibbon 1983). The La Crosse locality has a longer local sequence and may be the original area occupied.

Southeast Iowa

The Oneota manifestation in southeast Iowa represents a mixture of traits, particularly in ceramics, reflecting similarities with other Oneota regions not only in Iowa but around the Midwest in general. An overwhelming number of Oneota sites in southeast Iowa are situated along the Mississippi or its major tributaries, which include the Iowa River and the Skunk River. In fact, two large clusters of Oneota sites are grouped at the mouths of the Iowa and Skunk Rivers where they empty into the Mississippi. Tiffany (1988) has suggested that the locations of Oneota sites in southeast Iowa took advantage of these locations to protect themselves as well as to defend and possibly control travel into the interior of Iowa and into the reaches of the eastern plains.

One dilemma that has dogged Oneota research, and one that has particular importance to this region of Oneota occupation, are the proposed origins of the Oneota tradition. This is due to the rather close geographic proximity to the Cahokia complex in Missouri. In addition, the use of shell tempering at both Cahokia sites and Oneota sites

raises some intriguing questions, as well as their relatively close and simultaneous occupations of this region of the Midwest. Tiffany (1997:229, 1998:149-151) and Henning (1995:73) both seem to agree that the emergence of the Oneota in southeast Iowa is a site intrusion to the region, precipitated by the decline and eventual collapse of Cahokia and related Mississippian chiefdoms. Tiffany goes further to explain the connection between Oneota, Mississippian Cahokia, and Late Woodland populations by offering an explanation for the Oneota emergence in southeast Iowa. Essentially, the Oneota tradition developed from Late Woodland groups residing in the Upper Mississippi region, who became acculturated to Middle Mississippian lifeways through contact and interaction. As the Middle Mississippian power center at Cahokia began to decline, the Late Woodland groups began to reemerge and assert themselves throughout the Upper Mississippi, and by 1300 AD, what were once Late Woodland groups have now become Oneota groups through the influence of Middle Mississippian power and culture (Tiffany 1988; 1998:151).

Oneota research has been ongoing in southeast Iowa for a number of years. Twenty-two sites were recorded by Tiffany (1979a:90) and of these only a handful have seen concentrated excavations and research. Oneota sites that have been investigated in southeast Iowa include the Kelley site (13DM140), the Kingston site (13DM3), the McKinney site (13LA1), the Poison Ivy site (13LA84), the Schmeiser site (13DM101), and the Wever Terrace site (13LE9) (Alex 1978; Henning 1995; Slattery et al. 1975; Straffin 1971; Tiffany 1979a; 1988; 1997; 1998). In addition, a site catchment study of fifteen Oneota sites in southeast Iowa was undertaken by Tiffany (1982). Site characteristics such as major landform types, general location, and vegetative cover were used to model the prehistoric environment and to determine the overall resources available at each site. The twenty-two sites in the region fall into one of two categories: upland sites or lowland and floodplain sites (Tiffany 1982:6). Similar to northeast Iowa and other Oneota site locations in the Prairie

Peninsula, each of the sites is situated in an area where ecotones either of lowland forest/prairie or upland forest/prairie meet (Tiffany 1982:7). Thus it appears that the southeast Iowa Oneota inhabitants were locating sites where they would be able to maximize the exploitation of resources around the sites. Furthermore Tiffany (1982:13) has suggested that some sites have a seasonal occupation with another "sister" site close by. One example of this would be the geomorphic location and proximity to one another of the McKinney site and the Poison Ivy site. The paired sites would include one located on the uplands, such as McKinney, and the other site situated on the bottomlands of rivers (Alex 1978; Tiffany 1982).

Charles R. Keyes was instrumental in the first field surveys in the area, and attributed the Oneota materials found in southeast Iowa to a previously unknown Oneota manifestation, which he named the Burlington focus (Tiffany 1979a). Further work by Tiffany in the region prompted the naming and identification of four localities of Oneota occupation: the Kingston locality, the Toolesboro locality, the Spring Creek locality, and the Lost Creek locality (Tiffany 1979a:100). The Kingston locality has also been segmented into three phases: the Burlington phase, the Kelley phase, and the Bailey Farm phase (Tiffany 1979a; 1997). The Toolesboro locality, which includes the McKinney site, has also been provisionally split into an early and a late McKinney sequence (Tiffany 1997, 1998). Some radiocarbon dates have been taken for some sites and the radiocarbon assays put an estimated date for the occupation of the region from the fourteenth century to the seventeenth century (Boszhardt et al. 1995; Henning 1995; Tiffany 1979).

The artifact assemblage from these sites includes the ubiquitous triangular projectile point, end scrapers, biface knives, manos, metates, sandstone abraders, bone tools, and catlinite pipes (Slattery et al. 1975; Straffin 1971; Tiffany 1988). The tools reflect a broad based subsistence pattern of horticulture supplemented with animal hunting and wild plant

utilization. However, a significant area of complexity and confusion surrounds the diverse ceramic assemblage found at Oneota sites in southeast Iowa. The ceramics recovered at Oneota sites in southeast Iowa reflect similarities to Oneota ceramics found all over the Prairie Peninsula. A number of hours were spent by the author attempting to decipher the complexity of the situation, and what follows is a brief timeline of the different ceramic attributes found in the literature.

The earliest manifestation of the Oneota tradition in Southeast Iowa begins with the Burlington phase, which begins approximately 1315 CE (Tiffany 1997:206). The Oneota ceramics recovered from sites within the Kingston locality are globular in shape, with varied sizes and rounded bottoms. Decoration, like almost all other Oneota pottery, occurs on or inside the lip, upper rim, and upper shoulder areas of the vessels. While it appears that most of the decorative elements found on the lip and rim of Oneota vessels do not change markedly through time, the design elements found on the shoulders are the primary markers for change through time in Oneota pottery (Tiffany 1998:152). The upper shoulder area of Oneota vessels is commonly decorated with geometric combinations of trailed lines, punctates or both (Tiffany 1988:279). It is the manner in which these elements are combined which differentiates one period of time from another. As Tiffany (1997:226) states, it is the decorative representation on the shoulder that appears to have cultural and temporal importance between vessels and sites, rather than any particular technological or application features by which the design motif was made.

Many researchers (Boszhardt 1994; Gibbon 1983; Harvey 1979; Henning 1995; Osborn 1982; Tiffany 1997) have remarked on the similarity of early period Oneota pottery between southeast Iowa to the Correctionville and Moingona phases in Iowa, the Blue Earth phase in Minnesota, and the Brice Prairie phase in Wisconsin. Typical decoration for Burlington phase Oneota sites include tool impressed designs on the lip or lip interior and

rim. The rims are predominantly straight to slightly flaring. Shoulder decoration consists of a distinctive pattern of parallel lines known as the “nested chevron” motif (Tiffany 1979a). This pattern only shows up on early period Oneota ceramics, and is later replaced by a different motif that signifies a more recent period of occupation. In addition some ceramics have punctations applied as a border around the nested chevrons. The use of punctates as borders almost always occurs with trailed lines (Straffin 1971:24). Finally, the presence of stepped looped handles is another diagnostic element of Burlington phase ceramics (Tiffany 1979a).

The Kelley phase is the second phase, and it too is differentiated by stylistic changes of pottery design. The Kelley phase has ceramic decorative elements that are similar to sites in Illinois, Iowa, Nebraska, and Wisconsin (Boszhardt 1994; Tiffany 1997). Interestingly, the ceramics typical of Kelley phase Oneota occupation appear to be a form between the earlier Burlington phase ceramics and the later Allamakee Trailed pottery. As such Henning (1970) has suggested that these ceramic wares be termed intermediate.

Kelley phase ceramics are differentiated by their use of strap handles decorated with vertical parallel lines, deep tool or finger impressions on the lip or rim, and more angular flaired rims (Tiffany 1997). Shoulder decoration consists of a new type of element, which includes bands of parallel lines that may be horizontal, angular, or vertical in orientation. The shoulder lines are configured in patterns that resemble chevrons and alternating triangles filled with parallel lines (Tiffany 1997:224). Radiocarbon dates for the Kelley site, the type site for the Kelley phase, are calibrated to the fifteenth century (Boszhardt et al. 1995).

The final phase, the Bailey Farm phase, signals the final transition of ceramic design. Some ceramic design elements are carried over from the Kelley phase, such as strap handles decorated with vertical parallel lines. Lip decoration consists of scalloped or

crenellated lips resulting in a “pie crust” appearance (Tiffany 2000, personal communication). However, the design motifs located on the vessel shoulders are significantly different, in addition to a new type of vessel decoration. (Tiffany 1988:288) has termed this new vessel decoration and its resultant application to the vessel a “pumpkin pot.” This decorative element consists of deep and wide finger trailing applied vertically upon the shoulder of the vessel. These pumpkin pots also show up at the McKinney site in the Toolesboro locality of southeast Iowa and in the Orr focus of northwest Iowa (M. Wedel 1959).

The other design motif that shows up during the Bailey Farm phase is commonly found on Allamakee Trilled pottery of the Orr phase. This type of pottery decoration occurs at Orr phase sites in northeast Iowa, southeast Iowa, and Wisconsin (Boszhardt 1994; Henning 1970; Tiffany 1988, 1997; M. Wedel 1959). This shoulder design motif is a distinctive pattern of parallel lines that form triangles or chevrons, with the addition of punctates that are now used as a filler between groups of lines, rather than as a border around the lines as found at Burlington phase Oneota sites (Tiffany 1998:288).

One of the problems concerning southeast Iowa Oneota archaeology is the lack of much substantial data for any of the other sites not mentioned here. Most of the artifacts recovered from other Oneota sites are surficial collections that do not yield a number of ceramic remains to undertake a detailed and complete analysis to tie them into the existing chronology such as the one for the Kingston locality. With this being the case, Tiffany (1997, 1998) and Henning (1995) have offered suggestions for future research, which might help to clarify other relationships between Oneota sites in southeast Iowa as well as other Oneota sites across Iowa and the Prairie Peninsula.

Central Iowa

The Oneota manifestation in central Iowa is the earliest region inhabited within the state. The majority sites are located along the Des Moines River primarily in the Red Rock Reservoir (Gradwohl 1974). Initially, it was thought that the Oneota occupation of this region was limited to this area. However, new research in counties outside of the Red Rock area to the north and the south have led to the discovery of a number of Oneota sites that stretch for many miles along the Des Moines River (Moffat 1998).

Initial surveys undertaken by Iowa State University during the 1960's discovered a total of nineteen Oneota sites (Gradwohl 1974). Subsequent research and cultural resource projects within the area in addition to monitoring of the flood pool levels at both Red Rock and the Saylorville reservoirs attributed another thirty-one sites to the Oneota tradition based upon artifacts recovered (Moffat 1998:168). Of the original nineteen sites discovered, only four of them received focused attention by researchers. These sites include the Mohler Farm site (13MA30), the Howard Goodhue site (13PK1), the Clarkson site (13WA2), and the Cribb's Crib site (13WA105) (DeVore 1990; Gradwohl 1974:94; Osborn 1982). In addition recent excavations have also been undertaken at the Christenson site (13PK407) by David Benn (1991).

The Oneota manifestation within Central Iowa has been defined as the Moingona phase, and has an initial starting date for occupation in the mid to late thirteenth century (Boszhardt et al. 1995; Gradwohl 1967, 1974). This start date for an Oneota occupation of the Des Moines Valley makes it contemporaneous with the earliest Oneota complex in Wisconsin. The length of occupation of the central Des Moines Valley also makes the Moingona phase Oneota site contemporaneous with other regions in Iowa including southeastern Iowa and northwest Iowa. Sites consist of villages and base camps. Villages are recognized by the occurrence of numerous storage and refuse pits and a shallow

occupation midden that lies within the upper part of the plow zone (DeVore 1990; Osborn 1982). Base camps and temporary sites are characterized by a smaller overall area and a proportionately lower amount of artifacts, and possibly different locations for site selection (Benn 1991).

Oneota subsistence differs little within central Iowa compared with other Oneota occupations within the Prairie Peninsula. Evidence for the growing of cultigens as well as hunting activities and wild plant gathering are found at all sites. Cultigens recovered include corn, beans and squash, and domesticated seeds such as sunflower and marshelder (Alex 2000; DeVore 1990; Osborn 1982). A wide variety of wild plants such as chenopodium and little barley, and fruits including grapes, cherries and plums are also found at these Oneota sites, but preservation does make identification of plant remains rather difficult at times (Alex 2000; Osborn 1982). Faunal remains include species typical of a timber and prairie ecotone, with large animals such as white tailed deer present and some bison and elk remains in addition to smaller mammals used for food, hides, and bones for tools. The artifact assemblage includes triangular projectile points, end scrapers, bifaces, and other stone tools. Bone tools used for horticulture, hideworking, and fishing activities such as bison scapula hoes, elk horn artifacts, and fishhooks have also been recovered (Benn 1991; DeVore 1990; Osborn 1982).

Ceramics found at Moingona phase Oneota sites are characteristically a bit different with regard to ceramics found at other Oneota sites in Iowa, although some of their stylistic attributes are similar to Oneota sites found in Wisconsin. The vast majority of pottery is shell tempered; however some sherds recovered have grit as the tempering agent. Nearly all of the fragments recovered are from globular jars, although some remains at Oneota sites do exhibit a shape that may make them part of a bowl (DeVore 1990:53). Rim heights are variable, and are likely proportionate to the overall size of the vessel. Overall, the

construction of the vessels was performed extremely well and the decoration upon vessels was applied with care (Osborn 1982:85-86).

The decoration applied to vessels consists of trailed lines often representing the “nested chevron” design (Boszhardt 1994; Hall 1962; Tiffany 1979a). In addition, a large majority of the motifs found have punctates used as borders around the parallel lines and nested chevrons (DeVore 1990; Osborn 1982). There are, however a couple of design elements found on Moingona phase pottery that make them distinct. A number of the rim fragments recovered have interior rim decoration consisting of nested chevrons that point downward. This decorative attribute has been ascribed as a unique characteristic to Moingona phase Oneota ceramics (Gradwohl 1974:95). Another distinctive decorative attribute of these ceramics is the use of a small number of circular motifs. These designs consist of concentric rings or a “bull’s eye” motif, a “sunburst” motif, and a circle and cross motif (Benn 1991; Osborn 1982). These circular motifs occur predominantly above or within the nested chevrons on the shoulders of the vessels (Benn 1991:33). Some cord roughened sherds have also been recovered from central Iowa Oneota sites, and appear to be associated with these early sites. Finally, some vessels have small loop or eyelet attachments on the shoulder.

Northwest Iowa

Northwest Iowa Oneota will not be discussed here since the focus of this research concentrates in this region. Therefore the following chapter will be devoted to a detailed description of the area and the Oneota sites found there.

Summary

The Oneota tradition exhibits a suite of traits that make it distinct from other groups within the Prairie Peninsula as well as previous occupations from Woodland groups. The

beginning of what can be called "Oneota" is still being debated based upon radiocarbon assays, but it appears that the main area of its emergence appears to be in eastern Wisconsin in the 12th century (Hall 1962). From here Oneota culture spread to surrounding states including Minnesota and Iowa, and then later to a larger portion of the Midwest. Occupation was not simultaneous, but the locations and regions of where sites are found exhibit a commonality in terms of local environment and artifact assemblages that stays extremely stable and homogenous through time. Ceramics are the primary material culture that can be used to distinguish one Oneota occupation from another, and these ceramic traits have also allowed researchers to type and describe changes through time, creating a timeline of Oneota occupation throughout the Prairie Peninsula (Hall 1962; Henning 1961, 1970; Tiffany 1979a; M. Wedel 1959).

While the origins and taxonomy of the Oneota are still hotly debated among researchers, hopefully with enough research and available data, models can be developed which will be able to explain the great variability found within the Oneota tradition, and help to alleviate these problematic areas of research. This will allow for more commonality within articles and papers, giving Oneota researchers a common ground to explain and interpret their research for the benefit of all those interested in the Oneota tradition.

CHAPTER 3: ONEOTA IN NORTHWEST IOWA

Introduction

The Oneota tradition in northwest Iowa appears to be a bit more enigmatic than other regions within Iowa and around the Prairie Peninsula in general. Nearly all of the sites are located along the Little Sioux River, except for Blood Run (13LO2), which is located in extreme northwest Iowa along the Big Sioux River in Lyon County, Iowa and Lincoln County, South Dakota. The northwest Iowa sites appear to reside in three distinct geographic locales along the reaches of the Little Sioux River. The sites themselves range greatly in age; the oldest known Oneota site, Dixon (13WD8) dates to the fourteenth century (Boszhardt et al. 1995; Fishel 1999), while the most recent sites along the upper reaches of the Little Sioux River date to historic times (Tiffany and Anderson 1993; Titcomb 2000). These different locales and range of dates for occupation suggest that different groups occupied the Little Sioux Valley at different times. Another possibility is that the occupations may be the same group, who moved north up the valley and settled in different areas, perhaps due to dwindling resources or from pressure from other Native American groups.

One of the major obstacles in attempting to interpret the Oneota occupation of northwest Iowa is the relatively sparse amount of data, excavations and published reports from the region. Dixon has seen two major excavations in the last three decades, the most recent a result of the major damage done to the site during the summer floods of 1993 (Harvey 1979; Fishel 1995, 1999). Milford (13DK1) has also seen three excavations with the first occurring in the 1970s, and the most recent one during the summer of 2000 (Tiffany and Anderson 1993). Gillett Grove (13CY2) has also seen intermittent excavations during the 1990s associated with the Iowa Lakeside Laboratory archaeology field school (Titcomb

2000). The Office of the State Archaeologist of Iowa (OSA) has also conducted limited excavations at other Oneota sites such as the Bastian site (13CK28) (Tiffany 1979b).

Unfortunately, many of the sites in northwest have been subjected to major destruction due to natural causes from flooding and human activities such as gravel quarrying and near constant farming since Euro-American settlement. Local collectors have been removing artifacts for many decades, although some of them have kept fairly detailed records as to where and when they collected specimens. With some sites destroyed and others in danger due to human activities, research in the area is potentially threatened, not only for Oneota sites but for other prehistoric cultures as well including Woodland, Great Oasis, and Mill Creek.

This chapter details the Oneota tradition within northwest Iowa. Discussion will focus upon the regional environment and geologic history of the area, to be followed by individual site descriptions giving information on the immediate local environment, previous archaeological investigations, and temporal placement of the sites with regard to general Oneota chronology. A final summation will describe overall characteristics of northwest Iowa Oneota similar to the descriptions of other Iowa Oneota regions found in the previous chapter.

Regional Environment

The region in which the Little Sioux River traverses is one that contains a great diversity and mixture of landforms, topography, vegetation, and animal life. The Little Sioux River itself goes through five of the seven geologic regions of Iowa. Along its way the valley it has created goes from steep almost canyon like walls to broad meandering floodplain portions almost three miles in width. The history of the Little Sioux River is also quite intriguing; a large portion of the upper valley and river system was recently created during

the last 15,000 years and so geologically it is very young. The most recent Wisconsinan glaciation played a major role during the formation of the upper reaches of the Little Sioux Valley. The abundance of wildlife, not only within the vast expanses prairie, but also within the valley itself, along with readily available natural resources no doubt made northwest Iowa a very attractive area to live for many prehistoric groups.

Northwest Iowa Landform Regions

The Little Sioux River winds its way through parts of nine Iowa counties and drains into the Missouri River on the western border of Iowa in Harrison County (Figure 3.1). During its course, the river moves through portions of the Des Moines Lobe, the Northwest Iowa Plains, the Southern Iowa Drift Plain, the Loess Hills, and finally the Missouri Alluvial Plain (Prior 1991). Each of the major landforms has a suite of characteristics that differentiate one landform from another, primarily in terms of topographic relief, major geologic formations, and age.

The Des Moines Lobe is the last major reentrant of the Wisconsinan glaciation, which occurred from 30,000 BP to approximately 14,000 BP. The land is characterized by a relatively flat plain; the only major forms of relief coming from the sediment deposition as a direct result of the process of reoccurring glacial advance and ablation within the region. This deposited material, known as glacial till, has a mixture of sediment and various sizes of pebbles, cobbles and boulders embedded within its matrix. Many prairie lakes and potholes dot the Des Moines Lobe, indicating the rather poor drainage characteristics of the area in addition to the linked tunnel system of drainages that drained water out from under the Des Moines Lobe (Benn and Bettis 1985; Iverson 1999, personal communication). There are three major advances of the Des Moines Lobe, each of which has a characteristic moraine associated with it. These moraines are named, from north to south, the Algona, Altamont, and Bemis moraines (Prior 1991:39). The farthest reaching advance, and the one that has

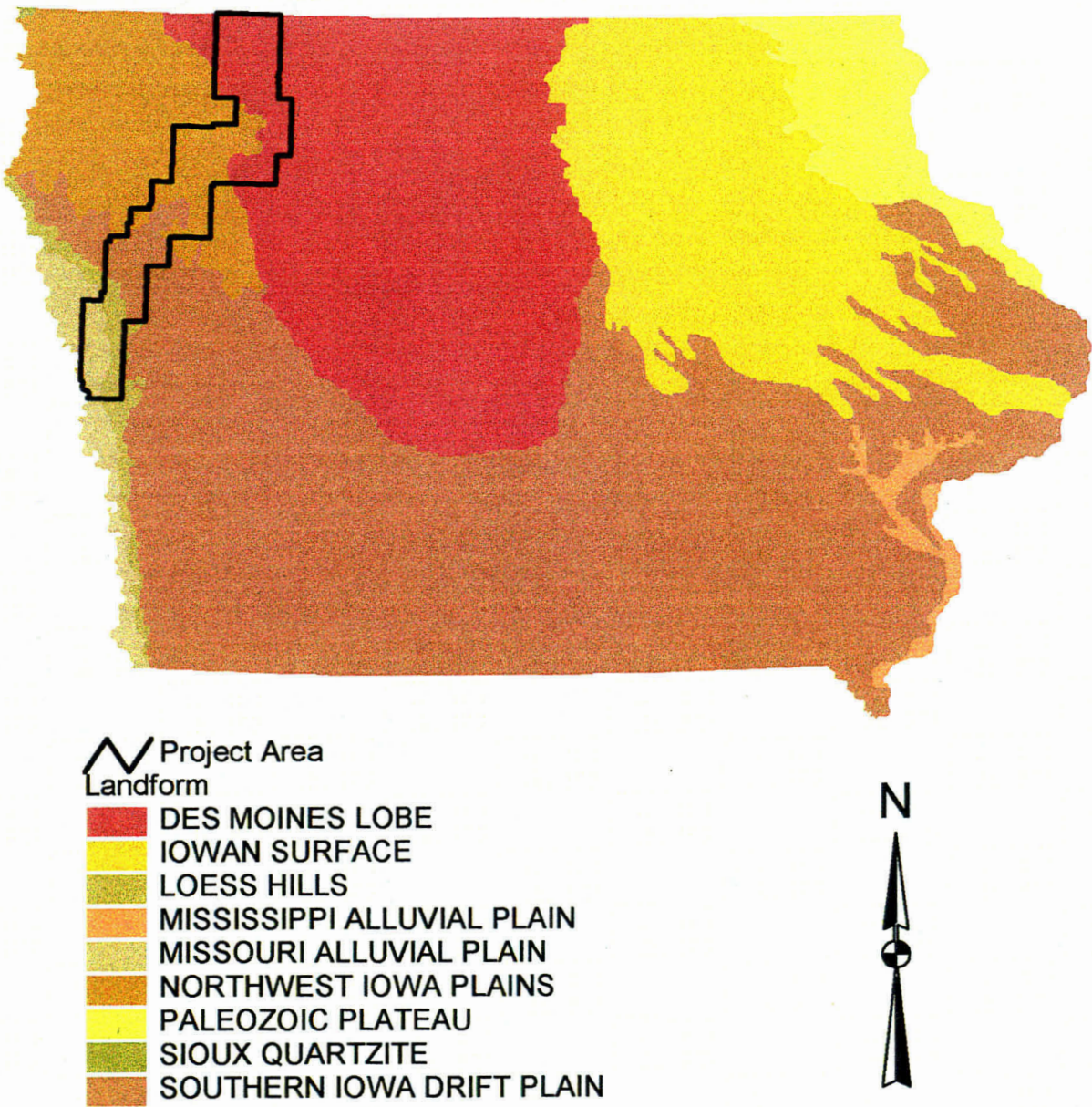


Figure 3.1. Map of Iowa Showing Major Landform Regions and Study Area.

the most impact on the Little Sioux Valley is the Bemis moraine. The western margin of this moraine coincides with the peculiar meandering pattern of the Little Sioux River farther north between the towns of Spencer and Gillett Grove (Hoyer 1980). Almost all of the landforms west of the Des Moines Lobe in northwest Iowa were not affected by the most recent Wisconsinian glacial episode.

The Northwest Iowa Plains is the second landform region through which the Little Sioux River passes. This Iowa landform region is somewhat of a transitional zone, reflecting characteristics of both the Des Moines Lobe to the east and the Loess Hills to the west. The Northwest Iowa Plains were affected by the Wisconsinian glacial episode, albeit at a date earlier than the final advance of glacial ice that created the Des Moines Lobe, occurring around 30,000 to 20,000 BP (Prior 1991:76). As a consequence, most of the drainage networks are more defined. In addition, large scale erosional activity has occurred due to the relatively older age of this landform resulting in long broad swells and hills (Prior 1991:78). Furthermore, aerosol deposits from the alluvial plains of the Missouri River and Big Sioux River have covered the entire area in a blanket of loess that tapers out from west to east in depth of deposition. These loessal deposits have steepened valley walls as well as filling in low lying areas of drainages (Prior 1991:79).

The third landform region is the Southern Iowa Drift Plain. This landform region is very old, dating from 300,000 to over 2 million years ago (Prior 1991). It is characterized by the well defined drainage networks within the area, which have had thousands of years to carve their valleys through the till deposits from previous glacial advances. The Wisconsinian glaciation did not reach this far into Iowa, and therefore was not a factor in the formation of the terrain. The area is characterized by a rugged topography with a near constant undulation of the land, going from river valley to uplands and then back into

another river valley (Prior 1991:59). The major forces at work altering the landscape have been periods of erosion from the elements and aggrading by stream deposits in large valleys. Loess deposits are found here as well, tapering off in depth from west to east.

The fourth landform region, the Loess Hills, is aptly named due the significant amount of loess deposition of this area. This loess deposition has created one of the most dynamic landscapes found within in Iowa and is one of only three loessal landforms of its kind on the planet. The major source of this loess comes from the Missouri River, where glacial meltwater was carried into the river along with the very fine silt and clay particles. The gradual decline of large amounts of meltwater resulted in extensive areas of exposed silt, which was then picked up by high winds and deposited over the state of Iowa (Prior 1991:51). Loess deposition near the Missouri Valley is extremely deep, averaging sixty feet, although some areas have deposits two hundred feet or higher. The highly erodable loess has been altered over thousands of years creating steep valley walls and a very rugged landscape. Off of the Missouri River the loess rises steeply upward, providing a very distinct boundary between the Loess Hills and the Missouri Alluvial Plain, and levels out to the east merging with the Northwest Iowa Plains and the Southern Iowa Drift Plain (Prior 1991:48).

The final landform region that the Little Sioux River travels through is the Missouri River Alluvial Plain. As the name implies, the major feature of this landform region is the Missouri River and its broad and level floodplain. This floodplain is rich in alluvial deposits, making it an excellent source of soil for the growth of crops (Prior 1991:101). Flooding occurred on an annual basis in the past. Flooding helped to replenish the nutrients within the soil as well as deposit more sediment upon the floodplain. Other features of this region include numerous oxbow lakes and river segments that have been cut off due to the extensive meandering of the Missouri River as well as terrace remnants, indicative of the river downcutting into the sediment deposits that comprise the valley floor (Prior 1991:101).

Geomorphology of the Little Sioux Valley

The Little Sioux Valley has a unique history with regard to its formation. The Little Sioux River, which has shaped and carved the valley was not always as large as its current size. Before the last major glaciation, the drainage basin was considerably smaller, with its headwaters at what is known today as Waterman Creek in O'Brien County. The Little Sioux River also drained to the east prior to the last glacial advance. Today, however, the Little Sioux River drainage basin is the largest in northwest Iowa, draining approximately 6800 kilometers² and the present length of the river is approximately 345 kilometers (210 miles) (Hoyer 1980:3).

The Little Sioux Valley can be divided into two distinct parts: the southern section that begins at Waterman Creek and heads south, and the northern section, which goes from Waterman Creek north to the present headwaters of the Little Sioux River in southern Minnesota. Regionally, both areas have a different topography and different drainage characteristics. The southern half of the valley is characteristically narrower, and the river channel flows directly south and west into the Missouri River. The northern half of the valley broadens out considerably, and the Little Sioux River meanders in a large arc east and north before looping back west and north again (Hoyer 1981:3). The Little Sioux River follows the western margin of the Des Moines Lobe in this area, and is in a way the demarcation between the Des Moines Lobes and the Northwest Iowa Plains (Prior 1991).

One major effect that Wisconsinan glaciation had on the Little Sioux River besides its formation is the direction of its drainage. Prior to the last Wisconsinan glaciation, the geographic divide separating the Missouri and Mississippi River drainage basins resided between Waterman Creek and Mill Creek (Hoyer 1980:39). It is this divide that Hoyer (1980:63) attributes to the stoppage of a major surge of ice into Iowa about 20,000 BP. A

second glacial advance led to the creation of glacial lakes along its margin, and also cut off drainage within the area to the Mississippi River (Hoyer 1980:10). As the lakes filled up with meltwater and reached their maximum depths, the water spilled out over the ice margin and began to rapidly cut down into the sediment creating small drainages along the edge of the ice. One large glacial lake, Glacial Lake Spencer is presumed to be the primary channel of a portion of the Little Sioux River in this area (Hoyer 1980:12). Through time, the glacial meltwater continued to cut down into the sediment, linking these smaller drainages together. As a consequence, the Ocheyedon River, and Willow Creek began to flow into one primary drainage channel. This primary drainage channel then linked up with Waterman Creek approximately 14,000 BP, and became the northern half of the present day Little Sioux River. As a consequence of this geological activity, a new drainage divide was created demarcating the Missouri and Mississippi drainage basins. The Little Sioux River presently drains a large portion of northwest Iowa that previously drained east towards the Mississippi River. Interestingly, however, the Little Sioux River still traverses the highest divide in the region to drain towards the Missouri River (Hoyer 1980:3).

The Little Sioux Valley also has a sequence of terraces that run alongside the valley walls. However, substantial portions of many terraces have been removed by erosion and human activities, and so only remnants remain. The Little Sioux Valley has a sequence of five terraces that can be divided into two clusters geographically. One group consists of the older T1 and T2 terraces. T1, the oldest terrace, dates to approximately 20,000 BP and very little of it remains today. T2 is the second oldest terrace and is also found in scattered remnants. However, the remnants for both of these terraces do not extend too far north from the confluence of Mill Creek and the Little Sioux River, indicating that terraces T1 and T2 were formed prior to the last glacial advance (Hoyer 1980:6-8).

The second terrace sequence, consisting of terraces T3, T4, and T5 are found along the entire length of the Little Sioux Valley. These terraces were created during the last 4,500 years and indicate fairly rapid downcutting of the Little Sioux River since that time (Hoyer 1980:8). In addition, the composition of the terraces is a bit different. The surface of T1 has a layer of loess upon it that averages seven feet in depth. Terraces T2, T3, T4, and T5 all have a loam or a sandy loam surface (Hoyer 1980:5). Terrace T1 is defined as the high Wisconsin terrace, T2 is the high Holocene terrace, T3 the high Holocene intermediate terrace, T4 the low intermediate terrace, and T5 the low terrace (Hoyer 1980:6). It should be noted this terrace numbering is the reverse of how terraces are normally designated within a valley.

The valley provides abundant resources of gravel underneath the soil, which has been exploited quite heavily in the last century. Unfortunately, most of Oneota sites in northwest Iowa reside in these areas and as a consequence many of them have been affected by gravel operations. However, the expanse of the valley does leave large areas of land that do have the potential to contain unknown Oneota sites in addition to prehistoric sites affiliated with other cultural traditions.

Climate, Flora, and Fauna of the Little Sioux Valley

Northwest Iowa has undergone a variety of changes with regard to climatic condition over the last one thousand years. Baerreis and Bryson (1965) initiated a pioneering study of climatic change in the upper Midwest that drew upon multiple disciplines to determine the effects of climate change on prehistoric cultures. From this research it was concluded that there was a series of Holocene climate fluctuations that affected available moisture, temperature, precipitation, growing season, and consequently human activity. These episodes are the Neo-Atlantic (800-900 AD), the Pacific (1250-1450 AD), and the Neo-Boreal (1450-1550 AD) (Baerreis and Bryson 1965; Harvey 1979:9). The episodes of

interest for this study are the Pacific and the Neo-Boreal. The Pacific episode, dating from 1250 to 1450 AD was marked by a change to warmer and drier conditions, which in turn allowed the Prairie Peninsula to expand. The Neo-Boreal episode followed the Pacific and dates from 1450 to 1550 AD. This climatic period marked a return to cooler temperatures. A main focus in northwest Iowa Oneota research concerns the affect these climatic changes may have had on the Oneota, particularly with regard to their subsistence regimen consisting of horticulture, hunting and gathering. As the growing seasons became shorter, more of an emphasis may have been placed upon hunting and gathering to offset any possible loss of crop yields. Harvey (1979:9-10) has a brief but clear explanation of this possibility.

Recent research by Laird et al. (1996), however, depicts a different sequence of events and climatic variability on the northern Great Plains. Using diatom remains from lakebeds and measuring salinity levels, Laird et al. suggest that the period before 1200 AD was actually warmer and dryer. This evidence goes contrary to Baerreis and Bryson's climatic model that suggested a trend in the opposite direction. Therefore, the period after 1200 AD was actually cooler and wetter and more like the climatic conditions today (Laird et al. 1996:553). During the initial occupation of the Little Sioux Valley in the fourteenth century, the area was experiencing some of the wettest conditions of the last two hundred or so years (Figure 3.2).

Present climatic conditions within northwest Iowa are representative of the Midwest. As one moves from east to west, the precipitation drops off. In Iowa alone, the annual precipitation falls from thirty-six inches a year along the Mississippi River to only twenty-six inches along the Big Sioux River (Harvey 1979:12). This dryness is attributed to the Rocky Mountains further west, where most weather systems release a majority of their precipitation on the eastern side of the mountain range. Nearly three-fourths of all precipitation in

Early Plains Village Cultures and Climatic Trends for the Northern Plains

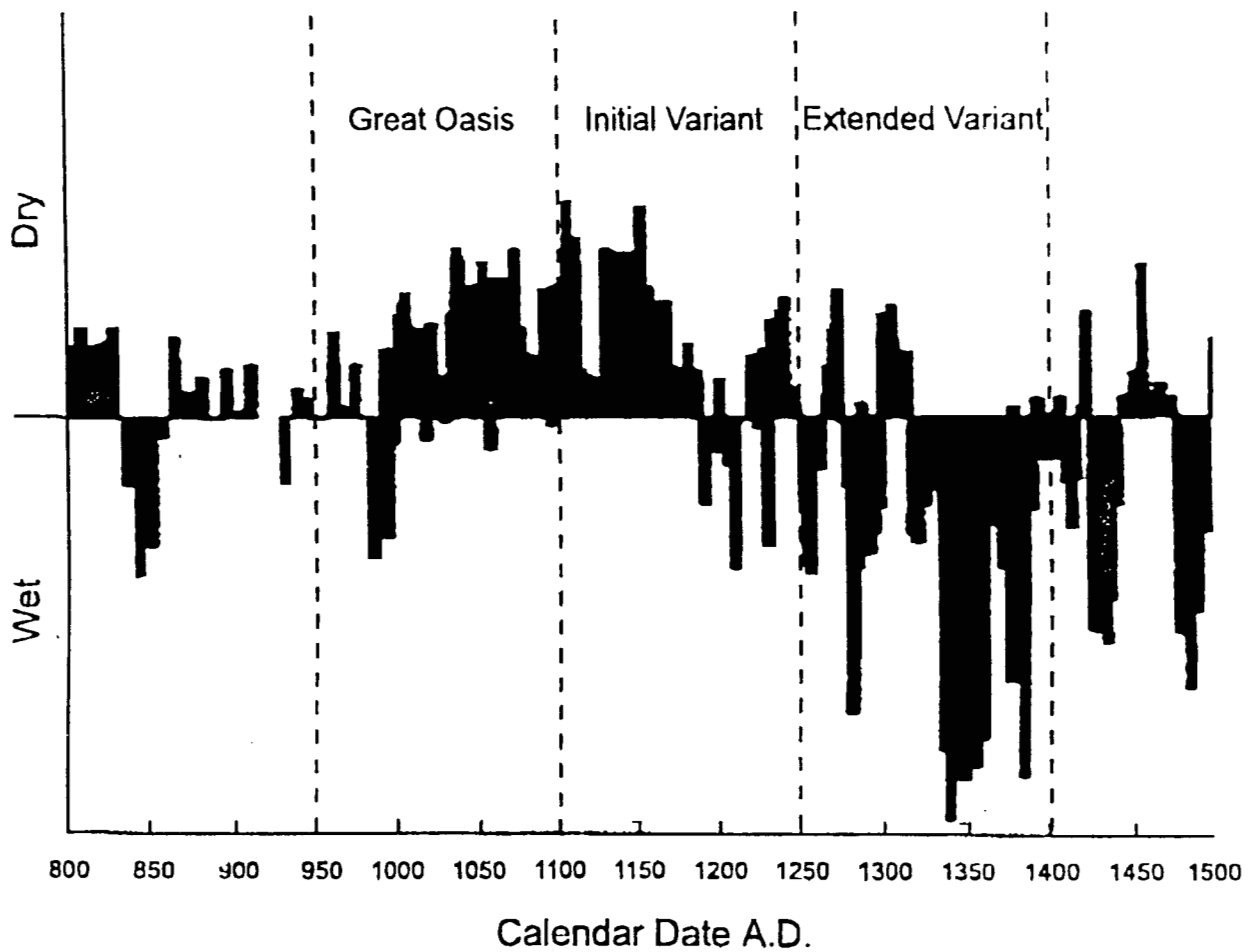


Figure 3.2. Moist and Dry Periods From Diatom Evidence During Pacific and Neo-Boreal Periods (From Stephen C. Lensink, 2000).

northwest Iowa comes between April and September in the form of rain, and over half of this rainfall occurs between the months of May and August (Harvey 1979:12). Further the prevalent wind direction is from the northwest, which is also highest in northwest Iowa, causing additional water loss through evaporation (Carter 1960:18). The prevailing westerlies are responsible for the region known as the Prairie Peninsula, within which northwest Iowa resides (Baerreis and Bryson 1965; Harvey 1979).

Temperatures vary significantly between winter and summer; within northwest Iowa, temperature variance between the two seasons can vary by as much as one hundred degrees or more (Carter 1960:18, 21-22). Winters as would be expected are longer and sometimes more severe in the northern part of the region. This would have an effect on growing season, thus any cultigens would have to adapt to survive in this climate. The growing season in northwest Iowa is also quite variable. Days for favorable growth range from 147 frost-free days in Lyon County to 159 frost-free days in Woodbury County (Harvey 1979:12).

The temperature, amount of precipitation per year, and geographic location all play significant factors in the types of flora and fauna that are found within the an area. The term Prairie Peninsula is aptly suited to a large geographic region occupying the central United States. It is wedged shaped, beginning west of the Rocky Mountains and tapers to a narrow termination in the Ohio River Valley. Harvey (1979:11) lists the dominant prairie grass species present within the northwest Iowa, which consists primarily of tall prairie grasses. Wildflowers and small hardy shrubs may also be present. The tall grass prairie covered nearly all of the upland areas in northwest Iowa. Through time, depending on factors of available precipitation, fire, and temperature variation, prairie grass regions would shrink or expand. This would allow some species of woody plants to become more dominant for a time until climatic conditions returned that were favorable to the tall prairie grasses.

Northwest Iowa resides along the northwest margin of this biome, and is surrounded by tall and short prairie grasses (Harvey 1979:7).

Within the prairies and woodlands of northwest Iowa, Oneota groups would find an abundance of edible plants, nuts and acorns from trees, and fruits and berries that flowered throughout the year (Table 3.1). This would allow the Oneota groups to gather a variety of food resources throughout the year, and to store certain types of seeds, grains, and dried fruits to be eaten at later times. In addition to being eaten, many species of plants were also used for medicinal purposes, and various parts could be used to make fibers as well as being used to make tools for everyday use.

Trees are confined mainly to the major drainages of northwest Iowa and are located on bottomlands and sideslopes extending up the valley walls and on to the margin of the uplands. Different associations of tree species will be present depending upon the location. Along bottomlands within the Little Sioux Valley, species such as willow (*Salix sp.*), elm (*Ulmus sp.*), and eastern cottonwood (*Populus sp.*) are the prevalent trees (Harvey 1979:11; Van Der Linden and Farrar 1984). Trees found along the slopes of the Little Sioux Valley and adjacent uplands include trees consisting of oak (*Quercus sp.*), walnut (*Juglans sp.*), and hickory (*Carya sp.*) (Harvey 1979:11; Van Der Linden and Farrar 1984). The latter are hardwood trees, and would have been useful in the construction of houses and other structures due to their durability and strength. Other uses would have included handles for tools, shafts for arrows, and fuel for fire.

These two habitats of woodlands and prairie were home to a variety of animal species. Further, the addition of the Little Sioux River would also make available aquatic animal resources to the Oneota. Within the Little Sioux Valley, there would be the potential for an ecotone between upland prairie and gallery forest, and an ecotone of bottomland prairie and forest.

In the uplands, bison would have been available and historically were found to be concentrated most within northwest and north central Iowa (Dinsmore 1994:12). These large herd animals would have provided ample meat and hides for clothing and other uses in addition to using bison scapulae for farming implements. Large numbers of these animals were apparently in northwest Iowa even up through the time Euro-Americans began to arrive in the area. Dinsmore (1994:13) recounts a sighting of a herd of 5,000 bison in Clay County in 1820. Potentially in prehistoric and protohistoric times, large numbers of bison would have been available to Oneota groups in the Little Sioux Valley.

Another large game animal that populated the uplands of northwest Iowa were elk. Although not as numerous as bison were, elk would be a welcome addition to the supplement the diet of Oneota people. The opportune time to hunt for elk would be during the winter season, as elk would congregate into large herds in the winter (Dinsmore 1994:25). Also during winter, they would seek shelter within the forests of river valleys to stay out of winter winds. This would possibly bring them into close proximity to Oneota villages or winter base camps within the Little Sioux Valley. During spring and summer elk would often be found alone roaming the prairies. Elk would provide meat, hides, and bone for potential uses.

The last large game animal that would have been of importance to Oneota people in northwest Iowa was white-tailed deer. Large numbers of these animals were found all over the state. While they were most abundant in eastern and southern Iowa, many could be found in the prairie regions of northern and western Iowa and the large majority of deer resided within wooded areas of river valleys (Dinsmore 1994:34; Harvey 1979:13). Deer are browsers and could be found within the wooded areas themselves, or along ecotones where forest and prairie would meet, to vary their diets (Buxton 1951). Deer would be hunted for their meat in addition to their hides for clothing and other uses such as pouches or carrying

Table 3.1. Domesticated and Wild Plants and Trees Potentially Used in Northwest Iowa¹.

Scientific name	Common name	Used parts	Aboriginal uses
Cultivated plants			
<i>Chenopodium berlandieri</i>	Goosefoot	Seeds, leaves	Food
<i>Curcubita pepo</i>	Squash	Seeds, flesh	Food
<i>Helianthus annuus</i>	Sunflower	Seeds	Food
<i>Hordeum pusillum</i>	Little Barley	Grains	Food
<i>Iva annua</i>	Marshelder	Seeds	Food
<i>Pharlaris caroliniana</i>	Maygrass	Seeds	Food
<i>Pharlaris arvinaceae</i>	Reed canary-grass	Seeds	Food
<i>Polygonum erectum</i>	Erect knotweed	Seeds	Food
<i>Zea mays</i>	Corn	Kernels	Food
Wild plants			
<i>Acer saccharum</i>	Sugar maple	Sap	Adhesive
<i>Acer saccharinum</i>	Silver maple	Sap	Adhesive, medicine
<i>Acer negundo</i>	Box elder	Sap	Adhesive
<i>Allium candense</i>	Wild onion	Bulbs	Food
<i>Allium tricoccum</i>	Wild leek	Bulbs	Food, medicine
<i>Amaranthus spp.</i>	Pigweed	Seeds	Food
<i>Amphicarpa brateata</i>	Hog peanut	Beans	Food, medicine
<i>Apios americana</i>	Rosary root	Tubers	Food
<i>Aralia racemosa</i>	Spikenard	Tips	Food, medicine
<i>Arisaema triphyllum</i>	Indian turnip	Tubers	Food, medicine
<i>Asclepias syriaca</i>	Milkweed	Shoots, greens	Food, fiber, medicine
<i>Asclepias tuberosa</i>	Butterfly weed	Shoots	Medicine
<i>Betula lutea</i>	Yellow birch	Sap	Adhesive, medicine
<i>Caltha palustris</i>	Marsh marigold	Greens	Food, medicine
<i>Carya cordiformis</i>	Swamp hickory	Nuts	Food
<i>Carya ovata</i>	Shagbark hickory	Cambium, nuts	Food, goods
<i>Celastrus scandens</i>	Climbing bittersweet	Cambium	Food, medicine
<i>Celtis occidentalis</i>	Hackberry	Seeds	Medicine
<i>Chenopodium spp.</i>	Goosefoot	Greens, seeds	Food
<i>Claytonia virginica</i>	Spring beauty	Tubers	Food
<i>Corylus americana</i>	Hazelnut	Nuts	Food, dye, medicine
<i>Dentaria laciniata</i>	Pepperroot	Tubers	Food
<i>Fagus grandifolia</i>	Beech	Nuts	Food, medicine, goods
<i>Fragaria virginiana</i>	Wild strawberry	Fruit	Food, medicine
<i>Fraxinus pennsylvanica</i>	Red ash	Cambium	Goods, medicine
<i>Gaylussacia baccata</i>	Black huckleberry	Berries	Food
<i>Juglans nigra</i>	Black walnut	Nuts	Food, dye
<i>Nelumbo lutea</i>	Water chinquapin	Seeds	Food

Table 3.1. (Continued)

Scientific name	Common name	Used parts	Aboriginal uses
<i>Nuphar advena</i>	Yellow pond lily	Tubers	Food, medicine
<i>Osmunda cinnamomea</i>	Cinnamon fern	Heads	Food
<i>Parmelia physodes</i>	Puffed shield lichen	Plant	Various
<i>Phaseolus vulgaris</i>	Garden bean	Beans	Food
<i>Physalis americana</i>	Ground cherry	Fruit	Food
<i>Podophyllum peltatum</i>	May apple	Fruit	Food
<i>Polygonatum spp.</i>	Solomon's seal	Rhizomes	Medicine
<i>Prunus americana</i>	Wild plum	Fruit	Food, medicine
<i>Prunus serotina</i>	Black cherry	Berries	Food, medicine
<i>Prunus virginiana</i>	Chokecherry	Berries	Food, medicine
<i>Pteridium aquilinum</i>	Bracken fern	Sprouts	Food, medicine
<i>Pyrus coronaria</i>	Crab apple	Fruit	Food
<i>Pyrus melanocarpa</i>	Black chokecherry	Berries	Food, medicine
<i>Quercus alba</i>	White oak	Acorns	Food, medicine
<i>Quercus macrocarpa</i>	Burr oak	Acorns	Food, dye, medicine
<i>Quercus rubra</i>	Red oak	Acorns	Food, dye, medicine
<i>Quercus velutina</i>	Black oak	Acorns	Food, dye, medicine
<i>Rubus occidentalis</i>	Black raspberry	Berries	Food, medicine
<i>Sambucus canadensis</i>	Common elder	Berries	Food, medicine
<i>Scirpus validus</i>	Great bulrush	Tubers, stems	Food, cordage
<i>Smilacina racemosa</i>	False solomon's seal	Berries	Food, medicine
<i>Tilia americana</i>	Basswood	Cambium, bark	Fiber, goods
<i>Ulmus rubra</i>	Red elm	Cambium, bark	Fiber, medicine
<i>Vaccinium corymbosum</i>	Highbush blueberry	Berries	Food
<i>Vaccinium vacillans</i>	Dryland blueberry	Berries	Food
<i>Ziziana aquatica</i>	Wild rice	Seeds	Food

[†] Plant data from Asch and Green 1992; Fishel 1999; Smith 1923, 1928, 1932, 1933; Will and Hyde 1917; Yamell 1970.

sacks (Lowie 1954:5). Further, deer jaws could be utilized to make deer jaw sickles to aid in the cultivation of crops.

Besides the large game animals, smaller animals would have been utilized as well. Rabbits, squirrels, skunks, beaver, gophers, groundhogs, mice were available in the forests and uplands along the Little Sioux Valley and are reported from archaeological sites (Table 3.2) (Harvey 1979; Fishel 1999; Tiffany and Anderson 1993).

Table 3.2. List of Animals Found in Northwest Iowa¹.

Scientific Name	Common Name
Mammals	
<i>Bison bison</i>	bison
<i>Blarina brevicauda</i>	short tail shrew
<i>Canis familiaris</i>	dog
<i>Canis latrans</i>	coyote
<i>Canis lupus</i>	gray wolf
<i>Castor canadensis</i>	beaver
<i>Cervus canadensis</i>	elk
<i>Cervus elaphus</i>	elk or wapiti
<i>Clethrionomys gapperi</i>	boreal red-back vole
<i>Erethizon dorsatum</i>	porcupine
<i>Felis concolor</i>	mountain lion
<i>Geomys bursarius</i>	plains pocket gopher
<i>Lutra canadensis</i>	river otter
<i>Mephitis mephitis</i>	skunk
<i>Microtus ochrogaster</i>	prairie vole
<i>Microtus pennsylvanicus</i>	meadow vole
<i>Mustela vison</i>	mink
<i>Odocoileus virginianus</i>	white tail deer
<i>Odocoileus sp.</i>	deer
<i>Ondatra zibethicus</i>	muskrat
<i>Peromyscus maniculatus</i>	deer mouse
<i>Procyon lotor</i>	raccoon
<i>Rattus sp.</i>	Old World rat
<i>Scalopus aquaticus</i>	Eastern mole
<i>Spermophilus franklinii</i>	Franklin's ground squirrel
<i>Spermophilus tridecemlineatus</i>	thirteen-lined ground squirrel
<i>Sus scrofa</i>	pig
<i>Sylvilagus sp.</i>	rabbit
<i>Tamias striatus</i>	eastern chipmunk
<i>Tamiasciurus hudsonicus</i>	red squirrel
<i>Taxidea taxus</i>	badger
<i>Urocyon cinereoargenteus</i>	gray fox
<i>Vulpes vulpes</i>	fox
<i>Zapus hudsonius</i>	meadow jumping mouse

Table 3.2. (Continued)

Scientific Name	Common Name
Fish	
<i>Amia clava</i>	bowfin
<i>Aplodinotus grunniens</i>	freshwater drum
<i>Esox sp.</i>	muskie
<i>Ictalurus sp.</i>	catfish
<i>Ictiobus sp.</i>	buffalo fish
Birds	
<i>Anas sp.</i>	green or blue winged teal
<i>Anseriformes sp.</i>	
<i>Butoridas virescens</i>	
<i>cf. Anatidae sp.</i>	
<i>cf. Icterinae sp.</i>	
<i>Fulica americana</i>	American coot
<i>Tetraoninae sp.</i>	
Reptiles	
<i>Chelydra serpentina</i>	snapping turtle
<i>Chrysemys picta cf. belli</i>	western painted turtle

¹ Faunal data from Fishel 1999; Harvey 1979; Tiffany and Anderson 1993; Titcomb 2000.

would also be available to take within the Little Sioux Valley as well. Species of hawk, geese, and ducks would be plentiful during specific times of the year (Baerreis et al. 1970). In addition, Harvey (1979:13) states that the Little Sioux Valley is along the Mississippi Flyway so during seasonal migrations of birds, large numbers of them would be available. Bird feathers and bird bone were used as ceremonial items for Oneota people (Harvey 1979; Fishel 1999).

Finally, aquatic animals could be taken within the Little Sioux River, its tributaries, and upland lakes. Species including reptiles, fish, and mussels could be used for meat to supplement the diet. In addition, mussel shells could be used for spoons or their shells could be ground up to be used for tempering in pottery and for ornaments such as beads (Harvey 1979; Fishel 1999; Titcomb 2000).

Within the valley there is a great diversity of both plant and animal life. Many of these would have been useful to the Oneota in northwest Iowa in a number of ways. Plants could be used for food as well as cordage, and be utilized for medicinal purposes. Animals would have provided meat, hides, and bone. The large game animals, particularly bison, would need the cooperation of many people for hunting and during specific times of the year to maximize their chances for success as well as having enough manpower to bring the kills back.

Oneota in Northwest Iowa

The Oneota tradition in northwest Iowa represents an occupation that spans over four hundred years. The earliest sites within northwest Iowa have dates putting initial occupation of the area in the middle to late fourteenth century (Boszhardt et al. 1995), while later occupations spanned possibly into the middle eighteenth century. Whether or not there was a continuous occupation of the region by the same group or multiple reoccupations by different groups is unclear at this time (Fishel 1999).

Oneota sites within northwest Iowa cluster along the Little Sioux Valley in three distinct geographic localities, and one much larger protohistoric site resides along the Big Sioux River in extreme northwest Iowa (Figure 3.3). These sites all vary in age, and become more recent as one moves farther north up the Little Sioux Valley. The oldest Oneota village sites within northwest Iowa cluster around the towns of Correctionville and Anthon, and are the Dixon site (13WD8), the Correctionville site (13WD6), and the Gothier site (13WD3) in addition to a burial site (13WD10) (Fishel 1999; Harvey 1979; Henning 1961). Further north up the Little Sioux Valley by the town of Cherokee lies the Bastian site (13CK28) (Tiffany 1979b). This site is unique in a couple of ways that will be discussed later. Finally, the last group of Oneota sites in northwest Iowa resides along a stretch of

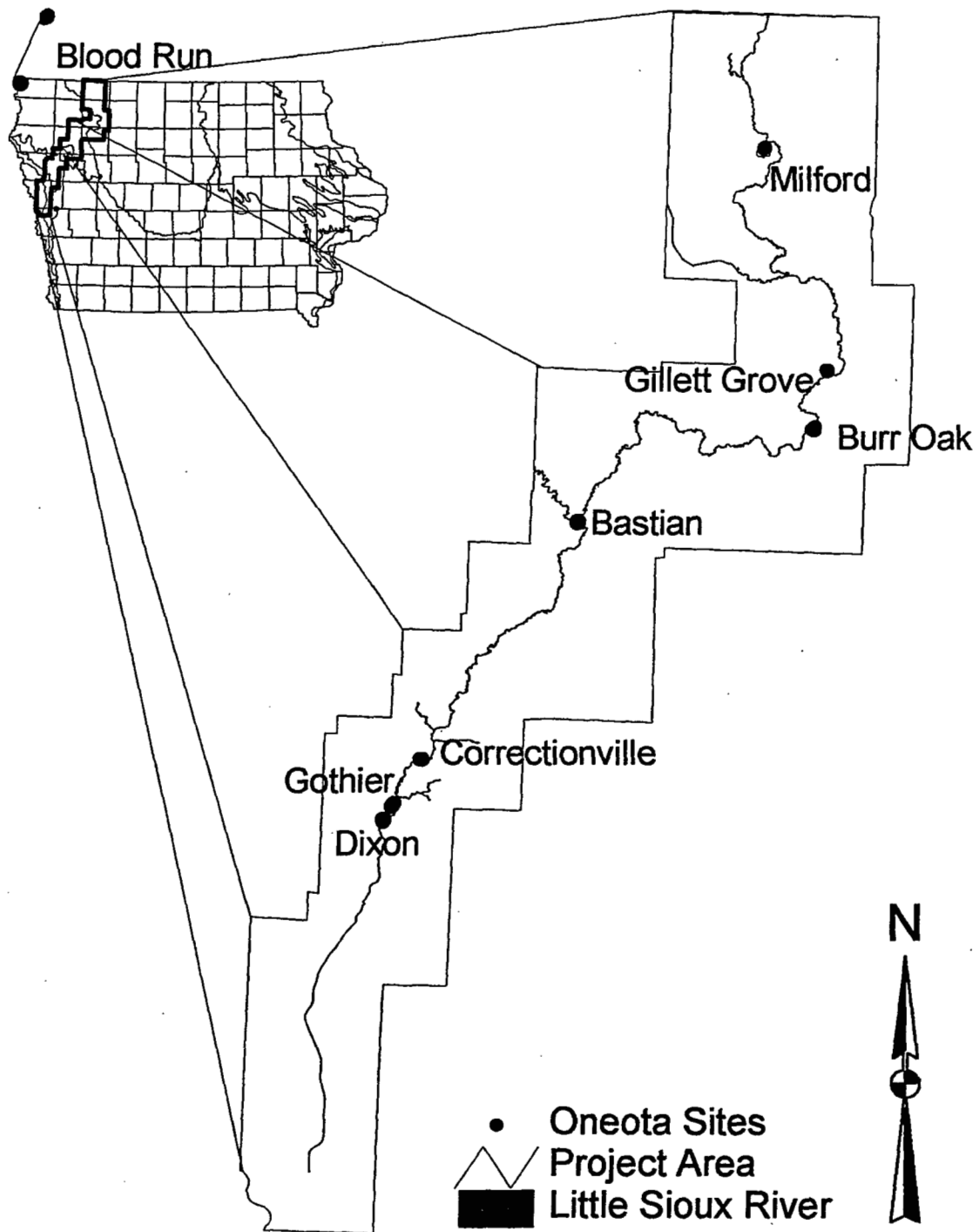


Figure 3.3. Map of the Study Area Showing Oneota Site Locations in the Little Sioux Valley.

land from the town of Gillett Grove to the town of Milford. These sites include the Burr Oak/Harriman site (13CY1), the Gillett Grove site (13CY2), and the Milford site (13DK1) (Henning 1961; Tiffany 1996; Tiffany and Anderson 1993; Titcomb 2000). Included with these sites is the Blood Run site (13LO2), located in extreme northwest Iowa in Lyon County, Iowa and in Lincoln County, South Dakota (Harvey 1979; Lueck et al. 1995). The Kirchner site (13CY14) is also listed as an Oneota habitation site, but not enough conclusive evidence has been recovered from the site to confirm an Oneota occupation. In addition to these sites, there are a number of other sites scattered throughout northwest Iowa that may have a probable Oneota component. Fishel (1999:120) lists an additional thirteen sites within Buena Vista, Crawford, Clay, Lyon, Plymouth, and Pocahontas Counties.

Taxonomy for the Oneota tradition in northwest Iowa consists of three defined phases (Willey and Phillips 1958), and are termed the Correctionville phase, the Cherokee phase, and the Iowa Lakes phase (Fishel 1999; Henning 1961). The Correctionville phase is limited to the group of Oneota sites in the Correctionville locality. The Iowa Lakes phase has been provisionally assigned to the sites within the northern part of the Little Sioux Valley and includes Burr Oak (13CY1), Gillett Grove (13CY2), and Milford (13DK1) (Fishel 1999:125). Finally Fishel (1999:124) also designates the Bastian locality and the Cherokee phase, although only Bastian (13CK28) and three smaller sites are within the area. No discussion of the smaller sites in relation to Bastian (13CK28) has been done to determine what diagnostic materials are present to include them in the Cherokee phase. The majority of artifacts from the Cherokee phase have been recovered from surface collections with no excavations taking place at these sites except for Bastian (13CK28) (Tiffany 1979b). The Blood Run site (13LO2) is not included in any phase. The following is a brief description of each of the phases in the study area for this thesis, and a detailed description of each site.

Included are data on previous excavations, materials recovered, local environment, and temporal placement of the sites in relation to one another.

The Correctionville Phase (1375-1500 AD)

The Correctionville phase was first delineated by Dale Henning (1961) as the Correctionville-Blue Earth phase, and is based upon the decorative styles applied to ceramic vessels in addition to location and radiocarbon dates. In its initial terminology, the Correctionville phase was known as the Correctionville-Blue Earth phase due to the striking similarities in pottery styles (Henning 1961; 1970). The Blue Earth materials come from Oneota sites located along the Blue Earth River located in southern Minnesota, and include the Humphrey and Vosberg sites (Henning 1970:152). Other sites that reflect similarities in ceramic styles to Correctionville phase Oneota sites also include sites in southeast Wisconsin, Nebraska, Missouri, and central and southeast Iowa (Boszhardt 1994; Henning 1970).

The major obstacle to the designation of the Correctionville-Blue Earth phase was its extremely large geographic range. The distance between the Correctionville and Blue Earth areas stretches for over 200 km (Fishel 1999:120). This large geographic expanse violates the definition set forth by Willey and Phillips (1958:22) for what constitutes a phase. Further, radiocarbon dates from selected Oneota sites in the Blue Earth locality are slightly earlier than Oneota sites in northwest Iowa (Boszhardt et al. 1995; Fishel 1999; Gibbon 1983).

The defining feature of the Correctionville phase is the ceramics associated with it. The ceramics are known as Correctionville Trilled and exhibit a variety of attributes that distinguish them from other Oneota ceramics that occur later in time. Correctionville Trilled pottery has as the dominant decorative element trilled lines, which are applied vertically, horizontally, or at acute angles on the vessels. Commonly, the trilled lines create a chevron-like motif that encircles the pot. In addition, punctates are also present on ceramic

vessels, with the punctates used as borders around the trailed lines. Decoration occurs on the lips of some vessels, and includes notching on the inner lip and trailing on the lip interior. Strap handles, found on some vessels, are attached at the lip, and are decorated with parallel lines, punctates, or a combination of the two. Decoration composed of nested chevrons is limited to the upper part of the vessel, primarily between the neck and upper shoulder (Fishel 1999; Harvey 1979; Henning 1961). These decorative elements are on ceramics at Oneota sites of the same age in other parts of Iowa as well, including central Iowa and southeast Iowa (Gradwohl 1974; Osborn 1982; Tiffany 1979a, 1997).

The Oneota sites included within the Correctionville phase include the Gothier (13WD3), Correctionville (13WD6), and Dixon (13WD8) village sites and the Anthon (13WD10) burial site. The site descriptions will follow an order determined by probable date of occupation from earliest to latest. The Anthon burial site will be excluded from the following site analyses since it is not a habitation site, but probably is associated with either Dixon (13WD8) or Gothier (13WD3).

Dixon (13WD8)

The Dixon village site (13WD8) is located along the east bank of the Little Sioux River, T87N-R43W within sections 7, 8, 17, and 18 with a large majority of the site in section 17. The size of the Dixon site is estimated to be 23.03 hectares (56.9 acres). The site most likely sits upon the T5 terrace defined by Hoyer (1980), although this is hard to determine due to the fact that terraces T3-T5 all merge into one another in this reach of the valley (Hoyer 1980; Van Nest 1999). What is important, however, is that the site sits high enough up from the current floodplain of the Little Sioux River that it has not been inundated by any recent flooding events, including the summer floods of 1993. Presumably Dixon has not been affected in the past by any major flood events either; if it had, the period of inundation was short enough to not leave sizable alluvial deposits on the site (Fishel 1999:21).

Currently a large portion of the site is in cultivation and the Little Sioux River cuts through the western portion of the site due to channel straightening of the Little Sioux River (Fishel 1999).

The Dixon site has been the subject of two major archaeological investigations. The first excavations were conducted in 1964 by Amy Harvey (1979) as part of her dissertation research. The second series of excavations were done in 1994 and supervised by Richard L. Fishel (1995) to assess damage to the site by the flood of 1993 and to conduct salvage operations along the eroded cutbank of the site. Each of these excavations revealed large numbers of storage and refuse pits, extensive quantities of artifacts, and numerous other features such as postmolds and houses. In addition the site has been collected for many years by local collectors, whose collections have been analyzed by researchers (Fishel 1999; Henning 1961).

The excavations done in 1964 concentrated on a large feature designated a house structure. The outline of the postmolds suggests that the structure may have been similar to a longhouse (Harvey 1979:109). Multiple features inside and around the immediate vicinity of the house structure yielded large quantities of material. Stone tools consisted of triangular projectile points, endscrapers, bifaces, knives, and manos and metates (Harvey 1979:80). Interestingly, the proportion of projectile points to endscrapers was nearly two to one in favor of endscrapers. In addition, a sizable quantity of bison, deer, and elk bone indicated the faunal preferences of the inhabitants of the Dixon village site. A diverse assemblage of bone tools was also recovered. The assemblage includes bison scapula hoes, bone fishhooks, bison scapula knives, and bone awls (Harvey 1979:88-89).

The ceramic assemblage included elements representative of Correctionville Trilled pottery. Groups of parallel lines arranged around the pot to produce the distinctive chevron motif along with punctates used as borders around the trailed lines were a common feature.

Some of the lips had interior decoration on them consisting of tool impressions around the orifice of the vessel. Strap handles were present with decoration of vertical lines or punctates or both. All of the handles were noted to be attached at the lip, and not below it (Harvey 1979:95-101).

The 1994 excavation concentrated on the bank of the Little Sioux River. Work consisted of the excavation of forty-four observable features eroding out along the bank. The excavations led by Fishel produced three new structures that were rectangular or ovoid in shape. Enormous quantities of material were recovered, including over 10,000 pottery sherds from the excavations (Fishel 1999:64). The ceramics recovered were very similar to those recovered by Harvey (1979) and others examined by Henning (1961). Rim height averages for both Harvey and Fishel came out to be close to twenty-five millimeters. Decoration was confined between the lip and shoulder of the vessels and consisted of parallel lines, chevron motifs, and punctates as borders. Strap and loop handles were present with various combinations of trailed lines and rows of punctates for decoration (Fishel 1999). Fishel (1999:73, 76), however, did note two distinctions concerning the ceramic assemblage. The first was that decoration on vessels seemed to increase, and second, twenty percent of the appendages were of the loop variety. Typical Oneota material culture was recovered including stone, bone, and groundstone tools similar to material recovered by Harvey.

The radiocarbon dates obtained for the site included twelve taken by Harvey and eleven taken by Fishel. Harvey's initial dates ranged from AD 974 – 1598, while Fishel's dates ranged from AD 1280 – 1470. Fishel (1999:50) combined the weighted average of the twenty-three calibrated dates using a five decal floating average and came up with a likely occupation date between AD 1300 – 1440. This occupation is younger than what

Harvey initially postulated, however the Dixon village site remains as the earliest known Oneota site in northwest Iowa.

Site inspection by the author in the summer of 1999 was done to become familiar with the area and to test for specific soil types within the site boundaries. The site was planted in beans at the time, and as a consequence, visibility was limited. However, surface inspection revealed ceramics, flakes and waste debris, and animal bone on the surface of the site. Along the cutbank of the Little Sioux River, artifacts were observed to be eroding out, and ceramics and bone were observed. No features were found, although lack of rain in the area for a number of days may have hindered the location of features. The soil profiles will be discussed in a later chapter concerning environmental site modeling.

No stands of timber occur in the immediate vicinity of the site, although a stand of trees is present on the eastern valley wall north and east of the site. In addition, a large continuous stand of trees occurs along the western valley wall and follows the previous channel of the Little Sioux River before its current channelization. The width of the Little Sioux Valley is approximately 1,900 meters west to east through the Dixon site. A small wetland exists south and west of the site along the previous river channel. The majority of the areas surrounding the Dixon site are in cultivation. Any areas not in crops appear to be either fallow fields or fields used for pasture.

Gothier (13WD3)

The Gothier village site is located approximately two kilometers north of the Dixon village site (13WD8) along the Little Sioux River. Harvey (1979:1983) describes the Gothier site as sitting on a cultivated lower terrace of the Little Sioux River, which may have been subject to period flooding in the past. Further, a raised, midden-like feature was observed, but no excavations have ever been conducted at the site. Its importance to the prehistory of

the Oneota is almost completely unknown. Unfortunately, excavations may never commence at the Gothier site due to modern land use.

Little is known about the Gothier village site. Harvey (1979:183-184) mentions the site and describes some of the artifacts found by local collectors. Henning (1970:153) mentions the Gothier site in passing with regard to settlement location, but no other information is given. Fishel (1999:123) also talks about the site in relation to temporal chronology of the Correctionville phase. Like Dixon (13WD8), Gothier has a greater proportion of endscrapers to projectile points. Groundstone tools were also found such as celts and axes. No bone material was found in any of the private collections. One of the important things that Harvey (1979:184) describes is the presence of catlinite disc pipes at Gothier. The appearance of these pipes has been mentioned by other researchers, and may be useful as a horizon marker for Oneota culture (Tiffany 1997). Fishel (1999:123) suggests that the occupation of Gothier was partly contemporaneous with Dixon (13WD8), but that the occupation of Gothier extended beyond the Dixon occupation due to its geographic location in addition to the appearance of catlinite disc pipes.

Ceramics were described by Harvey (1979:184) and appear to be very similar to those found at the Dixon site (13WD8). Rim heights were almost identical to those found at Dixon (25mm) with nested chevrons and punctates found as borders around the parallel lines (Harvey 1979; Fishel 1999). Handles attached at the lip were also recovered.

Harvey (1979:183) mentions the site was in cultivation at the time her research was ongoing at Dixon (13WD8). Currently, however, nearly the entire site has been destroyed by gravel operations in process. If any of the site still exists, only a very small portion at the extreme southern end of the site may have escaped the current gravel quarrying operations. The author did notice small depressions in the ground, but it is unclear whether or not they

would be associated with any cultural features without excavation. No artifacts were found on the ground or recovered as a result of soil profiling.

Currently the Little Sioux River is approximately 550 meters east of the site. From USGS topographic maps, the river may have been closer to the site in prehistoric times. In addition, the landform on which the site sits upon appears to be finger stretching out onto the floodplain; a previously used river channel appears on the topographic map to the west of the site or it may have been an area where backwaters collected. The Little Sioux Valley in this area is wide, almost 2,400 meters across from west to east. Timber is scarce around Gothier, with some stands north of the site on the floodplain right along the Little Sioux River and stands of timber occurring sporadically along the valley walls leading to the uplands.

Correctionville (13WD6)

The Correctionville village site was at one time thought to be two distinct villages (13WD6 and 13WD7). Harvey (1979:184) postulated that if these were indeed two separate sites, 13WD7 was probably occupied at a later date. Currently the two sites have been subsumed into one number and are now designated simply as 13WD6.

The Correctionville village site sits upon a terrace remnant of the Little Sioux River, and is approximately twenty-five feet above the river (Henning 1961:10). However, based upon the work of Hoyer (1980), it appears that the Correctionville site may rest upon a T3 terrace remnant due to its elevation of 1,140 feet. The estimated size of the Correctionville site is thought to be approximately twenty hectares (50 acres).

The site was discovered shortly after gravel quarrying operations began in the late 1950s, and as much material as possible was recovered by the Northwest Chapter of the Iowa Archeological Society while the site was essentially stripped off the land (Henning 1961:10). The salvage operation recorded twenty-seven cache pits within the quarry area and one more outside the immediate vicinity. Nearly all of the material recovered came from

these cache pits (Henning 1961). Materials recovered included projectile points and groundstone tools, bone tools, faunal remains, ceramics, and catlinite disk pipes. Fishel (1999:123) has noted the striking increase in the frequency of catlinite disc pipes found at Correctionville versus Dixon (13WD8) and Gothier (13WD3). This possible horizon marker would then postdate the occupation of the Correctionville site some time after Dixon and Gothier were inhabited.

The ceramic artifacts recovered from this locale gave rise to the name of pottery style found in the Correctionville locality. Henning (1961) analyzed the pottery sherds, totaling 3,901 in all, and the overwhelming majority of them (98.6%) were shell tempered. The remaining potsherds were grit tempered. Three categories of distinct design motifs were noted on the pottery found at Correctionville: opposed diagonals, vertical lines, and chevrons (Harvey 1979:185; Henning 1961). Fishel (1999:123) notes that the chevron motif increases significantly in the Correctionville ceramic assemblage; over fifty-seven percent of the ceramics observed by Fishel incorporated this design motif, while Henning's original analysis of Correctionville material showed that thirty-seven percent of the decorated sherds exhibited the chevron motif (Henning 1961:14). Additionally the lips of the vessels were also decorated with tool impressions or vertical trailed lines, and the lips were predominantly rounded (Henning 1961:11). This was also found to be the case with rimsherds recovered at the Dixon (13WD8) (Fishel 1999:69).

The author visited the site in the summer of 1999 and observed that gravel operations were still ongoing at the site; in all likelihood, the chances for any sizable portion of the site to be still intact is extremely remote. Two more gravel pits exist in the vicinity, one due north of Correctionville and another north and east of Correctionville. The extreme western edge of the site appears to be untouched, and at the time of my visit was in cultivation. No diagnostic Oneota artifacts were observed, although some flakes were

discovered on the ground. No soil profiling was done at the Correctionville site due to the planted corn. There are few trees within the immediate vicinity of the site, although sizable stands of timber do occur to the north and west of the site and on the opposite bank of the Little Sioux River on the floodplain and low terrace. In addition, the slopes on the eastern valley wall are also covered by stands of timber. Small shrubs exist in clumps along the cutbank and the vegetation to the south of the site on the east bank consists of grasses.

The Cherokee Phase (1450-1500 AD)

The Cherokee phase has been defined by Fishel (1999) and includes the Bastian site (13CK28). In addition, three other sites (13CK55, 13CK81, and 13CK86) are also included within the Cherokee phase, and are in close proximity to Bastian (13CK28). These sites are near the confluence of Mill Creek with the Little Sioux River. What separates the Cherokee phase from the earlier Correctionville phase are characteristics based upon the artifact assemblage. An argument concerning the settlement patterns as another characteristic of the Cherokee phase can also be made.

The artifact assemblage from the Cherokee phase is nearly identical to the sites found in the Correctionville phase with a few notable exceptions. Stone tools represent a range of implements from projectile points, endscrapers, bifaces, manos, metates, and abraders (Harvey 1979; Tiffany 1979b). With regard to endscrapers, however, there is a significant difference. The proportion of endscrapers to projectile points is much higher in this locality than from the Oneota sites farther south (Fishel 1999:124). Examination of the Sanford Museum collection of Oneota artifacts from the Bastian site reflects a ratio of more than five to one in favor of endscrapers (eighty-four endscrapers to sixteen projectile points) (Tiffany 1979b:25). In addition, the discovery of large amounts of catlinite also is another departure from the artifact assemblage found at Correctionville phase sites. The catlinite recovered from the Bastian site is found in worked forms reflecting pipes, small pieces with

cutmarks and striations on them. In addition, Nestor Stiles found a series of catlinite tablets in the 1920s showing a variety of engravings reminiscent of Southern Cult motifs representing the forked eye, maces, and arrows (Bray 1963; Harvey 1979:186). Bone tools are also present, with the majority of them being bison scapula hoes and antler tools (Harvey 1979:187).

Ceramics from the Cherokee phase are also unique in that there appears to be a blend of ceramic traits from both the earlier Correctionville phase and from the later Orr phase. As a consequence Henning (1970:153) has remarked the Bastian site may reflect a period of transition of ceramic decoration in favor of styles like those found on Orr phase Allamakee Trilled ceramics. Correctionville phase decoration is still present with chevron designs, but these are extremely rare, as is the practice of using punctates (Fishel 1999). Lip decoration still occurs, with notching the most common decorative element, and nearly all of the rimsherds found have decoration on them (Fishel 1979; Harvey 1979). However, the ceramic sample is considerably smaller from Bastian than Correctionville phase sites and this may have had an effect on the interpretation of the ceramic assemblage at Bastian. Handles are present on Cherokee phase ceramics, the dominant type being the strap variety and being attached at the lip (Harvey 1979; Fishel 1999). If then, the Cherokee phase represents a transition from Correctionville Trilled to Allamakee Trilled ceramics, the transition was just beginning during the occupation of the Bastian site, provided the ceramics found to date are a representative sample of what is actually at the site.

Bastian (13CK28)

The Bastian site is the type site for the Cherokee phase (Fishel 1999). The site rests upon a terrace remnant of the Little Sioux River. Based upon terrace designations from Hoyer (1980) for this reach of the Little Sioux Valley, the site appears to rest on the T4 terrace, as well as a possible T3 terrace remnant. The height of the terrace relative to the

current Little Sioux River floodplain is quite dramatic, and creates a distinctive boundary. Additionally, this is the area along the Little Sioux Valley where the southern and older drainage basin merges with the younger, northern drainage basin.

The Bastian site has seen only one archaeological survey since the site was discovered (Tiffany 1979b). The survey was done to assess the potential impact that a housing development would have on the integrity of the site (Tiffany 1979b:5, 8). The site has been farmed for many decades, and a small gravel quarry was opened on the site's southwestern edge and subsequently refilled. The site extends from the valley wall of Mill Creek to the far eastern edge of the terrace right before it abruptly drops off to the floodplain of the Little Sioux River. The site was discovered during the construction of the now defunct railroad line in the western half of the site. Since then development activities throughout the years have affected Bastian; numerous houses on the eastern edge of the terrace have all but destroyed this portion of the site. In addition a north-south county road cuts down through the western half of the site. The main portion of the site has mainly been affected by farming. Further, burials have been reported from the residential development of the east side of the Bastian site (Tiffany 1999, personal communication). One portion of the site that lies under the confines of a junkyard has been undisturbed by extensive development.

The artifact assemblage has already been discussed under the description of the Cherokee phase, and will not be reiterated here. What the site may be is not one large site, but an area intermittently occupied over many years as Oneota groups left and returned to this area (Fishel 1999; Tiffany 1979b:22). Thus, the Bastian site represents a possible multicomponent Oneota habitation site. However the degree to which certain areas were used before or later may never be known due to the turbation of the soil from farming and development activities. The smaller Oneota sites found outside the immediate vicinity of Bastian may be smaller hamlets or households (Tiffany 1979b).

The site is dated to approximately 1480 AD with a single calibrated radiocarbon date. Originally it was assumed that the Bastian site was occupied much later than the Correctionville sites (Harvey 1979). However, based upon the new date, Fishel (1999:125) contends that the Bastian site occupation, during its initial settlement, was partly contemporaneous with the occupation of the Correctionville sites.

The author visited the site in the summer of 1999 to survey the site and note general landform and soil characteristics. The survey discovered two artifact concentrations in a small, cultivated field north of the Russell Paeper residence. The main site area, in a plowed field was the primary area for soil profiling, and will be discussed in the environmental modeling section of this thesis. Artifacts noted within the area include flakes, groundstone tools, and deer jaws. Catlinite fragments were also found scattered throughout the site, but the majority of them occurred in the northern half of the site. The eastern portion of the site east of the roadway was mainly in residences and lawns. Any remaining areas were in pasture. Interviews with local residents corroborate Tiffany's findings (1979b) with regard to the artifacts found at the site. In addition, Michael Urban, local landowner of the large plowed portion of the site related an account of a young boy discovering an intact catlinite pipe off the roadway during regrading operations.

The area has a broad mixture of plant diversity. Floodplain areas have stands of trees and prairie grasses. In addition a sizable stand of timber exists on the east bank of the Little Sioux River that extends almost down to the town of Cherokee. Timber is also present along the Mill Creek Valley immediately west of the western boundary of the Bastian site. The amount of environmental diversity in the area was quite likely extensive during prehistoric times, and may have been one of the main reasons the site was settled and subsequently returned to during numerous visits. Faunal remains recovered from the site

reveal bison and white-tailed deer as the most important game animals taken by the inhabitants of the Bastian site (Tiffany 1979b).

The Iowa Lakes Phase (1690-1702 AD)

The Iowa Lakes phase represents the most recent, and last manifestation of the Oneota tradition in northwest Iowa; sites are protohistoric and historic in age. All of the sites affiliated with the Iowa Lakes phase are village sites, located along the bluffs of the Little Sioux Valley, making the name of the phase a curious one. Currently, this is the only landscape position known for Iowa Lakes phase Oneota sites, and if this is the case, it marks another significant departure from the previous settlement pattern of earlier Oneota sites residing on terrace formations within the Little Sioux Valley. The sites affiliated with the Iowa Lakes phase include the Burr Oak site (13CY1), the Gillett Grove site (13CY2), the Kirchner site (13CY14), and the Milford site (13DK1) (Fishel 1999; Henning 1961; Tiffany 1996; Tiffany and Anderson 1993; Titcomb 2000). Another protohistoric site, the Blood Run site (13LO2) will be mentioned on its own as a separate locality due to its isolation from the Iowa Lakes phase sites (Harvey 1979; Lueck et al. 1995).

Subsistence is still based on a pattern of horticulture, wild plant gathering, and large game hunting. Evidence of maize has been found at some sites (Titcomb 2000). Bison was apparently the large game animal of choice, with white-tailed deer following (Tiffany and Anderson 1993:298). Numerous other small game animals such as gophers and voles, reptiles, fish, and birds are also found at these Oneota sites.

The Iowa Lakes phase Oneota sites represent an amalgamation of indigenous traits and European influence. The short time span for this phase suggests rapid cultural modifications as the Oneota adapted to and adopted European technology. Thus, the defining factor of the Iowa Lakes phase is the presence of European artifacts and trade goods found at these late Oneota sites. In addition, the ceramic styles have changed from

the earlier Correctionville Trailed pottery to a ceramic assemblage made up almost exclusively of pottery with shoulder designs consisting of punctate filled chevrons such as those found on Allamakee Trailed pottery in northeast Iowa (Harvey 1979; Henning 1961, 1970; M. Wedel 1959).

European trade goods did not totally replace the indigenous artifact assemblage; rather they were a compliment to the tools used for so many years by the Oneota. Stone tools such as projectile points and endscrapers are still found along with plant processing tools. New artifacts such as metal points and knives, brass kettles, and firearms are some of the additions to the traditional artifact inventory (Tiffany and Anderson 1993; Titcomb 2000). Brass and copper kettles were also modified for other uses such as tinklers used for ornamentation (Titcomb 2000). Other decorative European goods found at these late Oneota sites include glass beads.

The ceramics recovered from the Iowa Lakes Oneota sites are similar to Allamakee Trailed pottery. Allamakee Trailed pottery is a diagnostic marker for Oneota sites of this time period throughout the Prairie Peninsula (Henning 1970; Tiffany 1979; M. Wedel 1959). Decoration consists of notching or tool impressions on the lip; other decorative motifs on the lip are finger impressions, resulting in a "pie crust" appearance (Henning 1961:28; M. Wedel 1959:91-92). Decoration on the shoulders of the vessels consists of groups of parallel lines arranged in horizontal, diagonal, or vertical fashion. Punctates also occur, but in contrast to Correctionville Trailed pottery, punctates are used as fillers between chevrons as opposed to being used as borders (Henning 1961:21; Tiffany and Anderson 1993; M. Wedel 1959:92). Strap handles are present with decoration consisting of trailed lines and punctates sometimes used in combination. Handles for Orr phase ceramics are attached *below* the lip, as opposed to being attached at the lip like Correctionville Trailed (Henning 1961:28; M. Wedel 1959:92). Therefore, handle attachment is another diagnostic marker of

Allamakee Trilled and protohistoric Oneota pottery. Of importance is that the ceramics recovered from Iowa Lakes phase sites are *generally similar* to Allamakee Trilled pottery. The use of Allamakee Trilled pottery should not be used as a diagnostic marker for these sites because as a type it generally shares decorative traits found at many other Oneota sites in Iowa and Wisconsin at this time (Boszhardt 1994; Henning 1961, 1970; Tiffany 1997; M. Wedel 1959). Tiffany and Anderson (1993:303) decline to include these northwest Iowa sites within the Orr phase due to the relatively long span during which Allamakee Trilled pottery was used, as well as citing ethnohistoric records demonstrating that most Orr phase sites can be attributed to historic Native American tribal groups such as Ioway or Oto (Blaine 1979; M. Wedel 1959, 1976, 1981).

Burr Oak (13CY1)

Little is known about the Burr Oak, or Harriman site in northwest Iowa because no archaeological survey or controlled excavations have ever taken place on the site. Henning (1961:32) describes artifacts recovered from the site that include ceramics resembling Allamakee Trilled, and historic artifacts consisting of copper or brass goods, glass beads, and an iron axe. It is apparent, however, even with this small assemblage that Burr Oak dates to the protohistoric or historic period. The land is currently owned and farmed by the Huffman family, who has prohibited collecting from the site since the 1950s.

The site itself sits upon an upland ridge just south of the Little Sioux River and has a commanding view to the north and west. (Henning 1961:32) initially thought that the site sat upon a high terrace, but based upon the work of Hoyer (1980) and USGS topographic maps, the Burr Oak site resides upon an upland landform east of the Little Sioux River. Trees are absent on the northern edge of the ridge, however a large stand of timber is present on the eastern side of the ridge as well as on the bottomlands to the west of Burr Oak. Small stands of timber are also present sporadically along the river channel farther

north and to the south. Presumably, more timber would have been present but were probably removed for farming and settlement in the area. The area below the ridge and the sideslope of the western edge are in pasture and wild grasses. Small marshy areas and oxbow lakes from previous river channels occur on the bottomlands that may have been good areas for acquiring aquatic species and birds.

Interviews with local collectors and subsequent examination of their collections support the ideas set forth by Henning (1961). Conversations with the son of the current landowner, Lou Huffman, recalls as a young boy how he used to find points on the ground and the area was an "Indian reservation" in the past. In addition to the artifacts mentioned by Henning (1961:32), local collectors have found small triangular projectile points, bifaces, trade beads, catlinite pipes, and Jesuit Rings. Local collectors have also mentioned the presence of other Oneota sites within the area along the lower terraces of the Little Sioux River. Inspection of one of these areas by the author in the summer of 1999 did not turn up any artifacts.

It does appear that the site is definitely associated with late precontact/early postcontact Oneota groups, but to what extent is unclear. No radiocarbon dates are available, and until some measure of the actual extent of the site and a temporal period of occupation is determined through controlled archaeological excavations, the Burr Oak site will remain an enigma.

Gillett Grove (13CY2)

The Gillett Grove village site is a postcontact Oneota village approximately five miles due north of Burr Oak (13CY1). The site has been a favorite for local collectors for many decades, and in the last five years has seen continual excavation during the summer as part of an ongoing field school for university undergraduate and graduate students (Titcomb 2000). Gillett Grove has been the subject of investigations from other researchers in the

past, beginning with Charles R. Keyes (Harvey 1979:188-189; Henning 1961:32; Titcomb 2000:55-56). Mounds have been noted within the vicinity of the site, but many have been obliterated due to farming activities. Additionally, a road project was begun along the eastern edge of the site and human burials were observed east of the main habitation area (Titcomb 2000). Currently the site is used for row-crop farming; however, the extreme southern portion of the site has not been farmed for quite some time. It is currently in pasture, and some mound features are visible (Tom Gross 1999, personal communication).

The site contains evidence for prehistoric as well as historic goods. The site is known locally for its prolific abundance of historic articles as well as prehistoric artifacts. Local collectors have amassed enormous collections from Gillett Grove, with the biggest one belonging to Mr. Parker Bargloff of Spencer, Iowa (Titcomb 2000). Artifacts recovered from the site include triangular projectile points, endscrapers, drills, groundstone tools, catlinite pipes and ceramics similar to Allamakee Trilled pottery. Bone tools include bison scapula hoes, antler tines, and even bone beads (Titcomb 2000:105). Historic goods include Jesuit rings, glass trade beads, brass kettle fragments, and iron projectile points and knives. A description of these artifacts is not needed here, as many of the artifacts described have been recently analyzed (Titcomb 2000).

The author has visited and excavated at the site during the 1999 summer field school affiliated with the Iowa Lakeside Laboratory and under the supervision of Dr. Michael Shott from the University of Northern Iowa. Artifacts recovered during the time the author was present at Gillett Grove include prehistoric artifacts such as projectile points and ceramics. Historic artifacts consisted of brass fragments, and glass trade beads. Soil profiling was done at the site to determine major soil types in the area as well as east of the road to determine if a site component was present. However, no artifacts were found in this area.

Gillett Grove sits upon an upland landform a few hundred meters north of the Little Sioux River. The land rises abruptly off of the floodplain, creating a distinct landscape different than the southern reaches of the Little Sioux Valley (Hoyer 1980). Gillett Grove is bordered on its east and west sides by two intermittent drainages that have separated it from the adjacent bluffs. To the north the upland formation spreads out with little topographic relief. The site has a commanding view of the Little Sioux Valley to the south and the west. Trees are absent on the upland landform, although stands of timber occur along the sideslopes and continue up the intermittent drainages in the area. In addition timber is also found on the floodplain of the Little Sioux River. The uplands not in cultivation contain wild grasses and plants and an occasional hardy shrub. Large open areas of grasses extend south from the east bank of the Little Sioux River.

Milford (13DK1)

The Milford site is the final site in the Iowa Lakes phase that has a definite Oneota component associated with it. The site rests upon a high terrace or outwash feature incised around its west, south, and east sides by the Little Sioux River. The site has been known for many years to local collectors who have collected a large assortment of artifacts from the historic period through postcontact Oneota assemblages.

The Milford site has been known to professional archaeologists since the early 1920s when Charles R. Keyes first recorded the site and noted its abundance of artifacts (Tiffany 1981). Since that time, one excavation by The University of Iowa in 1978 (Spargo 1984) and one excavation supervised by Joseph A. Tiffany from Iowa State University for the Iowa Lakeside Laboratory archaeological field school in 2000 have brought new materials to light concerning the occupation at Milford. In addition to these formal excavations, research has been done on the local site environment and additional research on the Milford ceramic and

stone assemblages, and European trade goods based on Spargo's excavations (D. Anderson 1994; Tiffany 1996; Tiffany and Anderson 1993).

The settlement patterns of Iowa Lakes phase Oneota sites is problematic because of the nature and materials used in the house structures and subsequent modification of the land by farming and development. The Milford site may have had the best chance to fill in some of the blanks with regard to house structures due to the location of previous excavations and the noted depressions and artifact concentrations there (Tiffany 1996; Tiffany and Anderson 1993). Unfortunately the excavations done by Spargo and The University of Iowa were not after this information, although wall profiles of some of the units do exist and the features noted therein do suggest the possibility that structures did exist where these previous excavations had occurred (Tiffany and Anderson 1993:289). Based upon the artifacts recovered at the site, bone fragments and some macrobotanical remains, the occupants of the Milford practiced a mixed subsistence economy consisting of hunting, horticulture, and plant gathering. Further, based upon certain artifact classes and MNI counts of species identified at Milford, there may be the possibility that hunting and animal meat were the primary activities and source of food for the occupants (D. Anderson 1994; Tiffany and Anderson 1993). This is perhaps one of the reasons why late Oneota sites are found on uplands as opposed to terraces and floodplains due to the fact that the subsistence economy changed.

The artifact assemblage contains a variety of goods varying from indigenous tools to European trade goods. The indigenous assemblage includes triangular projectile points, abraders, bifacial implements, and groundstone tools for processing of plant remains. Catlinite is also present at the site in the form of tablets, pipes, blanks, and pendants (Tiffany and Anderson 1993). Of interest is the lack of endscrapers recovered at Milford that were so common at earlier Oneota sites in northwest Iowa. This could be due to the fact

that certain precontact tools were beginning to be phased out in favor of the iron tools (D. Anderson 1994). Bone tools recovered from the excavations included antler tines, awls, fleshers, and a bison rib shaft straightener (Spargo 1984). Historic artifacts include Jesuit rings, kettle fragments, brass or copper tinklers, iron projectile points, and iron knives (D. Anderson 1994; Tiffany and Anderson 1993). Gun parts and flints have also been recovered from Milford, and some of these firearm pieces have been noted in personal collections (Frerichs 2000, personal communication).

The ceramics recovered from Milford have been analyzed by Tiffany (1996). The ceramics present at the Milford site reflect ceramic attributes similar to Orr phase Allamakee Trilled pottery. Lips are rounded and usually have decoration; rims are usually flaired and vertical. Decoration consists of groups of parallel lines, chevron motifs, and punctates used as filler on the shoulders of vessels (Tiffany 1996; M. Wedel 1959). Strap handles are present, and are decorated with trailed lines, punctates, or a combination of both of these and were attached to the vessel below the lip (Tiffany 1996:64).

The author visited the site in the summer of 1999 and did a pedestrian survey, soil profiling, and examined the local site environment. The site sits upon a fairly level high terrace or outwash feature created by the meandering of the Little Sioux River. The location provides a commanding view to the east, south, and west. Along the Little Sioux Valley stands of timber occur on the sideslopes and valley walls. Timber is also present on the floodplain in some areas. Some portions of the site are in cultivation, while another large portion is covered by a residence and adjoining lawn and pasture to the east. Large areas of rock concentrations were noted especially north of the residence, and numerous stone artifacts were observed on the surface. Bone was also present in three clusters immediately north and west of the residence property line. Some pottery sherds were found scattered around the vicinity of the site, including one rimsherd with lip decoration. Intermittent

springs are also present along the sideslopes of the valley wall and terraces, and are due to the properties of the soil substratum (Tiffany and Anderson 1993).

Kirchner (13CY14)

The Kirchner site is located in the town of Spencer, Iowa along the Little Sioux River. It appears to rest upon a low terrace approximately ten to twelve feet away from the current floodplain of the Little Sioux. Unfortunately, this site must be excluded from the purposes of this study due to the lack of archaeological surveys and extreme paucity of artifacts recovered. Only one Oneota-like sherd was recovered from a surface survey and recorded at the Office of the State Archaeologist of Iowa.

The field crew from the Iowa Lakeside Laboratory in 1999 examined three large strips of land exposed by a tractor and plow. A handful of waste flakes was noted and no other artifacts were found in the field or along adjacent property. Until more evidence is revealed from the Kirchner site, the validity of it containing an in situ Oneota component remains in question.

The Blood Run (13LO2) Locality

The Blood Run is an enormous post-contact village located in portions of northwest Iowa and southeast South Dakota along the Big Sioux River, with Blood Run Creek running through the site on the Iowa side. The actual size of the site is unknown, although the main concentration of cultural material extends for some five hundred to six hundred acres. In addition, artifacts have been located even further away from the main concentration, and peripheral estimates encompass an area of at least 1200 acres.

Blood Run is an intriguing site because of its large size and the numerous mounds that have been recorded in the area. Researchers have been conducting investigations at the site for over one hundred years, and were primarily focused upon the burial mounds (Orr 1963; Pettigrew 1901; Starr 1887). Many of the mounds have been obliterated by modern

agricultural activities and on-going gravel quarrying at the site, although Harvey (1979:136) mentions that 100 mounds were still visible on the Iowa side of Blood Run and several more on the west bank of the Big Sioux River on the South Dakota side.

Another reason that Blood Run has received much attention is due to the inhabitants of the site. While the post-contact component of the site is affiliated with the Oneota, the Oneota groups at the site are believed to be the ancestors of the Ioway, Omaha, Oto, and Ponca tribes. Ethnohistoric research by Mildred Wedel (1976, 1981), and Thomas Thiessen (1999) and ethnographic research (Fletcher and LaFlesche 1911) have substantiated these claims that indeed at one time or another, the preceding tribes did congregate at a village site along the banks of the Big Sioux River, and that site is believed to be Blood Run.

The cultural material from the site contains an extremely diverse assemblage of stone, bone, and European artifacts. Small triangular projectile points, scrapers, knives, groundstone tools, and catlinite plaques, pipes, and fragments constitute an important portion of the stone tool assemblage. Bone tools consist of modified long bone, rib, and scapula tools, awls, and chisels. In addition, shell beads have also been recovered at Blood Run. European goods include glass trade beads, copper coils, and copper beads (Harvey 1979).

The ceramic assemblage is similar to Allamakee Trilled pottery. Harvey (1979) did observe, however, a few significant differences with respect to Blood Run ceramics and "typical" Orr phase Allamakee Trilled pottery. The most obvious difference was a marked increase in the quantity of grit tempered sherds recovered from the site; twenty-eight percent of the ceramic sample available to Harvey (1979:171) had grit inclusions. This large increase in grit tempered pottery may also have been due to a relatively small ceramic assemblage. Distinct motifs could not be defined, although the majority of the decorated sherds exhibited groups of parallel lines and punctates used as fillers, typical decorative

elements used in late Oneota ceramics (Harvey 1979; Henning 1961, 1970; M. Wedel 1959). Lips and rims were also decorated, and strap handles were also recovered from Blood Run, with the handles attached below the lip (Harvey 1979:190).

The author visited the Blood Run site in the summer of 1999 to note the landforms and general characteristics of the area. The Blood Run site is situated upon upland formations, and on terrace formations. Many of the mounds sit upon the bluffs overlooking the Big Sioux River to the west. The entire area is dissected upland/lowland-floodplain land formations from the activities of both the Big Sioux River and Blood Run Creek. Timber stands were present along the courses of the Big Sioux River and Blood Run Creek. Significantly more timber occurred on the west bank of the Big Sioux River. However, the east bank of the Big Sioux River had considerably more farming activities on both the floodplain and the uplands and hence many trees may have been removed for farming.

The mounds were severely eroded, and some of the mounds had animal burrows in them. Animals had brought up artifacts and human bone that was visible in the spoil piles of the animal activity. No other artifacts were visible due to the groundcover and vegetation in the area. No soil profiling was done at the site due to the large expanse of the site, and also because of its protected status as a National Historic Landmark. Unfortunately, even with its designation as a National Historic Landmark, portions of Blood Run are still being destroyed because of on-going gravel operations.

Summary

The Little Sioux Valley contains evidence for a lengthy Oneota occupation of the region for over four hundred years. However, the data currently available has led researchers to believe that the occupation was not continuous, but one consisting of three

periods of occupation through time (Harvey 1979; Fishel 1999). In addition, the locations of the three clusters of sites are situated upon three distinct landforms. The Correctionville locality, which contains the earliest dated sites, is located upon the low terraces of the Little Sioux River. The Bastian locality contains sites situated upon the high terraces of the Little Sioux River, and the sites are a considerable distance from the older Correctionville area. Finally, the protohistoric and post-contact sites are all situated upon the uplands of the Little Sioux Valley. The Blood Run site (13LO2) is in a different locality and is situated on several landforms within the Big Sioux Valley and valley wall. This trend of later sites located at higher elevations does not only occur in Iowa; researchers have also documented this changing settlement pattern of Oneota sites in other regions (Boszhardt 1994; Henning 1970). Radiocarbon dates for many of these sites also supports the evidence that earlier Oneota sites are found on landforms positioned lower than later sites (Boszhardt et al. 1995).

The Oneota artifact assemblage in northwest Iowa is very similar to other Oneota regions throughout the Prairie Peninsula. Triangular projectile points, endscrapers, and groundstone tools make up the bulk of most Oneota site assemblages. Catlinite is introduced later in time and is found at Oneota sites dating from the fifteenth century onward, and is found in the form of tablets, pipes, pendants, and beads. Ceramics are predominantly shell tempered globular vessels; possible bowl forms also present at some sites. These vessels have a suite of attributes that include types of decoration, motifs, and handle form and attachment that distinguish Correctionville Trained from the Allamakee-like ceramics in the Little Sioux Valley (Harvey 1979; Henning 1961). The evidence for European trade and contact is reflected in brass kettles, brass tinklers, glass trade beads, gun parts, iron points, axes, and knives, and rings (Titcomb 2000). This contact and acculturation no doubt affected how the post-contact Oneota groups adapted. European

goods eventually replaced the indigenous materials, but initially may have been used as a supplement to traditional tools.

The subsistence patterns of Oneota groups in northwest Iowa reflect a mixture of horticulture, wild plant gathering, and hunting of big game animals (Harvey 1979; Tiffany and Anderson 1993). The main species of large animals recovered at Oneota sites are bison and white-tailed deer. Through time, however, it does appear that the Oneota groups began to rely more upon bison as the primary source of meat. This could be due to sampling areas within the sites, the total areas of sites excavated, or breakdown of the bone within the soil. Another possibility would be climatic changes that forced the Oneota to adopt different subsistence strategies to cope with the changes in the environment.

Fishel (1999) has suggested three models of Oneota population migration into and out of the Little Sioux Valley. These models are consistent with ethnohistoric records of some Native American tribes within Iowa and neighboring areas, in particular the Ioway and the Omaha, and the Ponca (Fletcher and LaFlesche 1911; M. Wedel 1959, 1981). Similar connections with other historic tribes with regard to Oneota prehistory have also been suggested by others (Hall 1962, 1995; Henning 1970). However, some caution against this direct correspondence between Oneota and historic tribes because of the rapid changes that occurred to the Oneota tradition after European contact, and the dependence upon pottery attributes (Mason 1994).

Northwest Iowa does not appear to have an early Oneota component. With Dixon (13WD8), the oldest known Oneota site in northwest Iowa dating to the middle to later thirteenth century, the gap in time between the earliest sites in Wisconsin and northwest Iowa is too great. The similarity between Correctionville Trained and Blue Earth pottery has been noted by some researchers (Harvey 1979; Henning 1961, 1970), and (Henning 1999) suggests that the Blue Earth River region may be the area from which Oneota people

migrated to reach the Little Sioux Valley. From the Correctionville locality, the Oneota people may have traveled up the Little Sioux River to the Bastian locality, and then perhaps farther north and west to Blood Run (13LO2). Another possibility is that the Oneota people in the Correctionville area left and headed north and east to the Upper Iowa River region (Fishel 1999:125-126). The possible validation of this migration model or any others, unfortunately, are difficult to test given the broad geographic range of the Oneota tradition and because of the shallow depth of deposits for Oneota cultural material. In addition, modern land use techniques would likely mix possible multicomponent sites together into one homogenous layer, thereby making any sort of distinction between multiple occupations extremely difficult.

The archaeological record of northwest Iowa with regard to the Oneota tradition has seen increased attention from many researchers over the past years. While some sites such as Correctionville (13WD6), and Gothier (13WD3) have almost been totally destroyed, perhaps there are more Oneota sites within the Little Sioux Valley that have yet to be discovered. What is clear is that more research needs to be done in order to understand fully the Oneota tradition and its importance to Iowa prehistory, and the overall prehistory of the Great Plains.

CHAPTER 4: SITE CATCHMENT ANALYSIS

Site Catchment Analysis

Site catchment analysis is a method used by archaeologists to analyze the resources and local environment around a site. The study of the environment can give the archaeologist information on past climatic conditions, what species of plants and animals were present at the time of the occupation of the site, and what types of other resources were utilized by the inhabitants of a particular locale (Flannery 1976; Vita-Finzi and Higgs 1970). This type of environmental analysis is often termed "eco-functionalism," an area of emphasis that arose out of processual or New Archaeology (Hodder and Orton 1976). While some may perceive that studying environmental factors as cultural processes is environmental determinism, it must still be acknowledged that the environment had a substantial role to play in the lives of prehistoric groups.

The idea of site catchment analysis in archaeology was borrowed from geography and was first used in the 19th century by a German, J.H. von Thünen. Von Thünen hypothesized that if one were to lay concentric rings around a town, then the more important, and hence more utilized areas and resources, would be closer to town (Hodder and Orton 1976:229; Gibbon 1984:199). Land would be utilized less the farther from the town center. Other factors included the assumptions that: 1) the town was perceived as an isolated state, receiving little or no outside interference; 2) the town was located on a uniform plain upon which the catchment rests; and 3) transportation consisted only of a horse and cart (Hodder and Orton 1976:229). Von Thünen's criteria focused upon a dichotomy between rural and urban land use. However, these criteria would not be acceptable for examining resource utilization of prehistoric groups who had no similar technology or social organization.

Traditional Methods of Site Catchment Analysis

The idea of a catchment area composed of concentric rings was first used in archaeology by Claudio Vita-Finzi and Eric S. Higgs in 1970 during their study of the Mt. Carmel region in the Near East. Vita-Finzi and Higgs (1970:5) define site catchment analysis as “the study of relationships between technology and those natural resources lying within economic range of individual sites.” Economic range is the extent that prehistoric human groups would have traveled from a site, a distance that would still make the collection of resources advantageous. That is, the potential energy obtained would be greater than the energy expended in order to acquire the requisite resources. Within the catchment the idea of reduced exploitation the further one moves from a site has been shown to be supported in the ethnographic literature (Lee 1969).

Vita-Finzi and Higgs employed site catchment analysis in archaeology by assuming, like Von Thunen that land closer in proximity to a site would be exploited more intensively than land farther away. Therefore, their method utilizes catchment areas defined by either set intervals of distance, or by maximum walking time. The walking time most commonly used is one hour for agriculturalists, and two hours for hunter-gatherer groups (Higgs and Vita-Finzi 1975; Roper 1979; Vita-Finzi and Higgs 1970). These catchments were then weighted by percentage for utilization. For example the first ring was weighted at one hundred percent utilization, and the last ring was weighted at twenty percent utilization. This method was employed in Vita-Finzi and Higgs' first site catchment analysis.

Vita-Finzi and Higgs also believed that technology was of prime importance in how resource procurement was actually achieved. The technology that prevails will determine the range of resources that can be exploited, and will affect the shape and size of the

catchment or territory of the site (Higgs and Vita-Finzi 1975:28). The assumption that follows then, is more technologically advanced groups will be able to exploit their territories more effectively and in different ways than other groups who lack a similar technology.

Finally, Vita-Finzi and Higgs tabulated by percentage the available land resources, based upon soil types to determine how much of a particular land resource was available to the inhabitants of a site within the catchment area (Higgs and Vita-Finzi 1975; Vita-Finzi and Higgs 1970). The implicit assumption within this method of site catchment is that most groups will locate their habitations based upon areas where they can procure the widest diversity of resources. Therefore, the location of the site will be able to give archaeologists information as to how the site functioned; site location, local environment, and site function are linked and can be directly inferred.

This method of site catchment analysis has been widely employed by others in analyzing resource diversity and availability around a site. Tiffany (1982) used this method of analysis in determining the economic potential of Oneota sites in southeast Iowa where he determined that Oneota sites were located in the areas of greatest environmental diversity. In addition the sites were postulated to be located not only for resource procurement, but for other culturally defined needs such as defense, trade or communication (Tiffany 1982:10). These conclusions were drawn based upon site location and local environment.

Michalik (1982) also used site catchment analysis to describe local site conditions at Huber Phase Oneota sites in Illinois. Since data were relatively complete for both floral and faunal species, they were included to determine relative percentages of those resources procured around the site and which species were preferred or exploited most based upon quantity of remains found at the sites. Conclusions drawn about the overall settlement and subsistence patterns of Oneota people in this region of the Midwest were based upon the

site catchment results, which were that the Oneota groups in this area were not placing primary importance on horticulture as evidenced in the soil types, and the people were exploiting river and aquatic resources more heavily than most other Oneota groups (Michalik 1982:44-53)

Another example from Schermer and Tiffany (1985) using site catchment analysis in addition to statistical analysis was performed on a series of Woodland sites located around the Coralville Reservoir in eastern Iowa. Site catchment was done first to produce a vegetative model of sites to account for environmental diversity and then tested statistically to determine what resources were most influential in determining site location (Schermer and Tiffany 1985:223-225). A similar method was also used by Tiffany and Abbott (1982) and Abbott (1984) to describe various projects around Iowa. Here site catchment analysis was used as a preliminary tool in ascertaining local environmental diversity. More complex analyses, including the creation of a predictive model were completed after local site environments were modeled (Tiffany and Abbott 1982:320-322). Both of these studies show how site catchment analysis was the first step to more advanced methods of archaeological environmental analysis.

While the method of Vita-Finzi and Higgs has been used quite extensively, critics have pointed out some of the implicit assumptions underlying the method that may affect conclusions based upon the analysis site catchments. Two important assumptions include: 1.) that prehistoric environments are similar to those in the present, and 2.) subsistence patterns of groups have not been altered significantly (Hodder and Orton 1976:233; Roper 1979:127). Butzer (1982:218) criticizes the original method for including the assumption that technology was an independent variable leading to a deterministic oriented method of analysis; the technology of a group will directly affect what resources they will acquire and how far they would be able to travel. However, Butzer also fails to mention any idea of

trading between groups to acquire items, or how strong a correlation there is between technology and resource procurement. Furthermore, Roper (1979:127) and Butzer (1982:218) point out problems with using modern land and soils maps, and argue that climate and environment could have been much different in the past than it is today. Roper also cautions the use of modern vegetative maps as they may lead to unreliable conclusions about past land use. Finally Gibbon (1984) faults site catchment, not on environmental discrepancies, but for a lack of anthropological insight. That is, earlier site catchments tended to place a great emphasis upon the interaction between site and environment, but neglected any cultural influences upon site selection and location. Villages and towns may be located in specific areas for reasons other than local resource exploitation: a settlement may be a node within a formal trade network, or the settlement may be an administrative center that receives its food through import (Gibbon 1984:199).

An alternative to the method of site catchment analysis as explained by Vita-Finzi and Higgs is a method devised by Kent Flannery. Instead of working with maps and calculating percentages of landform types around a site, Flannery (1976) examined the environmental data available at a site and determined how far away resources would have traveled to make it to the site. The justification for this process being that one does not decide whether or not a village was farming by calculating the percentage of good farmland within 5 km; one decides by finding out whether the remains in the site are wild or domestic (Flannery 1976:104). Flannery's method includes three steps: 1) accumulation of empirical data through archaeological excavation, 2) determination of major physiographic zones around the site, and 3) calculations of resource types recovered from the site and correlated with the local site environment and physiographic zones. Flannery's method is inductive, taking evidence recovered from archaeological sites to form general conclusions about settlement behavior.

Flannery's method of site catchment agrees with the idea of Vita-Finzi and Higgs that the most intensively utilized areas of the environment are the closest to the site itself, particularly in reference to agricultural activities. However, Flannery goes one step further by taking into account travel distance to acquire animals, up to a limit of fifteen kilometers. In addition, cultural items could have been obtained up to fifty kilometers from the site, thus yielding a large "regional catchment", or the entire area from which goods found at a site were acquired from (Flannery 1976: 109-111).

While this method of site catchment is a different way of examining environmental area around a site and has been praised by others (Butzer 1982; Roper 1979), there are some implicit assumptions that Flannery uses that may appear to be not all too different from those constructed by Vita-Finzi and Higgs. Flannery uses the same method as Vita-Finzi and Higgs to delineate areas of catchment zones, primarily physiographic zones, but nonetheless they are still arbitrary. While the physiographic zones may be natural breaks, Flannery uses arbitrary circles to define the resource zone limits. In addition Flannery (1976:107) acknowledges the zone from which diminishing returns begins, and as Flannery asserts, this is about five kilometers from the sites in this study. The problem deals with the idea of a regional catchment, or catchments so large in size that one is now not dealing with the immediate site or sites under study, but of entire geographic regions where resources were acquired. In the case of the Oneota, using Flannery's method, their catchments could stretch for hundreds of miles, particularly during their annual bison hunts. Furthermore, Flannery (1976:106) demonstrates that the first zone of resources (2.5 km) held much more arable land than needed by the inhabitants of the site, and therefore only a very small proportion of the land would need to be utilized to sustain the population, on the order of only seventeen percent of the total arable land mass. Therefore, the land was utilized one hundred percent according to Flannery. What Flannery does not take into account,

however, was that the seventeen percent utilized would have been one hundred percent utilization to the people at the site. If Flannery did realize this, he does not state it in his case study. A final criticism of Flannery's method is while the work he did was important and another tool to be used by archaeologists, he does not compare the results of his method with the method of Vita-Finzi and Higgs to see whether or not there were significant differences in their results.

Recent Methods of Site Catchment Analysis

Another variant of site catchment analysis proposed by Gallagher and Stevenson (1982) took the site catchment model originated by Vita-Finzi and Higgs, and added the calculation of walking time to model a site catchment based upon how far people would be able to move in a direction before the energy expended became greater than the energy acquired. Their data was dependent upon maps available so they would be able to model the prehistoric environment. This environment was then divided into distinct physiographic zones, and these zones are based upon the most constant physiographic features within the area (Gallagher and Stevenson 1982:17). Gallagher and Stevenson (1982:21) calculated their walking time algorithm as a correlation between slope and walking speed. Therefore, the size of the catchment was a function of a person's ability to traverse terrain. The walking algorithm was then used to create a series of zones, which were then laid upon the resource maps, and the percentage of resources were then calculated within each walking zone to determine the proportion of resources available (Gallagher and Stevenson 1982:21). The land areas were then weighted according to the method devised by Vita-Finzi and Higgs.

One of the nice features of this method, which Vita-Finzi and Higgs and Flannery did not implement, was terrain. By doing this, the catchments would not be an arbitrary circular

shape, but rather a catchment based upon how difficult the terrain would be to traverse to acquire a given resource. This would mean that in some instances, the most direct route would not necessarily be the easiest route.

In addition to using walking time, Gallagher and Stevenson also created catchments using canoes due to the extensive waterways in the area of their study. The walking and canoe catchments were then combined to create a catchment that took into account a larger proportion of the area that could be exploited by adding a second mode of travel.

This method is conducive for further research strategies in that the site catchments could be used as a model for what to expect and then data from the site can be used to help support or refute the results based upon the site catchment models.

The pitfalls in using this type of catchment analysis would be the same as those for the Vita-Finzi and Higgs method, namely dependence upon potentially inaccurate maps and the idea that prehistoric vegetation and environment are similar to the environment and vegetation today. However, the method devised by Gallagher and Stevenson does add a new dimension to using site catchment analysis.

Site Catchment and Geographic Information Systems

The introduction of geographic information systems (GIS) into archaeological theory and practice has made a huge impact upon current environmental research. In particular, one of the areas in which a GIS can be very beneficial is in calculating a site catchment (Maschner 1996:9). Studies within the last ten years demonstrate how useful a GIS software package can be in constructing site catchments. Hunt (1992) shows how a GIS software package can be used to take advantage of the vast amount of data now available to archaeologists concerning the local environment. In addition, the study also demonstrated how more information could be obtained from using a GIS and continuing to

use the concentric rings advocated by previous site catchment studies. Limp (1991) demonstrates that a GIS site catchment does not have to be defined arbitrarily by any geometric, but the data from the different maps can be combined into a layer called a *cost surface*. It is this concept that is arguably the most critical and most beneficial area in which GIS can aid site catchment analysis.

Critics of Vita-Finzi and Higgs (Hodder and Orton 1976; Van Leusen 1998) argue that laying out concentric rings, or any other geometric shape onto a map for analysis effectively produces an isotropic environment. This type of an environment is one in which travel in any direction is the same, thereby negating any benefit or hindrance caused by terrain, vegetation, or elevation. Essentially, a two-dimensional object is used to represent a three-dimensional space. Van Leusen (1998) and others have created a variety of algorithms with which to demonstrate the possibility of taking variables such as terrain and elevation into account. By doing so, an anisotropic environment is created, in which travel is not equal in any direction, which should give a more accurate representation of how overland travel may have occurred. In other words, a three-dimensional representation of the site catchment can now be examined. What has not been tested currently, however, is the reliability or accuracy of this method of site catchment analysis versus those of the earlier methods.

A cost surface is a map layer that is a combination of different map layers added together. For example, individual maps that show vegetation, slope, and soil type could be added together to create a cost surface for a given area around a site. These cost surfaces also take into account a specified walking time by using formulas to calculate a cost factor through a given locality of an area. By using this technique along with a GIS to construct site catchments, an archaeologist may finally be able to produce a more reliable and accurate representation of how prehistoric and historic groups may have traveled to acquire

resources and how far they would have been able to go given the difficulty of the landscape. Other factors which are beneficial to site catchment analysis and which a GIS can support include the ability to manage large amounts of data and extract results quickly given adequate computer processing power and the ability to consolidate numerous datasets in one area which can be recalled at any time (Stine and Lanter 1990). In addition, the ability to calculate areas, totals, and percentages is rapidly increased with GIS software, and more importantly, the ability to add, change, or remove data or maps from an analysis is very easy to do, and recalculation of the data can take place in a matter of minutes, if not seconds. A GIS is also very flexible in that one is able to analyze the same data in different ways, and some GIS software packages have extra modules which can be bought and used to further increase the analytical capabilities of the core GIS software package.

Like the more traditional methods of site catchment analysis, site catchment with a GIS is not without its problems. The biggest inhibiting factor dealing with a GIS is availability of pertinent data. For example, while soil surveys are plentiful, not all of that data has been digitized for every state or county yet. The unfortunate downside to this would be that particular soils datasets would be unavailable for use with a GIS in a study area. Another problem would be inaccurate maps, a problem which Roper (1979) asserts and which is also echoed by more recent studies within the field of GIS and archaeology (Savage 1990). In addition, maps already have a small degree of acceptable error "built in" to them, and the error becomes more significant as the scale of the map becomes larger. This could lead to erroneous results or conclusions during analysis thereby throwing off the accuracy or validity of a study. Along the same lines, small scale maps are virtually worthless in a study such as site catchment analysis because the resolution and detail are so general, large amounts of minute detail are lost. In other words, landscape and terrain details at the site level of inquiry cannot be defined, much less analyzed.

However, the ultimate determining factor lies with the archaeologists themselves. Archaeologists must be competent and knowledgeable in not only the archaeology, environment, and prehistory of a region, they must also be knowledgeable in the use the GIS software, and any supporting programs that may be necessary to complete an analysis. A working knowledge of spreadsheet and database programs as well as third party statistical programs may be required. A solid background in statistical methods and techniques is also required, since many of the procedures and algorithms used in a GIS come from statistics. More advanced GIS analysis such as predictive modeling requires an even greater understanding of statistical methods, to understand fully and interpret the numbers which the GIS will calculate (Warren 1990a).

Each of the different methods of site catchment analysis described have their strengths and weaknesses. No one technique or method can conclusively answer a question to the satisfaction of everyone; the criticisms leveled upon the various methods of site catchment analysis demonstrate this. However, with the right data and the correct questions, insights into prehistoric environmental resource procurement and exploitation can be gained.

The method used in this study is a combination of the previous site catchment methods. Vita-Finzi and Higgs' ideas of zones of exploitation and energy expenditure will be taken into account, modeling of the prehistoric environment, and environmental diversity, concepts that have been used in previous site catchment studies (Schermer and Tiffany 1985; Tiffany 1982; Tiffany and Abbott 1982). Flannery's idea of on-site examination of the local environment is also used during multiple visits to each site in this study to examine the sites themselves and the resources within their immediate vicinities. In addition, cost distances and cost surfaces as advocated by Gallagher and Stevenson (1982) and Van Leusen (1998) are also used to generate site catchments that will take into account changes

in elevation and terrain that would affect movement and traveling distances away from a site. The GIS software to be used in this study is ArcView GIS 3.1, produced by the Environmental Studies Research Institute (ESRI). Additional data analysis modules such as Spatial Analyst and ESRI 3-D Analyst for ArcView will also be used to examine the site data and environmental data. These data will be used to create the cost surfaces for each catchment area of a site. Finally, the catchments will be used to model the prehistoric environment around the sites in the study area, and to analyze the catchments with regard to resource types and percentages of resources within the zones of the catchment, as well as to make comparisons of resource types and percentages between catchments. These catchments will then be compared with other site catchment analyses already done on other Oneota sites to see if there are any correlations or similarities between different locales and environments.

CHAPTER 5: SITE CATCHMENT ANALYSIS AND RESULTS

The use of geographic information systems for site catchment analysis gives the archaeologist another tool in examining environmental resources and settlement patterns. The advantages of using a GIS package for these types of analyses are numerous: the speed with which GIS software packages can query databases and calculate results are much faster than hand calculation; GIS software can work with enormous amounts of data quickly and efficiently, thereby expediting the analysis process; multiple sets of data can be used singly or in combination to create specific datasets needed for analysis; data and databases can be stored indefinitely without loss of information; and finally, current data can be updated quickly with newer data or new sources of information can be added to the datasets.

Even with these advantages available to geographic information systems, there are some drawbacks with their uses. First, and arguably most important, is the limited availability of data. Absence of data for a particular dataset such as soils leaves the archaeologist with two options: exclude the dataset from analysis, which is potentially problematic and can lead to misinterpretation of the results, or create the dataset from the paper maps, a process which requires expensive digitizing equipment, software and which can be very time consuming. Another problem deals with scale and the inherent error built into the paper maps. USGS topographic maps depending upon their scale have various levels of error which are deemed acceptable. A USGS large-scale 1:24000 topographic map has a maximum error for a point of 12 meters (39.4 feet). Therefore, the maximum error between two points is 24 meters (78.7 feet) (Marozas and Zack 1990:169). USGS small-scale 1:250000 regional maps have an acceptable error of 127 meters (416.7 feet) for one point, with the maximum error between two points 254 meters (833.3 feet) (Marozas

and Zack 1990: 168). This rate of error is much too large when dealing with small features such as archaeological sites. Another problem deals with the resolution of maps with regard to map scale. Typically, large-scale map shows much greater resolution than a small-scale map. If an archaeologist was to use a small-scale map, the potential for loss of features such as hills, ridges, and small but significant changes in elevation will be excluded from small-scale maps (Carmichael 1990; Kvamme 1990). Again, small-scale maps with little detail will be nearly worthless for use in archaeological data analysis.

The overall danger in the inherent error of maps is this: archaeological research requires the use of multiple datasets and map layers for analysis, the more map layers one uses, the greater the chance for cumulative error. For example, if one uses four map layers at a scale of 1:24000, the margin for error for one point is 48 meters (157.5 feet), and between two points the margin of error is 96 meters (315 feet). In other words, the margin of error is additive (Marozas and Zack 1990:170). Finally, other potential problems include digitizer error, initial surveyor error, and digitized data error, for example whether the data has been coded in a discrete or continuous manner (Kvamme 1990; Marozas and Zack 1990; Zubrow 1990a).

Even with these potential problems, the only two specific to GIS software and data are digitizer error and data type (discrete or continuous). The remaining problems also plague site catchment analysis using any of the other methods described in previous sections. The potential error inherent within maps is something that cannot be overcome. However, scale and resolution problems can be minimized by using the most detailed, and largest scale maps available for analysis. Ultimately, proper map choices and datasets coupled with the knowledge of the environment, archaeology and prehistory of groups, and proper methods and interpretations will allow the archaeologist to minimize any other potential errors that may arise.

Site Catchment Procedures and Construction

Data Acquisition

The GIS software used to create the site catchments for the Oneota sites in northwest Iowa is ArcView 3.1 along with the Spatial Analyst 1.1 extension, both created by the Environmental Systems Research Institute (ESRI). 3D Analyst 1.0 was also used to create 3D models of the site catchments. In addition, various ArcView scripts from the World Wide Web were downloaded and implemented to expedite data aggregation and analysis.

Two data types were available for use in this study. The first data type is raster data, which is data coded as a matrix of grid cells. These grid cells have values that are referenced in a corresponding database with the cell values (Burrough 1986:20; Savage 1990:24; Zubrow 1990b:69). A digital elevation model (DEM) is an example of a dataset coded in raster format. The second type of data available is vector data, which represent continuous values. Datasets coded in vector format include soils data, road data, and point data locations, and are used to represent spatial information (Burrough 1986:25; Savage 1990:24; Zubrow 1990b:70). Based upon other studies of spatial analysis with GIS software, it was determined that the raster data format would be most beneficial for this particular study (Altschul 1990; P. Anderson 1996; Carmichael 1990; Kvamme 1992; Parrish 1998; Warren 1990b). This raster data will also be used to create the predictive model outlined in the following chapter.

The data used for this research were gathered from the following Web sites: The Mid-Continent Mapping Center (MCMC) of the US Geological Survey, the Iowa Department of Natural Resources Geographic Information System Library (NRIGIS), and the Natural Resources Conservation Service Iowa Cooperative Soil Survey (NRCS/ICSS). Digital

elevation models were obtained from the MCMC and NRGIS websites. Soil data were obtained from the NRGIS and ICSS. Finally, regional landform information, hydrology, vegetation, county information, and digitized topographic maps were obtained from the NRGIS. Each of the preceding datasets are known as primary coverages, and contained an ArcView shapefile, a grid file, or an image file along with an associated attribute database file. Some of these primary coverages were queried to create additional datasets, or secondary coverages (derived themes), that were used in the site catchment analysis (Table 5.1). Not all of the secondary coverages were used to construct the site catchments due to the fact that some information was duplicated between two datasets or was simply not needed for the site catchment analysis.

Table 5.1. Digital Data Available for Use in Site Catchment Analysis.

Source	Primary Coverage	Secondary Coverage
Digital Elevation Model	Elevation	Hillshade Slope Aspect Slope
Hydrology Map	Streams and lakes	Stream and lake sizes
Iowa Map	Map of Iowa	Landform Regions
Soil Map	Soils	Crop Ratings Drainage Characteristics Landforms Slope Soil Types
Topographic Map	Reference	None
GLO Vegetation Maps	Vegetation	Vegetation Types

After the source data were collected, the process of combining certain data types was needed to cut down on seek and redraw times in ArcView. Digital elevation models were mosaiced into one file with the Spatial Tools extension available from the USGS Alaska Biological Science Center. The soil shapefiles were merged by county using commands from the XTools extension made available by the Oregon Department of Forestry. Soil databases were also merged with their corresponding Iowa Soil Properties and Interpretations Database (ISPAID) file, which contains many of the soil characteristics found in the paper county soil survey manuals. The shapefile attribute database files and ISPAID files were combined in ArcView using the *join* command for tables. After these data were compiled the process of creating the necessary secondary coverages could proceed.

As previously stated, the raster data format was selected to perform the site catchment analysis. Data conversion to the raster grid format for selected secondary soil coverages and the GLO vegetation maps was necessary. This was accomplished by using the *convert to grid* command in ArcView Spatial Analyst. The secondary soil coverages converted to the raster format were slope range, landform or landscape position, and soil type. The GLO vegetation coverage reflecting vegetative types was also converted to raster format.

Resolution for these raster grid files were matched to the grid cell size for the digital elevation models because these were available only in raster format. The cell size for the DEMs was 30 meters, which is a higher resolution than previous studies which utilized this procedure (P. Anderson 1996; Carmichael 1990; Kvamme 1992; Marozas and Zack 1990). The grid coverages could have been increased to a higher resolution, but this would have significantly increased the files sizes for these coverages, and would not be necessary based upon the studies cited.

Cost Distance

The primary reason for doing site catchment analysis utilizing digital GIS technology was to create catchment areas of northwest Iowa Oneota sites that would reflect terrain differences and their effect on travel time. To accomplish this, a function called *CostDistance* available within ArcView was used to achieve this objective. Typically, use of this algorithm requires the user to know either an in-depth understanding of ArcView script coding, or attempt to call the function within the *Map Calculator* function. Fortunately, a small script was written by ESRI that allows access to the *CostDistance* function through a graphical user interface to perform cost distance calculations.

CostDistance requires the user to have available three items of information: a cost surface coverage, a threshold limit or maximum cost distance, and a coverage to use as the starting point (Mitchell 1999). The cost surface coverage was created within ArcView by using *Map Calculator* to combine the GLO historic vegetation coverage and slope range coverage. The cost surface coverage was created in raster format with a cell size of 30 meters. Initial costs for slopes were dependent upon slope steepness. For example, slope ranges between 0 and 5 percent were assigned a cost value of 2 sec/meter travel time, while the steepest slope ranges were assigned cost values of 5 sec/meter or higher travel time. The GLO historic vegetative coverage was assigned cost factors based upon the type of vegetation present within the cell. Within the northwest Iowa study area, most vegetative cover consists of prairie or timber. Prairie was given a cost value of 1 sec/meter travel time and timber was assigned a cost value of 2 sec/meter travel time. A cost surface map was created for each county in the study area that had a known Oneota site present.

The second parameter needed was a threshold limit. Without this parameter the cost distance algorithm will, by default, calculate cost values over the entire extent of the cost surface. Roper (1979:123) suggests some different time measurements dependent

upon whether or not the group under study is primarily foraging or horticultural. Based upon this information and other literature, it was decided that a cost distance threshold of two hours was sufficient. This threshold limit was converted from hours into seconds, giving a maximum threshold of 7200 seconds per catchment.

Finally, the initial starting point for each of the catchments was a point polygon coverage representing the center of each Oneota site in the study area. The cost distance algorithm then calculates the cost through each cell from the center of the site out to the maximum threshold limit of 7200 seconds. The cell values are additive, meaning that each succeeding cell has the value of previously calculated cell values surrounding it (Mitchell 1999:144).

Environmental Modeling

After the catchments were created for each site, they were queried to produce zones representing walk times of twenty minutes per interval through the catchment. These grid catchments were then saved as separate datasets. The next step was to take the grid catchment themes and convert them into vector themes for further analysis. These vector catchment themes were needed as templates to create a map of the soils found within the catchment area and to model prehistoric vegetation. The conversion was done using the *convert to grid* command using the Spatial Analyst extension.

The new theme and attribute database file that describes the soils within the catchment was queried to show vegetative types in the catchment. Unfortunately, the digitized soils maps reflect current vegetation in the area due to the soil properties, and so it was necessary to consult the soil survey books and the author's notes and photographs to determine portions of the catchments that had vegetative types other than prairie. The primary reason nearly all of the area is in prairie is due to the predominant soil types. These soil types reflect a soil formation process dominated by prairie vegetation (USDA 1998,

1999). As a result of this, any older soils that may have been formed by forest growth have been buried. Another possibility is that the older soils have been subjected to extensive erosion thereby leaving little trace of their previous presence. Based upon published county soil survey reports, there was a significantly greater proportion of timber in the catchment areas than what was reflected in the digitized soil coverages. The author digitized timber areas not identified on the digitized soil maps and a new database field was added to each catchment database file to reflect the updated timber resources. Since the vegetation within the northwest Iowa study area is fairly homogenous, three new themes were created: a timber coverage, a prairie coverage, and a river coverage. Each of these coverages was saved as a separate dataset and then aggregated together using the *merge* command from the XTools extension. The attribute database information was then transferred to a master attribute database file that includes all of the relevant variables needed to model the prehistoric environment for individual sites. A final landform field was entered into the master database site files that describe major landforms types used by archaeologists. This was necessary because of the fact that some landform designations given by the USDA were divided into many different landform subcategories, some of which were unnecessary for this study.

It should be noted however that the prehistoric modeling of the native vegetation with regard to timber amounts in each catchment represents an approximation and is a conservative estimate of the relative proportion of this resource. Factors such as erosion, change and growth of plant communities, soil formation, and historic land use have altered the landscape considerably. The possibility exists that more timber was available at the time the Oneota people were in northwest Iowa given recent diatom studies (Laird et al. 1996). Based upon historic documentation of Europeans who traveled through the region, the Little

Table 5.2. Site Catchment Descriptive Variables.

Variable	Variable Description¹	Source Data
Soil types	Soil types in the catchment	Soil map
Landforms	Landform types in the catchment	Soil map
Land capability class	Soil suitability for crops	Soil map
Primeland	Land best suited for crops	Soil map
Corn suitability rating	Potential for intensive crop production	Soil map
Corn yield	Corn yield in bushels per acre	Soil map
Tilth rating	Tilth rating	Soil map
Flood Frequency	Potential for flooding on the soil	Soil map
Permeability	Ability for water to move downward through soil	Soil map
Drainage class	Frequency and duration of periods of saturation	Soil map
Vegetation	Vegetative cover in the catchment	Soil map

¹ Variable descriptions taken from ISPAID manual except for landform and vegetation.

Sioux Valley contained larger stands of timber on the floodplain and along the valley walls than what is currently present (Harvey 1979).

Proportions of stream, prairie, and timber for each catchment in hectares and acres were also computed to model prehistoric vegetation based upon landform setting. The variable descriptions in Table 5.2 are used to determine the overall productivity of the soils and their propensity for flooding and drainage characteristics (USDA 1996). This hopefully gave a fairly accurate assessment of the potential for cultivation within each catchment.

Environmental and Resource Parameters

The primary goal of this portion of the research was to determine whether or not the Oneota groups who inhabited these sites would be able to sustain themselves with the resources found in the catchment, or if they would have to travel more than two hours to acquire needed resources.

Studies suggest that Oneota groups would need access to a wide variety of resources to survive in their environment. This would include access to tracts of arable land for agricultural fields, sufficient quantities of timber for structures, and access to large game to supply meat. The subsistence strategy of semi-sedentary groups like the Oneota relied on a mixed economy of horticulture supplemented by wild plant gathering and large game hunting, primarily bison (Lehmer 1970). Other large game animals taken include deer and elk (Fishel 1999; Harvey 1979; Tiffany and Anderson 1993). It follows then that the majority of these resources should be acquired within the boundaries of the site catchment. The one exception would be bison hunting, which required large communal hunts that could take many weeks and could involve traveling long distances to seek out herds of sufficient size. While this threefold system of subsistence was in use by the Oneota during their occupation of northwest Iowa, the proportions of horticulture, gathering, and hunting changed. Through time there appears to be a shift in the subsistence economy, with bison hunting becoming more prominent, and with horticulture declining in importance. The following discussion focuses upon the three “primary” environmental resources of arable land, large game, and timber. Each of these groups is based upon a variety of factors and procedures used to calculate utilization of a particular resource within the catchment.

Horticulture

Based upon ethnographic accounts and Oneota field studies, the majority of cultivated fields were located on the bottomlands or terraces of river systems to take advantage of arable soils and nutrients (Blaine 1979:7; Fletcher and LaFlesche 1911:269; Gallagher and Sasso 1987; Gallagher et al. 1985). The soils necessary for cultivation would need to be light enough so they could be tilled easily using scapula hoes and antler rakes. This would require that the soils not contain a significant proportion of clay. Additionally, nutrients would have to be replenished annually without the aid of fertilizers other than

manure. Even so, it appears that groups did not favor the use of manure. Manure caused a wide variety of weeds to grow in the garden plots the following spring as well as harboring insect larvae and worms (Wilson 1917:117). Having fields on bottomlands of streams allowed for a replenishing of nutrients during the spring due to seasonal flooding.

Fields used for cultivation were dependent on factors such as types of crops grown and distances to terraces or bottomlands. Paleobotanical studies and ethnographic sources reflect the three major crops being cultivated were maize, beans, and squash, with maize being the most important (Fletcher and LaFlesche 1911; Nepstad-Thomberry 1998; M. Wedel 1976; Wilson 1917). Crops were grown in rows in the field, with alternating rows of beans or squash (Fletcher and LaFlesche 1911:269; Wilson 1917:25).

Field size varied depending on the size of the family. Based upon Buffalo Bird Woman's recollection, the largest field her family used was one measuring one hundred eighty yards long and ninety yards wide, and was used for a family of fourteen individuals (Wilson 1917:24-25). This field size is equivalent to 1.62 hectares (4 acres). Similarly Fletcher and LaFlesche (1911:269) note that Omaha fields ranged from 0.20 hectares (0.5 acres) up to 1.21 hectares (3 acres), although some plots were larger depending on the size of the family or the industry of the individuals. M. Wedel (1976:22) also shows that some loway were using fields varying in size from 0.10 hectares (0.25 acres) to 0.20 hectares (0.5 acres). These fields were used during their residence on the loway reservation, and as a consequence it is unclear whether or not fields of the same size were used in the past.

Field size is important to this study in order to determine if there was enough land area on terraces or bottomlands to sustain the Oneota at the northwest Iowa sites. Taking into consideration the above references, the average field size to be used in this study will be 0.81 hectares (2 acres). It is acknowledged that field size could vary considerably from

year to year depending upon the amount of crops grown or excess surplus from the previous year.

Another factor to be considered is the amount of the bushels of maize per acre that maize varieties could produce that were utilized by prehistoric groups. Will and Hyde's (1917:141-143) ethnographic studies on the Mandan and Hidatsa suggest that maize varieties were able to produce 25 bushels of maize per acre. Nepstad-Thornberry (1998:59, 83) also utilized this figure in his study and subsistence model of prehistoric plant utilization in Iowa and South Dakota during the Initial variant of the Middle Missouri tradition. Geographically, these regions are close to the Little Sioux Valley and similar in local environment. For this study it is assumed that these previous studies are adequate to use the average of 25 bushels per acre of maize. This is by no means a definitive number but an approximation of potential yields per year. Factors such as climate fluctuations, precipitation amounts, nutrients within the soil, flooding, or bad or abundant harvests all can have an effect on the total amount of maize produced per year.

To calculate the amount of arable land available to the site occupants, a derived theme was created that represented a thirty-minute walk time from each site. A further distance would be difficult since women undertook most of the cultivation activities and had to watch over their children whom they sometimes brought into the fields to assist them (Fletcher and LaFlesche 1911; Wilson 1917). These coverages were then queried to show soil types situated on bottomlands of the Little Sioux River and the total amount of land available. These results were then divided by the average field size of 0.81 hectares (2 acres) to yield the potential number of fields available for each site (Table 5.3). The potential number of fields available was then multiplied by the expected yield per acre of maize. The result of this calculation for each site is given in Table 5.4. While this shows the possibility of total utilization of all arable land areas, it does not mean that all of these fields

Table 5.3. Potential Number of Crop Fields at Northwest Iowa Oneota Sites¹.

Site Name	Bottomlands	Terraces	Total area	Number of fields
Dixon	56.55ha/139.74a	23.51ha/58.10a	80.01ha/197.71a	99
Gothier	51.94ha/128.35a	8.45ha/20.88a	60.39ha/149.23a	75
Correctionville	60.63ha/149.82a	27.06ha/66.87a	87.69ha/216.69a	108
Bastian	29.24ha/72.25a	4.29ha/10.60a	33.53ha/82.85a	41
Burr Oak	1.86ha/4.60a	—	1.86ha/4.60a	2
Gillett Grove	3.39ha/8.38ha	—	3.39ha/8.38a	4
Milford	19.70ha/46.68ha	23.52ha/58.12a	41.22ha/101.86a	51
Blood Run	21.01ha/51.92a	22.98ha/56.79a	42.99ha/106.19a	53

¹ Constant of 0.81ha (2 acres) used for calculation of arable land for each site.

Table 5.4. Potential Number of Bushels of Maize Per Acre¹.

Site Name	Bottomlands	Terraces	Total
Dixon	3493.5	1452.5	4946
Gothier	3208.8	522	3731
Correctionville	3745.5	1671.8	5417
Bastian	1806.3	265	2071
Burr Oak	115	—	115
Gillett Grove	209.5	—	210
Milford	1167	1453	2620
Blood Run	1298	1420	2718

¹ Constant of 25 bushels/acre used in the total calculation of bushels of maize at each site.

were used at one time. This factor is dependent on the number of people living at the site and their preference for maize in their diet.

The results of the calculating the total area of arable land potential bushels of maize show marked differences between the sites in the southern, central, and northern portions of the Little Sioux Valley. Dixon (13WD8), Gothier (13WD), and Correctionville (13WD6) in the south show large expanses of land available for farming. More than likely there were large surpluses of maize available after each year's harvest. Bastian (13CK28), the only known Oneota site in the central portion of the Little Sioux Valley has less arable land, but still potentially more than adequate to cultivate the required amount of maize necessary to sustain the occupants. The northern Oneota sites Burr Oak (13CY1) and Gillett Grove (13CY2) show a dramatic decrease in the amount of fields available for farming. Milford (13DK1) demonstrates a level of potential farming that is more acceptable than the results at Burr Oak or Gillett Grove.

There appears to be two factors that have influenced the results of this analysis. The first is the landform position that each site rests upon (Table 5.5). Sites situated on terraces or closer to the Little Sioux River should have more arable land available for cultivation than sites further up the valley wall and on uplands. The second factor that influenced the amounts of arable land for the northern sites situated on uplands would be the cost distance algorithm used.

To test this second hypothesis, a catchment ring with a radius of 500 meters was drawn around both Burr Oak and Gillett Grove, and the landforms were analyzed in the same manner used for the cost distance catchments. The results of this indicate that while Burr Oak received an additional amount of land, Gillett Grove actually lost land that would have been available for farming. Therefore, it seems that site location had more influence than the cost distance algorithm (Table 5.6, Figure 5.1).

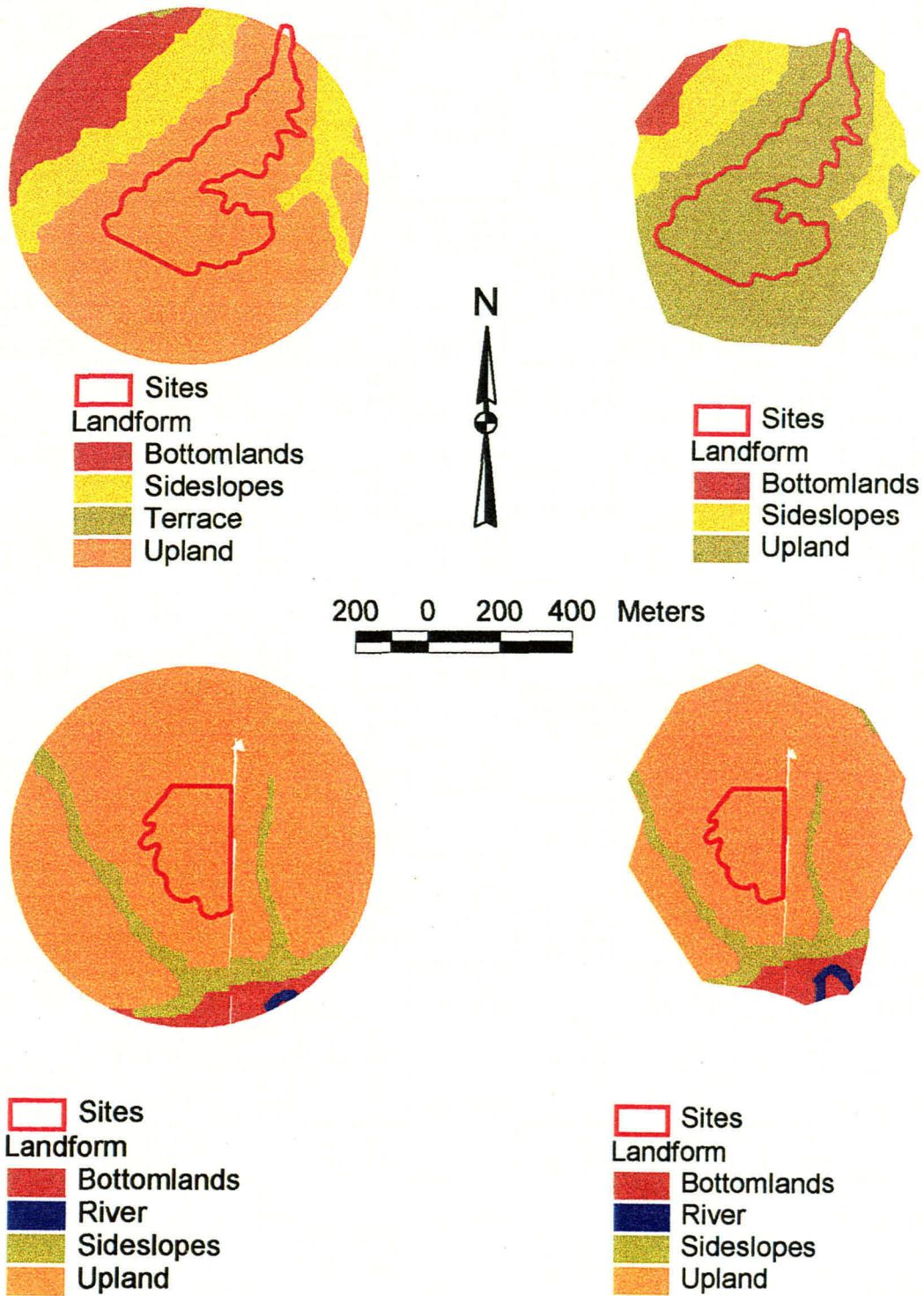


Figure 5.1. Comparison of catchments between a 30 minute walk time and a 500 meter circular catchment for Burr Oak (13CY1) and Gillett Grove (13CY2).

Table 5.5. Site Location and Landform Position for Northwest Iowa Oneota Sites.

Site name	Site number	Landform	Site Size
Dixon	13WD8	Low terrace remnant	23.30ha
Gothier	13WD3	Low terrace remnant	26.05ha
Correctionville	13WD6	Low terrace remnant	14.42ha
Bastian	13CK28	High terrace remnant	26.53ha
Burr Oak	13CY1	Upland ridge	14.34ha
Gillett Grove	13CY2	Upland ridge	6.72ha
Milford	13DK1	Glacial outwash terrace	9.02ha
Blood Run	13LO2	Upland ridge	400.00ha

Table 5.6. Comparisons of Cost Distance and Circular Catchments for Gillett Grove and Burr Oak.

Case	Bottomlands	Total Area	Fields	Bushels
Gillett Grove Cost Distance	3.39ha/8.38a	3.39ha/8.38a	4	100
Gillett Grove Circular Catchment	2.92ha/7.20a	2.92ha/7.20a	4	100
Burr Oak Cost Distance	1.86ha/4.60a	1.86ha/4.60a	2	50
Burr Oak Circular Catchment	10.25ha/25.33a	10.25ha/25.33a	13	325

The soil associations for each site and for arable land appear to follow a pattern.

What follows is a brief description of the major soil types upon which each site sits and the soils available for possible cultivation.

Dixon (13WD8), Gothier (13WD3), and Correctionville (13WD6) are located on Wadena silt loam. Wadena silt loam is classified as a mesic Cumulic Hapludolls (Worster et al. 1972:41, 79). This soil consists of a dark brown silt loam A horizon followed by a brown and yellowish brown silty clay substratum which overlies a mixture of sand and gravel (Worster et al. 1972:41). These characteristics give the soil moderate to very rapid drainage. As a consequence it is suited for extended habitation. The risk of damage to property and goods is minimal and cache pits would be relatively safe.

The soils at these sites available for cultivation are Colo silt loam, Kennebec silt loam, and McPaul silt loam (Worster et al. 1972). Colo silt loam is an organic rich soil that drains somewhat poorly although its productivity is high with regard to crops and is classified as a mesic Cumulic Haplaquolls. Kennebec silt loam is a well drained soil that contains some of the best areas for farming and is a mesic Cumulic Hapludolls (Worster et al. 1972:23). McPaul silt loam is another well drained soil whose properties make it ideally suited for cultivation and is a mesic Typic Udifluvents, however this soil is subject to alluvial deposition. The task of constructing and maintaining fields would not be as strenuous since these soils are silt loams. Additionally, Correctionville has one other soil type, Calco silty clay loam. Calco silty clay loam is another organic rich soil that has somewhat poor drainage but is high in organic content (Worster et al. 1972:11). Calco silty loam is classified as a mesic Cumulic Haplaquolls.

Bastian (13CK28) includes on three soil types, which are Allendorf silty clay loam, Dickman sandy loam, and Wadena silt loam. Allendorf silty clay loam is a moderate to well drained soil and is classified as a mesic Typic Hapludolls. This soil formed in silty alluvial and loess deposits over sand and gravel (Ceolla 1989:28, 68). Dickman sandy loam is a moderate to well drained soil and is a mesic Typic Hapludolls. Dickman sandy loam formed in loamy and sandy sediments deposited primarily by water, but also by wind (Ceolla 1989:17-18, 70). Wadena silt loam is the same as described for the sites in the southern area of the Little Sioux Valley and will not be repeated here.

Arable soils around Bastian (13CK28) are numerous, with nine different soils identified. These soils are: Allendorf silty clay loam, Coland clay loam, Dickman sandy loam, Fluvaquents-Omadi complex, Kennebec silty clay loam, Omadi silty clay loam, Spillville loam, Steinhauer-Hawick complex, and Wadena silt loam. Allendorf silty clay loam, Dickman sandy loam, and Wadena silt loam have already been described. Coland clay

loam is a poorly drained bottomland soil subject to flooding, but is well suited to crop growth. This soil formed in loamy alluvium and is a mesic Cumulic Haplaquolls (Ceolla 1989:27-28, 69). Fluvaquents-Omadi complex is a mixture of various soils with Omadi silty clay loam. These soils are poorly drained and are poor for crops. These soils are classified as mesic Fluvaquents and mesic Fluventic Hapludolls (Ceolla 1989:44-45). Omadi silty clay loam is a moderately to well drained soil that formed in silty alluvium, and is suited for crops. It is classified as a mesic Fluventic Hapludolls (Ceolla 1989:28, 75). Spillville loam is a moderately to well drained soil that formed in silty alluvium. It is classified as a mesic Cumulic Hapludolls and is well suited for crops (Ceolla 1989:35-36, 79). The Steinhauer-Hawick complex is a mixture of Steinhauer clay loam and Hawick sandy loam. It is a well to excessively drained soil complex and is unsuitable for crops due to its drainage and erosional characteristics (Ceolla 1989:40-41).

The soils at Burr Oak (13CY1), Gillett Grove (13CY2), and Milford (13DK1) are a diverse mixture of soil types. Burr Oak is situated on four different soils: Everly clay loam, Primghar silty clay loam, Sac silty clay loam, and Storden loam. Everly clay loam is well drained soil formed from gritty sediments overlying Wisconsinan glacial till. It is classified as a mesic Typic Hapludolls (Fisher 1969:20). Primghar silty clay loam is a somewhat poorly drained soil formed in loess over glacial till and is a mesic Aquic Hapludolls (Fisher 1969:32-33). Sac silty clay loam is a well drained soil formed in loess overlying glacial till. This soil is classified as a mesic Typic Hapludolls (Fisher 1969:34-36). Storden loam is another well drained soil and developed in calcareous glacial till. Storden loam is classified as an mesic Entic Hapludolls (Fisher 1969:38-39). Available arable soil at Burr Oak (13CY1) is Colo silty clay loam, which has already been described.

Gillett Grove (13CY2) sits upon three soil types: Everly clay loam, Primghar silty clay loam, and Storden loam. The soil type available for cultivation is Colo silty clay loam. All of these soils have been previously described.

Milford (13DK1) is situated on three soil types: Coland silty clay loam, Estherville loam, and Wadena loam. Coland silty clay loam is a poorly drained soil and formed in silty and loamy alluvium. It is classified as a mesic Cumulic Hapluquolls (Dankert 1983:26-27, 68). Estherville loam is an excessively drained soil that formed from loamy material that lies over calcareous sand and gravel. Estherville loam is classified as a mesic Typic Hapludolls (Dankert 1983:20-22, 73-74). Wadena loam is a well drained soil formed from loamy material overlying sand and gravel. It is classified as a mesic Typic Hapludolls (Dankert 1983:25-26, 34-35, 90-91).

Arable soils identified around Milford include the following: Calco silty clay loam, Coland silty clay loam, Coland-Spillville complex, Estherville loam, Millington channeled, Spillville loam, and Wadena loam. The Coland, Estherville, and Wadena soil have already been described site soils description. Calco silty clay loam is a poorly drained soil and formed in silty alluvium and lies over calcareous clay and sandy loam. It is classified as a mesic Cumulic Haplaquolls (Dankert 1983:42-43, 65-66). Coland-Spillville is a mixture of Coland silty clay loam and Spillville loam and is a poorly to somewhat poorly drained soil and are suited to growing crops. The Coland-Spillville complex is classified as a mesic Cumulic Hapludolls and a mesic Cumulic Haplaquolls (Dankert 1983:31). Millington channeled is a poorly drained soil subject to flooding and is considered unsuitable for cultivation. This soil formed in loamy alluvium and is classified as a mesic Cumulic Haplaquolls (Dankert 1983:45, 80). Spillville loam is a somewhat poorly drained soil formed in loamy alluvium. It is well suited for cultivation and is classified as a mesic Cumulic Hapludolls (Dankert 1983:38-39, 87-88).

Blood Run (13LO2) has seven soil types suitable for cultivation. Due to its large extent, these results are based upon a centered point within the confines of the site boundaries. The soil types are alluvial land, Benclare silty clay loam, Colo silty clay loam, Davis silt loam, Dempster silt loam, Estherville loam, and Omadi silt loam. Alluvial land is a mixture of Spillco, Millington, and Davis soils found on bottomlands of rivers. It is unsuitable for crops due to its frequency of flooding and has a variety of soil characteristics (Dankert and Hanson 1978:13). Benclare silty clay loam is a moderately well drained soil that formed in alluvium. This soil is suitable for cultivation and is classified as a mesic Pachic Haplustolls (Dankert and Hanson 1978:13-14). Colo silty clay loam is a somewhat poorly drained soil but is rich in organic content and is suitable for crops. This soil formed in alluvium and is classified as a mesic Cumulic Hapluquolls (Dankert and Hanson 1978:17). Davis silt loam is a moderately well drained soil formed in alluvium. The high organic content makes this soil suitable for cultivation although it does have a tendency to flood. It is classified as a mesic Pachic Haplustolls (Dankert and Hanson 1978:19-20). Dempster silt loam is a well drained soil formed in silty sediment lying over sand and gravel. It is suitable for cultivation and is classified as a mesic Udic Haplustolls (Dankert and Hanson 1978:20-21). Estherville loam is a somewhat excessively drained soil formed in alluvium from glacial meltwater and can be used for cultivation, although erosion and drainage can be a problem. It is classified as a mesic Typic Hapludolls (Dankert and Hanson 1978:23-25). Omadi silt loam is a well drained soil formed in alluvium and is suitable for cultivation. It is classified as a mesic Fluventic Hapludolls (Dankert and Hanson 1978:34).

Fauna

Faunal resources were also calculated based upon literature and previous studies (Fishel 1999; Harvey 1979; Semken and Falk 1987; Tiffany 1979b; Tiffany and Anderson 1993; Titcomb 2000; Wirth 1999). These data take into account the large game animals

only and include deer, elk and bison. While smaller mammals such as squirrels and gophers are present, their preservation in the archaeological record makes their identification extremely difficult, more so than the larger mammals (Fishel 1999; Harvey 1979). Further, their contribution to the subsistence of prehistoric groups would have been minimal at best due to their overall size and meat yield (Theler 1987:23).

Sites that have information for faunal remains include Dixon (13WD8), Bastian (13CK28), Gillett Grove (13CY2), Milford (13DK1), and Blood Run (13LO2) (Fishel 1999; Harvey 1979; Tiffany 1979b; Tiffany and Anderson 1993; Titcomb 2000). The remaining sites in the study area either do not have any faunal remains analyzed, or have not been excavated. These data results are based upon minimum number of individuals (MNI) present at each site. The data presented here are to be taken as a conservative estimate. Climate fluctuation, habitat changes, and human activities have altered the populations of these animals drastically as well as their distributions.

To determine the overall requirements for faunal resources, two factors are necessary. The first is the potential meat resources available to the site inhabitants (Nepstad-Thornberry 1998; Tiffany 1991). This was accomplished by calculating the total area and volume for each site. The volume excavated for each site that had MNI faunal data was then calculated and divided by the total site volume to determine the percent excavated for each site (Table 5.7). The data was then extrapolated out to the entire area of the site to determine potential faunal resources (Table 5.8). This study assumes that the data collected is representative of the site and that there is an even distribution of faunal remains across the site. The second factor is the yearly requirement of meat for one individual (Table 5.9). Based upon previous studies of subsistence and environmental analysis within northwest Iowa (Nepstad-Thornberry 1998; Tiffany 1991; Tiffany and Anderson 1993), this study assumes that bison was the large game animal of choice

Table 5.7. Site Characteristics of Oneota Sites in Northwest Iowa.

Site Name	Site Number	Site Area (m ²)	Site Volume (m ³)	Volume Excavated (m ³)	Percent Excavated (%)
Dixon	13WD8	230285	92114	33.4	0.00036
Gothier	13WD3	260465	—	—	—
Correctionville	13WD6	144186	—	—	—
Bastian	13CK28	265310	—	—	—
Burr Oak	13CY1	143386	—	—	—
Gillett Grove	13CY2	67154	20146	19.36	0.00096
Milford	13DK1	90176	36070	142.4	0.0039
Blood Run	13LO2	—	—	—	—

Table 5.8. Potential Animal Resources from Two Oneota Sites.

Site Name	MNI			Potential Yields		
	Bison	Deer	Elk	Bison	Deer	Elk
Dixon	13	6	2	36111	16667	5556
Milford	34	7	2	8718	1795	513

Table 5.9. Meat Required for One Average Adult Per Year.

Animal	Ratio	Meat Per Day	Meat Per Year	Meat Per Animal ¹
Bison	0.85	0.59 kg	215.4 kg	272.2 kg
Deer	0.10	0.07 kg	25.6kg	38.6 kg
Elk	0.05	0.04 kg	14.6 kg	158.8 kg

¹ Data from Theler 1987

providing 85% of the meat consumed, with deer comprising another 10%, and elk comprising the remaining 5%. Further, this study also assumes that 0.7 kg (1.5 lbs), or half the diet of the Oneota consists of meat resources. This result is consistent with other studies and models that have used the conservative estimate of 1.36 kg of meat consumed per day by groups that relied heavily on large game animals for their subsistence (Ewer 1955; Tiffany 1991).

Based upon the numbers calculated for sites with MNI counts for faunal data, there are enormous quantities of meat potentially available. In all probability there was more meat available than people to eat it. One unfortunate obstacle that this study is faced with is missing data from a number of sites. One problem is that faunal data is available, but is not calculated as an MNI result such as previous excavations at Dixon (Harvey 1979), or excavations at Gillett Grove (Titcomb 2000). Another problem is while an MNI exists for species, the data collected was done by pedestrian survey. As a result no volumetric parameters are available, which is the case for Bastian (13CK28) (Tiffany 1979b). Correctionville (13WD6) was excavated as part of a salvage project, but again no faunal data were available (Henning 1961). Finally, sites such as Gothier (13WD3), and Burr Oak (13CY1) have never been excavated. The results from Table 5.9 show that one person would most likely need less than one animal per year of each of the main large animals in order to survive.

The sites with no faunal data have been given an estimated MNI count based upon the following calculations. The sites with faunal data (Dixon and Milford) were added together to come up with a "benchmark" site. The total area and MNI counts were combined to come up with an area of 320,461 square meters and an MNI total for each animal. Each site was then divided by the total area of Dixon and Milford to arrive at a percentage of the sites relative to the benchmark site. This percentage was then multiplied by the MNI counts for each animal to come up with an estimated MNI total (Table 5.10).

While this is merely an estimate for each site, the data could be tested in a number of ways. One would be to compare these estimates of the MNI totals with the catchment areas with regard to habitat locations and land area. This would work for deer and elk, but likely not for bison since bison were usually acquired some distance from the sites during annual bison hunts. Another possibility would be to excavate a portion of those sites without

Table 5.10. Estimated MNI Totals for Oneota Sites Based Upon MNI Totals from Dixon and Milford.

Site Name	MNI	Potential Yields					
		Bison	Deer	Elk	Bison	Deer	Elk
Dixon and Milford		47	13	4	44829	18462	6069
Gothier		38	11	3	17840	5164	1409
Correctionville		21	6	2	9859	2817	939
Bastian		39	11	3	18310	5164	1409
Burr Oak		21	6	2	9859	2817	939
Gillett Grove		10	3	1	4695	1409	470
Blood Run		--	--	--	--	--	--

MNI totals with a volumetric percentage equal to the combination of Dixon and Milford and see if the result for faunal remains comes close to the estimated results obtained in this study.

Timber

Timber would be used for a variety of tools and more importantly structures for habitations. Ethnographic sources demonstrate that multiple house types were used by historic tribes believed to be descendants of Oneota groups (Blaine 1979; Bushnell 1922; Fletcher and LaFlesche 1911; Radin 1971; Skinner 1926). Most houses were rectangular or oval in shape covered by bark or thatch. House features excavated at Dixon (13WD8) revealed rectangular houses and oval houses (Harvey 1979; Fishel 1999). Possible house structures also exist at Gillett Grove (13CY2) and Milford (13DK1) (Tiffany and Anderson 1993; Titcomb 2000). In addition to the more permanent house structures, timber would be needed for shelters during annual bison hunts. Timber would also be used for handles for digging implements (Wilson 1917), as well as for arrow shafts. Dead wood could also have been used as a source of fuel.

Timber needed for each house would vary considerably. Factors such as family size, type of house built, and overall house size would have to be taken into account. W. Wedel (1979) determined that most rectangular and circular earth lodge type dwellings needed between twelve and twenty large vertical posts just for the superstructure. Archaeological reconstructions of lodges needed on average fifty trees for the superstructure and the bark required to cover a bark lodge (D. Anderson 2000, personal communication). Most tipis needed on average between fourteen to sixteen poles for the frame and ten to twelve bison hides to cover it (Fletcher and LaFlesche 1911:95). For this study, a few factors will be assumed. The first is that an average family consists of ten individuals. The second factor utilizes W. Wedel's (1979) analysis of Central Plains structures and his calculation of 5m² of floor space per individual. The third factor assumes that each habitation will be in use for ten years before it is abandoned or rebuilt. Finally, this study assumes that it requires fifty trees plus to build one house. Therefore, the average house size is 50m², which essentially works out to one tree per square meter.

Timber resources were determined based upon trees per hectare and the proportion of timber resources within each catchment. There are currently no published data available for tree density within the Little Sioux Valley. However, the United States Forest Service has an online searchable database that can be queried to show the amount of timberland and tree species within the United States. This was used to get the necessary data for each of the counties in the study area. Counties that do have timber data available include Buena Vista, Cherokee, Clay, Lyon, Monona, O'Brien, and Woodbury (Table 5.10). The counties of Ida and Dickinson that do not have timber survey data available were estimated based upon tree density of surrounding counties (Table 5.11). Dickinson was estimated based upon the average tree density for Clay and Lyon Counties. Ida tree density was calculated from the average tree density from Cherokee and Woodbury Counties.

Table 5.11. Major Forest Associations in the Study Area and Forest Extent.

County	Short Pine	Oak-Pine	Oak-Hickory	Elm-Ash-Cottonwood	Maple-Beech-Birch
Buena Vista	—	—	1499 ha	—	1701 ha
Cherokee	—	—	—	1499 ha	—
Clay	—	—	1170 ha	1170 ha	—
Lyon	—	—	—	1170 ha	—
Monona	1256 ha	729 ha	6723 ha	1013 ha	2916 ha
O'Brien	—	—	1499 ha	—	—
Woodbury	—	—	1985 ha	1863 ha	972 ha

Table 5.12. Timber Areas and Tree Density Per Hectare by County.

County	Timber Extent	Trees Per Hectare
Buena Vista	3200 ha	890
Cherokee	1499 ha	373
Clay	2340 ha	1237
Dickinson	—	740
Ida	—	419
Lyon	1170 ha	243
Monona	12637 ha	948
O'Brien	1499 ha	1476
Woodbury	4820 ha	465

Based upon the timber survey data, there are two main timber associations, and three secondary timber associations in the study area. The two main associations are the Oak-Hickory forest located on sideslopes and valley walls, and the Elm-Ash-Cottonwood forest primarily found on bottomlands of rivers and streams. The secondary timber associations are the Short Pine, Oak-Pine, and Maple-Beech-Birch forests (Schwartz 2001, personal communication). The locations of these forests are dependent upon a number of factors including, but not limited to slope aspect, available moisture, landform and elevation, and competing species of plants and other trees. Tree density varies widely throughout the

counties in the study area. A great majority of these trees will be found in the valleys of river systems such as the Little Sioux. It may be that greater tree density farther north is the result of narrower valley widths. If the floodplain and bottomland areas are not wide enough for historic development or farming, the timber stands might have been left relatively unaltered or removed.

Site Catchment Results

The analysis of the Oneota site catchments reflects a composition of a variety of landforms and habitats. Landforms were categorized by the author based upon studies of Oneota site catchments in other regions (Table 5.13). Vegetative communities were also categorized by examination of previous literature and environmental studies of Oneota sites (Tiffany 1982; Tiffany and Anderson 1993). These vegetative communities reflect a mixture of lowland forest and prairie, gallery forest, and prairie (Table 5.14).

Resource Procurement

Resource necessities for a given population depend upon mode of subsistence, population, and economic potential of a given area. For the Oneota sites in northwest Iowa, it has been determined through archaeological excavation and survey that Oneota groups were using a broad spectrum of subsistence coupled with a rather permanent settlement pattern for an extended period of time.

In order to understand the economic potential of each site catchment, different population numbers will be utilized in conjunction with different years of occupation. For the purpose of this study, population estimates from fifty up to two hundred fifty individuals with the length occupation ranging from one to fifty years are shown (Table 5.15). The major resources of maize, large game requirements, and timber are calculated for each of the population groups and occupation years. These results were then compared with the

Table 5.13. Landform Categories in Hectares and Percent of Total for Northwest Iowa Oneota Sites.

Site Name	Site Number	Bottomlands	Terraces	Sideslopes	Uplands	River	Water	Total
Dixon	13WD8	869.76 54.48	114.33 7.16	114.08 7.15	453.77 28.42	23.47 1.47	21.05 1.32	1596.45 100.00
Gothier	13WD3	739.71 51.53	176.96 12.33	85.69 5.97	401.35 27.96	30.44 2.11	1.47 0.10	1435.62 100.00
Correctionville	13WD6	596.04 37.94	311.74 19.84	120.07 7.64	515.41 32.8	27.946 1.78	-- --	1571.20 100
Bastian	13CK28	304.33 23.47	360.31 27.78	261.367 20.15	328.71 25.35	39.80 3.07	2.40 0.18	1296.92 100.00
Burr Oak	13CY1	172.96 14.06	70.666 5.74	112.35 9.12	859.55 69.85	14.50 1.18	0.557 0.05	1230.58 100.00
Gillett Grove	13CY2	141.27 9.46	186.10 12.45	64.80 4.34	1082.75 72.47	16.48 1.10	2.657 0.18	1494.05 100.00
Milford	13DK1	198.82 12.71	399.45 25.52	73.84 4.72	860.30 54.97	31.814 2.03	0.762 0.05	1564.99 100.00
Blood Run	13LO2	118.34 12.91	297.22 32.42	152.81 16.67	330.21 36.03	18.03 1.97	-- --	916.61 100.00

Table 5.14. Vegetative Communities in Hectares and Percent of Total for Northwest Iowa Oneota Sites.

Site name	Site number	Lowland prairie	Lowland woods	Wooded hillslopes	Prairie hillslopes	Upland prairie	Gallery forest	Water
Dixon	13WD8	975.74 61.12	8.35 0.52	20.46 1.28	93.63 5.86	332.34 20.82	121.43 7.61	44.52 2.79
Gothier	13WD3	904.44 63.00	12.22 0.85	13.75 0.96	71.94 5.01	248.63 17.32	152.72 10.64	31.91 2.22
Correctionville	13WD6	829.62 52.80	78.16 4.97	12.85 0.82	107.22 6.82	381.26 24.27	134.15 8.54	27.95 1.78
Bastian	13CK28	402.62 31.04	146.46 11.29	25.34 1.95	150.65 11.62	407.64 31.43	122.00 9.41	42.21 3.25
Burr Oak	13CY1	147.88 11.90	99.59 8.01	6.89 0.55	105.46 8.49	668.57 53.79	199.43 16.05	15.06 1.21
Gillett Grove	13CY2	299.78 20.06	26.73 1.79	38.11 2.55	26.69 1.79	930.61 62.29	152.99 10.24	19.14 1.28
Milford	13DK1	10.89 0.70	187.93 12.01	48.10 3.07	25.74 1.64	1123.32 71.78	136.43 8.72	32.58 2.08
Blood Run	13LO2	339.58 37.05	75.10 8.19	8.97 0.98	143.84 15.69	294.35 32.11	36.75 4.01	18.03 1.97

Table 5.15. Resource Needs Based Upon Population Size and Occupation Years.

Population	Resource	1 Year	10 Years	20 Years	30 Years	40 Years	50 Years
50 People							
	Maize	934 bushels					
	Bison	40	396	792	1187	1583	1979
	Deer	34	332	664	995	1327	1659
	Elk	5	46	92	138	184	320
	Timber	250 trees	500 trees	750 trees	1000 trees	1250 trees	1500 trees
100 People							
	Maize	1869 bushels					
	Bison	80	789	1583	2375	3167	3957
	Deer	67	664	1327	1990	2653	3317
	Elk	10	92	184	276	368	460
	Timber	500 trees	1000 trees	1500 trees	2000 trees	2500 trees	3000 trees
150 People							
	Maize	2803 bushels					
	Bison	119	1187	2374	3561	4748	5935
	Deer	100	995	1990	2985	3980	4975
	Elk	14	138	273	414	552	690
	Timber	750 trees	1500 trees	2250 trees	3000 trees	3750 trees	4500 trees
200 People							
	Maize	3737 bushels					
	Bison	159	1580	3167	4748	6331	7914
	Deer	133	1327	2653	3980	5306	6633
	Elk	19	184	368	552	736	920
	Timber	1000 trees	2000 trees	3000 trees	4000 trees	5000 trees	6000 trees
250 People							
	Maize	4671 bushels					
	Bison	198	1979	3957	5946	7914	9892
	Deer	166	1659	3317	4975	6633	8291
	Elk	23	230	460	690	920	1150
	Timber	1250 trees	2500 trees	3750 trees	5000 trees	6250 trees	7500 trees

catchment areas for each Oneota site to determine how long the site could have been inhabited before resources became too low to sustain the population.

Actual population estimates were not calculated since that is beyond the scope of this research. Furthermore, there does not exist sufficient subsistence data from enough sites to determine the overall importance of horticulture, hunting, and gathering relative to one another. With this being the case, resource requirements for subsistence will assume a diet based upon maize and hunting, with each lending half of the total diet. While other crops such as squash and beans were utilized in addition to wild plants, these are left out of the following analyses. While sites such as Dixon do have some seed analysis data available (Fishel 1999), the majority of sites in the study area do not. Therefore, the maize requirement needed for one individual per day is calculated to be approximately 1.3 kg (2.9 pounds). This result is based upon other subsistence studies whose populations have a similar mode of subsistence as the Oneota (Nepstad-Thornberry 1998:83).

Large game animals of importance such as bison, elk and deer have their calculated daily requirements per individual for one day and one year are given in Table 5.9 and will not be repeated here. Table 5.10 also has useful information regarding estimated MNI totals for bison, deer, and elk for each of the sites in the study area. Deer estimates of 14 deer per square kilometer are used based upon previous studies in Iowa (Wirth 1999).

Timber resources as previously mentioned are calculated at fifty trees per habitation and an average size of 50m² per habitation. This result was derived from W. Wedel (1979) and his analysis of floor space per person. Finally, it is also assumed that each household contains ten individuals as outlined earlier in this chapter.

While this serves as a model for possible resource utilization by Oneota groups in the Little Sioux Valley, the basis for these results stems from previous research in the area and is supplemented by ethnographic accounts of historic tribes thought to be descendants

of the Oneota and also with ethnographic studies of other historic tribes who shared similar subsistence practices and lived in a similar environment.

Dixon (13WD8)

Dixon sits upon a terrace remnant that is composed of a moderate to well-drained soil that would be ideal for habitation (Figure 5.2). Dixon is surrounded by lowland prairie and is close to gallery forest and prairie (Figure 5.3). The Dixon catchment has the bottomlands of the Little Sioux River as its largest landform. Upland areas constitute the next largest landform type. Dixon also appears to be the most abundant with regard to potential resources. Timber is scarcest at Dixon, with just under ten percent (9.41%), or 150.24 hectares (371.25 acres) of the total vegetation comprising timber. However, there would still be more than enough timber available for dwellings or other structures. With an estimated 465 trees per hectare, 3 hectares (7.41 acres) of timber would have to be cut down to secure enough timber to build 25 lodges.

MNI counts of potential faunal remains at Dixon demonstrate that enormous amounts of bison may have been available. If this was the case, the inhabitants of Dixon were possibly accumulating large surpluses. Depending upon population size, deer required per year would range between 34 animals for 50 people up to 168 animals for 250 people. With deer preferring a woodland and edge habitat, 27 deer would be available from the catchment, including a buffer distance of 20 meters to simulate edge between the forest and prairie. Either the inhabitants of Dixon would have to range further to seek out deer, or they were possibly relying more upon bison or other animals to supplement their diet. It should also be noted that the deer count used per square kilometer is also a conservative estimate so more deer could have been in the area.

Horticultural lands include well-drained soils with a high potential for growth and would require minimal modification to the soil based upon modern soil classification. The

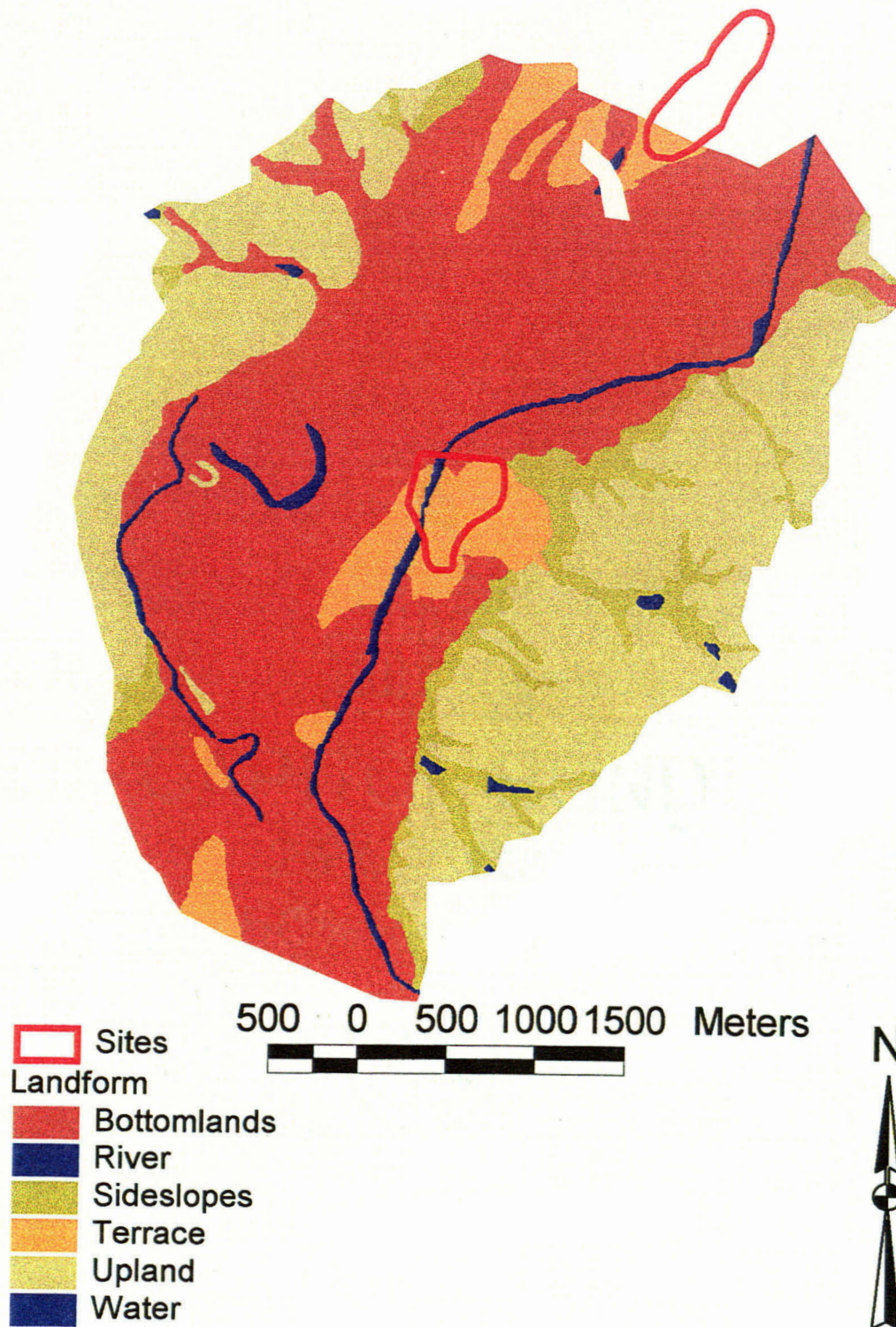


Figure 5.2. Landforms within the Dixon (13WD8) site catchment.

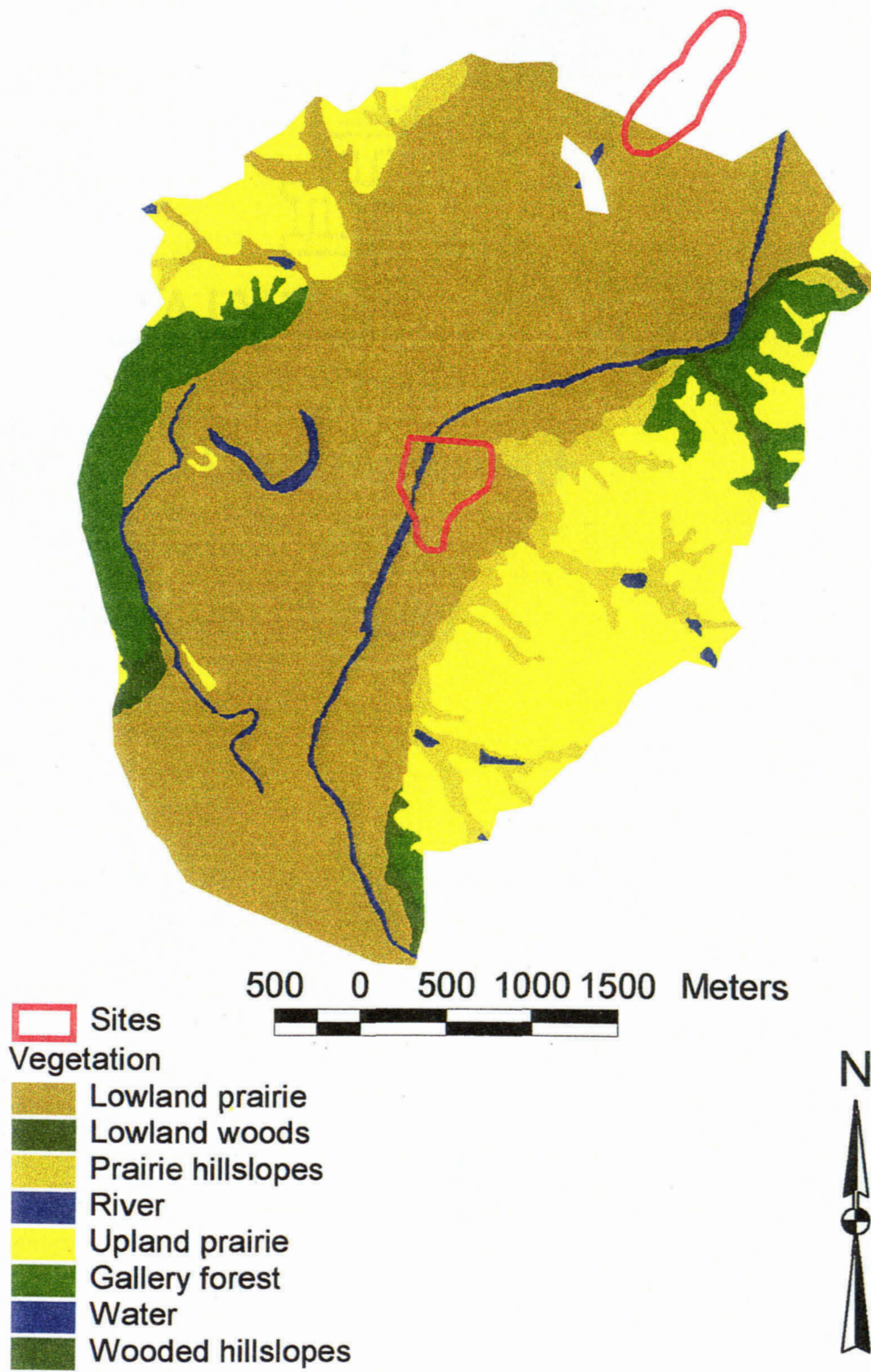


Figure 5.3. Model of prehistoric vegetation in the Dixon (13WD8) site catchment.

soils available for farming have the highest classified land designation units. Defined as primeland, it produces the highest yields with minimal inputs of energy and economic resources, and farming results in the least amount of environmental damage (ISPAID 1996:8). Thirty-eight acres would need to be farmed for 50 people, while 187 acres would have to be farmed for 250 individuals.

Gothier (13WD3)

Gothier resides on a terrace remnant north and east of Dixon (13WD8). Gothier also sits upon a well-drained soil with the same soil characteristics of Dixon (Figure 5.4). As such it is ideally suited for a habitation area. The Gothier catchment has lowland prairie as the most dominant vegetative type (Figure 5.5). The predominant landform at Gothier are the bottomlands associated with the Little Sioux River. Upland areas are the next largest landform in areal extent. Timber along the valley walls and upland prairie are found to the northwest and southeast of the site.

Timber regions constitute 178.69 hectares (441.55 acres), or 12.45 percent of the total catchment area. As a result, more than enough timber is located in the catchment to fulfill necessary building needs, even for 250 inhabitants occupying the site for 50 years.

While Gothier has never been excavated, the estimated MNI counts from table 5.10 may give indication of the faunal remains that could have been at the site, since nearly all of the site has been destroyed by gravel operations. The total habitat area for deer, counting only timber and a 20 meter buffer around the timber for edge, comes out to 222.66 hectares (550.2 acres), or 2.23 square kilometers. Given the conservative estimate of 14 deer per square kilometer, 32 deer would be available to the inhabitants of Gothier. A situation similar to Dixon (13WD8) is also present at Gothier; either not much reliance was put on deer, or they would have to travel further away from the site to obtain them.

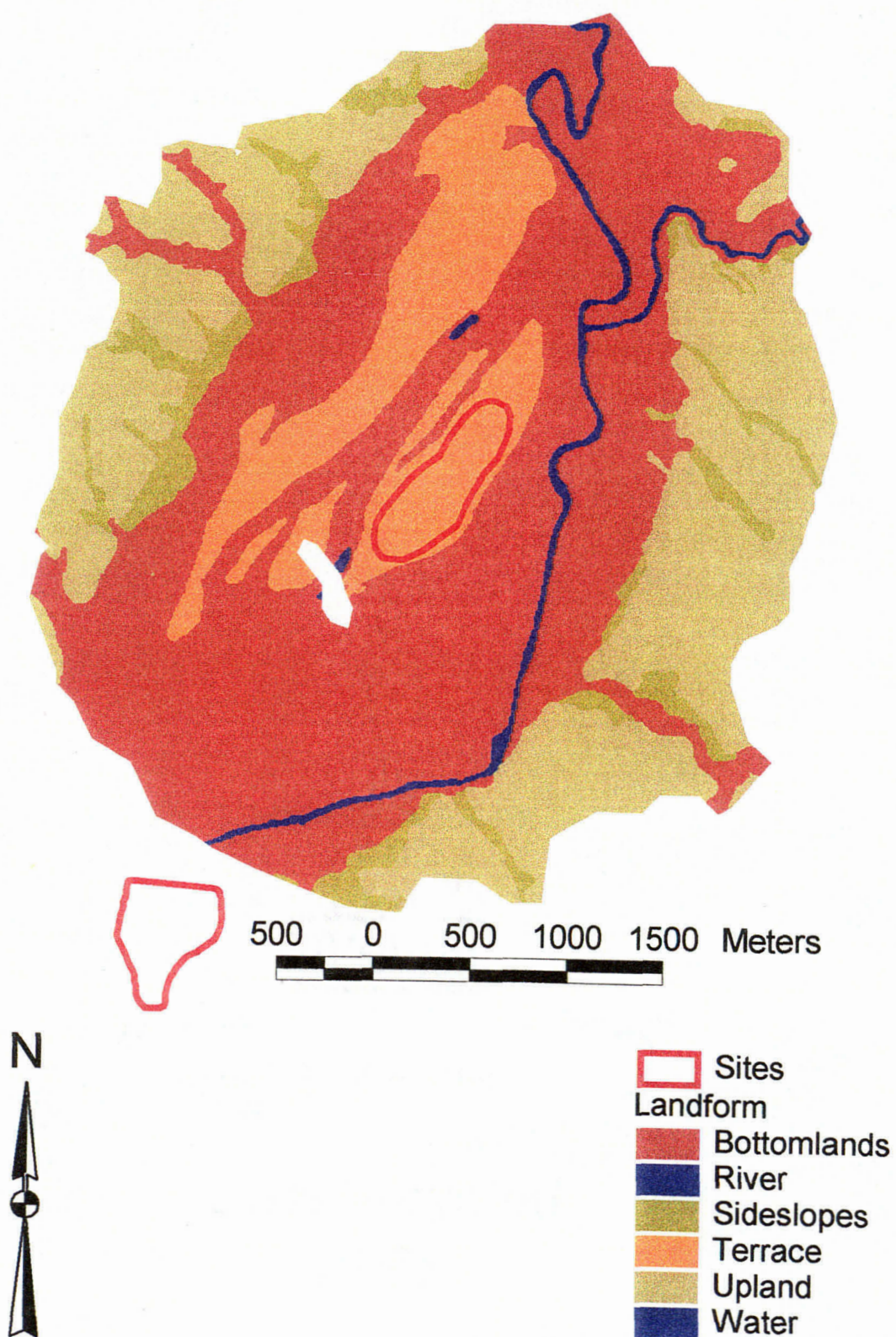


Figure 5.4. Landforms within the Gothier (13WD3) site catchment.

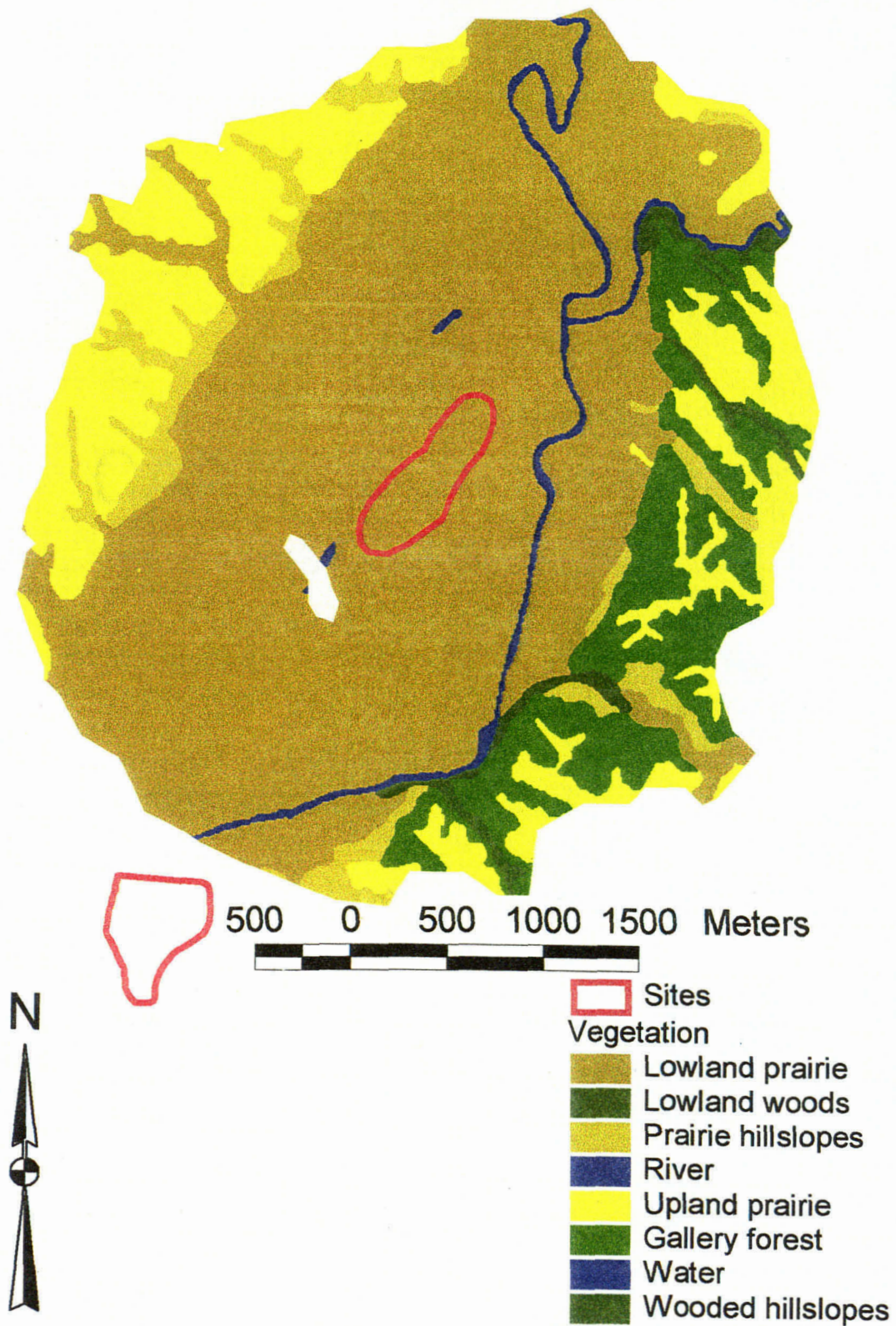


Figure 5.5. Model of prehistoric vegetation in the Gothier (13WD3) site catchment.

There is enough land around Gothier with suitable soil characteristics to produce 3730 bushels of maize per year (Table 5.4). Likely not all of this land would be utilized, since there would be inadequate numbers of people to cultivate all of the land.

Interestingly, the Gothier catchment overlaps with the Dixon catchment. If the hypothesis put forth by Fishel (1999) is taken into consideration, Gothier may represent the movement of people from Dixon to the Gothier site area after the resources around Dixon were depleted to the point of not being able to sustain them. Both Dixon and Gothier have similar percentages of vegetative communities within each catchment, and roughly the same diversity of landforms.

Correctionville (13WD6)

The Correctionville site rests upon another terrace remnant of the Little Sioux Valley, which has the same soil type and properties also found at Dixon (13WD8) and Gothier (13WD3). The dominant landform in the catchment is the bottomland region of the Little Sioux River (Figure 5.6). Upland areas constitute the next largest landform in the catchment. Most of the vegetation consists of lowland and upland prairie (Figure 5.7).

The prehistoric model of the Correctionville site catchment has timber present, swinging in an arc from southwest to northeast along the southern portion of the catchment. The total area of timber is 225.16 hectares (556.38 acres), or 14.33 percent of the total site catchment. This demonstrates that there are adequate timber resources within the vicinity of the catchment to satisfy the demand for required habitations or other structures for up to 250 people occupying Correctionville for 50 years.

Correctionville has had salvage excavations conducted on it by the Northwest Chapter of the Iowa Archaeological Society in the 1960s (Henning 1961). Outside of this, gravel operations have destroyed almost the entire site. As a result, estimated MNI counts were calculated (Table 5.10) to give some indication of the animal remains. Timber areas

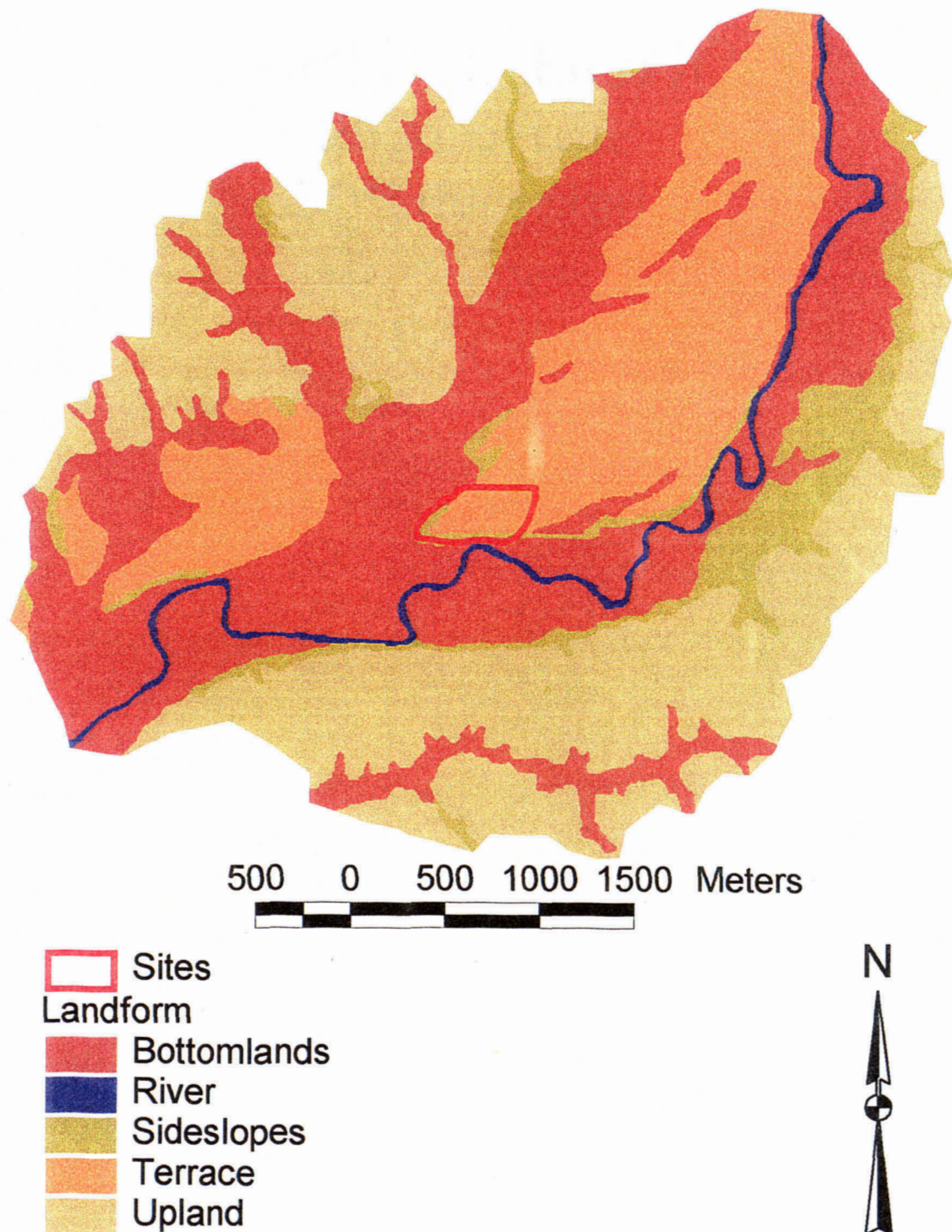


Figure 5.6. Landforms within the Correctionville (13WD6) site catchment.

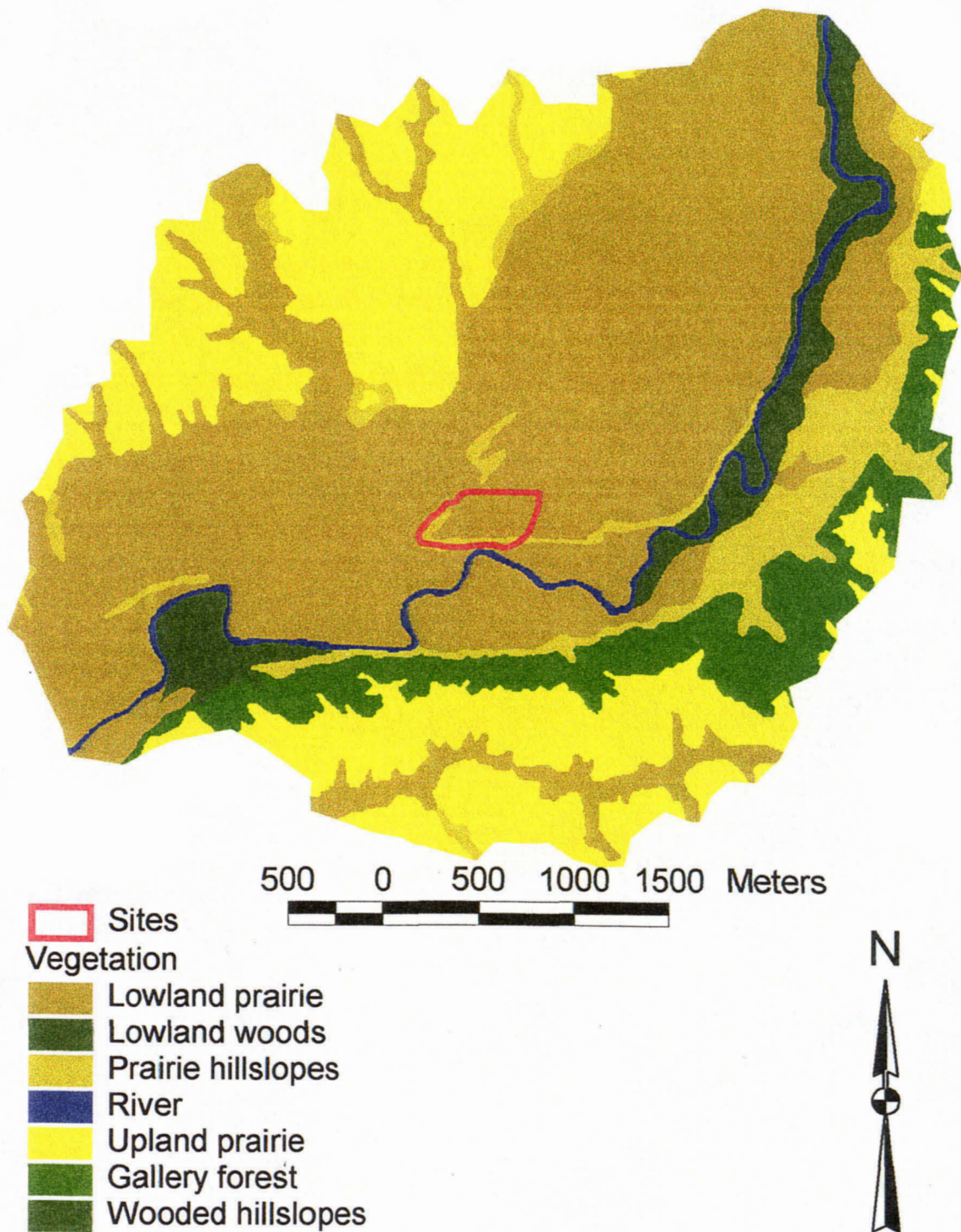


Figure 5.7. Model of prehistoric vegetation within the Correctionville (13WD6) site catchment.

and a 20 meter edge buffer were created yielding a total of 288.77 hectares (713.56 acres), or 2.89 square kilometers for deer habitat. Forty-one potential deer could have been available to the Correctionville inhabitants on an annual basis.

Correctionville has the largest arable land section of all of the northwest Iowa Oneota sites defined by a 30 minute walking time. Arable land available around the site is calculated to be 60.39 hectares (149.23 acres). Like Dixon (13WD8) and Gothier (13WD3), Correctionville has surrounding it some of the most productive soils in the area, making the area ideal for maximum cultivation. If all the arable land around Correctionville was utilized, over 5417 bushels of maize could be harvested each year (Table 5.4). If half the land was utilized, a population of 150 people could live at Correctionville for 50 years without problems with regard to horticultural practices, assuming continuous cultivation.

Bastian 13CK28

The Bastian site is located on a higher terrace remnant than the sites found at the Correctionville locality, and is at the confluence of the Little Sioux River and Mill Creek. This higher terrace remnant is subsequently older than the terrace remnants found at Correctionville. The site is strategically located in limiting access farther north on the Little Sioux River and northwest by way of Mill Creek. The soil composition and characteristics are identical to the soils found at the Correctionville locality: well drained soils with a highly productive agricultural index (ISPAID 1996). Bottomlands, terraces, and uplands constitute an almost equal percentage of the catchment relative to one another at 23.47, 27.78, and 25.35 percent respectively (Figure 5.8). The uniqueness of this geomorphological association is perhaps due to the differing ages and junction of Mill Creek and the Little Sioux River.

The major vegetation type in the Bastian site catchment is prairie on the bottomlands and uplands, comprising over 60 percent of the total area (Figure 5.9). However, there is

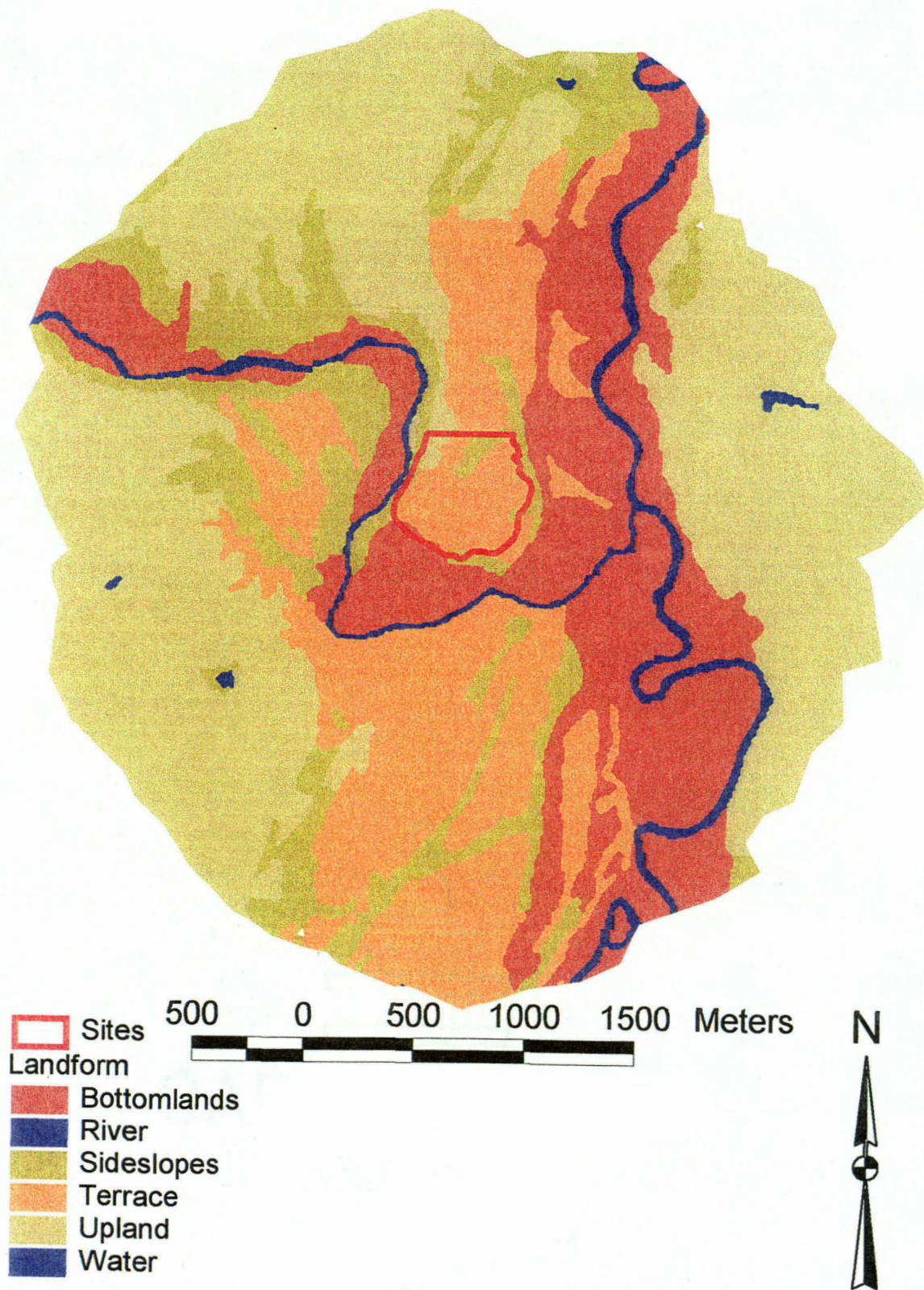


Figure 5.8. Landforms within the Bastian (13CK28) site catchment.

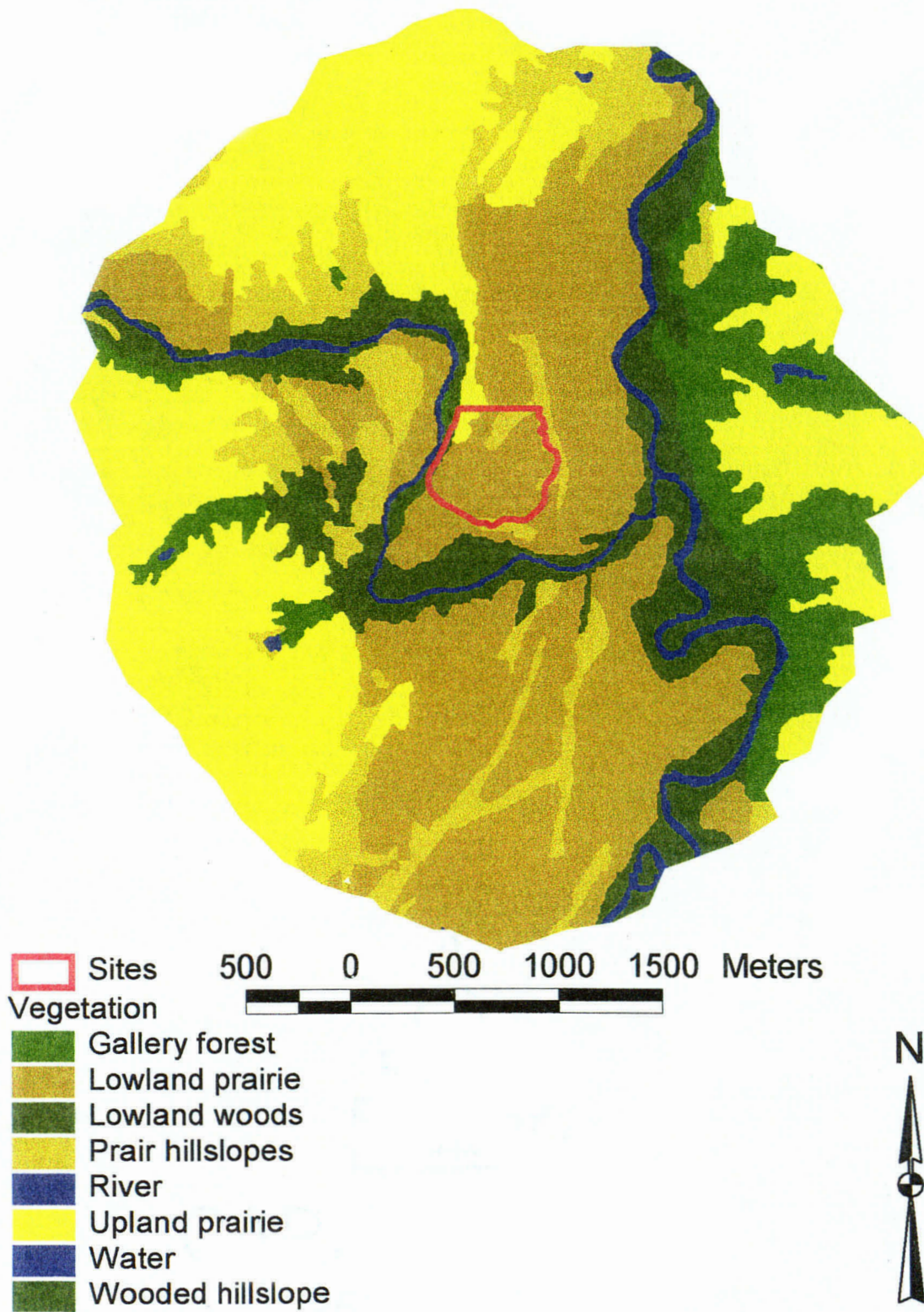


Figure 5.9. Model of prehistoric vegetation in the Bastian (13CK28) site catchment.

more forested area around Bastian. Timber comprises 293.8 hectares (726.9 acres), or 22.65 percent of the total catchment area, with an average of 373 trees per hectare. The timber is found primarily as gallery forest occupying the walls and bottomlands of both Mill Creek and the Little Sioux River. This abundance of timber in the catchment based upon the prehistoric modeling demonstrates that adequate timber resources could be found within the Bastian catchment.

Faunal resources are estimated in Table 5.10. By calculating a 20 meter edge buffer around the timber in the Bastian catchment, 4.05 square kilometers of deer habitat is found in the catchment. With an estimate of 14 deer per square kilometer, approximately 57 deer would be available to the people at Bastian. Depending upon their preference for deer or its importance in the diet, more deer would have to be found outside the catchment if deer were taken only from forest areas.

Horticultural activities could take place on the terrace remnant or on the bottomlands of the Little Sioux River or Mill Creek. The soils are highly productive based upon modern farm indexes of crop yields. A total of 2071 bushels of maize would be available if all of the farmland around Bastian utilized. If half of the arable land was utilized for horticulture, a group of 50 people could live comfortably at Bastian for 50 years.

Burr Oak (13CY1)

The Burr Oak site represents a significant shift with regard to the site location of earlier Oneota sites in the southern portion of the Little Sioux Valley. Burr Oak is situated at the end of an upland interfluvium facing north towards the Little Sioux River. The Burr Oak site catchment is dominated by upland landforms, which comprise 69.85 percent of the total catchment area (Figure 5.10). Bottomlands along the Little Sioux River constitute the next largest landform category. The soils around Burr Oak are well drained and have good potential for cultivation.

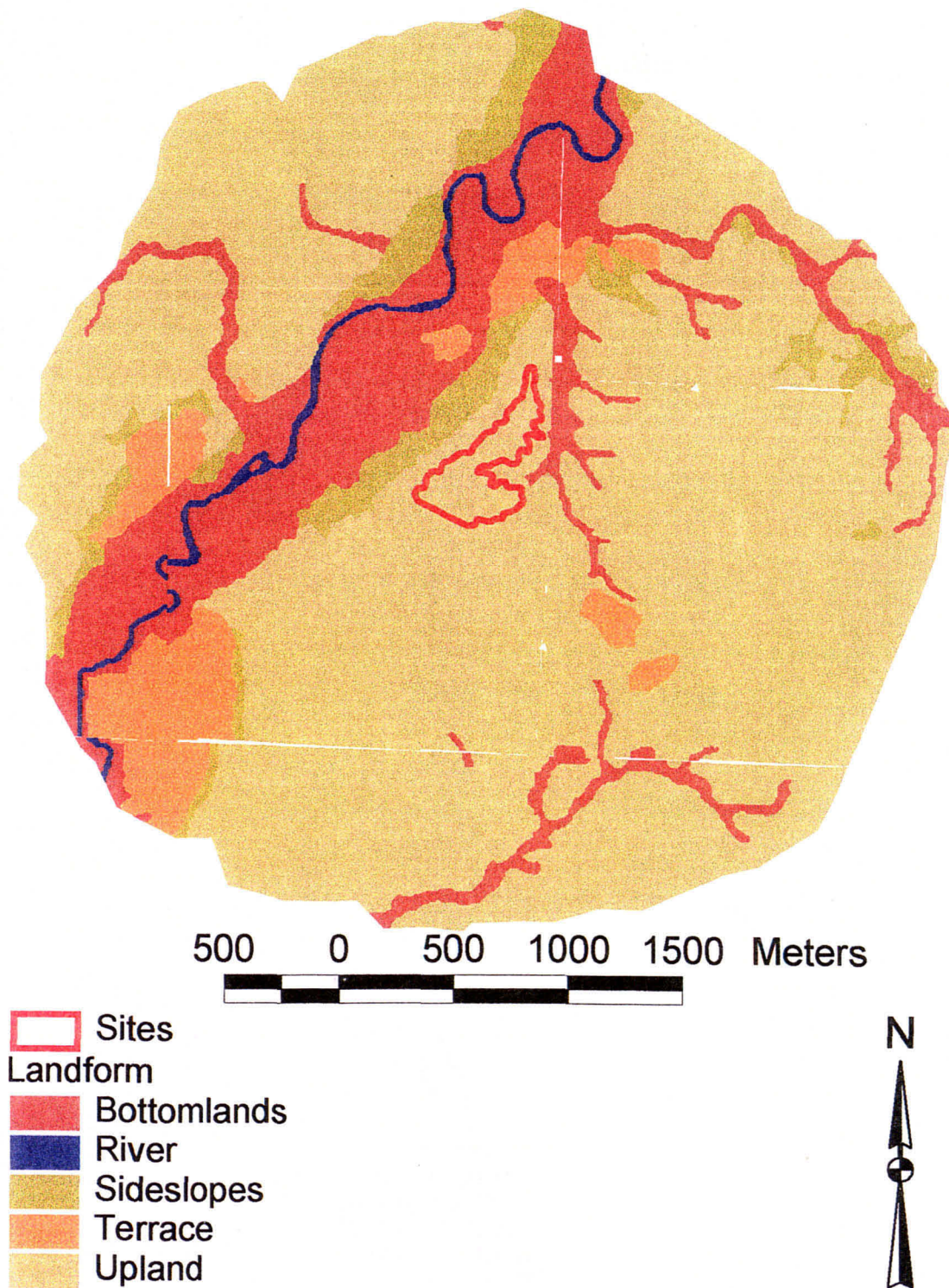


Figure 5.10. Landforms within the Burr Oak (13CY1) site catchment.

A great majority of the Burr Oak catchment is covered by upland prairie. In addition, Burr Oak has the largest expanses of timber of all the northwest Iowa sites containing 305.91 hectares (755.6 acres), or 24.61 percent (Figure 5.11). Since Clay County has a high density of trees, there are substantial amounts of timber available within the Burr Oak catchment to satisfy any demands for houses or other structures.

Like other Oneota sites in the Little Sioux Valley, Burr Oak has never been excavated or systematically surveyed. As a result estimated MNI were estimated for Burr Oak (Table 5.10). Considering timber as the primary habitat for deer, and creating a 20 meter buffer around the timber within the Burr Oak Catchment, 4.1 square kilometers are available for hunting deer. This results in 58 deer available for the inhabitants of Burr Oak. The calculation does not provide enough deer. Therefore, deer would have to be taken farther away from the catchment if deer were hunted only from forest habitats.

As described earlier in this chapter, Burr Oak has a significant lack of arable soils around the immediate vicinity of the site. Most of the soils found within the farming area are very good soils for cultivation, however, they are situated on the steep sideslopes of the valley, making them unsuitable for farming. Therefore, in order to do any sort of farming, the inhabitants of Burr Oak would have to go farther out onto the bottomlands or farm nearby the site on the uplands south of the site itself. Based upon the parameters stipulated in Table 5.15, 50 people could live at Burr Oak for approximately 10 years or less.

Gillett Grove (13CY2)

Gillett Grove is another upland Oneota site five miles directly north from Burr Oak (13CY1). It is located on an upland landform adjacent to the valley wall of the Little Sioux River (Figure 5.12). Upland landforms constitute 72.47 percent of the catchment, far surpassing any other landform (Table 5.13). Terrace remnants are the next largest category of landforms. The soils around Gillett Grove on the uplands are good for growing crops.

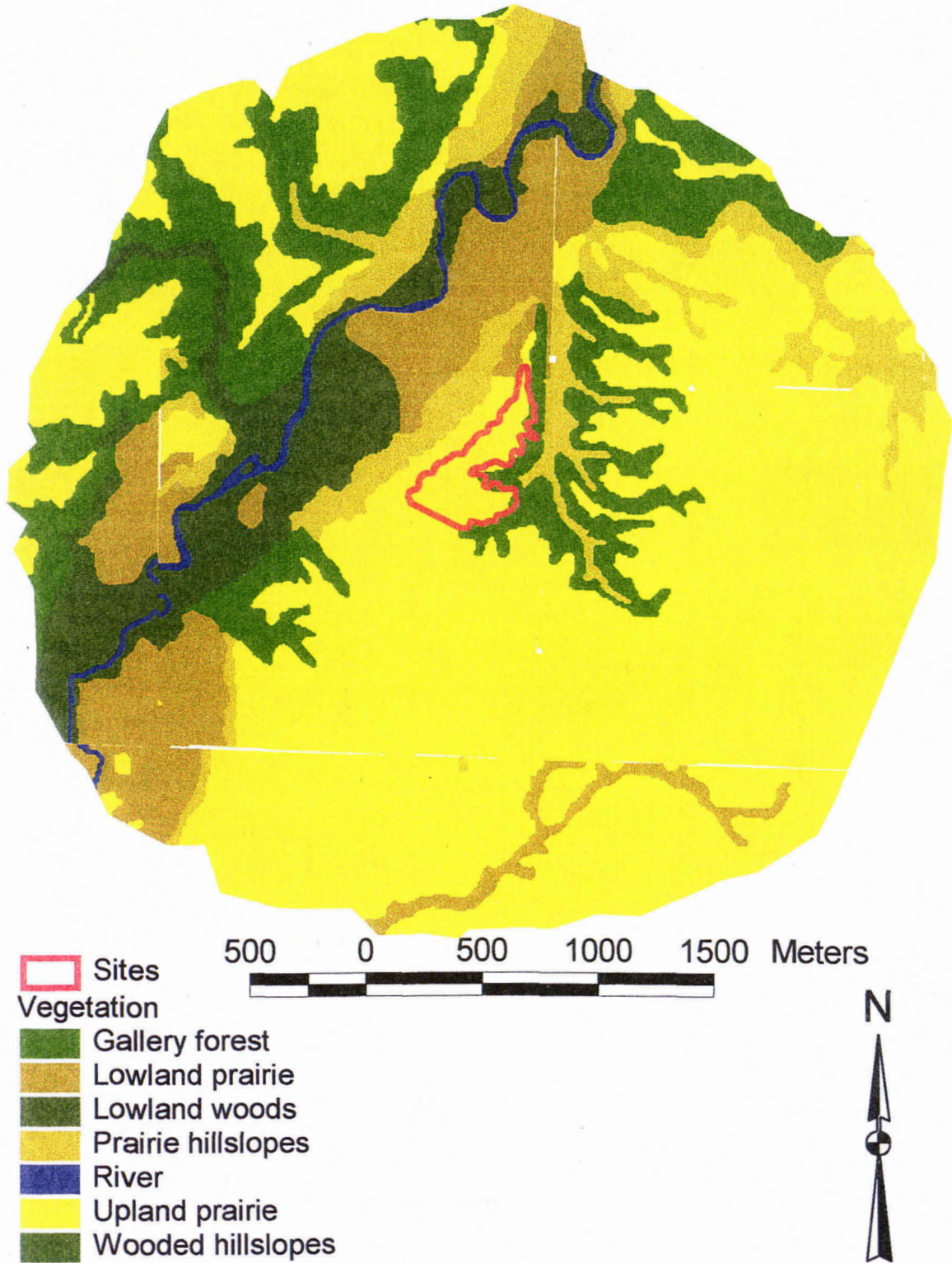


Figure 5.11. Model of prehistoric vegetation in the Burr Oak (13CY1) site catchment.

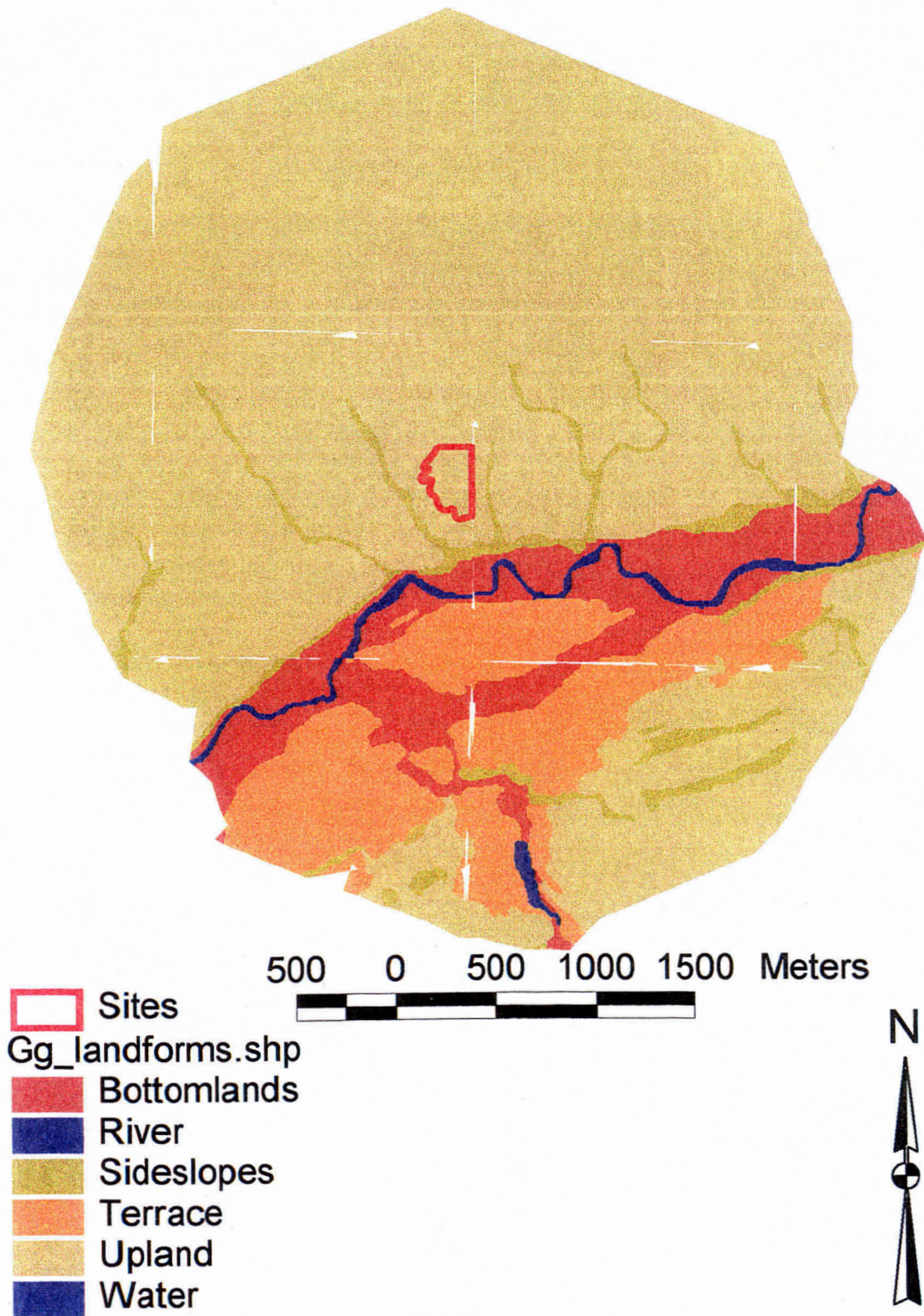


Figure 5.12. Landforms within the Gillett Grove (13CY2) site catchment.

However, the soil upon which Gillett Grove is on is a poorly drained soil, making it somewhat anomalous with regard to Oneota sites of earlier age in the Little Sioux Valley.

Vegetation in the Gillett Grove catchment consists mainly of upland prairie and gallery forest (Figure 5.13). Most of the timber in the catchment can be found on the west bank of the Little Sioux River, with some available on the bottomlands. There are 217.83 hectares (538.27 acres) of timber available around Gillett Grove, which is more than enough to construct and maintain any structures.

Habitat for deer using only timbered areas within the catchment is calculated at 278.41 hectares or 2.78 square kilometers, which includes a 20 meter edge buffer. This results in a total number of 39 deer. Based upon this outcome, there would be an inadequate deer population within the Gillett Grove catchment for a population over 50.

Gillett Grove has the same limitations with regard to horticultural lands as Burr Oak (13CY1). With the site located in the uplands, the access to horticultural lands on the bottomlands of the Little Sioux River is extremely limited. As demonstrated earlier, this discrepancy is not the result of using the cost distance algorithm (Table 5.6). Like Burr Oak, the Gillett Grove inhabitants would have to farm close to the site on the uplands or travel further out to obtain sufficient land nearby the Little Sioux River. Based upon values given in Table 5.15, group of 50 people could live at Gillett Grove for approximately 10 years.

Milford (13DK1)

The Milford site is the final known Oneota village site in the Little Sioux Valley. Milford sits on a glacial outwash terrace, but is at one of the highest points of elevation in the area. Another uniqueness of the area around Milford is the point of entry to the site. The site is only accessible from the north by land; the east, south, and west portions of land around Milford have been cut off by the downcutting of the Little Sioux River. The largest

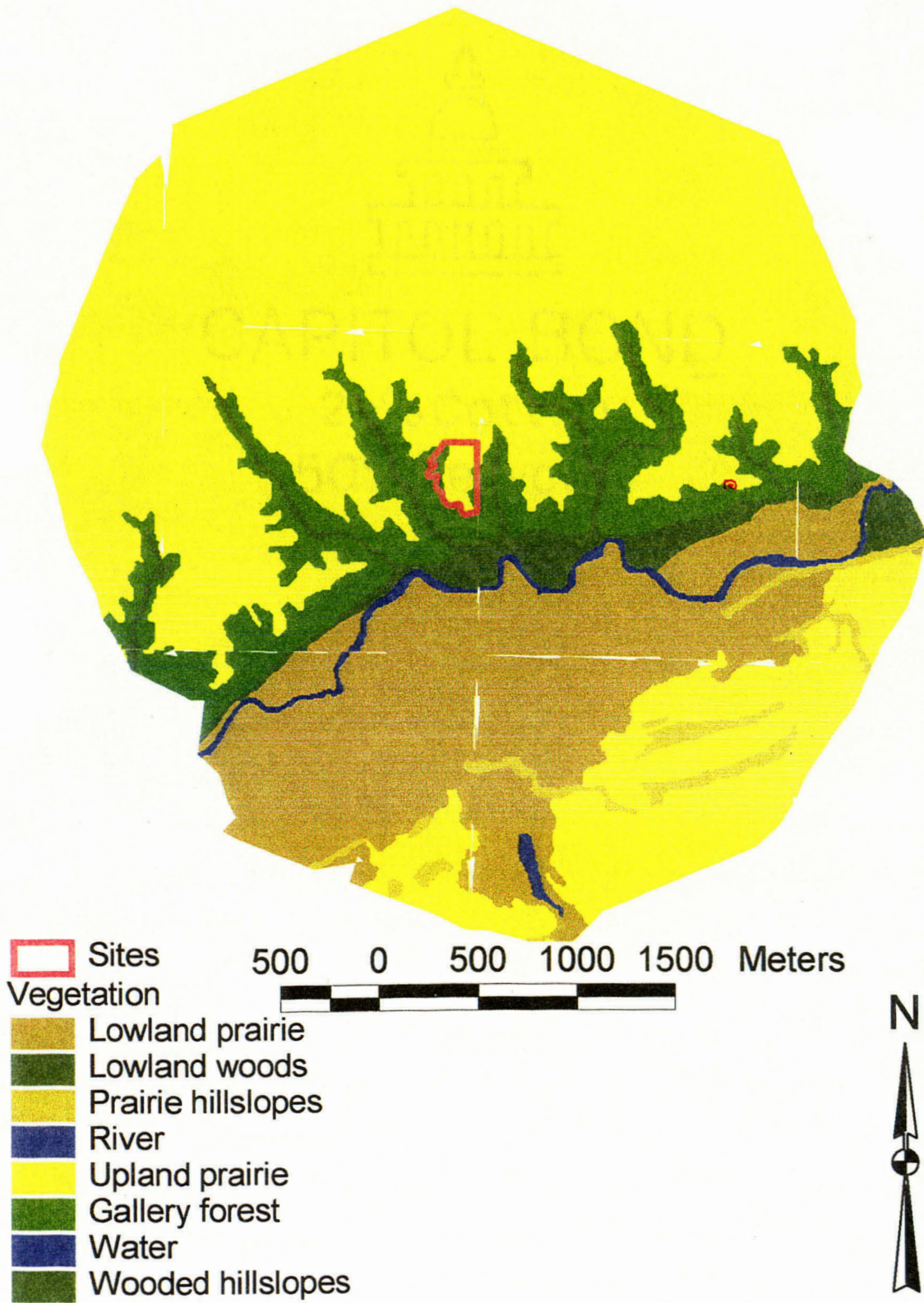


Figure 5.13. Model of prehistoric vegetation in the Gillett Grove (13CY2) site catchment.

landform region in the Milford catchment is the uplands, followed by a rather high percentage of terrace formations (Figure 5.14). This is likely due to the exposed outwash terraces in this portion of the valley. The soils at Milford are well drained soils, identical to the soil types found at the Correctionville locality. These soils are also well suited for cultivation.

The vegetative communities consist of upland and lowland prairie and gallery forest found within the Little Sioux Valley, with some timber extending on to the uplands and in the intermittent drainages that feed into the Little Sioux River (Figure 5.15). Total timber area in the Milford catchment is 372.46 hectares (920.36 acres) or 23.8 percent. This total is the second largest expanse of timber out of all of the Oneota catchments. Therefore, sufficient amounts of timber are available to the inhabitants of Milford.

Timber habitat for deer totals 493.52 hectares or 4.94 square kilometers including a 20 meter buffer for edge. Even with this quantity of forest habitat present in the Milford catchment, insufficient numbers of deer would be available from gallery forest alone based upon an estimate of 70 deer. Other means or locations for acquiring deer would have to be arranged to procure sufficient quantities of deer for Milford if the population was large.

The soils around Milford available for farming are highly productive (ISPAID 1996). Milford has the potential to produce 2620 bushels of maize if all of the land available for cultivation was utilized (Table 5.3; Table 5.4). If half of the land was used, Milford could sustain a population between 50 and 100 people reasonably for 50 years (Table 5.15).

Blood Run (13LO2)

Given the large expanse of the Blood Run site, the catchment represents only a portion of the area. Possibly a large portion of the core area of the site, estimated at 400

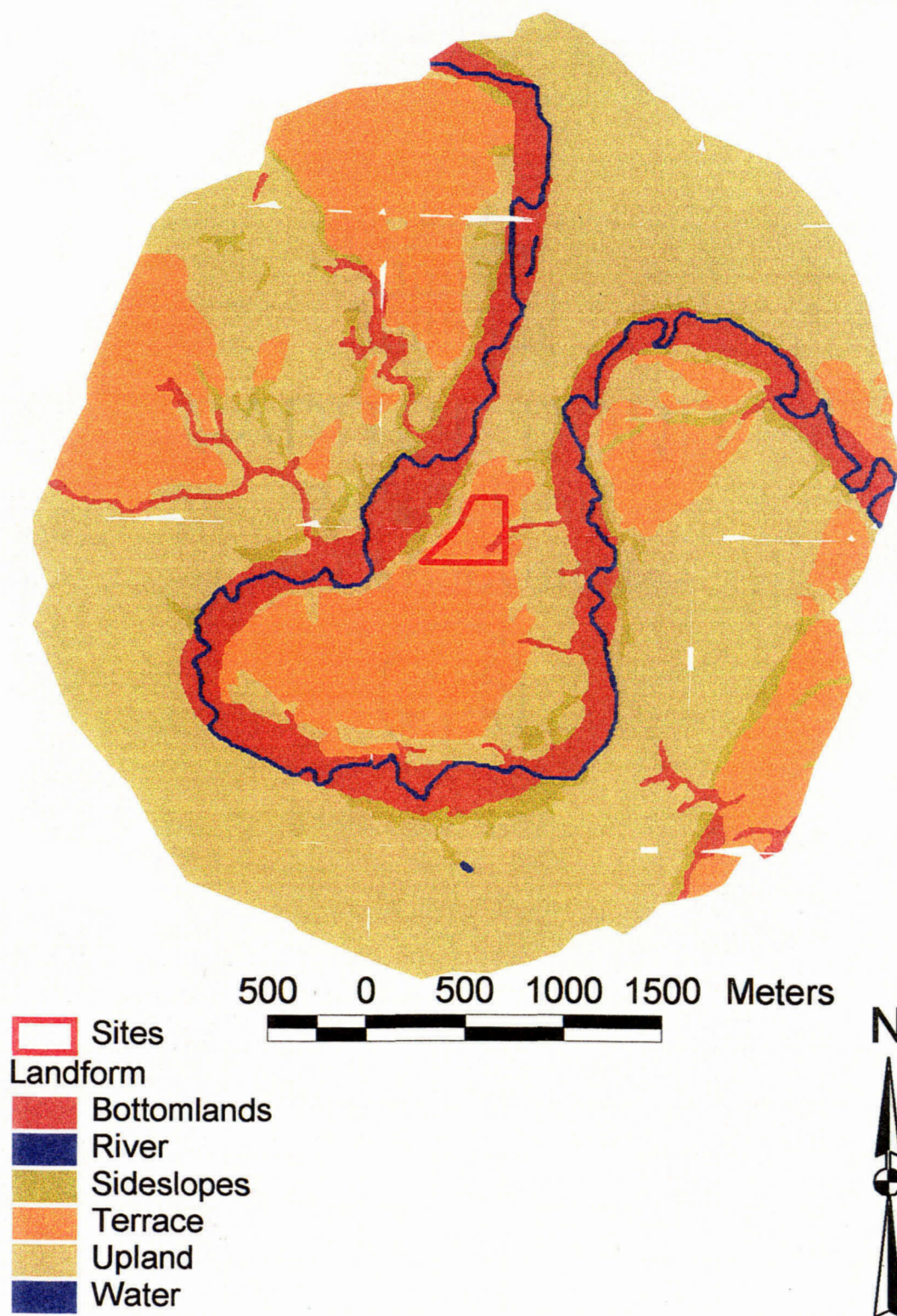


Figure 5.14. Landforms within the Milford (13DK1) site catchment.

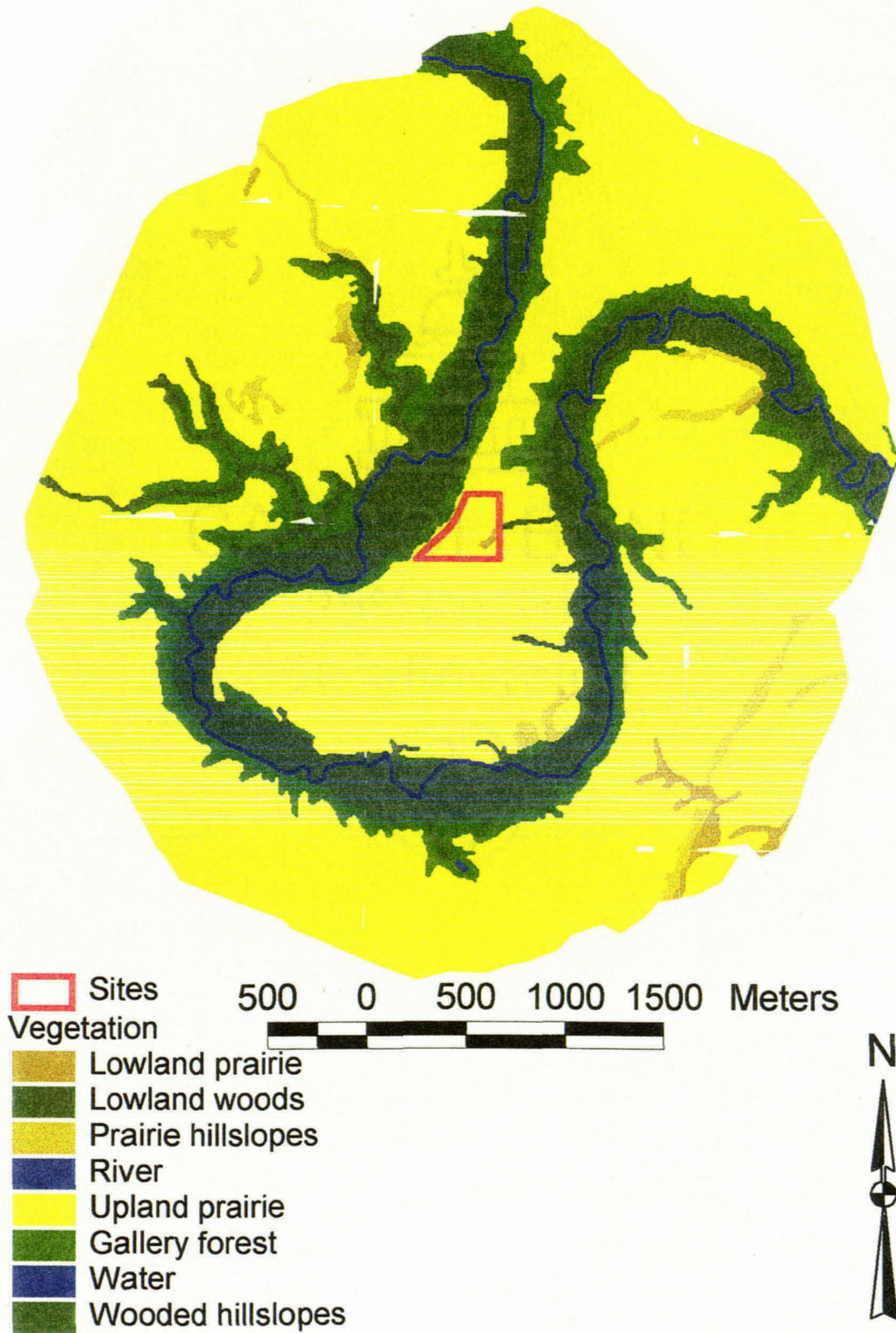


Figure 5.15. Model of vegetation in the Milford (13DK1) site catchment.

acres is included within the catchment. The area chosen for site catchment focuses on the confluence of the Big Sioux River and Blood Run Creek.

The area designated as the "center" of the site is located on a high terrace remnant east of the Big Sioux River and south of Blood Run Creek (Figure 5.16). This site is similar to Bastian (13CK28) where a site or portion of it is at the confluence of two stream systems. Uplands and terrace remnants make up a large portion of the landforms in the catchment. The soils around the site are well drained soils making them suitable for habitation.

Nearly 85 percent of the catchment vegetation is lowland and upland prairie. Timber is another 13.18 percent, with the rest being water resources (Figure 5.17). Tree density in this area is low compared to the Little Sioux Valley, with approximately 243 trees per hectare. While this may be able to sustain a small population, the expanse of Blood Run suggests that there may not have been sufficient timber in the area for permanent structures. However, the identification of cobble rings on the ground may indicate that non-permanent house form were the common dwelling type rather than more permanent lodges or houses (Fletcher and LaFlesche 1911; Harvey 1979; Lueck et al. 1985).

Deer acquisition would also be a tough proposition. Based upon the catchment calculations, 25 deer would be available from the Iowa side. However, ethnographic accounts of tribes including the Ioway, Omaha, and Oto suggest that Blood Run was an area where they met and lived for a short period (Blaine 1979; Fletcher and LaFlesche 1911; M. Wedel 1976). It may be with a few thousand people together that deer were not altogether important, but perhaps more emphasis was placed on bison since one bison equals seven deer with regard to edible meat.

Horticultural activities are also vague since the catchment does not represent the entire Blood Run site. General characteristics of the soils within the catchment, however, demonstrate that well drained soils with generally good productivity are present. If maize

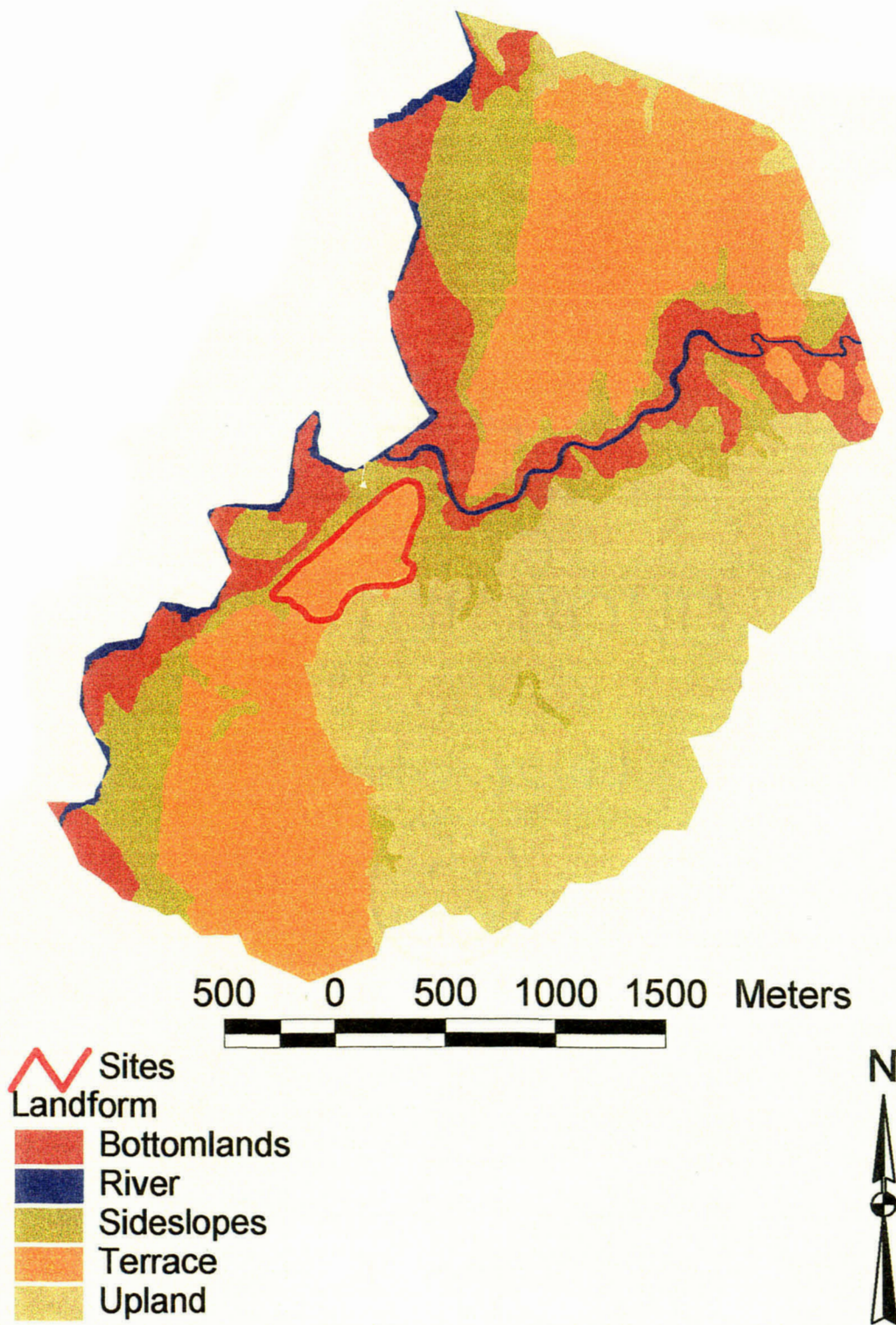


Figure 5.16. Landforms within the Blood Run (13LO2) site catchment.

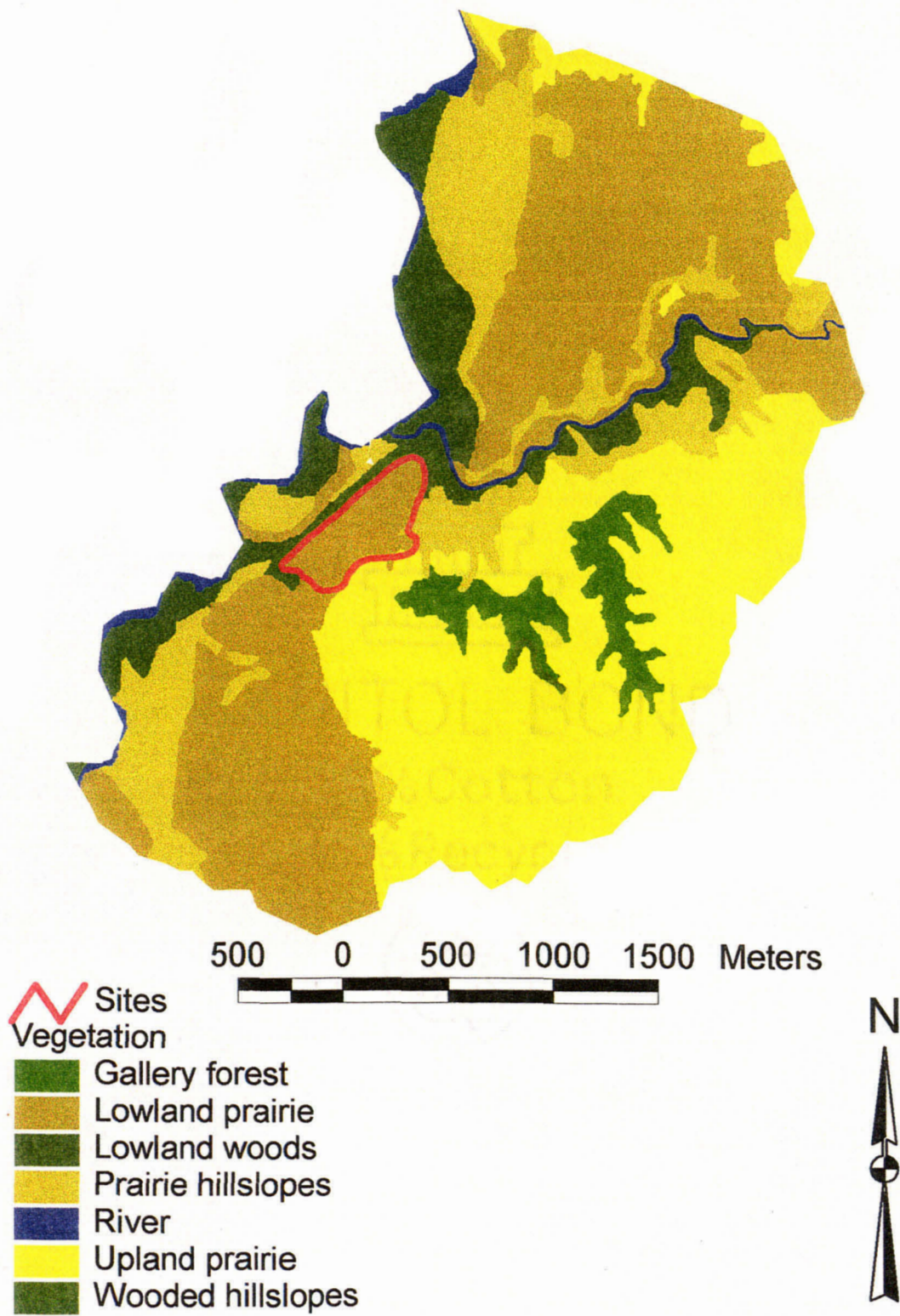


Figure 5.17. Model of prehistoric vegetation in the Blood Run (13LO2) site catchment.

was a significant portion of the diet, there would not be a lack of space for fields provided the fields were not limited to the bottomlands of the Big Sioux River or Blood Run Creek.

Regional Comparisons

The Oneota sites cluster into three locations. The southernmost region is the Correctionville locality and includes Dixon (13WD8), Gothier (13WD3), and Correctionville (13WD6). Vegetation in each of the catchments is overwhelmingly dominated by lowland and upland prairie. Gallery forests existed along larger stream systems such as the Little Sioux River. Based upon climate shifts and written accounts by Europeans explorers who traveled through northwest Iowa, this was to be expected (Baerreis and Bryson 1965; Harvey 1979). Climatic change may have caused the prairie grass communities to expand across the Midwest, with forest communities being confined to the valleys of stream systems. The proximity of the three sites in relation to the Little Sioux River shows that each of them are within 500 meters (1640 feet) of the present course of the river.

The Little Sioux Valley is widest in this southern region, and this is also the oldest part of the valley (Hoyer 1980). Consequently this reach of the valley has undergone the most change geologically from erosion, and downcutting and meandering from the Little Sioux River. All of the sites reside upon terrace remnants and are within the valley itself. Dixon (13WD8) and Gothier (13WD3) are at an elevation of approximately 335 meters (1100 feet). Correctionville (13WD6), about 8.5 kilometers (5.3 miles) north and east is at an average elevation of 1130 feet. They would be relatively sheltered from the elements during winter and have immediate access to permanent water and land for cultivated fields. Bison would have to be acquired, however, by venturing out of the valley and onto the uplands. All of the sites appear to be situated in an area where there is a convergence of lowland and upland vegetative communities and geological landforms. This would allow them to take

advantage of a diverse array of resources within relatively close proximity to the habitation area.

The central region of the Little Sioux Valley contains the Bastian (13CK28) site. Located at the confluence of the Little Sioux River and Mill Creek, Bastian displays a pattern of vegetative communities on the uplands and lowlands similar to the sites at the Correctionville locality. Proximity of Bastian to the Little Sioux River is greater than the distance to Mill Creek, but still within 1000 meters (3280 feet) of the present course of the river. Bastian also is approximately 22 meters (72 feet) above the active floodplain, making it safe from any seasonal flooding from either the Little Sioux River or Mill Creek. Bastian is at an average elevation of 379 meters (1240 feet).

Bastian is located in the younger southern half of the Little Sioux Valley. The age of Little Sioux Valley in relation to the age of the Mill Creek Valley shows that Mill Creek is older by the presence of T1 terrace remnants at the higher elevations along the valley wall of Mill Creek (Hoyer 1980). The Little Sioux Valley is still fairly wide, but begins to narrow to the north. There appears to be a higher density of trees along this stretch of the valley, particularly along the east bank of the Little Sioux River.

Conditions around Bastian are suitable for habitation. The ecotones between gallery forest and upland prairie would allow the group at Bastian to take advantage of this biodiversity. Additionally, close proximity to two stream systems would allow them to travel farther north up the Little Sioux River or into the interior of northwest Iowa by using Mill Creek.

The last location, or the northern region of the Little Sioux Valley, which is the most recent portion of the valley, contains the final cluster of sites that include Burr Oak (13CY1), Gillett Grove (13CY2), and Milford (13DK1). Burr Oak and Gillett Grove sit upon the uplands of the Little Sioux Valley. These two sites are located at elevations of 424 meters (1390

feet) and 418 meters (1370 feet) respectively. Milford is situated upon a glacial outwash terrace remnant, but sits at an elevation greater than Burr Oak or Gillett Grove at 436 meters (1430 feet). The Little Sioux Valley in general is narrower farther north up in this area, although some wider expanses do exist (Hoyer 1980). The valley is also asymmetrical in some portions, in particular where the Little Sioux River makes wide bends along its course. The dominant landform within each of the site catchments is the upland area. The Burr Oak catchment contains 69.85 percent of uplands, Gillett Grove has 72.47 percent uplands, and Milford has 54.97 percent uplands. No other landform in any of the three catchments comes close in size.

Vegetation is dominated by prairie, specifically upland prairie. However, Burr Oak and Milford also have the highest percentage of timber of the eight Oneota sites in the valley, with 24.61 percent and 23.80 percent respectively (Table 5.14). While Gillett Grove only has 14.58 of its total catchment area in timber, Clay County also has the second highest density of trees in the study area at 1237 trees per hectare. Dickinson County where Milford is located has a tree density of 740 trees per hectare.

Blood Run (13LO2) while not within the Little Sioux Valley but located along the Big Sioux River, has a verified Oneota component and is similar in age to the Oneota sites in the northern region of the Little Sioux Valley. Most of Blood Run sits upon the terrace formations overlooking the Big Sioux River and Blood Run Creek. This is another site at the confluence of two stream systems much like Bastian (13CK28). The dominant landform type in the Blood Run site catchment is upland. The elevation of Blood Run is 399 meters (1310 feet). Although Blood Run is located nearly 115 kilometers (71 miles) west of Milford, the ecotonal pattern of prairie and gallery forest is still present.

As mentioned previously in this chapter, the eight Oneota sites analyzed in this study appear to be situated in areas to take advantage of resources on various landforms and

vegetative communities. Even though there are three distinct shifts in location of Oneota sites with regard to elevation and landform positions, all eight sites still contain a mixture of prairie and gallery forest, and are in very close proximity to major stream systems in northwest Iowa. The possible reasons for this settlement pattern will be discussed in Chapter 7.

CHAPTER 6: GIS PREDICTIVE MODELING

Predictive Modeling in Archaeology

The use of predictive modeling has received increased attention in archaeology for its use as a tool for both research and for more practical studies such as land management. What has allowed predictive modeling to become an important tool in archaeology is the adoption of computer technology. This has allowed more complex analyses to be accomplished in less time due to increasing processing power and relatively efficient digital data storage solutions. Geographic Information Systems technology has allowed archaeologists to create large databases of archaeological information that can be updated and modified accordingly as new data become available. These data can then be used to generate predictive models of potential site area. The underlying assumption for creating and using predictive models is that, if constructed properly, they should have a greater chance of locating unknown archaeological resources or guiding field study to make it more efficient.

Predictive modeling using GIS has been used for testing surveys, land management and development (P. Anderson 1996; Altschul 1990; Carmichael 1990b; Kvamme 1990, 1992; Warren 1990b). Prior to the use of computer technology, predictive modeling was accomplished much in the same way as site catchment analysis was by using paper maps and performing manual calculations (Schermer and Tiffany 1985; Tiffany and Abbot 1982).

The steps for creating predictive models using either method are essentially the same. First, a database of relevant information pertaining to the research area and archaeological manifestations must be created. Next, variables to be used in the creation of the predictive model must be selected. Archaeologists can select variables used by other models from literature, or they can use statistical techniques to determine which variables

are most significant predictors their study area. The primary statistical measure used in predictive modeling to determine the importance and relationship of variables is Chi-Square analysis (P. Anderson 1996; Parrish 1998; Schermer and Tiffany 1985). This procedure is known as exploratory data analysis (EDA), or descriptive modeling. EDA attempts to show the characteristics of the dataset, and aids in finding correlations between variables (Zubrow and Green 1990:132). Third, the predictive model can be created using this information, and can be updated and refined as new data become available. Finally, the model should be tested in the field to verify the accuracy of it and to determine if any weaknesses are inherent in its structure.

Modeling Procedure

Modeling algorithms are quite varied and different types can be used depending upon the available data. Multivariate statistical algorithms such as discriminant function analysis or logistic regression are commonly used (Warren 1990b). Based upon previous predictive modeling literature, it was decided that logistic regression, or logit modeling, would be the most appropriate choice for a modeling algorithm (P. Anderson 1996; Kvamme 1992; Parrish 1998; Warren 1990a, 1990b). There are four main reasons for choosing logistic regression over other statistical procedures. The first is that logistic regression does not need a normal distribution of the population to be effective. The second is that other statistical tests demonstrate that it provides more consistent predictions, and does not fail when assumptions are violated. Third, multiple variable types can be incorporated into the algorithm (Warren 1990b:95). In other words, nominal, ordinal, interval, and ratio-scale variables can be used together. Finally, logistic regression provides readily interpretable predictions of site-presence or site-absence probability (Warren 1990b:96).

The database for this research consists of two primary database files and numerous coverages containing data in the study area and their associated databases. Vector themes

for soils data were converted into multiple derived themes that reflect pertinent soil characteristics, such as soil type, drainage, landform type, and permeability. These datasets were then converted to raster themes and then combined together to create one theme of the entire study area for each dataset. Digital elevation models for the study area were clipped from a statewide DEM file and then converted into derived themes that represent slope, elevation, and slope aspect of the study area. Proximity themes that represent distance to permanent streams in the study area were also converted and analyzed. Finally, Government Land Office (GLO) digitized historic vegetation maps were converted to raster format and combined. Each of the themes are scaled at 1:24000, which is the most detailed large scale maps that are available for major geographic and cartographic data.

The two primary database files represent two populations. The first database was constructed to hold data characteristics of the northwest Iowa Oneota sites. Preliminary steps included converting the vector site theme into a raster theme that was then used as template to create a point theme. The second database contains information on the points chosen at random from within the study area that represent known non-site areas. This theme is also a point theme created using a third party extension for ArcView that performs statistical random sampling.

Each theme was then draped over a grid theme, and where each point lay for the known sites and known non-sites, a specific value for that cell was entered and saved in the corresponding point database. The variables used for the predictive model are a combination of ordinal (ranked) and ratio scale variables (Table 6.1). Ordinal variables were scaled based upon the site catchment results and literature. Scores represent values from excellent (5) to poor (1) with regard to a specific variable class. Each of the ordinal variables was then subjected to a 2 x 5 Chi-Square analysis to determine independence and

Table 6.1. List of Variables and Their Scale and Score.

Variable	Coverage	Scale	Score
Elevation	DEM - primary	Ratio	Cell value
Slope	DEM - secondary	Ratio	Cell value
Slope aspect	DEM - secondary	Ordinal	1 to 4
Proximity to stream	River - secondary	Ordinal	1 to 5
Drainage class	Soils - secondary	Ordinal	1 to 5
Landform type	Soils - secondary	Ordinal	1 to 5
Vegetation	GLO - primary	Ordinal	1 to 4

statistical significance. Ratio scale variables were subjected to a Kolmogorov-Smirnov test.

Statistical Hypotheses and results

Null and alternative hypotheses were used were created for each of the variables listed above. Each set of hypotheses follows the format given below:

H_0 : The selected variable has no effect on the settlement patterns of Oneota sites in northwest Iowa.

H_a : The selected variable has an effect on the settlement patterns of Oneota sites in northwest Iowa.

Significance was determined for a variable based upon the results of a Chi-Square test and consulting a Chi-Square significance table to determine the cut point for statistical significance and the variable's degrees of freedom. Statistical significance was determined at the .05 p level similar to other studies (Schermer and Tiffany 1985). The known site cells, which make up the eight Oneota sites in the study area, total 1507 30 m by 30 m cells. The random sample of the study area that does not have an Oneota archaeological component total 1733 30m X 30m grid cells. More cells are used for the non-sites sample in hopes of gaining a more representative picture of the study area and its geomorphology, vegetative,

and hydrological resources (P. Anderson 1996, Kvamme 1992; Parrish 1998, Schermer and Tiffany 1985).

A distinction between non-sites and known non-sites should be addressed. Warren (1990a, 1990b), and Altschul (1990) address this idea in their outlines of predictive modeling. Known non-sites as opposed to non-sites are those areas where surveying or archaeological investigation has taken place, but did not yield any evidence for a site of a particular cultural manifestation. This area is then defined as a known non-site area. A non-site, therefore, is an area that has not been surveyed, but because no archaeological evidence for a particular cultural manifestation has been identified, it is assumed not to contain a site. This study uses the non-site definition due to the fact that intensive archaeological surveying with regard to Oneota sites has never been done. Therefore, all of the cells selected for the non-site sample are assumed to be cells that do not have an Oneota component in them.

Landform Type

Landforms were grouped into five classes: uplands, terraces, sideslopes/alluvial fans, bottomlands, and water. Based upon the site location and dominant landform, each landform category was scored, with terraces receiving the most favorable score of 5, while water received the least favorable score of 1. Non-site cells were also scored accordingly to represent the study area. The null hypothesis for this variable was landform type has no effect on the settlement patterns of northwest Iowa Oneota sites. Chi-square analysis of the sites (observed cells) versus non-sites (expected cells) yielded a statistically significant result at the 95% confidence level (Table 6.2). Therefore the null hypothesis was rejected and landform types do have an effect on the settlement patterns of northwest Iowa Oneota sites. This variable is included in the predictive model.

Table 6.2. Chi-Square Analysis of Landforms for Known Sites vs. Non-sites.

Landform	Terrace	Upland	Sideslopes	Bottomlands	Water	Totals
Known sites	1045	374	47	22	19	1507
Non-sites	123	1182	59	347	22	1733
Totals	1169	1556	106	369	41	3240

Chi-Square: 1426.391

df: 4

p: 14.86

Stream Proximity

Stream proximity was created by buffering the major streams within the study area out to 2500 meters (8202 feet) in increments of 500 meters (1640 feet). Proximity from 0-500 m was assigned a score of 5, while any cells 2500 m out and further were assigned a score of 1. The null hypothesis was proximity to streams had no effect on the settlement patterns of northwest Iowa Oneota sites. Chi-square analysis yielded a statistically significant result at the 95% confidence level (Table 6.3). Therefore the null hypothesis was rejected and the proximity to streams does have an effect on the settlement patterns of northwest Iowa Oneota sites. This variable is included in the predictive model.

Table 6.3. Chi-Square Analysis of Stream Proximity for Known Sites vs. Non-sites.

River Proximity	0-500	501-1000	1001-1500	1501-2000	2001+	Total
Known sites	1122	367	0	0	18	1507
Non-sites	111	85	106	93	1338	1733
Total	1233	452	106	93	1356	3240

Chi-Square: 2485.192

df: 4

p: 14.86

Soil Drainage

Soil drainage was determined by examining the characteristics of the soils and scoring them accordingly. Well drained soils were given a rating of 5 while very poorly drained soils were given a rating of 1. Drainage scores were determined based upon the descriptive modeling and site catchment results. The null hypothesis was soil drainage did not have an effect on the settlement patterns of northwest Iowa Oneota sites. Chi-square analysis yielded a statistically significant result at the 95% percent confidence level (Table 6.4). Therefore the null hypothesis was rejected and soil drainage characteristics did have an effect on the settlement patterns of northwest Iowa Oneota sites. This variable is included in the predictive model.

Table 6.4. Chi-square Analysis of Soils for Known Sites vs. Non-sites.

Drainage	Excessive	Well	Moderate	Poor	Very Poor	Total
Known sites	1245	102	61	18	81	1507
Non- Sites	953	32	242	453	53	1733
Total	2198	134	303	471	134	3240

Chi-Square: 578.132
 df: 4
 p: 14.86

Vegetation

Vegetation was prepared from the Government Land Office land survey maps and notes created during the 19th century. This vegetation theme depicts an area that has been completely overcome by prairie. Timber stands exist in extremely small patches along major river systems in northwest Iowa. As such, it is difficult to determine how accurately the GLO map reflects vegetative cover prior to European settlement. Site catchment modeling of the prehistoric vegetation, current tree densities, and even current soils survey maps depict a much different picture of vegetative cover in the study area. Therefore, the significance in

vegetative cover between known sites versus non-sites was assumed to be less than with the other variables described. Nonetheless, it is included here as a potential variable since it does correlate with vegetative types listed in the soils themes. Scores were based upon vegetative cover, with timber areas receiving the most favorable score of 4. Least favorable areas that include water were given scores of 1. The null hypothesis was vegetative cover was not a factor in the settlement patterns of northwest Iowa Oneota sites. Chi-square analysis yielded a result that was significant at the 95% confidence level, although the chi-square result was much lower than the previously described variables; however, this was to be expected. The null hypothesis was rejected and the alternative hypothesis was accepted.

However, this variable was not included in the predictive model because of the discrepancy between the site catchment vegetative models and the GLO maps. It is believed that the inclusion of this variable in the model may lead to erroneous results.

Table 6.5. Chi-Square Analysis of Vegetation for Known Sites vs. Non-sites.

Vegetation	Timber	Prairie	Wetlands	Water	Total
Known sites	126	1381	0	0	1507
Non-sites	29	1666	2	36	1733
Total	155	3047	2	36	3240

Chi-square: 110.132

df: 3

p: 12.84

Aspect

Aspect measures the orientation of the cell with regard to compass direction through the full 360 degrees. Values of -1 obtained for a number cells indicates that the particular cell is flat and therefore has no compass orientation. The values for this variable were classified into 5 groups: -1 was flat ground, 316-45 degrees was considered north, 46-135

degrees was considered east, 136-225 was considered south, and 226-315 was considered west. The null hypothesis was aspect has no effect on the settlement patterns of northwest Iowa Oneota sites. Chi-square analysis determines that there is a statistically significant relationship between site location and aspect, with many of the site cells oriented in southern and westerly directions. The results are significant at the 95% confidence level (Table 6.6). Therefore the null hypothesis was rejected and the alternative hypothesis that aspect does have an effect on the settlement patterns of northwest Iowa Oneota sites is accepted. This variable was included in the predictive model.

Table 6.6. Chi-Square Analysis of Aspect in Degrees for Known Sites and Non-sites.

Aspect	Flat	316-45	46-135	136-225	226-315	Total
Known sites	130	212	297	406	462	1507
Non-sites	143	364	403	399	424	1733
Total	273	576	700	805	886	3240

Chi-square: 42.917

df: 4

p: 14.86

Elevation and Slope

Elevation and slope were variables that the author was apprehensive in applying the chi-square statistic to due to the fact that the elevation and slope data were ratio scale values. The only way to apply the chi-square statistic would have been to group the elevation and slope values into arbitrary "bins." Therefore, a different test statistic was applied to the elevation data. This test statistic is known as the Kolmogorov-Smirnov test, and has been used in similar predictive modeling cases (Kvamme 1992), and is often used in place of the chi-square test statistic for data of this type.

The Kolmogorov-Smirnov test statistic evaluates two groups of one variable to determine whether or not their distributions are equal (Chakravat 1967; SPSS, Inc 1998).

Like chi-square analysis, the function is a non-parametric test, meaning that the data do not have to represent a normal distribution, and is appropriate when using ratio scale variables (Kvamme 2000, personal communication). The Kolmogorov-Smirnov test calculates a statistic referred to as the D-value, and is the largest absolute difference between the observations of two groups (Massey 1951). This D-value is compared against a critical D-value for a given confidence level. For this study a 95% confidence level was used. If the D-value is higher than the critical value, the null hypothesis is rejected since the distributions differ significantly. For a sample of 3240 observations (1507 known sites and 1733 non sites), the critical D-value is calculated by dividing 1.36 by the square root of the sample size. For this study, the critical D-value for a sample size of 3240 was 0.024. The null and alternative hypotheses take the following general form:

H_0 : There is no difference between the values of the variable between known site and non site distributions.

H_a : There is a significant difference between the values of the variable between known site and non site distributions.

Elevation data were ordered from smallest to largest for both known and non-site data. A grouping variable labeled site presence was used to separate the known site cells from the non-site cells. The Kolmogorov-Smirnov test statistic was performed and the critical D-value was compared to the observed D-value calculated by SPSS (Table 6.7). Comparison of the critical and observed D-values demonstrates that there are significant differences in elevation between known sites and non-sites, and therefore the null hypothesis was rejected.

Even though the result turned out to be statically significant, the variable was not used in the predictive model for the following reasons. The first is that there would have been no way to include the variable without grouping it into arbitrary bins, similar to chi-square analysis.

Table 6.7. Kolmogorov-Smirnov Test of Elevation Data of Known Sites and Non-sites.

Group	Known sites	Non-sites	Total
N	1507	1733	3240
Critical D-value: 0.024			
Observed D-value: 12.454			

This would have defeated the purpose of performing this test. Another reason is that this study has the inclusion of landform position as a variable. Landform position, a relative elevation would have more of an impact on the location of Oneota sites than absolute elevation, since relief in the study area differs by only five hundred 500 feet. Finally, the inclusion of both landform and elevation may interact with one another, thereby reducing the predictive power of the landform variable.

Slope values were also calculated in a manner identical to the elevation values, with the critical D-value set at 0.024. Comparison of the critical and observed D-values show that there is a significant difference in the distributions of slope values for known sites and non-sites (Table 6.8). The null hypothesis was subsequently rejected.

However, this variable was not used in the predictive model for reasons that are similar to the elevation variable. Like elevation, the slope values would have to be categorized and scored arbitrarily. Secondly, it is evident that habitation sites will be located on level to fairly level ground. Third, soil types and their variants are usually formed on specific slopes. For example, a silty clay loam may be found on slopes ranging from zero to six percent. However, the composition of those soils in addition to characteristics such as drainage and proportions of clay, silt, and loam will differ. Further, soil types, slope, elevation and landform are interrelated. It was also thought that the inclusion of this variable might reduce the importance of landform type as a critical factor in Oneota site placement.

Table 6.8. Kolmogorov-Smirnov Test of Slope Values of Known Sites and Non-sites.

Group	Known sites	Non-sites	Total
N	1507	1733	3240
Critical D-value: 0.024			
Observed D-value: 3.495			

Model Creation

After the variables were selected for the model, a weight was applied to each variable and associated theme. This weight was based upon the chi-square results and assumed importance of the variables relative to one another. Supplemental support included Oneota site settlement research and general settlement studies literature.

The themes of the variables included in the predictive model were multiplied by their corresponding weight value and then added together using *Map Calculator* in the spatial analyst function in ArcView. This created a composite coverage of scores that represent the score for each cell. This composite coverage is also the primary coverage of the predictive model (Figure 6.1). The formula for the composite coverage is as follows:

$$CS = (C_1 * M_1) + (C_2 * M_2) + \dots + (C_n * M_n)$$

Where: CS = Composite cell score

C_n = Coverage and

M_n = Weight Multiplier

Based upon the weighting of the various themes, the model shows high probabilities in areas close to the Little Sioux River with soils that have good drainage characteristics (Figures 6.2a-6.2h). Landform type was not as significant a factor due to the dichotomous location of currently known Oneota sites in the Little Sioux Valley; sites are located on either terrace remnants or upland landforms. Cells with southerly or western exposures also added some influence on predicted site location areas. Overall the scores of the cells

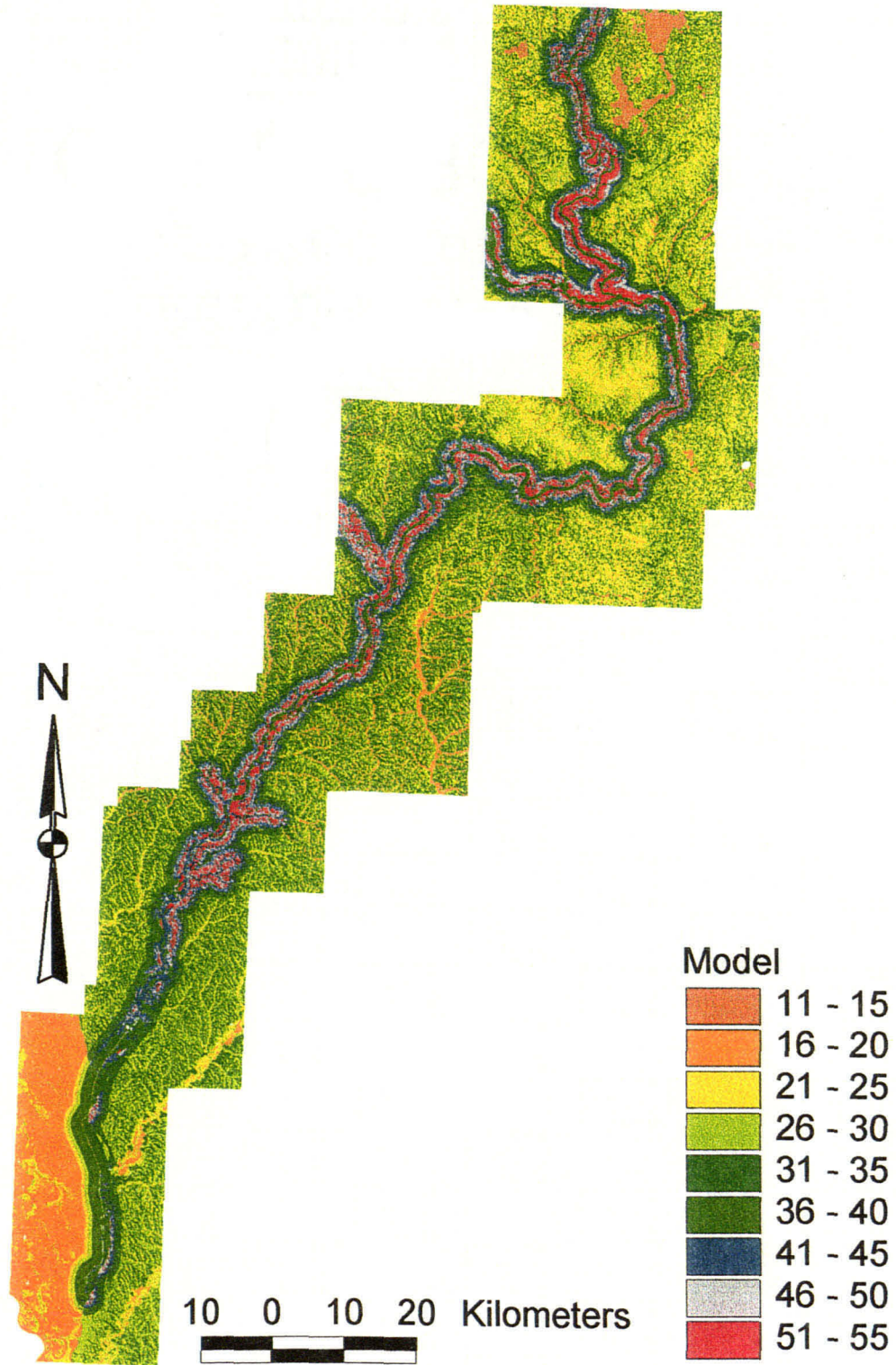


Figure 6.1. Map of the predictive model and study area.

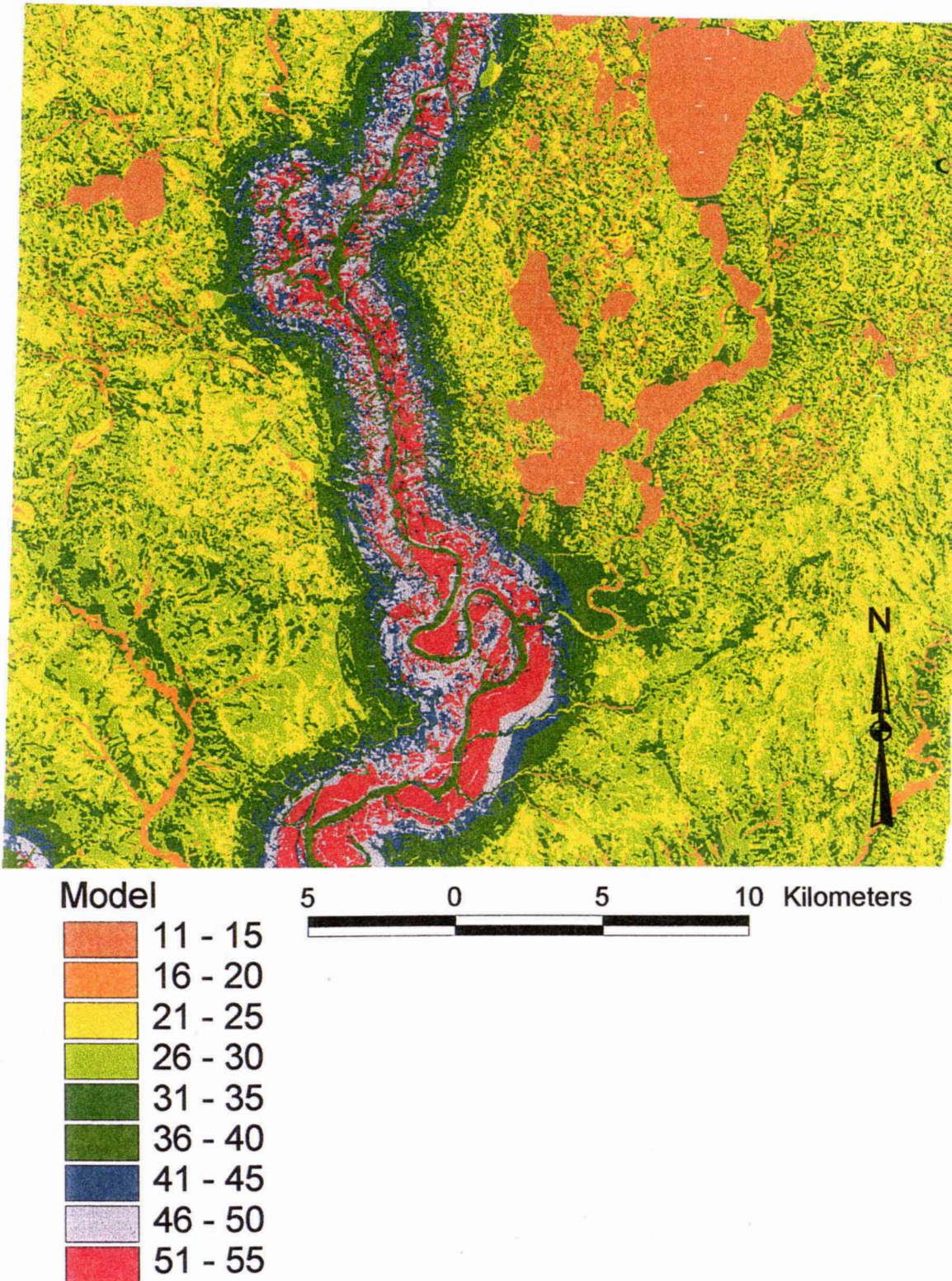


Figure 6.2a. Predictive model map of the portion of the study area in Dickinson County.

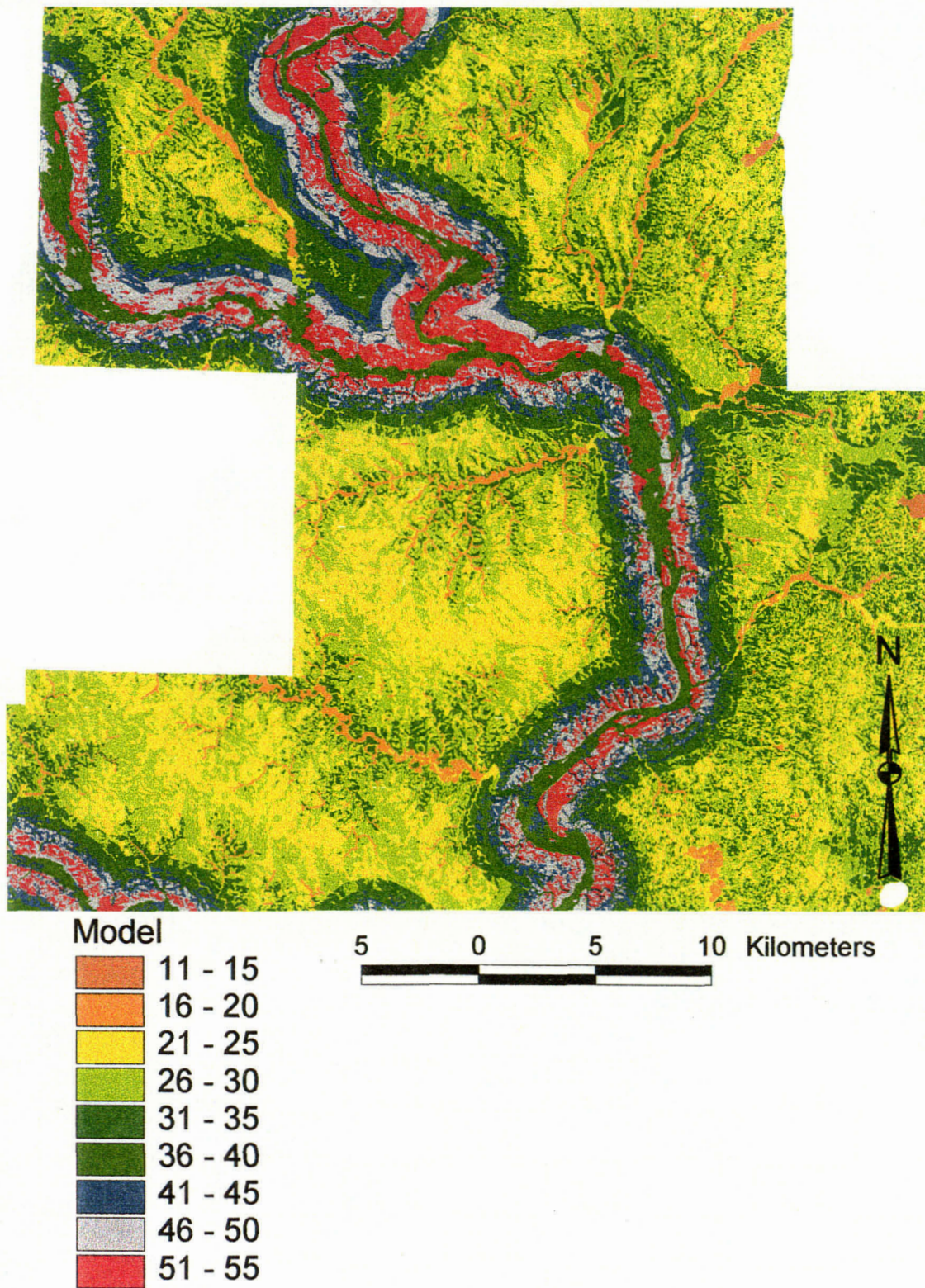


Figure 6.2b. Predictive model map of the portion of the study area in Clay County.

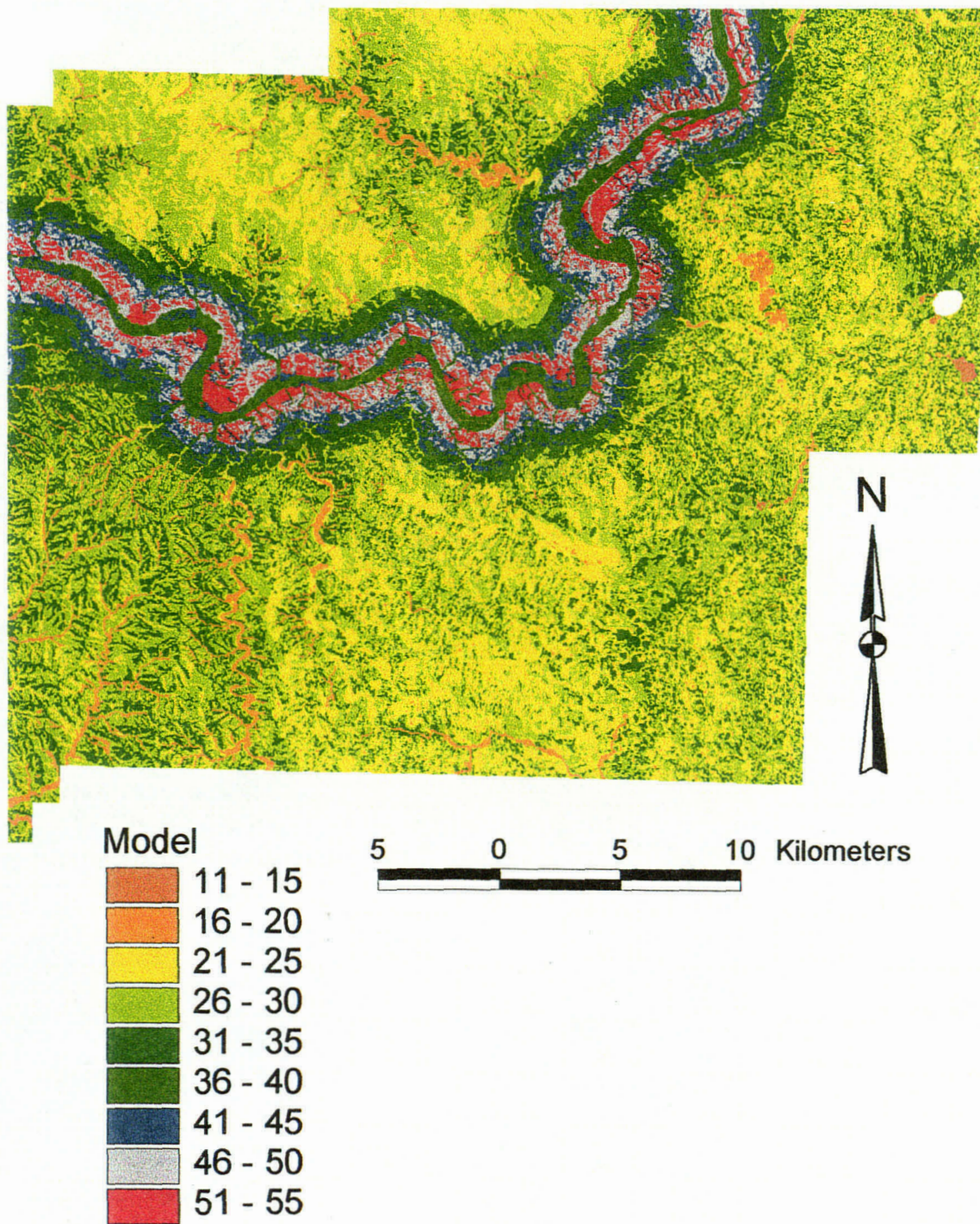


Figure 6.2c. Predictive model map of the portion of the study area in Buena Vista County.

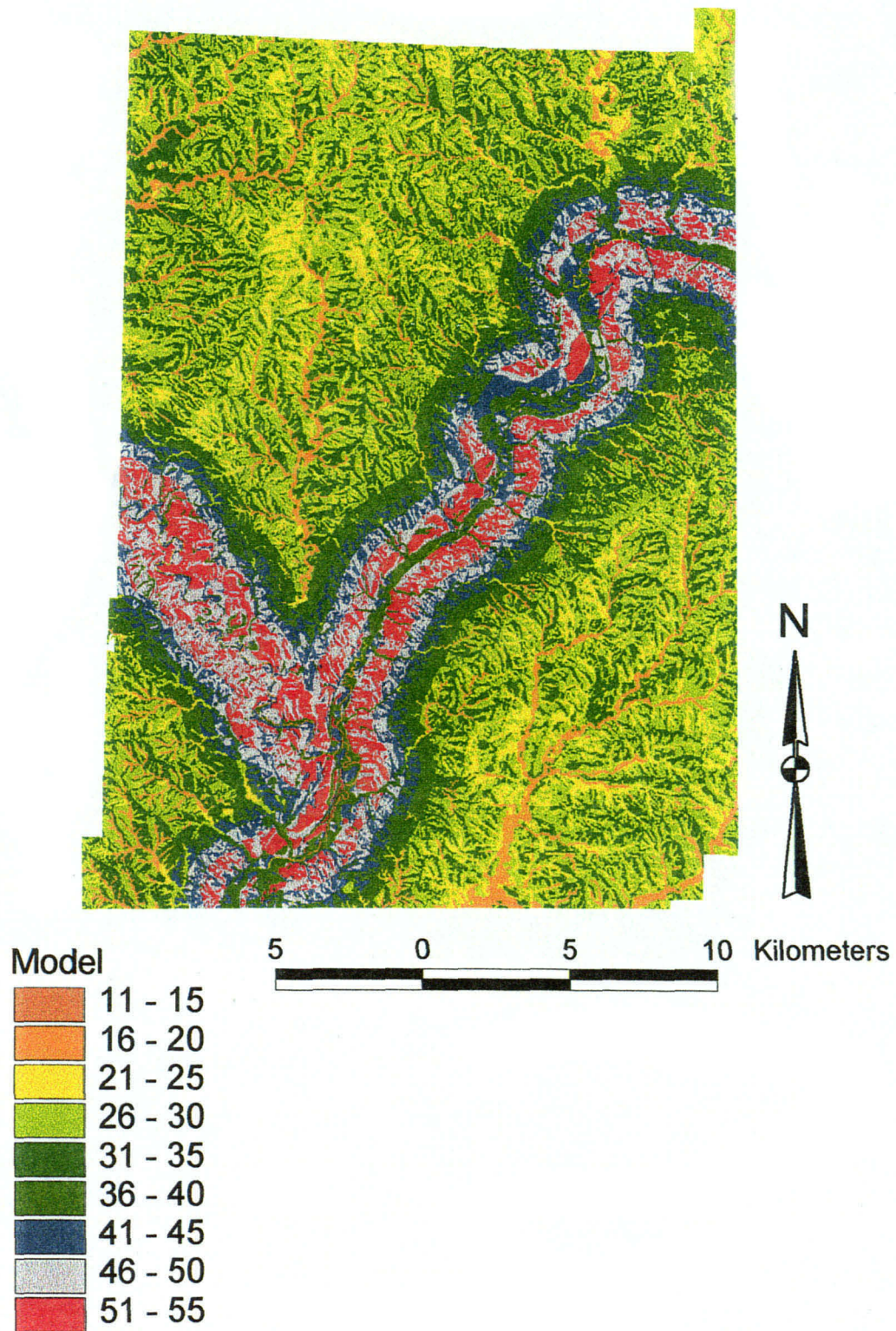


Figure 6.2d. Predictive model map of the portion of the study area in O'Brien and northern Cherokee County.

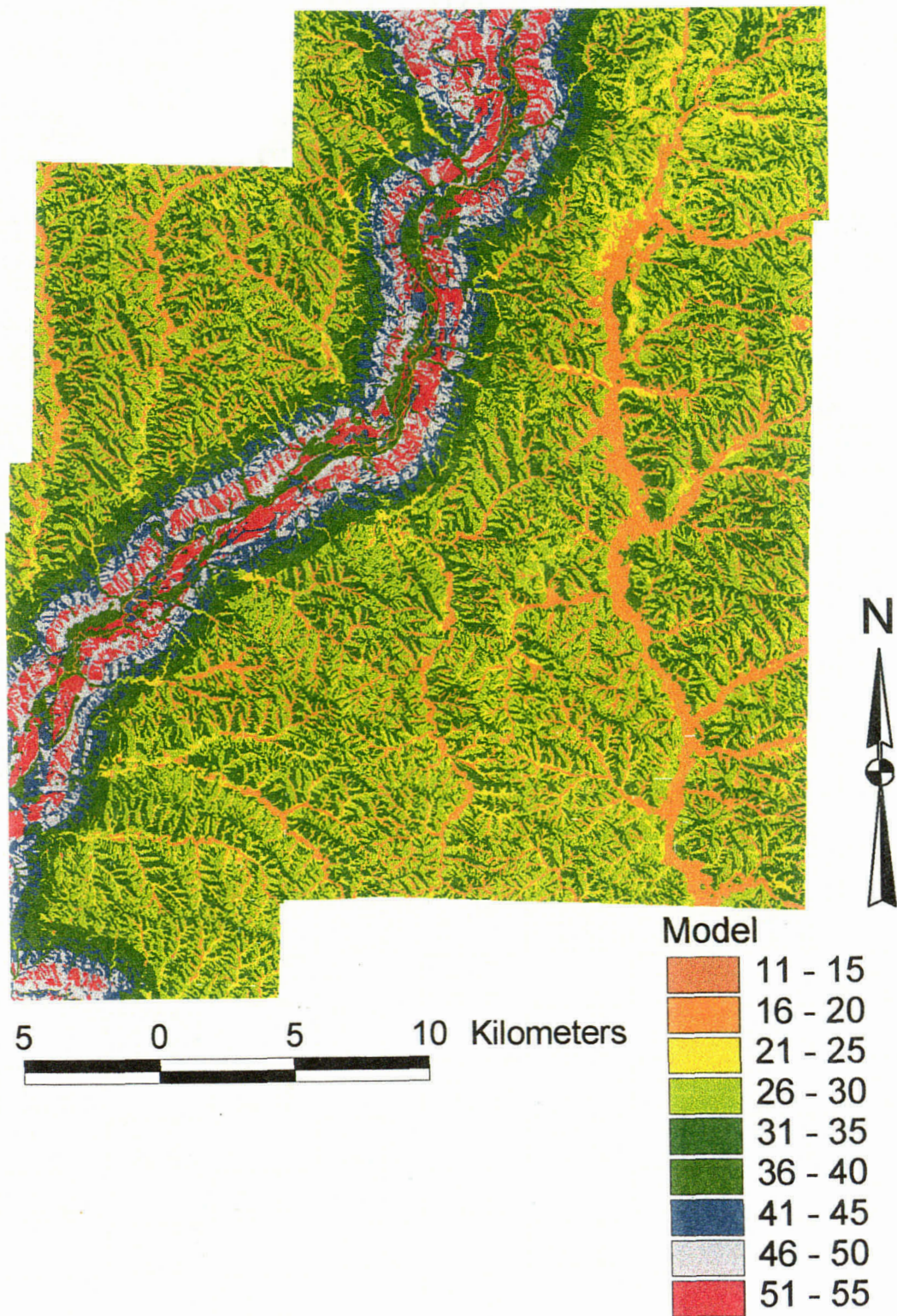


Figure 6.2e. Predictive model map of the portion of the study area in Ida and southern Cherokee County.

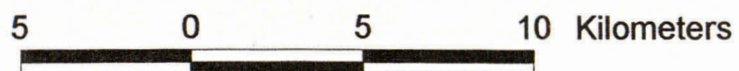
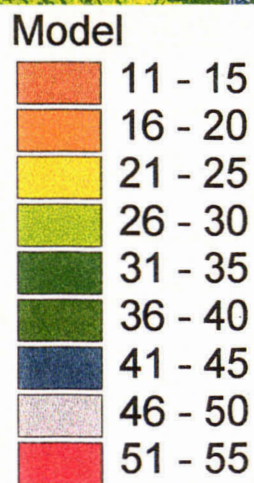
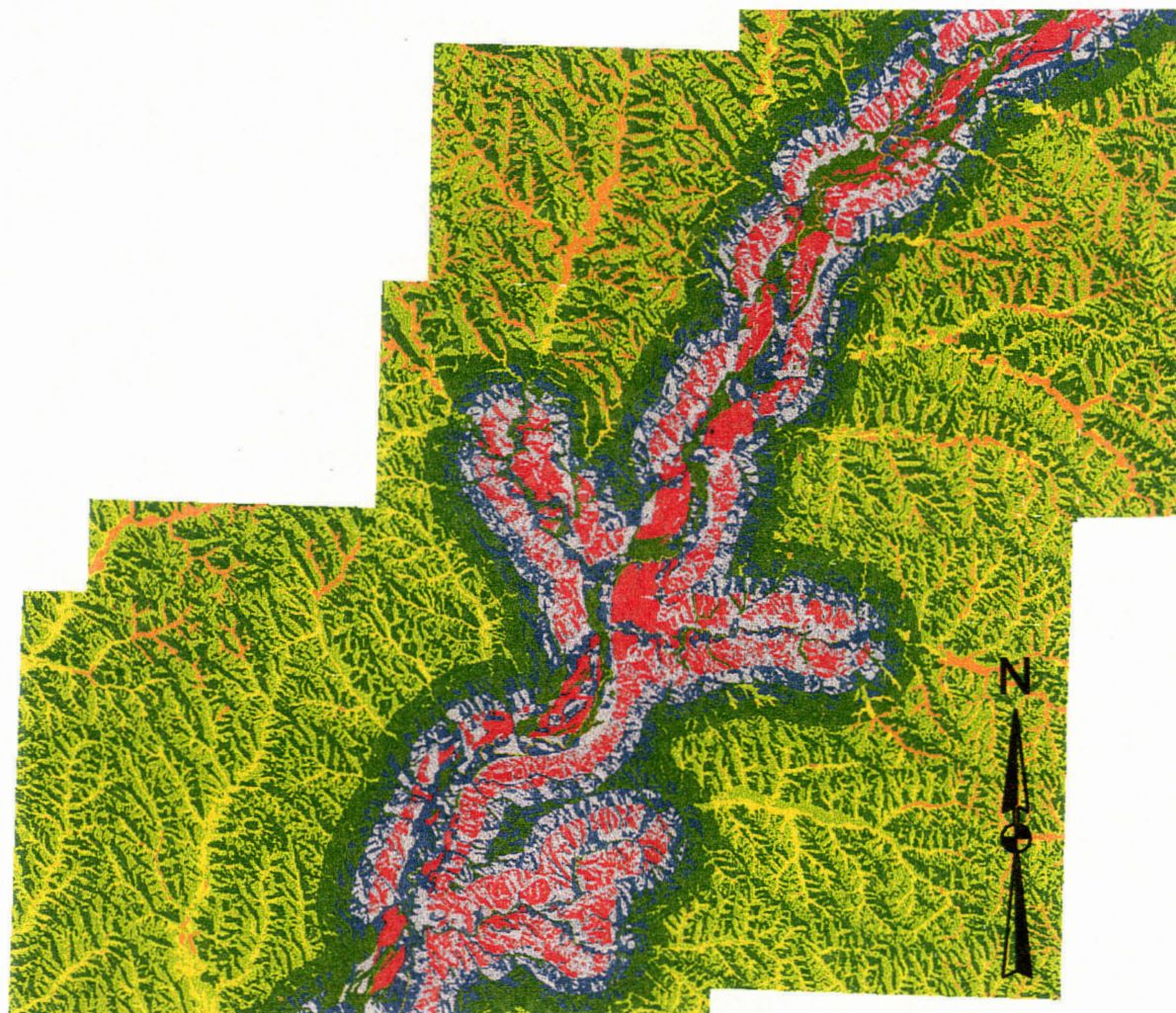


Figure 6.2f. Predictive model map of the portion of the study area in northern Woodbury County.

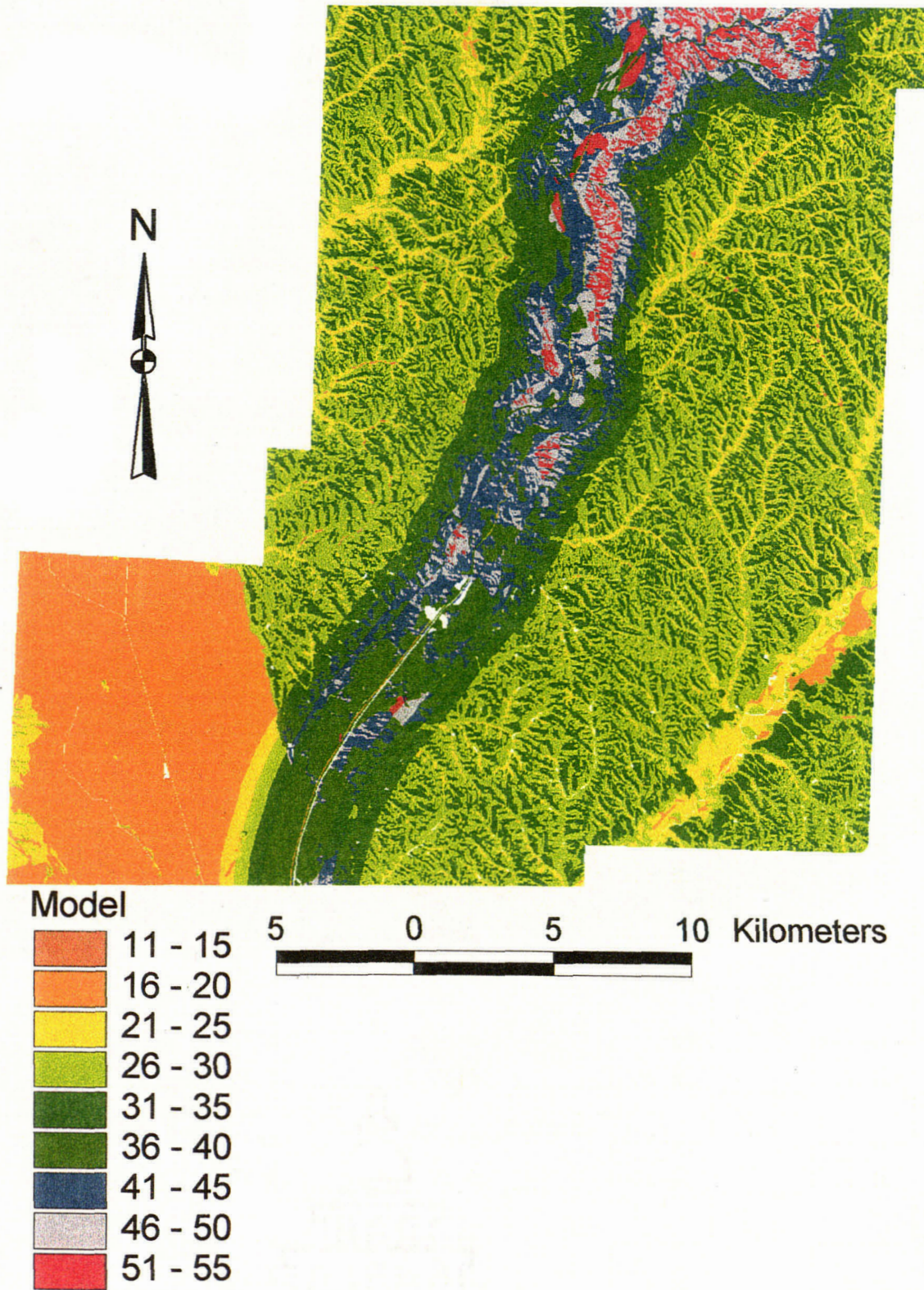


Figure 6.2g. Predictive model map of the portion of the study area in southern Woodbury and northern Monona County.

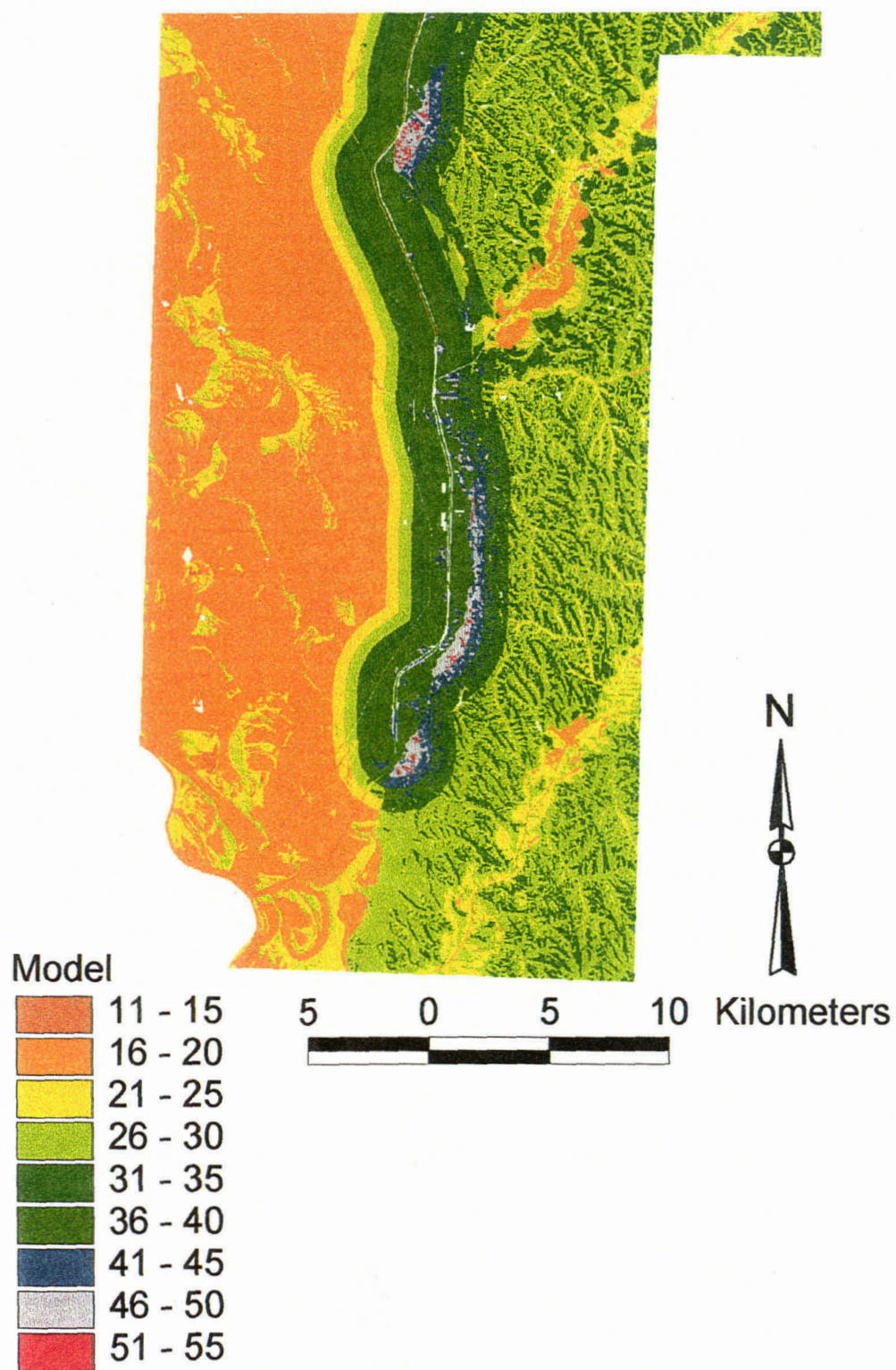


Figure 6.2h. Predictive model map of the portion of the study area in southern Monona and Harrison County.

decline as cells are distanced farther from the Little Sioux River, which is to be expected based upon the data and location of the known sites.

After the predictive model was created, the known site cells were then compared with the predictive model to see how well the known sites correlated with their locations and their cell composite scores. Overall, the match between known sites and their associated composite cells scores is excellent. The scores for the known sites and non-sites were then analyzed to determine the effectiveness of the predictive model presented in this study. Frequency counts for known sites and non-sites were tabulated to reflect where the cell scores were distributed (Figure 6.3, Figure 6.4). Cumulative percent was also calculated for both the known sites and non-site cells (Figure 6.5). Percent classified correct was also determined by taking the inverse of the non-site cumulative percent scores and plotted against the cumulative percent of known site scores (Figure 6.6). Finally, improvement over chance was tabulated as a function of cell score (Figure 6.7). The last figure represents the effectiveness of the model versus randomly venturing out into the study area to look for Oneota sites. The greatest improvement over chance is found at a cutpoint cell score of 43 with a percentage of 83.47 percent improvement over chance. This is also termed the cutpoint score and shows the point where the most known site cells and non-site cells are correctly classified (P. Anderson 1996; Kvamme 1992; Warren 1990a).

The study area contains 6,671,477 thirty-meter grid cells, of which 607,569 cells, or 9.1% have a cell score of forty-six or higher. The score of forty-six is the 84th percentile with regard to the scoring scale of the predictive model. In other words, only areas that contain cells with a score of forty-six or greater need to be carefully surveyed. The predictive model has eliminated over ninety percent of the study area for survey, which would allow archaeologists to concentrate in the high probability areas.

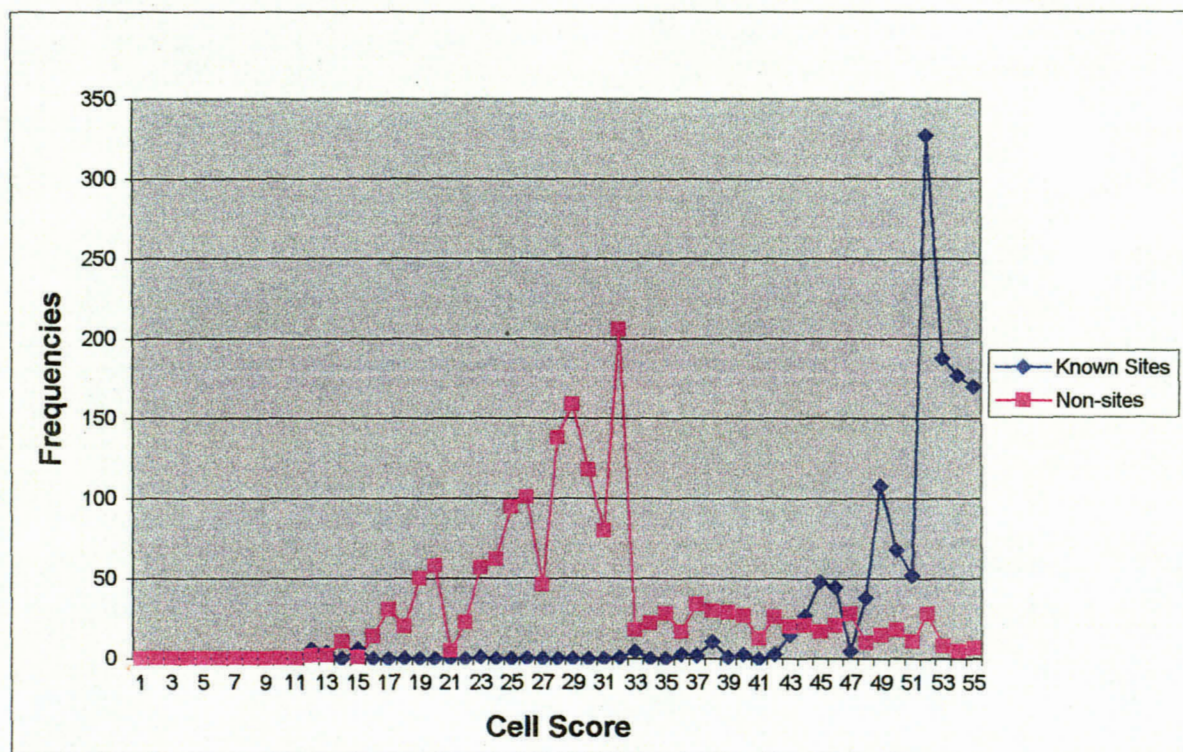


Figure 6.3. Graph of observed frequencies of cell scores.

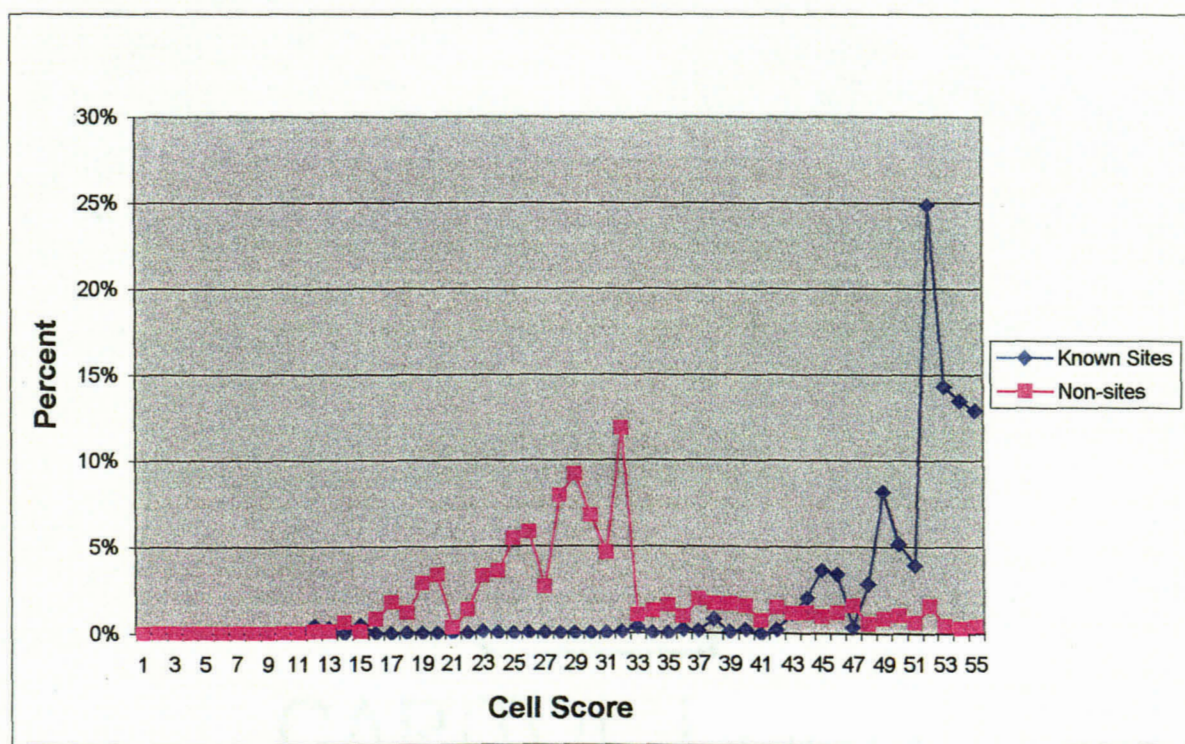


Figure 6.4. Graph of observed frequencies by percent.

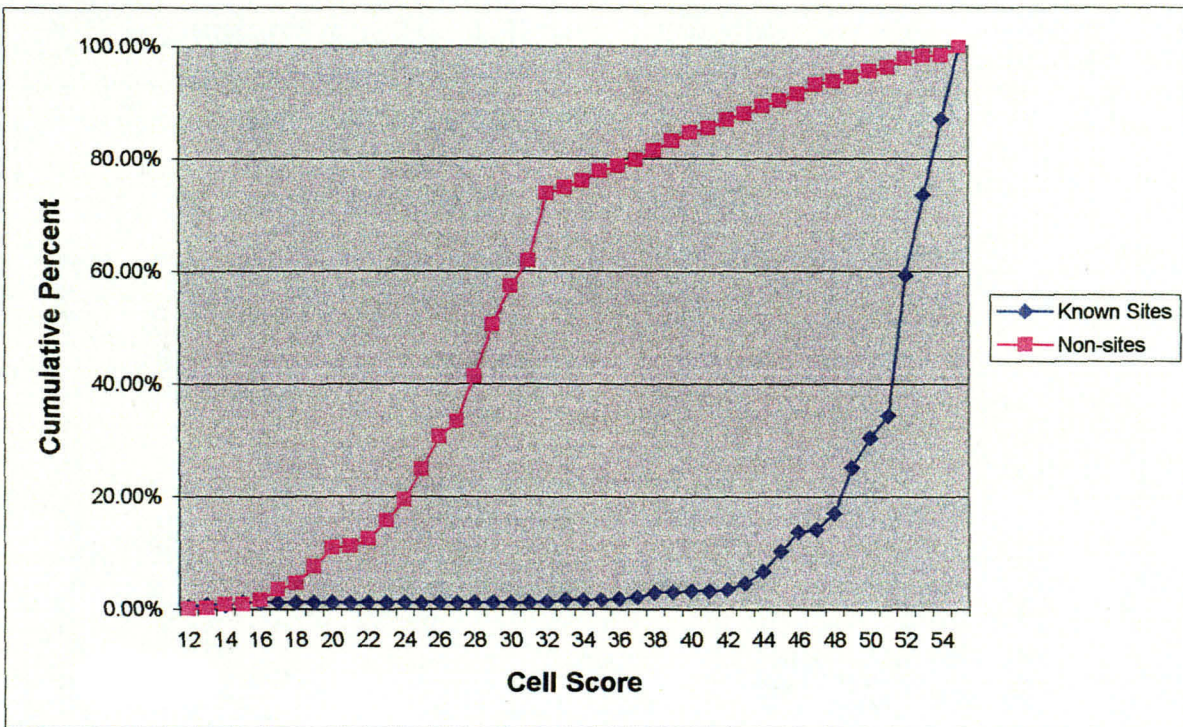


Figure 6.5. Graph of cumulative percent distributions.

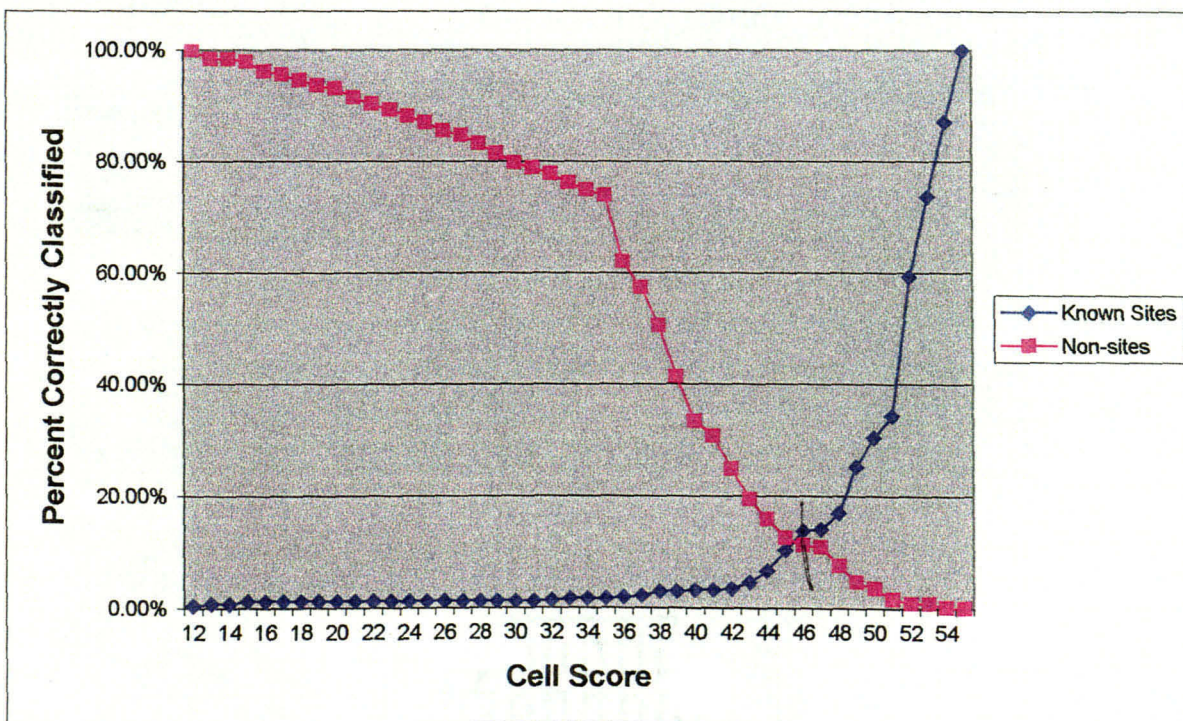


Figure 6.6. Graph of cells as percent classified correct.

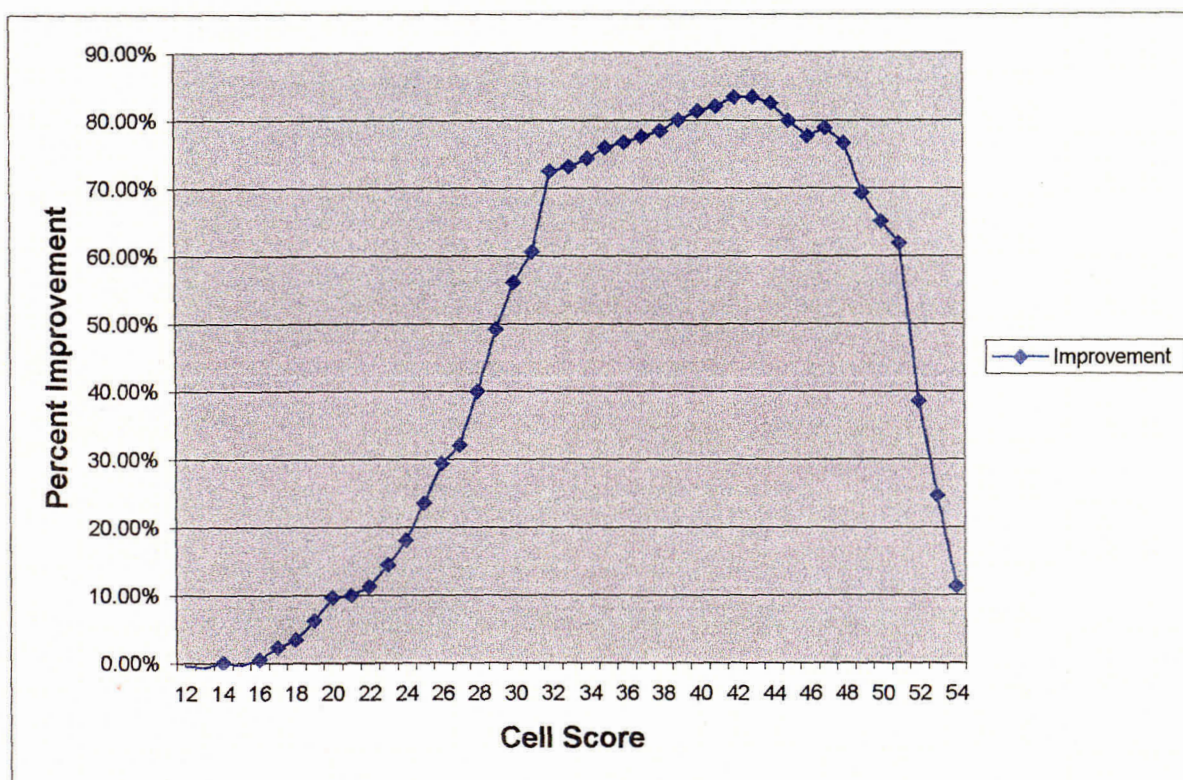


Figure 6.7. Graph of model improvement over chance.

Based upon the values calculated through the logistic regression analysis, the model constructed for the study area has the potential to be very useful. Oneota sites are likely to be found in close proximity to the Little Sioux River or its major tributaries and where soils have good drainage characteristics. The cell scores and cell locations of the known Oneota sites in the Little Sioux Valley further support this model.

The model constructed and presented in this study does not guarantee the presence of Oneota sites in every area where the model has selected high cell scores. Additionally, it does not mean that the model should be used in place of traditional archaeological surveying techniques. Rather, it should be seen as a device to help assist in the surveying of areas that do not contain known Oneota sites and as a supplement to archaeological surveying. Furthermore, as new data are acquired, the model can be continually refined to help increase its effectiveness.

CHAPTER 7: ONEOTA SETTLEMENT PATTERNS

Site Catchment Review

In Chapter 5 it was noted that the Oneota sites in northwest Iowa cluster in three distinct locations within the Little Sioux Valley. These clusters are separated both geographically and temporally; older sites are farther south while more recent sites are located in the north. This clustering of sites has been observed in other regions of the Great Plains where Oneota sites exist (Dobbs and Shane 1982; Henning 1970; Michalik 1982; M. Wedel 1959). This is not to say, however, that the possibility for older Oneota sites farther north in the Little Sioux Valley does not exist or vice versa.

The eight Oneota sites in the study area reflect what may be considered a broad spectrum economy, depending upon hunting, wild plant gathering, and horticultural activities as their mode of subsistence. As noted by other researchers, Oneota groups utilized a wide variety of resources both wild and domesticated (Alex 2000; Harvey 1979; Tiffany 1982; Tiffany and Anderson 1993). It follows then that in to find this diversity of resources, Oneota groups would need to locate their habitations in areas where they could maximize their potential of resources and at the same minimize their energy expenditure. Environmental transition areas, or ecotones, would allow Oneota groups to exploit the greatest diversity of resources within a given area.

Examining the site catchments of northwest Iowa Oneota sites, one observes that there are four main habitat areas. The first is lowland prairie areas located on bottomlands and terrace formations within the catchment. The second habitat would be lowland wooded areas, comprised of soft woods such as cottonwood. Forest composed of hard woods such as oak and hickory are found on slope, valley walls, and some upland areas comprise the third habitat zone. Finally, upland prairie constitutes the remainder of habitat areas in the

site catchments. Each of these habitat zones transitions into one or more adjacent habitats to produce ecotonal areas. These zones also contain various other grasses, shrubs, and plants that could be utilized for food, material objects such as cordage and arrow shafts, or building resources. Various species of small and large game would also be present.

Each catchment in the study area has varying proportions of these habitat zones. The Correctionville locality has larger amounts of lowland areas, due primarily to their location on terraces in the Little Sioux Valley. The Bastian locality has nearly equal amounts of the major resources, also due site location. Finally, the sites in the northern reaches of the Little Sioux Valley have much larger areas of upland prairie in their catchments, again caused by the location of the site and geomorphological setting.

One of the goals of this study is to compare the site catchments of Oneota sites in northwest Iowa with site catchments created in other areas of Iowa in addition to other states. While the number of site catchment studies is small, there is enough information to describe a general idea of what type of environmental setting other Oneota groups were selecting, and if there are any major differences between northwest Iowa Oneota sites and other locales.

Site Catchment Comparisons Within Iowa

Site catchment studies of Oneota sites have taken place in southeast Iowa (Tiffany 1982) along the Mississippi River, and in central Iowa (DeVore 1990) along the Middle River. The Oneota sites in southeast Iowa that Tiffany examined included twelve lowland and three upland sites. The sites classified as lowland sites are located upon either stream terraces or alluvial fans (Tiffany 1982:7). The lowland sites were all dominated by bottomlands and second order stream floodplains. The three upland sites are located on upland divides and sit very close to the bluff edge (Tiffany 1982:6).

Upland sites have a much smaller percentage of land classified as upland areas in comparison to the Oneota sites along the Little Sioux Valley. Vegetation is comprised of upland and lowland prairie, lowland and gallery forest, and gallery and lowland mixed prairie/forest. Trees comprise on average approximately thirty percent of the total catchment area. This is in marked contrast to sites in the Little Sioux River Valley. Of all of the sites analyzed in southeast Iowa, all of them are located on or near major ecotones of these vegetative communities (Tiffany 1982:7). This mixture of predominantly prairie and forest vegetation makes for very similar ecotones found in northwest Iowa. Interestingly, many of the catchments overlapped one another. This suggests that the Oneota groups who lived in southeast Iowa were preferentially locating habitation sites near areas of selected resources (Tiffany 1982:7).

The only site in central Iowa that has had a site catchment analysis performed on it is the Cribb's Crib site (13WA105). This site is located in the central Des Moines Valley on the Middle River, a tributary of the Des Moines River. Cribb's Crib is located on the west bank of the Middle River on a terrace (DeVore 1990:48). Most of the soil types at Cribb's Crib are well drained soils formed through local climatic and geomorphologic processes (DeVore 1990:49). The site is bordered by two large upland interfluvies. DeVore did not calculate percentages of landforms within the catchment, but inspection of the site catchment suggests that roughly half of the catchment is comprised of bottomlands and terraces. The bulk of the remaining land area is taken up by the two upland areas.

Vegetative types in the Cribb's Crib site catchment were taken from USDA soil surveys and reflect differing categories of prairie and forest. Prairie comprises the largest vegetative community at 52.7 percent. Forest areas make up another 18.7 percent of the vegetation, and the remaining 18.1 percent is a mix of prairie and forest (DeVore 1990:49). Cribb's Crib is located in area where there are four ecotones, which would allow the Oneota

inhabitants to exploit the maximum amount of resources around the vicinity of the site (DeVore 1990:49).

The site setting of Cribb's Crib is similar to Oneota sites in northwest Iowa, particularly Bastian (13CK28). Both are located near confluences of river systems and have roughly the same amounts of vegetative types. Overall, however, the local environment at Cribb's Crib is quite similar to not only northwest Iowa Oneota sites, but also of Oneota sites located in southeast Iowa.

Site Catchment Comparison Outside of Iowa

Site catchment studies for Oneota sites elsewhere include one study in Wisconsin (Gallagher and Stevenson 1982), and research in Illinois (Michalik 1982). Gallagher and Stevenson (1982:21) took a different approach to site catchment analysis by implementing an algorithm that calculated walking speed as a function of slope steepness for a two-hour walking time. Michalik used the more traditional method of using weighted concentric circles.

The Oneota sites in Wisconsin studied encompass the La Crosse locality, and included eight Oneota sites. This is an area dominated by the Mississippi Valley and smaller order stream systems (Gallagher and Stevenson 1982:15). All eight sites are located on the eastern side of the Mississippi Valley, and all reside on terrace remnants at an elevation of approximately 700 feet. Based upon their location, the predominant landforms within the catchments are bottomland and terrace areas, although upland areas are present and constitute varying proportions of the total catchment areas. Furthermore, all of the sites are located on high, well drained, sandy soils (Gallagher and Stevenson 1982:24). Highly productive soils for horticulture are also found close by, which could have been used for farming. Taking these factors into consideration, it would appear that Oneota groups in the La Crosse area were selecting areas of well drained soils in their search for

suitable habitation areas. This is similar to sites in northwest Iowa such as Dixon (13WD8), Gothier (13WD3), Correctionville (13WD6), Bastian (13CK28), and Milford (13DK1). All of these sites are located on well drained soils in addition to having soils nearby that would be well suited to horticultural activities.

Vegetative resources within the catchments are composed of prairie, forest, and a prairie/forest mix, or savanna. In addition there are marsh areas and wetlands that cover much of the active floodplain of the rivers in the region. Examination of the vegetation for the Oneota sites reveals that savanna and lowland vegetative communities predominate (Gallagher and Stevenson 1982:22 Table 1). No other distinction can really be made since distinctly separate categories such as forest areas are not present. What is clearly evident, however, is that Oneota groups around La Crosse were locating sites in areas to take maximum advantage of the environment in addition to locating areas that have soils suitable for both habitation and farming (Gallagher and Stevenson 1982:27). The vegetation is generally similar to northwest Iowa, in particular with regard to the older Oneota sites located at the Correctionville locality and the Bastian site. This would be expected due to similar landform settings and site locations.

The Oneota sites in Illinois that were analyzed by Michalik include thirteen sites clustered in three areas around the Sag-Des Plaines and Little Calumet rivers. Interestingly, most of the soils in this area are very poor with regard to drainage characteristics and horticultural potential (Michalik 1982:32). No regional map is included with the original article, but it can be assumed from the vegetative types in the area and soil characteristics that most if not all of these sites are located on the bottomlands or low terraces of the aforementioned rivers. Since the soils generally have poor characteristics, it is suggestive of a subsistence pattern that was not representative of other Oneota complexes in the Midwest (Michalik 1982:44, 53). Aquatic and marine animals were the dominant species identified as

meat resources at all of the sites that had faunal analysis completed (Michalik 1982:34). Of large game animals, only white tail deer exhibit contribute a fairly significant amount to the overall diet.

Vegetative communities include a mix of prairie and deciduous forest in addition to large amounts of wet prairie and marshlands. Vegetative communities were not calculated by percentage. Most of the analysis relied upon the categorization of soil types and their characteristics (Michalik 1982:40). Therefore it is difficult to determine the extent and percentages of different vegetative types within the catchments. However, the conclusions reached by Michalik (1982:34, 44, 52) suggest that Oneota groups in this area utilized a broad spectrum of hunting and gathering with some horticulture as well as increased reliance on aquatic animals for meat because there was greater environmental stress. Furthermore, these sites were determined to be seasonally occupied to maximize the potential at each site without depleting resources (Michalik 1982:39-40).

There are some general similarities between the different regions. The first is the preference for locating sites close to permanent water sources. This would be necessary for crops and for drinking water. Additionally, this would be helpful for exploiting any resources that are found in marshy areas or wetland habitats.

Horticultural practices are also evident at each area, although determining the extent of its importance is difficult to assess due to differential factors of preservation, local environment, and research goals of each study. Nonetheless, each region has been noted to contain remains of maize, beans, and squash, including sites in the Chicago area.

Finally, perhaps the most telling similarity between all of these areas is the local environment within the catchment. In each region Oneota sites are located in places where prairie and forest merge together. This would allow Oneota groups to take advantage of plants and animals that could be found in each of the main vegetative zones. Additionally,

landforms also play a part in this since with regard to vegetative community locations. In other words, upland prairie habitats are dissimilar to prairie located on bottomlands and terraces. Therefore, the plant and animal communities that inhabit these zones will differ (Semken and Falk 1987).

Oneota Settlement Patterns in Northwest Iowa

The importance of settlement patterns with regard to archaeological analysis and interpretation of prehistoric groups should not be underestimated. Willey (1953) defines the analysis of settlement patterns as a strategic starting point for helping to answer other archaeologically relevant questions. Trigger (1968:55) has categorized the analysis of settlement patterns into three groups. The first is analysis of the individual structure; the second is the analysis of the site relative to the grouping of structures; and third, the analysis of sites distributed over the landscape. This third level will be the focus of this chapter with regard to Oneota sites in northwest Iowa.

Trigger (1968:54) also defines two approaches to settlement patterns: one focuses on the settlement patterns of a group as a function of the interaction between environment and technology; the second is using settlement patterns as a basis for making inferences about cultural facets of a group such as social or political organization. The latter approach cannot really be used in this analysis because of the fact little is known about the social or political organization of Oneota groups. Furthermore, none of the sites has been fully excavated; there is no way to define community layouts or groupings of structures. The former definition is suitable, but does not reflect any cultural influences on settlement patterns explicitly. The possibility of cultural factors of settlement patterns do need to be explored since some researchers have put forth the idea that Oneota sites were not necessarily located purely for environmental reasons (Tiffany 1982).

The ultimate goal of this study is to attempt to determine, or at least give some suggestions and ideas with regard to the settlement patterns of Oneota groups in northwest Iowa. For example, were decisions on settlement location based upon primary needs for resources, and therefore focusing upon the local environment, or were there other factors, perhaps culturally influenced, that had more importance? Why are all but one of the Oneota sites in Northwest Iowa to date found in the Little Sioux Valley and not on adjacent tributaries? Do settlement patterns of Oneota groups in northwest Iowa reflect the same sort of settlement patterns observed in other regions of the Great Plains? Is the ethnohistoric record useful in supporting the interpretations? These are some of the questions that will hopefully be answered. The analysis of site catchments and comparisons of those site catchments with other areas of the Great Plains were the primary tools used to assist in this endeavor. Additionally, ethnographic sources were also used as well as brief remarks on recent interpretations by other researchers, for example Fishel (1999).

The distribution of Oneota sites in northwest Iowa reflects discrete spatial clustering. This clustering of Oneota sites has also been noted by other researchers (Harvey 1979; Henning 1970). Additionally, the site clusters are separated temporally, with sites in the lower portions of the Little Sioux Valley older than the site farther north.

From a purely environmental and subsistence standpoint, a number of observations can be made. First, all of the sites are in close proximity to major stream systems or their tributaries. Tiffany (1982:7) has suggested that the inclusion of second and smaller order stream systems would be a good source of alluvium for farming. The importance of locating sites close to permanent water sources is self-evident: it gives the site inhabitants easy access to potable water, aquatic and marine animals can be used for food, native lowland grasses can be exploited for food or other needs, farming could take place on these

bottomland areas due to their rich nutrient content, and finally larger game might be taken if these stream systems are the only major source of water in the area.

Situating sites close to the river would allow for a natural system of transportation where people could travel up and down the waterways quicker than by overland travel to certain destinations. Ioway individuals recall using bullboats and rafts constructed of logs to cross streams (Skinner 1926:280). Winnebago tribesmen also remember using birch bark and dugout canoes during the prehistoric and historic periods (Radin 1971:75). Stream routes could also be used for acquiring resources outside of the immediate site area as well (Gallagher and Stevenson 1982). The preceding discussion is most likely why earlier sites are located on the terraces, and the later sites on the uplands are located so close to the edges of bluffs.

A second observation deals with the location of the sites in relation to landforms. Five sites are located on terraces, while the remaining three are located on uplands. Most likely site location preference would have focused on terraces. However, looking at the regional topography around sites in the northern region of the Little Sioux Valley, upland locations might have been preferred. The Little Sioux Valley becomes more asymmetrical as the Little Sioux River get closer to its source (Hoyer 1980). A look at a topographic map around Gillett Grove (13CY2) reveals that the east bank of the Little Sioux River rises up slowly; there is no steep ascent from a valley wall to the uplands. Furthermore, terrace remnants may have held the possibility for frequent flooding, particularly in the spring. If this were the case, a site located on the terraces would have been subjected to inundation on an annual basis.

The size of Burr Oak (13CY1) as mapped by the Office of the State Archaeologist of Iowa is a large site. No area in the catchment of Burr Oak on the bottomlands or the terrace remnants in the area would have been able to situate it. Also, this area is very prone to

flooding as observed by the author during the summer of 1999. It can be said then that in relation to these two sites, an upland location would be far more preferable than the alternative of locating the sites on terraces.

Another consideration that was taken into account with regard to Oneota sites in northwest Iowa appears to be soil types, not only for habitation but also for horticultural purposes. All eight Oneota sites are located on well-drained soils. This soil characteristic would facilitate movement of water through the soil substratum, leaving less chance for ponding of water on the surface. This would also be helpful for sites that contain large amounts of cache pits for storage, a characteristic of many Oneota sites (Fishel 1999; Harvey 1979; Henning 1970).

Oneota groups are also known for including horticulture as a significant component of their subsistence activities. As such they would need access to soils that are both highly fertile and easy to work. Many of the sites except for Burr Oak (13CY1) and Gillett Grove (13CY2) have more than enough arable land in the immediate vicinity of the site to satisfy this requirement. Many of the soils are silty or sandy loams, which would make them easily tillable with the tools used by Oneota groups.

Burr Oak and Gillett Grove pose an interesting problem. The site catchments described in Chapter 5 demonstrate that they do not hold sufficient quantities of land on the bottomlands or terraces along the Little Sioux River. This does not mean, however, that horticultural activities were not present at the time the site was occupied. Seeds including maize have been recovered from the Gillett Grove site, but have not yet been fully analyzed (Titcomb 2000). Burr Oak's status is unknown because no archaeological investigations have taken place there. Moreover, research on Oneota crop fields in Wisconsin demonstrate that some sites have fields located in upland settings (Gallagher et al. 1987; Moffat 1979). These fields were located primarily in sandy soils, which would be

advantageous in tilling. The land immediately around both Burr Oak and Gillett Grove has Primghar silty clay loam as the soil type, which has a high crop yield potential (Fisher 1969:32-33).

This raises some different possibilities with regard to these two sites. One is that horticulture may not have been as important in this area. It must be kept in mind that these sites are much later than sites such as Dixon (13WD8) or Gothier (13WD3), and hence subsistence emphasis may have changed. In other words, hunting may have gained more importance and farming contributing less to the diet. This hypothesis was put forth by Gibbon (1972), and supported to some extent by others (Tiffany 1982).

Finally, examining each site catchment one recognizes that there are a variety of vegetative communities within each catchment. While each catchment is primarily composed of prairie and timber, the location of each community with regard to landscape position is key. Habitats for upland and lowland prairie will differ, and as such plants and animals that inhabit one or the other zones will differ. For example, lowland prairie will contain various types of prairie grasses, sedge grasses, and plants suited to wet and marshy conditions. Upland prairie will contain plants and grasses more suited for dryer and less moist zones. The same can be said for timber areas situated on lowland areas or along the valley walls and sloping ground. Lowland forests are comprised of softwoods, primarily cottonwoods, willows, and other trees suited to wet conditions (Van Der Linden and Farrar 1984). Forests and stands of timber on sloping higher grounds are composed of hardwoods, such as oak, hickory, and walnut (Schwartz 2000, personal communication; Van Der Linden and Farrar 1984). Oak stands could also be found on bottomland areas relatively safe from flooding as well.

Within these different vegetative zones, different animal species could also be found. The lists of faunal remains from Oneota sites in northwest Iowa attest to the wide range and

diversity of animals in this region (Harvey 1979; Tiffany and Anderson 1993; Titcomb 2000). Some of the smaller animals can also be used to help model prehistoric climatic conditions in the study area as well. Semken and Falk (1987) and Tiffany and Anderson (1993) suggest that based on the presence of smaller animals in northwest Iowa at the time the area was occupied by Oneota groups, the environment was cooler and more mesic than the present. By locating villages in these areas where convergence of these different zones were present, Oneota groups gave themselves access to a wider variety of resources than they would have had if they located villages in areas with just one or two of these vegetative communities. Therefore, it seems that Oneota groups living in the Little Sioux Valley were also selecting site locations to take advantage of these vegetative communities and their zones of convergence.

Another reason related to subsistence and site location with regard to geographic location and time is the suggestion of a change in emphasis in the subsistence economy. Gibbon (1972) put forth the idea that after the thirteenth century, Oneota groups began to rely more on bison as the primary source of sustenance as well as people splitting up into smaller groups and settling in new regions. Previous Oneota settlement and environmental studies also provide support for this hypothesis (Tiffany 1982; Tiffany and Anderson 1993). Current research has also tended to support the idea that Oneota groups became more reliant on bison (Fishel 1999:118, 128; Harvey 1979; Sasso 1993). This may be in part true, but the importance of horticulture does not seem to diminish, at least for sites that have had floral remains analyzed (Fishel 1999; Lippincott 2001). Additionally, one of the major areas of evidence for this increasing reliance on bison came from the idea that the climate changed to a cooler and dryer environment after 1200 AD (Baerreis and Bryson 1965). However, current research has demonstrated that the climate was actually cooler and wetter

after 1300 AD than before (Laird et al. 1996:553). In this respect, the conditions for horticulture would have been more favorable after 1300 AD than before this time.

Fishel (1999:125-126) has suggested some migration models for northwest Iowa Oneota migrations into and out of the Little Sioux Valley. One of these models has the Oneota moving from the Little Sioux Valley to northeast Iowa (see M. Wedel 1959), and then returning to northwest Iowa. Research from northeast Iowa and the upland protohistoric Oneota sites suggests that these groups may be one and the same based upon artifact attributes (M. Wedel 1959; Titcomb 2000). The interesting thing is that the sites in northeast Iowa are located on high terraces and uplands, with similar environmental characteristics as northwest Iowa. The possibility exists that the protohistoric Oneota sites in northwest Iowa were not located to take advantage of bison numbers, but were looking for areas with similar environmental characteristics that resembled the northeast Iowa environment.

To summarize the environmental data above, it suggests that the most prominent factors for Oneota site location would be preference for well-drained soils to locate the village and for horticultural activities, and for selecting areas that would have the largest diversity of natural resources to exploit. This criterion for selecting suitable site locations is also found elsewhere where Oneota sites are known to exist (Gallagher and Stevenson 1982; Tiffany 1982).

Ethnographic literature also helps to support the suggestions given above for site location. For example, the Omaha tribe always chose a site location near a running stream convenient to timber and not far from the hills (Fletcher and LaFlesche 1911:95). Additionally, other ethnographic and ethnohistoric has placed the protohistoric Oneota sites along the Little Sioux Valley and include Gillett Grove (13CY2) and Milford (13DK1), and Blood Run (13LO2) along the Big Sioux River as being affiliated with either the Omaha, Ioway, or Oto tribes (Fletcher and LaFlesche 1911; Harvey 1979; M. Wedel 1959, 1976,

1981). Mention is also made of the loway in particular of their horticultural practices, for which they were distinguished from other tribes by French explorers and traders (M. Wedel 1976:21-22, 1981:4). Perhaps another reason why the later Oneota sites are located on the uplands was so that traders or explorers in the region could access them easier. Le Seuer, a French trader had established a French trading post named Fort Vert on the Blue Earth River in 1700, and asked the loway and others to acquire beaver hides for trading. However, no permanent village was ever established and the trading was subsequently abandoned in 1704 (M. Wedel 1976, 1981). Other cultural factors that could lead to an upland site location could be needs for, trade, or accessibility to natural resources (Harvey 1979; Tiffany 1982). Tiffany (1982) has also suggested that Oneota sites in southeast Iowa were located in areas to strategically limit traffic into the interior of Iowa by way of water travel. Population migrations and pressures from the east could also have led to a shift in site location (M. Wedel 1976). Locating sites on the uplands could have been a defensive measure, since more of the surrounding landscape could be surveyed and escape could be easier on the uplands than from lower elevations. In this regard, protohistoric Oneota groups in northwest Iowa were seeking to protect themselves with these upland sites. One final possibility is that the upland sites could possibly be summer sites with other sites used during the winter months. The climate in northwest Iowa would be particularly harsh during the winters, and it is unlikely that Oneota groups would choose to stay on the uplands, vulnerable to the cold and bitter winds. This situation would be similar to that found in southeast Iowa, where sites are paired and occupied at different times of the year (Tiffany 1982). However, if this is the case in northwest Iowa, the winter sites have not yet been discovered. These could all be viable explanations, but more work would need to be done both archaeologically and ethnohistorically in order to fully substantiate these suggestions with regard to northwest Iowa Oneota sites.

Comparison of Settlement Patterns

The final section of this chapter presents a comparison of settlement patterns between northwest Iowa and other regions in Iowa and the Midwest. The scope of this analysis is limited to areas where sufficient research has been done to give some idea of how Oneota groups were locating sites and for what reasons. Most regions are located on major river systems and since the vegetation across the Great Plains is generally similar, the general settlement patterns and subsistence practices should not differ that greatly.

Iowa

Comparisons of regions within Iowa include southeast Iowa and central Iowa. Settlement information for southeast Iowa is derived from Straffin (1971) and Tiffany (1982, 1998). Settlement data for central Iowa comes from DeVore (1990), Benn (1991), and Moffat (1998).

Southeast Iowa Oneota sites are located along terraces and bluffs adjacent to the Mississippi River or its major tributaries. Like the sites in the Little Sioux Valley, the dominant vegetative communities in southeast Iowa are comprised of forest and prairie and mixed forest/prairie habitats. Additionally, sites cluster in groups in four localities in southeast Iowa. The Oneota sites in this area are most likely positioned in the midst of the greatest local environmental diversity nearest to them (Tiffany 1982:10). Based upon the catchment summaries described earlier in this chapter, these sites were placed to take advantage of both upland and lowland and floodplain resources. The sites are also believed to have been reoccupied over a period of time (Tiffany 1998:147).

Floral and faunal analyses from these sites reflect a pattern of subsistence that incorporates hunting, farming, and plant cultivation and gathering (Straffin 1971; Tiffany 1998). The extent or importance of each subsistence system in relation to each other is unclear, however. Additionally, southeast Iowa sites are located on well drained to

excessively drained soils (Tiffany 1998:148). Another possibility is that the sites were seasonally occupied, with an upland and lowland site paired together. One example of this pairing would be the McKinney site and the Poison Ivy site (Alex 1978; Tiffany 1986). From a subsistence and environmental perspective, Tiffany (1982:10, 1998:148) asserts that the difference between the upland and lowland sites with regard to environmental diversity is negligible. It follows then that if resource procurement was not a motivating factor for site location, other reasons would have to be deciding factors in site placement.

Tiffany (1982:12, 1998:148) suggests that site placement was selected in areas to control or regulate resources within the area. For example, two localities are located at confluences of major Mississippi River tributaries that lead into the interior of central Iowa. The Toolesboro locality is situated at the confluence of the Mississippi and Iowa/Cedar rivers, while the Spring Creek and Lost Creek localities sandwich the confluence of the Mississippi River and the Skunk River (Tiffany 1998:148). Additionally, the Kelley site is located in an area close to the rock quarries that produce Burlington chert, a stone that was highly regarded and used for manufacturing lithic tools (Tiffany 1998:148). The sites are also conveniently located for access to the Mississippi River as well. Control of these resources would have been critical to any group living in this area, as there would be the possibility of attacks or raids from neighboring groups.

Central Iowa Oneota sites are located along the Des Moines River. Currently, all of the sites are affiliated with the Moingona phase (Gradwohl 1974). There is a considerable diversity of Oneota sites in this region, ranging from villages such as Clarkson (Osborn 1982) and Cribb's Crib (DeVore 1990), to smaller, possibly seasonally occupied camps (Benn 1991).

The settlement patterns within the Des Moines Valley perhaps reflect more of an agricultural emphasis in this region. Most of Oneota sites in central Iowa are located on

intermediate or high Holocene terraces (Moffat 1998:169). Additional sites are also located on the high Wisconsinan intermediate terraces (Moffat 1998:169).

Moffat (1998:169) suggests that there is a high degree of association between Oneota village sites and soil types. Accordingly, soil type was a critical factor in deciding where to locate the larger village sites. Vegetative modeling at certain sites including Cribb's Crib and Christenson reflect the common pattern of upland and lowland prairie, and lowland and gallery forest (Benn 1991; DeVore 1990). Floral and faunal remains reflect a subsistence strategy of hunting, horticulture, and gathering. The sites in the Des Moines Valley region are some of the earliest Oneota sites in Iowa. Moffat (1998:169) also asserts that site locations in this area were not geared toward defensible means or for control or regulation of goods. The main reasons for site location and placement were due primarily for subsistence pursuits (Moffat 1998:169). Central Iowa appears to have site location criteria similar to northwest Iowa. Settlement appears to have depended upon vegetative communities and soil types for both habitation and for horticultural activities.

Minnesota

Minnesota data on settlement patterns comes from research done along the Blue Earth River in southwestern Minnesota. In this region, there are two clusters of Oneota sites located along the Blue Earth River and two of its tributaries. Work on settlement patterns has been by Dobbs and Shane (1982) and Dobbs (1984).

The Oneota sites in the Blue Earth region conform to settlement patterns found in other areas of the Great Plains. First, sites are clustered spatially, and are close to a major river system or its tributaries. In this case, the Oneota sites in southwestern Minnesota cluster around Center Creek and Willow Creek (Dobbs and Shane 1982:59). Other large village sites along the Blue Earth River include the Vosburg and Humphrey village sites (Gibbon 1983). Sites are located on floodplains and uplands around these two localities and

vary in size from small campsites to large semi-sedentary villages (Dobbs 1984). Further, Dobbs (1984:181, 199) demonstrates that there is a significant correlation between large villages and soil types. Large village sites are located on well-drained soils and in areas adjacent to tracts of arable land. This correlation suggests that horticultural activities were important to the Oneota groups living in this region.

Vegetative communities are typical of the Prairie Peninsula, with expanses of prairie and gallery forest located along stream systems. Dobbs (1984:199) asserts that, at least in this area, that the major determinants that affected site location include soil type mentioned previously, and areas where resource zones were varied. This implies that the Oneota groups in Minnesota were selecting areas to take advantage of resources found along the streams, uplands, and lowlands. Additionally, Dobbs (1984:200) also suggests that protection from prairie fires was also a factor in choosing site location, due to local topography.

In the Blue Earth River region, Oneota groups were practicing a broad spectrum subsistence pattern, utilizing the lowlands for cultivated fields, the uplands and lowlands, and the river environment. Gibbon (1983:9) also suggests that there may be more of a reliance upon bison than other large game animals. This is a definite possibility considering the geographic locale of the Blue Earth River, but to what extent is unknown. Additionally, the hypothesized settlement shifting away from the terraces to the uplands is also unclear at this time.

Wisconsin

Wisconsin has numerous Oneota sites located in various parts of the state such as Carcajou Point and Crabapple Point located along lake margins in eastern Wisconsin and the Sheffield site located along the St. Croix River in eastern Wisconsin. (Gibbon 1971, 1973; Hall 1962; Spector 1975). The region of comparison for this study will be the La

Crosse locality, where settlement studies have been undertaken. The Oneota sites in the La Crosse locality are situated close to the Mississippi River and its tributaries in the region (Arzigian and Boszhardt 1989; Boszhardt 1998; Gallagher and Stevenson 1982). This area was continuously occupied by Oneota groups for over three hundred years and was abandoned just prior to the introduction of items of European manufacture (Boszhardt 1998:197). Sites are located along the terrace remnants as well as being located on uplands in some areas. Here in the La Crosse locality there is evidence for the Oneota settlement shift from the lowlands to higher elevations at later times (Boszhardt 1994, 1998).

Site catchment studies and further environmental analysis demonstrate that earlier sites were taking advantage of a lowland and riverine procurement strategy with some access to upland resources (Arzigian and Boszhardt 1989; Boszhardt 1998; Gallagher and Stevenson 1982). Later Oneota sites, located further back from the river margin and close to bluff edges suggest that a change in subsistence may have taken place to take advantage of more upland resources (Boszhardt 1998:202). The reasons for this shift are unclear, but one site at the La Crosse locality, the Valley View site, has evidence for fortifications, so defensive considerations may have played a role in the shift to a higher elevation (Boszhardt 1998:202). However, continued occupations at various locations in the La Crosse locality continued, so it is unclear as to the true reasons for locating some sites further up the valley wall.

Subsistence strategies relied on hunting, horticulture, and gathering. Floral analysis at the Valley View site reflects a dependence upon starchy seeds and grains that included maize (Arzigian 1989:152). Faunal studies reveal that large game animals including bison, deer, and elk provided a substantial portion of the meat diet supplemented by smaller animals, avifauna, and aquatic animals (Theler 1989:223, 235-237). Based upon the evidence from Valley View and site catchment analysis of other sites, the Oneota groups at

La Crosse were practicing a subsistence economy similar to other regions discussed in this study. Other sites located at Lake Koshkonong including Carcajou Point and Crabapple Point also support this broad spectrum subsistence pattern (Hall 1962; Spector 1975). In this locale, however, Spector (1975:340) states that wild plants and maize recovered from excavations were the primary basic elements of the diet with meat used as a supplement. Maize was highly ubiquitous at Valley View, suggesting that maize was a significant portion of the plant diet (Arzigian 1989:140).

Overall, the La Crosse locality reflects general trends and similarities with northwest Iowa with regard to site location and subsistence practices. It can be inferred that to some extent, resource procurement was a significant factor in locating sites in the area. The idea of a settlement shift through time away from the terraces and lowlands to upland settings is also supported.

Summary

Reviewing the information from northwest Iowa and other regions of the Great Plains where Oneota groups settled and lived, a number of trends are apparent. First, in nearly every region, Oneota sites cluster in groups and are located along stream systems. Secondly, sites are situated to take advantage of a variety of resources located on different landforms as well as different vegetative communities. Horticultural activities seems to influence site location as well since quantities of arable land would have to be available to sustain large villages and their inhabitants, not only for the short term, but also for months when other wild plant resources were becoming low or hunting was not as plentiful.

One current topic of interest pertinent to this study, and mentioned briefly previously in this chapter, is the impact of bison hunting and whether or not Oneota groups were

shifting their subsistence and settlement practices to take advantage of the numerous bison on the plains. Fishel (1999), Harvey (1979), and Henning (1998) are of the general opinion that bison hunting was a major, if not the most important subsistence pursuit for Oneota groups in northwest Iowa and farther west. One of the main lines of argumentation was the climatic deterioration model advanced by Baerreis and Bryson (1965). However, this model has been demonstrated to be contradictory to current research (Laird et al. 1996).

Additionally, there are other lines of support that bison hunting may not be the driving force it is thought to be. Brown (1982:111) states that the Oneota subsistence economy was likely never seriously threatened by any sort of climate deterioration. Additionally, when one thinks about the issue, pursuit of large game animals across vast expanses of land poses a risky proposition. Villages would have to be abandoned and nearly the entire population uprooted itself to go on the hunt, leaving a small group behind to protect not only the village, but also elderly and sick individuals, as well as look after crops that were still maturing. The missed chance of securing enough meat to sustain the population would be disastrous. The penalties for botching a kill opportunity were often severe if not deadly as evidenced by the ethnohistoric record (Fletcher and LaFlesche 1911). Further, large game hunting of animals such as bison were expensive strategies that would not be viable without considerable subsistence security (Brown 1982:111). Finally, Henning (1998:239) states that shortly after European contact, bison could be found in number east of the Mississippi River. If this were the case, there would really have been no need to migrate further west just for the sake of hunting bison.

As a result of this research, the author suggests that the Oneota groups in northwest Iowa were concerned primarily with looking for site locations that had good soils, both for horticulture and for village locations. The importance of horticulture has been demonstrated in both archaeological excavations and in ethnohistoric literature and research (Fishel 1999;

Harvey 1979; M. Wedel 1976, 1981; Wilson 1917). Furthermore, access to a wide array of natural resources both for food and for everyday supplies was also a significant factor in site location. Bison hunting, while no doubt an integral part of the subsistence strategy, does not seem to be as significant a factor taking into consideration the amount of resource diversity available to the Oneota groups in northwest Iowa. The shifting in site locations from the terraces to the uplands may not be the result of a change in the subsistence economy, but rather due to the topographic and landform limitations in the northern region of the Little Sioux Valley. However, if more sites are indeed present in the Little Sioux Valley and have not been discovered, this settlement shift may be nothing more than an under representation of the total number of sites in northwest Iowa. Cultural factors such as defensible site locations are also a possibility as well as control of resources or control of vital waterways that led further into the interior of Oneota lands. Trade, at least directly with Europeans as a reason for site locations in upland settings, does not seem to be a viable explanation in the opinion of the author since one trading post was erected in southern Minnesota, but was abandoned after less than four years of being occupied (M. Wedel 1976, 1981).

CHAPTER 8: SUMMARY AND CONCLUSIONS

The purpose of this study was to determine the possible reasons for Oneota site locations and settlement patterns in northwest Iowa along the Little Sioux Valley. As a result, four objectives were defined to accomplish this result. The objectives were: 1) to perform site catchment analysis on the known Oneota sites in northwest Iowa using geographic information systems technology, to model the prehistoric vegetative cover in each site catchment, and to compare the site catchments of northwest Iowa Oneota sites to other regions where site catchment analysis has been performed on Oneota sites; 2) to perform exploratory data analysis (EDA) on variables thought to have significant influence on site location selection, and to determine their statistical significance; 3) to create a predictive model of the Little Sioux Valley using the ArcView geographic information systems software package utilizing the variables found to be statistically significant for Oneota site location; 4) to discuss the potential reasons for Oneota site location based upon this research and to compare those results to other areas in Iowa and the Midwest where Oneota settlement studies have taken place.

Site catchment analysis was accomplished using GIS software and available data from a variety of sources including topographic maps, soil maps, and vegetation maps. These map coverages were converted into secondary map coverages where appropriate to add additional information and data about land characteristics around each site. This study differed from previous studies in site catchment analysis by using an algorithm that computed walk time over a three dimensional surface. This allowed topography to be taken into account, which affected the overall size and shape of the catchment around each site. Landforms and vegetative communities were modeled similar to studies by Gallagher and

Stevenson (1982), Tiffany (1982), (Tiffany and Abbot 1980), and Tiffany and Anderson (1993) to reflect overall proportions of these data at each site. These results were then compared to other Oneota regions throughout the Midwest to determine similarities and differences between the local site environments.

Exploratory data analysis (EDA) was performed on the site catchments to assess the landform types and vegetative communities within each catchment. The results from this analysis revealed some of the environmental variables that may have been significant in determining Oneota site location in northwest Iowa. The variables that were thought to be influential factors in determining Oneota site location were soil types, soil drainage characteristics, proximity to water, landform type, elevation, slope, aspect, and vegetative cover. Descriptive statistics were performed that included measures of mean, frequencies, and proportions of these variables to quantify and determine any general trends and correlations between site location and various environmental variables. These data were collected and saved in ArcView GIS database files. These data were subsequently used as the primary layers for the creation of the predictive model.

The creation of the predictive model was done using ArcView. However, before this could be accomplished, variables had to be selected from the suite of variables mentioned previously. To determine which variables would be used, various statistical techniques were utilized including chi-square analysis and the Kolmogorov-Smirnov test to demonstrate statistical significance. Variables used in the creation of the predictive included landform type, soils drainage, proximity to river, and slope aspect. The remaining variables were excluded due to a variety of factors that may have reduced the predictive power of the model or led to spurious results. New themes were created for each of these variables representing the scores found in each cell. These variables were then scored based upon the variable in question and weighted with a constant. Scores were recorded for both

known sites and a random sample of non-sites in the study area. Logit modeling procedures were used to compare the known site cells and non-site cells and to determine the overall predictive power of the model.

The ultimate goal of this study was to determine or give suggestions about the settlement patterns of Oneota groups in northwest Iowa. Based upon the site catchment analysis and literature review of northwest Iowa Oneota sites and ethnographic sources, this study suggests that environmental factors were the primary determinants of site location. Specifically, proximity to permanent water and soil types for both village locations and arable land for crops were the major characteristics looked at. Additionally, vegetative communities were also determined to be very important. The mix of lowland and upland prairie and lowland and upland forest allowed the Oneota groups in northwest Iowa to maximize their subsistence procurement within the area of the site catchments and to allow them to continue their reliance on hunting, horticulture, and wild plant gathering for subsistence. Other culturally related reasons such as locating sites to control or regulate trade or resources, or trade with Europeans in the later protohistoric period were also examined, but were determined not to be major factors in site placement. The settlement patterns in northwest Iowa were then compared with other Oneota regions in the Midwest to determine any similarities or differences between these locations.

Research Implications

The significance of this research focuses upon three of the four major goals outlined above: 1) site catchment analysis and settlement patterns and 2) the predictive model. First, the site catchment analysis reflects a general trend of similar local environments at each site. This suggests that the Oneota groups in northwest Iowa were continuing to exploit similar plant and animal species through time at each site. In other words, the

subsistence patterns do not appear to change that significantly. Second, this study suggests that horticultural activities were a method of subsistence security for Oneota groups in this region. Third, this study also suggests that bison hunting was not as important as it is believed to be. This is based upon the site locations and site catchment analysis performed, in conjunction with subsistence economy literature and ethnographic sources. The primary evidence for the importance of bison hunting, relied upon a model of climatic deterioration and supported by others, has been demonstrated to be contradictory to current lines of evidence and research (Baerreis and Bryson 1965; Harvey 1979; Gibbon 1972; Laird et al. 1996). Therefore, the previous interpretations of Oneota settlement in northwest Iowa may be biased in favor of this climatic deterioration, when in fact it had nothing to do to affect the subsistence practices Oneota groups in northwest Iowa (Brown 1982; Lippincott 2001). Additionally, excavations at Oneota sites in northwest Iowa show that horticulture was still a major mode of subsistence, and could likely have been the stable base of subsistence that allowed bison hunting to take place at locations away from the site, possibly at considerable distances.

The predictive model is also an important component of this research. Based upon the known site locations, the model predicted areas where there may be other unknown Oneota sites. The model created for this project, shows areas of high potential of sites located in areas close to the Little Sioux River with soils that have good drainage characteristics and can be used for both habitation and cultivation. This is important for a number of reasons. First, archaeologists have thought that more sites are present in northwest Iowa. This model could be used to help locate new sites in areas that have not yet been examined. Second, the location of more sites would allow archaeologists to further define the Oneota presence in northwest Iowa, and to help refine current theories about the Oneota tradition in this area as well as throughout the Great Plains. Third, the model could

be used in future research as well as development or cultural resource management projects. If the model is successful, it could help to save time and money when doing archaeological surveys by focusing in on areas in proposed development or survey area that have the potential to contain a possible Oneota site.

Future Research

This research has demonstrated that there is still much to learn about the Oneota tradition in northwest Iowa, not only in terms of settlement and subsistence practices, but also with regard to material culture and general Oneota practices. Many of the known Oneota sites in the region are in danger of being completely destroyed by current human activities within the vicinity of these sites. Hopefully more information can be gathered from these sites before they are destroyed.

The predictive model shows areas along the Little Sioux Valley where Oneota sites may exist, but have not yet been discovered. Some of the areas to look at within the Little Sioux Valley are areas farther south of the Correctionville locality, as well as around the vicinity of Bastian (13CK28). Bastian is particularly important because there is evidence at this site that suggests a transition between pottery types from Correctionville Trained to Allamakee Trained. If more sites are found that exhibit the characteristics found at Bastian, this possible transition period could be better defined. It has been noted in other areas such as Wisconsin, but the evidence in northwest Iowa is not as strong (Boszhardt 1994, 1998). Additionally, areas north of the Milford site (13DK1) should also be examined. Ethnographic research by M. Wedel (1976, 1981) has shown that the Ioway were in this general area in the seventeenth and eighteenth centuries and possibly lived in the great lakes in Dickinson County. Questions about the link between the protohistoric sites and the Ioway tribe in addition to other historic tribes could be further refined.

Finally, if the predictive model is successful in locating other Oneota sites, the model could be continually refined and updated as new information and data become available. One must also not overlook the large expansive collections, both in universities and in private hands. Many local collectors have enormous amounts of material that could help to fill in gaps of material culture of excavated Oneota sites (Titcomb 2000). What is clear is that there is much more work to be done in northwest Iowa in order to fully understand the Oneota tradition in this region, and to determine its overall significance in the overall picture of Oneota research taking place across the Midwest.

It is hoped that the research presented in this study will help to clarify some of the issues that surround Oneota settlement and the reasons for specific site locations in northwest Iowa. While no project is ever truly complete, hopefully this study will spur on more research efforts in northwest Iowa to understand the Oneota tradition, its importance to the prehistory of the state of Iowa, and its importance to the prehistory of the native people of this land.

APPENDIX:
GIS AND CIRCULAR CATCHMENT COMPARISONS

Appendix A compares two selected cost distance site catchments with circular site catchments. The two sites chosen for this comparison were the Dixon site (13WD8) and the Milford site (13DK1). The reasons for this additional data are twofold. To the knowledge of the author, this is the first time that a cost distance algorithm using a GIS has been used to create site catchments. Others have created site catchments with GIS software, but used the traditional circular catchment as their method of analysis (Hunt 1992). As such it would be beneficial to see if the results differ significantly with regard to proportions and percentages of landform types and vegetative communities between the two different catchment methods. Second, some individuals who have implemented different methods of site catchment analysis (i.e. Flannery 1976) have not, to the knowledge of the author, published any comparison between their method of site catchment analysis versus the traditional method outlined in Chapter 4. Therefore it is difficult to assess, for example, the degree of how Flannery's method compares with Vita-Finzi and Higg's method and vice versa.

The procedure for doing circular catchments is relatively easy to do in ArcView. Additionally they are simple to create in other vector based GIS software packages as well (Hunt 1992). To begin with, two circular dots were placed on top of the site polygons that represent the site boundaries of Dixon (13WD8) and Milford (13DK1) used in previous analyses. These points serve two purposes. First, the point represents the 'center' of the site as measured by the author. Second, these points will be used as the point of origin for the circular catchments. This is similar to other site catchment analyses of Oneota sites created for southeast Iowa (Tiffany 1982).

The second step involved on deciding a catchment size. Studies utilizing the circular catchment have used circles of varying sizes, such as boundaries set at one kilometer, or one mile. Other studies have used a series concentric circles set at equal intervals and

extend outward to a specified distance to represent resource zones. The sizes of the catchments used for this comparison are two thousand meters in diameter, which equates to approximately one and a quarter miles in diameter. Considering that the cost distance catchments are on average about two thousand four hundred meters across, a circular catchment of two thousand meters is adequate.

The circular catchments were created in ArcView by having the program digitize a buffer with a radius of one thousand meters. This buffer was then saved as a circular polygon shapefile. The soils coverage for each county the sites are located in were then clipped using this circular polygon shapefile to create a new shapefile that represents the soil types and numerous other soil characteristics for the circular site catchments. The databases were then edited for each catchment to add a new *prehistoric vegetation* field. The records for this field were added in by comparing the database of the cost distance catchments with their corresponding circular catchments. The databases for the circular catchments were then queried to represent the landforms and vegetative communities at both Dixon (13WD8) and Milford (13DK1).

Some observations that are readily apparent by visual inspection are that the circular catchments are not quite as large in areal size as the cost distance catchments. This difference in overall size will affect the proportions of landform types and vegetative communities in the catchment, but this was to be expected. However, had the author chosen to use circular catchments as the tool of environmental analysis, two thousand meter catchments would have been used, which is similar to catchment sizes used in southeast and central Iowa (DeVore 1990; Tiffany 1982). In this regard, the examples from Dixon (13WD8) and Milford (13DK1) will give a good indication of the results if circular catchments were used in the original analysis. The results for landforms and vegetation are shown in Table A.1. and Table A.2. respectively.

Table A.1. Table of Comparisons for Landforms Between Cost Distance and Circular Catchments for Dixon (13WD8) and Milford (13DK1).

Site Name	Bottomlands	Terraces	Sideslopes	Uplands	River	Water
Dixon	869.76	114.33	114.08	453.77	23.47	21.05
	54.48	7.16	7.15	28.42	1.47	1.32
Dixon Circle	639.54	73.63	98.14	401.08	16.95	20.57
	51.17	5.89	7.85	32.08	1.36	1.65
Milford	596.04	311.74	120.07	515.41	27.95	—
	37.94	19.84	7.64	32.8	1.78	—
Milford Circle	183.67	320.45	68.57	645.11	28.74	0.76
	14.73	25.69	5.50	51.72	2.30	0.006

Table A.2. Table of Comparisons for Vegetative Communities Between Cost Distance and Circular Catchments for Dixon (13WD8) and Milford (13DK1).

Site name	Lowland prairie	Lowland woods	Wooded hillslope	Prairie hillslope	Upland prairie	Gallery Forest	Water
Dixon	975.74	8.35	20.46	93.63	332.34	121.43	44.52
	61.12	0.52	1.28	5.86	20.82	7.61	2.79
Dixon Circle	713.17	—	10.84	87.30	318.03	83.05	37.52
	57.06	—	0.87	6.98	25.44	6.64	3.00
Milford	10.89	187.93	48.10	25.74	1123.32	136.43	32.58
	0.70	12.01	3.07	1.64	71.78	8.72	2.08
Milford Circle	7.63	176.04	45.13	23.45	837.56	128.00	29.5
	0.61	14.11	3.62	1.88	67.15	10.26	2.37

The Dixon site (13WD8) shows small drops in landforms such as bottomlands, terraces, and river area, but slight increases in uplands, sideslopes, and water sources (Figure A.1). The Dixon circular catchment is still dominated by the bottomlands of the Little Sioux River with upland landforms the second largest landform in overall extent. In terms of

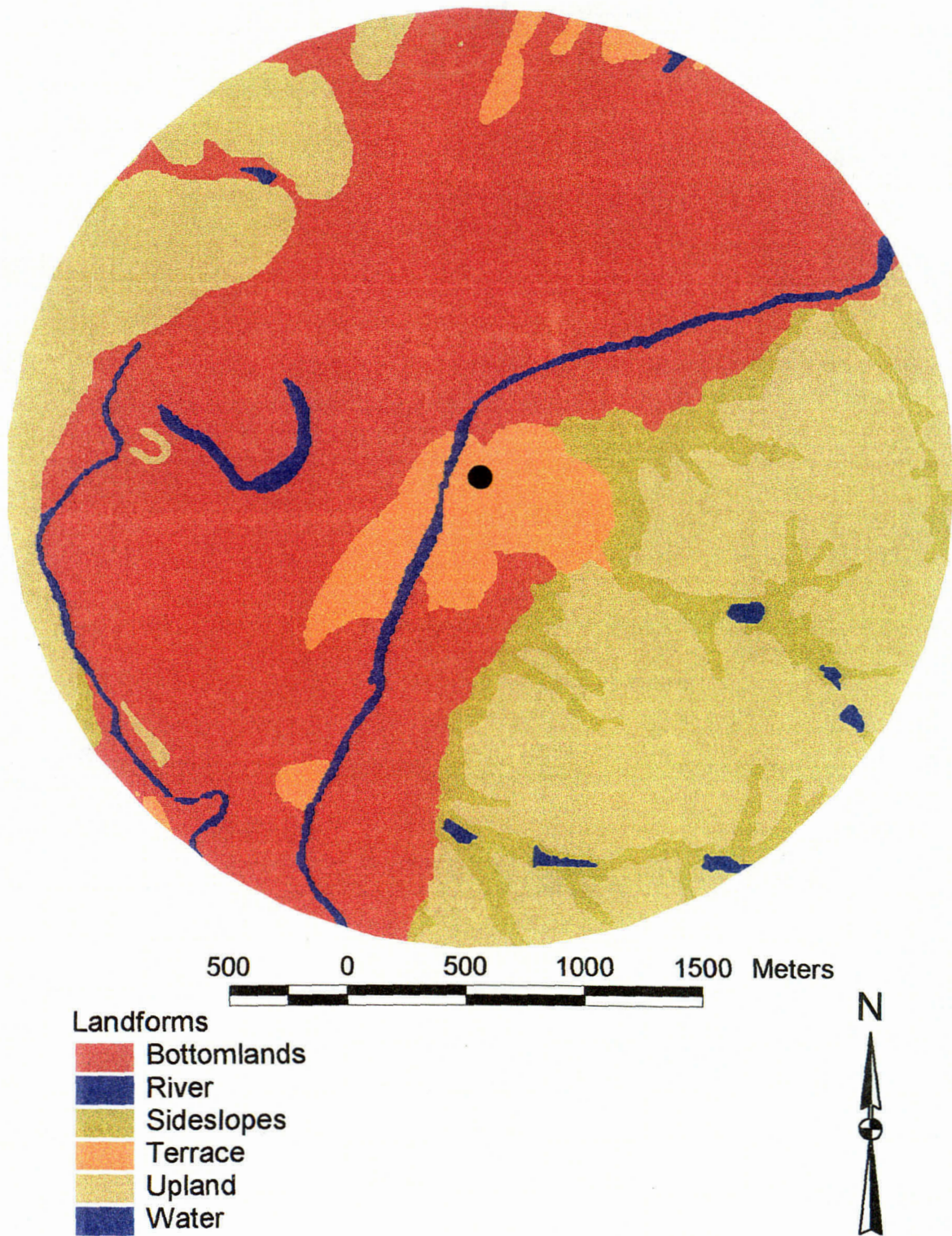


Figure A.1. Landforms within the Dixon site (13WD8) circular catchment.

overall areal extent, the Dixon circular catchment is 346.55 hectares (856.34 acres) smaller than the cost distance catchment.

Vegetation is still predominantly lowland and upland prairie Dixon circular catchment (Figure A.2). Within the circular catchment, however, lowland woods are absent and wooded hillslopes are virtually gone as well. Additionally gallery forest areas are reduced by approximately 38 hectares (93 acres). However, based upon these calculations, there would still be sufficient resources within the circular catchment to sustain a population size of 200 to 250 individuals for an extended period of time. Therefore, had a circular catchment been used instead of the cost distance catchment for the Dixon site, the final results with regard to resource availability and stability would have been somewhat similar.

The Milford site (13DK1) circular catchment shows a rather marked difference in the proportions of landforms when compared with the cost distance catchment. The major landform types in the circular catchment are uplands and terraces (Figure A.3). Bottomlands show a dramatic decrease in overall extent due to the increases in uplands and terrace formations. The Milford circular catchment is 323.91 hectares (800.40 acres) smaller than the Milford cost distance catchment.

Interestingly, however, even though there are significant landform shifts in percentages, vegetative communities do not change much at all (Figure A.4). This is likely due to the proportionately smaller size of the circular catchment in relation to the cost distance catchment. For example, while overall extent of gallery forest decreases in the Milford circular catchment, its percentage of overall area actually increases. Like the Dixon circular catchment, there are still enough resources within the Milford catchment to sustain a population between 50 and 100 people for up to 50 years, which was the same total derived for the cost distance catchment.

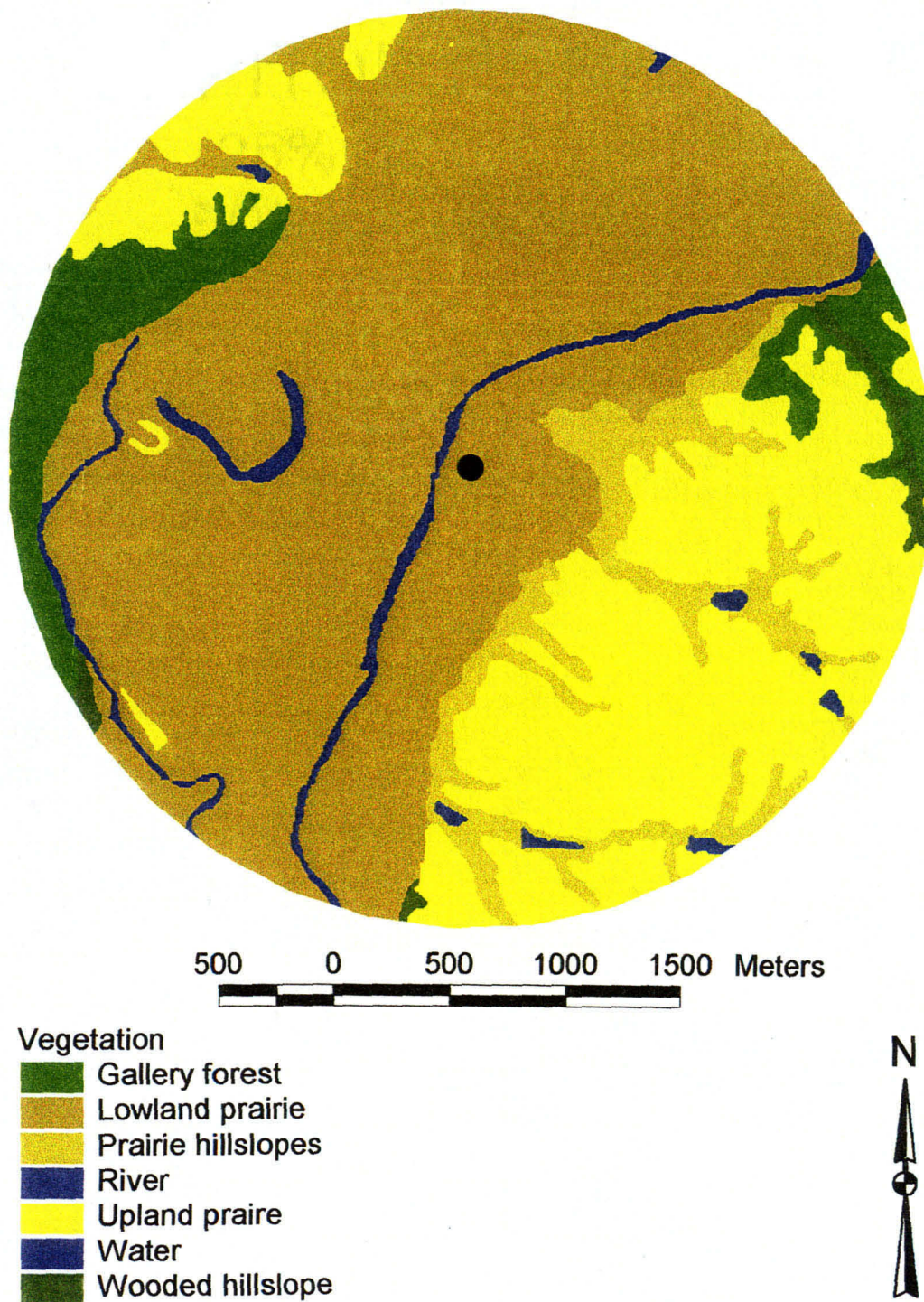


Figure A.2. Model of prehistoric vegetation in the Dixon site (13WD8) circular catchment.

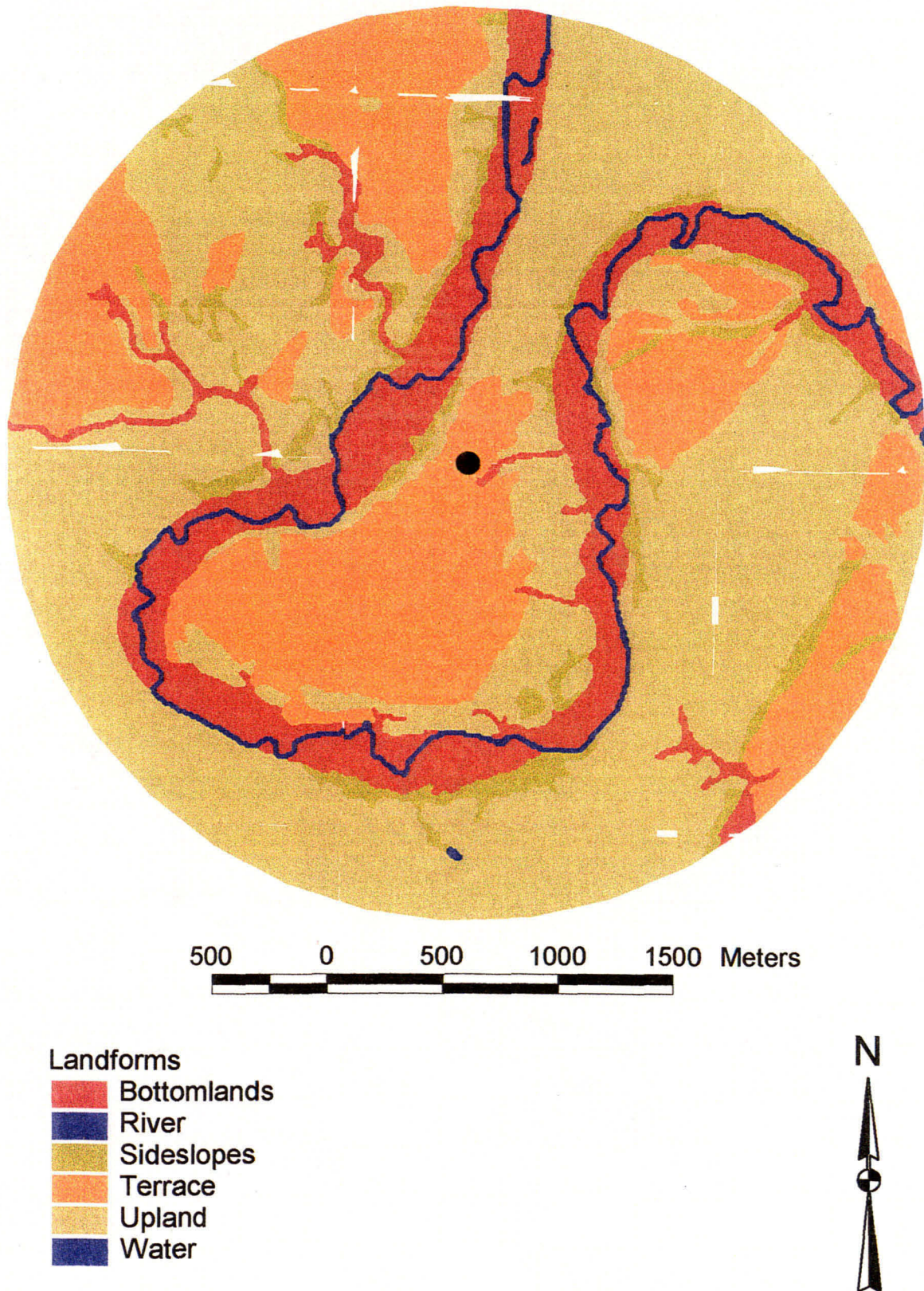


Figure A.3. Landforms within the Milford site (13DK1) circular catchment.

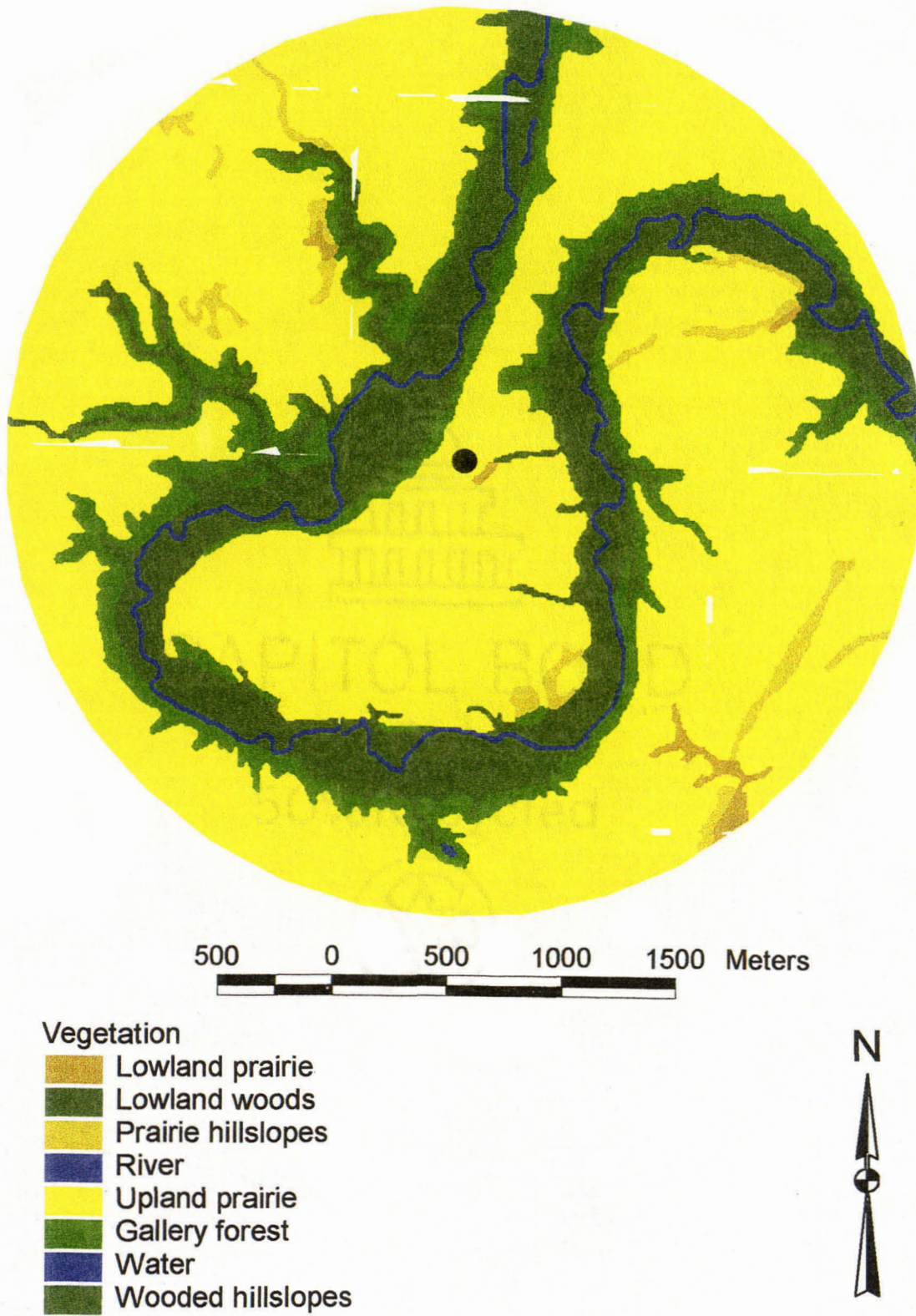


Figure A.4. Model of prehistoric vegetation in the Milford site (13DK1) circular catchment.

What this comparison demonstrates is that there is not a significant difference between the cost distance catchments used in this study and the circular catchments. However, it is hard to determine with sufficient confidence if this would hold for the remaining six sites in the study area. With the example from Milford, significant changes can be observed with regard to landform types between one catchment method and the other. Even so, vegetative communities and their overall proportions relative to the catchment sizes are comparable. Overall, it appears that the catchment methods compared here do not differ all that much, but the observed variables under question, in this case landform type and vegetation, are more sensitive to size of the catchment rather than the method of the site catchment procedure.

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