Middle/Late Woodland settlement systems: An analysis of prehistoric locational behavior in the Central Des Moines Valley

by

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This is to certify that the Master's thesis of

Stephen Wallace Parrish

has met the requirements of Iowa State University

Signatures have been redacted for privacy

for my wife, Kerry Anne
whose patience and encouragement
made this possible.
I love you.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER 1. INTRODUCTION

The primary objective of this study is to detail the development of predictive models for Middle and Late Woodland settlement patterns in the Central Des Moines Valley. The predictive models involve a stratified random sample of the study area to garner statistically representative site and assemblage samples. A second objective is to evaluate previous investigations in the region against the model to ascertain whether or not sites from earlier survey work were also representative (Ashworth and McKusick 1964; Brown 1966; Carr and Tiffany 1980; Gradwohl 1969a, 1969b, 1973, 1974, 1975, 1982; Gradwohl and Osborn 1973a, 1973b, 1974, 1975a, 1975b, 1976, 1977, 1985; Hotopp, Cook and Till 1979, 1981; McKusick and Ries 1962; Osborn 1982; Osborn et al. 1989; Osborn, Marshall and Thies 1982; Osborn and Gradwohl 1981, 1982; Schroeder 1979; Schulte 1974; Thies 1989; Timberlake 1981; Weichman 1975; Weichman, Osborn and Mills 1975). Previous investigations in the area were comprised primarily of surface survey, and it is not known whether or not they are a representative sample. A third objective of this study is to develop a database with which to quantify archaeological sites with respect to their landform location. Quantification of site distribution with respect to landform allows for comparison with previous interpretive models for the study area; comparison with similar models developed for other regions; and for identification of under represented landforms in the study area that would have a high potential for archaeological sites. A final element of this study is to examine quantitatively the distribution of sites in the Central Des Moines Valley within the context of the random sampling process. With a random sample, further examination of the correspondence of site location and distribution can be studied systematically with regard to site data gathered from the non-random survey in the valley.

The database for this research is derived from archaeological fieldwork conducted during the summer of 1997 as well as extant collections at the Iowa State University Archaeological Laboratory (ISUAL). The fieldwork for this project was conducted on land currently owned and operated by the Iowa 4-H Center, and adjoining federal property of the Saylorville Reservoir Historic Preservation District, managed by the United States Army Corps of Engineers Rock Island District. Archaeological work in the Iowa 4-H Center was conducted under the auspices of a Memorandum of Understanding between the Anthropology Department at Iowa State and the Youth and 4-H Program of University Extension. Archaeological work on adjoining federal property was conducted under an archaeological permit issued to Joseph A. Tiffany by the Corps of Engineers, Rock Island District, under procedures mandated by federal law.

Archaeological fieldwork at the Iowa 4-H Center was initiated in order to provide a foundation for the Iowa 4-H Center's public education program for middle grade students, and to initiate a cultural resource survey program. The data from which was then used for the purposes of this thesis. Fieldwork was conducted by Iowa State University students participating in the 1997 Anthropology field school (Anthropology 428/528), supervised by Dr. Joseph A. Tiffany and assisted by the author. These students conducted a stratified random survey, and were involved in subsurface testing of landforms in the Iowa 4-H Center and adjoining federal property.

The Iowa 4-H Center (IFHC) and adjoining federal property are located along the east bank of the Des Moines River, in Boone County, Iowa. The IFHC encompasses most of section 10, and the north one third of Section 15, T- 82N, R- 26W, Douglas Township. The project area is approximately 6.43 km (4 miles) to the north and east of the City of Madrid, Iowa. Much of the IFHC consists of true upland landforms, although there is a great variety of other surficial features including: Low, Intermediate and High Holocene terraces; Late Pleistocene terraces; Holocene alluvial fans; numerous hillslopes bounding interfluves, the Des Moines Valley, Richardson's Creek and a Late Wisconsinan bench.

Significance of Research

Analysis of prehistoric settlement patterns can provide archaeologists with a great deal of information regarding past societies including, economic activities (Schermer and Tiffany 1985:228), population estimates (Sharer and Ashmore 1993:498), and political and social relations (Trigger 1967:152). All of these aspects of culture are crucial to our understanding of past societies. The research presented here is significant in that as of yet, there does not exist any detailed settlement pattern data for any of the prehistoric cultures in the study area. Trigger (1968), suggests that settlement patterns represent a response to numerous different factors including ecology, warfare and religion (Trigger 1968:70). It follows then that analysis of these patterns will give insights into what factors were affecting the people of the Central Des Moines Valley during the Middle and Late Woodland period. Moreover, this research is important in that it will provide archaeologists with a greater understanding of Middle and Late Woodland lifeways in the Central Des Moines Valley, particularly with regard to evaluation of the existing data base. Finally, this research is important in that once developed, it can be practically applied to both past and future studies. Future studies will benefit in that researchers would know a priori, the approximate number, landfrom distribution, and location of sites in a given region. Past studies may be evaluated against the model to determine the number of sites actually found versus the number of sites predicted, providing an estimate as to the amount of information lost or unaccounted for. All of these applications translate into a greater understanding of our collective past, which is one of the central goals of archaeology.

Plan of Presentation

This study is presented in the following manner. Chapter 2 provides details regarding methods used and justifications for those methods. Chapter 3 describes the general environmental setting of the project area, and gives a history of the formation of the central Des Moines Valley. The sequence of human occupation within the valley, from the earliest Paleo-Indian period to present, and previous archaeological work, is the topic of Chapter 4. Chapter 5 provides detailed information on the methods used and on each new site identified as a result of the survey conducted for this study, including analysis of the material remains. Chapter 6 presents a model of archaeological settlement systems and provides statistical analysis of the results of the survey. Also in chapter 6, the results of this study are compared to other studies both within the Central Des Moines Valley, to ascertain if these results are comparable to studies from other regions. Chapter 7 provides the reader with an Arcview GIS modeling of the study area. This model shows areas of high potential for archaeological resources, and from the data, interpretations regarding other high potential areas are identified. Chapter 8 includes a final summary and interpretive comments.

CHAPTER 2. METHODS

The Central Des Moines Valley contains a wide variety of distinct landforms (Figure 1). Because of this variation, the size of the project area, along with current ground cover and land use practices, it was necessary to generate a sampling technique designed specifically for the study area that would give the maximum return of archaeological information, and still be statistically viable. Many areas at the 4-H Center have undergone a significant disturbance in the past, a factor that further necessitated the sampling strategy.

Episodes of periodic flooding are quite common, and have either buried sites in the Central Des Moines Valley with a deep layer of alluvium, or have destroyed them all together. Historic air photos show that tributaries and drainage systems of the Des Moines River, such as Richardson Creek have undergone considerable meandering and channel alteration since the time of prehistoric occupation. This meandering has resulted in the destruction of early Holocene Terraces in these systems and any archaeological materials contained within them. Clear cutting of timber and strip mining during the 19th and early 20th centuries caused an increase in the amount of erosion and hillslope run off occurring in the area. This erosion created many of the deep ravines, and steeply banked hillslopes visible in the study area presently.

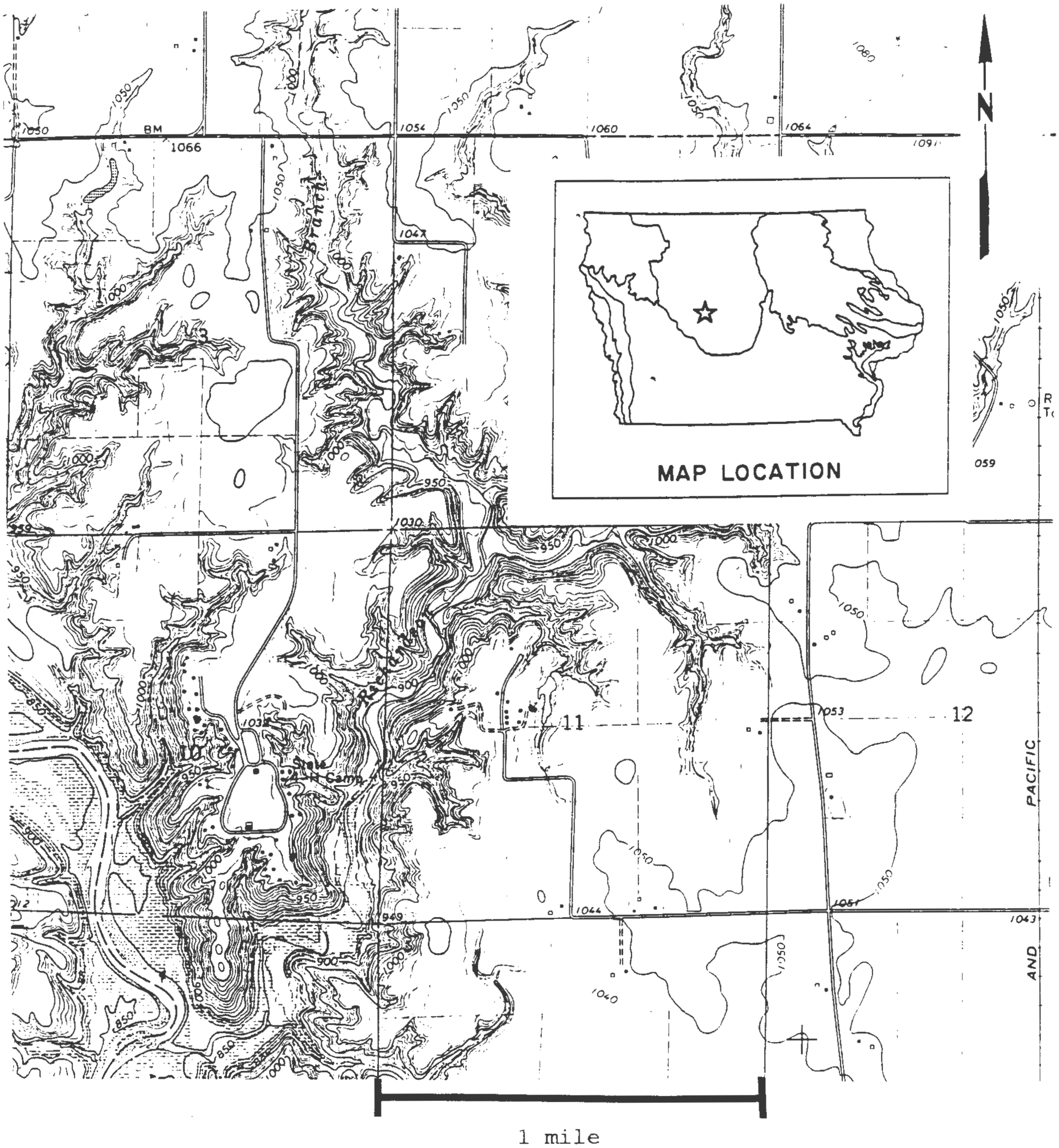


Figure 1. Location of the project area and landform variability in the Central Des Moines Valley. From USGS Boone, Iowa, Luther Quadrangle, 1980.

Erosion has also caused colluvial depostion that has resulted in the burial of many downslope sites and the destruction of upland sites due to a downslope movement of artifacts resulting from the back wasting of the hillslopes. For these reasons, many sampling techniques were deemed unacceptable in that they would lead to an over-sampling of areas that were meaningless with respect to viable archaeology. A purely random sample, or a sample based on long transects that bisected the entire length of the 4-H Center grounds, for example, would not be adequate. Such a sampling procedure would involve the archaeological testing of many areas such as hillslopes and meander channels, that make up the majority of the 4-H property, yet contain little if anything of archaeological value. The hillslopes were excluded from the sampling procedure. Exclusion of hillslopes is justified because 1) no archaeological sites are expected on hillslopes; 2) any artifacts located there would be the result of down slope erosion from the interfluves and uplands and would consequently be out of context; and 3) these areas at present are highly modified by 19th and 20th century land use. What this means in the sampling design is that the kind, number and nature of cultural resources on this landform cannot be characterized because it was not sampled. There is a good rationale for not sampling hillslopes, but this is not the

the same as categorically demonstrating whether or not sites are present on them.

In light of such factors, a stratified random sampling technique was selected. This procedure consisted of sampling approximately fifteen percent (758.3 hectares, 307 acres) of the project area in the following manner (Figure 2). The strata were defined based on landform units within the study area and divided among the following categories: uplands, interfluves, Late Pleistocene terraces, High, Intermediate, and Low Holocene terraces, benches and hillslopes (Figure 3). A grid, consisting of equal area polygonal blocks of 4.04 hectares (ten acres) each, was laid over the entire project area. Each 4.04 hectare block within each landform class was then assigned a consecutive number. Using a random number table, a random sample was drawn from each landform class. As Stephen C. Lensink and Frederick O. Lorenz (personal communications, 1998) indicate, it is not necessary to sample these landforms based upon the amount that each represents of the total area. The exclusion of hillslopes allowed a greater percentage of other landforms to be sampled, resulting in a greater understanding of archaeological resources in the area to the detriment of hillslope study. This would not have been as feasible in practical application with any other type of sampling strategy. A final aspect of the survey made possible

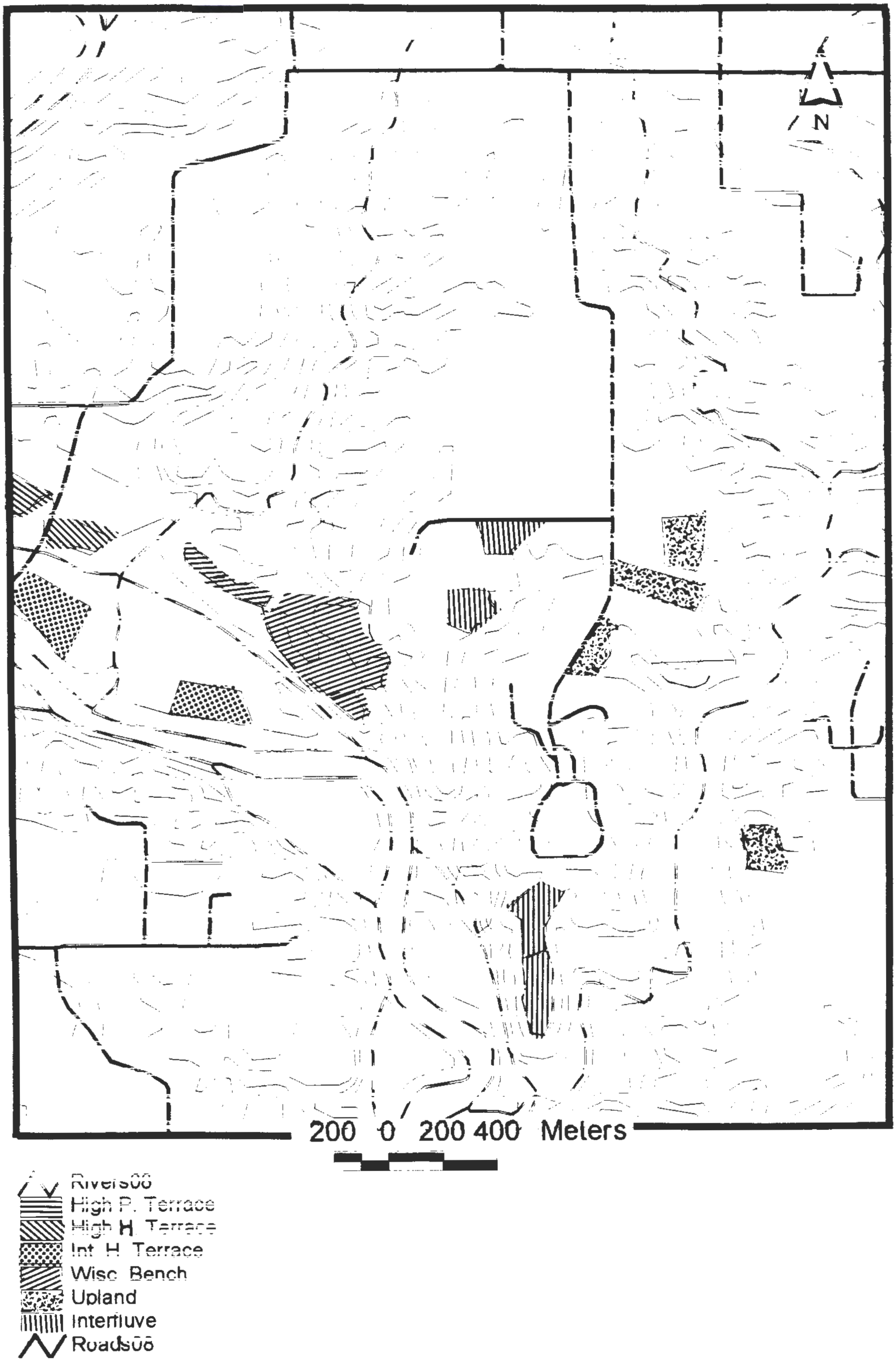


Figure 2. Location of 4.04 hectare polygons selected for survey.

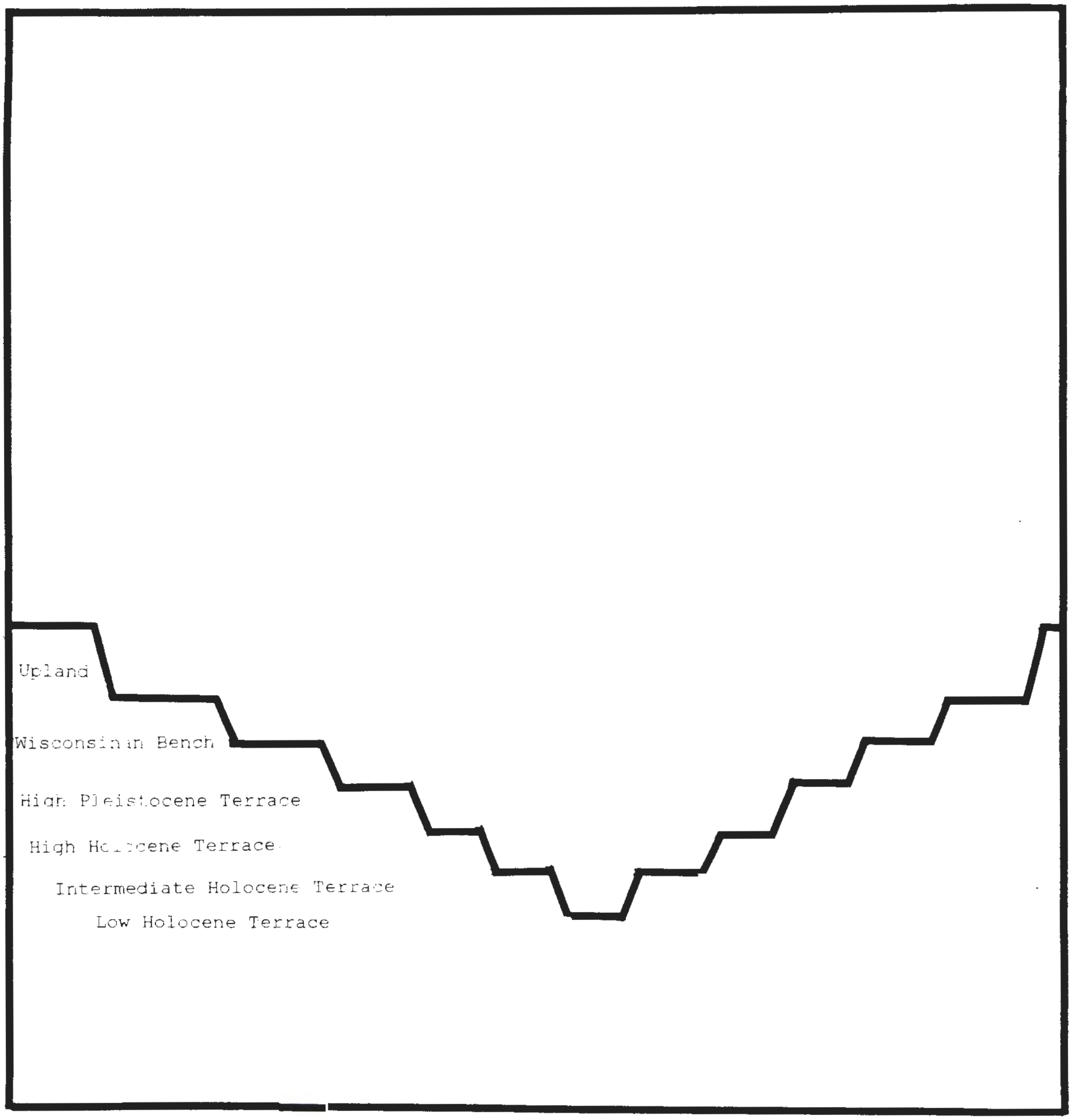


Figure 3. Position of landforms analyzed within the Central Des Moines Valley.

by this sampling strategy is the amount of each landform unit sampled. The stratified sampling technique allowed different percentages of each landform to be sampled and remain statistically valid (Drennan 1996; Stephen C. Lensink, Frederick J. Lorenz, personal communications, 1998). Because of this landforms that were expected to contain a higher frequency of archaeological sites were sampled at a higher percentage than those that were not expected to have sites. This procedure allowed for maximum efficiency without sacrificing the statistical viability of the survey strategy. As a result, for example, 100 percent of the Wisconsinan bench was surveyed.

While no sample or sampling technique is purely unbiased, several measures were taken in order to make this particular sampling strategy as unbiased as possible. Because some areas included in the present survey had been surveyed in the past, prior knowledge of areas where sites were or were not located could lead to unintentional biasing in sample selection, by selecting areas where sites were known to be located, or by dismissing areas where sites were known not to occur. Additional bias could potentially enter the sampling design through in the field judgment of the fieldworker. Individual crew members could bias the sample if they had knowledge of the location of previously known sites. This knowledge could possibly lead to disregarding potential artifacts in areas where it was believed that there were no sites, or conversely, collecting non-artifacts in areas where sites were known to be present. A final bias possible in this situation involves the sampling grid. Knowledge of site location prior to fieldwork could lead to a widening or narrowing of the test excavation grid depending upon whether or not sites were known to be located in the area (Stephen C. Lensink, personal communication, 1998).

The best way to prevent these potential biases from entering the sampling strategy is to employ a double blind technique. This entails that whomever selects the units for survey has no a priori knowledge regarding previously recorded sites. This individual would then relay the information of where to sample to a fieldworker who was equally ignorant of the location of any archaeological materials in the area. While this double blind technique was not feasible, given that all of the individuals involved in drawing the random sample had some prior knowledge regarding previously recorded sites, a number of steps were taken to reduce sampling bias. The random sample units were drawn from a USGS quadrangle map of the project area that did not contain any information regarding archaeological sites. The sample units, drawn from a table of random numbers, were never replaced and redrawn because of any preconceived notions regarding potential for archaeological resources. The field crew was never shown a site map of the area during the course of the survey, as a result, none of the crew members had any prior knowledge regarding the archaeology of the area they were sampling. Whether or not the field workers had any information from other sources obtained on their own is not known. The crew was made up of mostly undergraduates, and individuals who had not been enrolled in any sort of archaeological field school prior to the survey, and should not have had any knowledge about the archaeology of the area. Prior to fieldwork, the crew was trained to reconize artifacts. Any questionable artifacts were examined by the author and Dr. Joseph A. Tiffany. Because of these factors, their judgment in the field was most likely unbiased. In all instances of subsurface testing, auger holes were dug as close to uniform depth and width as possible. Uniform grids were used in the sample units drawn. The location of test units was predetermined, and uniform for all survey blocks. Any material of potential significance was bagged, and brought back to the lab with provenience data recorded on each bag. This was done so that final determination and identification of the material was conducted in a setting where decisions could be made without bias. While it is impossible to avoid bias altogether, every effort was made to ensure that the same criteria, established prior to survey and sample drawing, were applied to each sampling unit irrespective of fieldworker judgment in the field.

The survey was conducted using the following procedures. All of the survey units drawn and archaeological sites excavated for the purpose of this survey were tested in accordance with the Iowa State University Archaeological Laboratory (ISUAL) policies and procedures manual. As dictated by this document, initial survey of the 4.04 hectare units was conducted with a 100 percent surface survey of the area. Survey units were located by measuring distances and compass headings from fixed points as determined by the USGS quadrangle map, Luther quadrangle, Boone County, Iowa. In rare instances where the exact edges of survey units was indeterminable as a result of a lack of fixed landmarks, heavy forest or undergrowth, or topography, the survey was extended significantly beyond the 4.04 hectare boundary line to ensure 100 percent coverage. In no instances were archaeological sites identified outside of a given 10 acre survey unit as a result of this extension of the survey universe.

Surface survey was conducted by pedestrian survey, with an interval of between 5 and 15 meters depending upon the amount of surface visibility and vegetation in the sample unit. Modern land use practices in the project area have resulted in a mosaic of ground surface vegetation ranging from open fields and pastures to dense underbrush and forest vegetation. Because of these modern land use practices, the surface survey interval was narrowed to 5 meters in areas where surface visibility was less than 30 percent. This included areas where organic material such as tall grass, dense underbrush or deciduous forest detritus covered the ground surface significantly. In areas where surface visibility was deemed excellent, between 85 and 100 percent, such as plowed fields the interval was widened to 15 meters. All surface survey in areas planted with row crops was conducted prior to, or immediately following the emergence of the various crops from the soil solum. Reduced visibility as a result of agricultural crop growth was never encountered.

Subsequent to the surface survey previously mentioned, subsurface testing of the A and B soil horizons was conducted with hand augers. Transects were established based on compass headings as close to magnetic north as possible, that would remain parallel to the edge of the predetermined survey unit. Auger test intervals ranged from 5 to 25 meters apart (Figure 4). The majority of auger test units were 15 meters apart. The width of the auger transects was dependent upon the amount of vegetation that covered the ground surface, and was applied

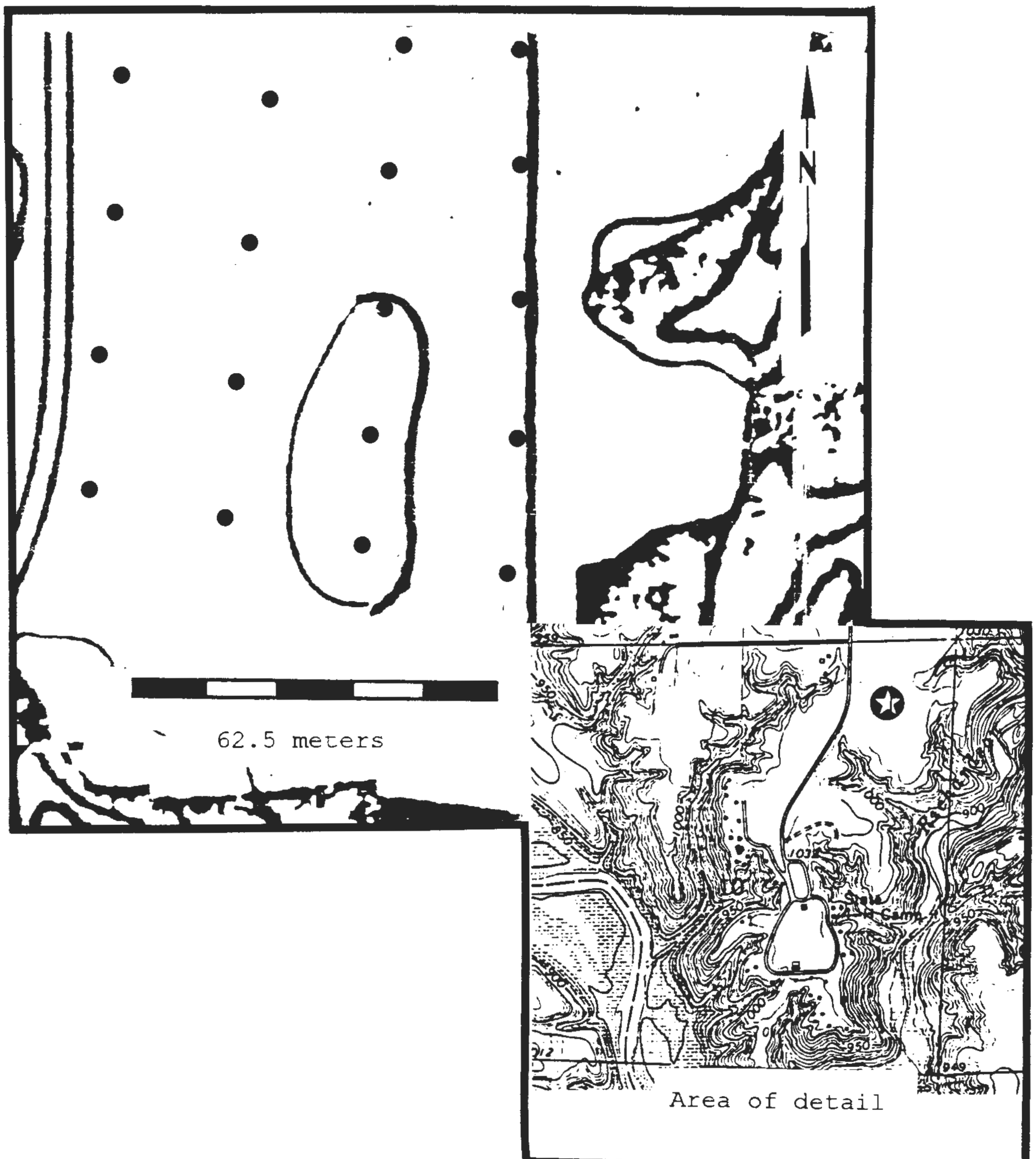


Figure 4. Placement of subsurface auger test units within 4.04 hectare survey units.

equally to all areas. Excavated sediment was subsequently screened for artifacts with 1/4 inch mesh screens and notes regarding soil and sediment changes was recorded for each test unit. In several instances, auger test units were excavated to depths of 100 cm or more, well into the C horizon, to insure against the possibility of buried soils and to gain a better understanding of the soil profile. In all instances, auger units were excavated as uniformly in depth and width as possible. As will be explained in greater detail later, areas with a high probability for buried sites, such as floodplains and alluvial fans, were more intensively scrutinized. In these areas, auger units were excavated to the water table or until glacial gravel deposits made further excavation impossible.

When archaeological materials were recovered from auger units, or in areas where artifacts were visible on the surface, the grid was narrowed in all instances to 5 meters. This was done in an attempt to locate the spatial extent of the site, and in the hope of recovering diagnostic materials in undisturbed context. None of the sites exhibited enough of a concentration of intact artifacts or features to warrant excavation units, and as a result subsurface testing was limited to auger units.

All archaeological materials recovered during the course of this project were washed, catalogued and reposed in accordance with the Iowa State University Archaeological Laboratory (ISUAL) policies and procedures manual. These artifacts, auger notes and records and a copy of this thesis are currently housed in the ISUAL federal repository at Iowa State University.

CHAPTER 3. THE ENVIRONMENTAL SETTING

Geologically, the Central Des Moines Valley is a relatively recent phenomenon. This valley was created as a result of the swift currents of meltwater associated with the recession of the Algona moraine of the Des Moines lobe during Late Wisconsinan times (Ruhe 1969; Benn and Bettis 1985:8). Today, the Des Moines river is the largest tributary of the Mississippi River within Iowa. It functions as the major drainage system between the Missouri and Mississippi Rivers (Osborn 1976:8), and drains an area of 40,000 square kilometers (12,000 square miles) in Iowa, along with 2,453 square kilometers (1,525 square miles) in Minnesota and roughly 120.7 square kilomters (75 square miles) in Missouri (Lees 1916:429). The Des Moines River flows primarily in a south to southeast direction down the axis of the Des Moines Lobe landform region of north-central Iowa and then the Southern Iowa Drift Plain (Prior 1976:54). The study area is characterized by hot summers and very cold winters, with temperatures ranging from -30° to +110° Fahrenheit, and mean annual precipitation from 30-32 inches. These figures were recorded at the City of Des Moines, where most of the precipitation is received during the summer months (Anderson and Welp 1960:30; Kincer 1922, 1928).

The Des Moines lobe represents a portion of an enormous continental glacier centered in Hudson's Bay that covered a large portion of eastern North America. This glacier began forming approximately 70,000 years before present (BP) and was the last glacier to form in North America during the Pleistocene epoch. The Des Moines Lobe (Figure 5) was a massive wall of slow moving and accumulating ice occupying an area of approximately 15,867 square kilometers (12,300 square miles) of central and northern Iowa (Ruhe 1969:54), and is responsible for most of the land formations in the area. In Late Wisconsinan times, the Wisconsinan ice sheet reached its maximum extent in Iowa (the Bemis Moraine) near the modern City of Des Moines (Prior 1991:42). The dates for the glacial retreat and events leading to the creation of other landforms in the area are well established by 14^{c} dating of organic materials such as peat and hemlock wood among others, found within the soil of the end moraines (Ruhe 1969:61).

With the end of the Pleistocene epoch, mean annual temperatures rose, and the Des Moines ice sheet began its slow retreat northeastward leaving in its wake glacial till, the remnants of rock, sediment and organic debris ground up and moved along within and under the ice sheet as it passed over existing landforms, vegetation and rock outcrops. By 13,500

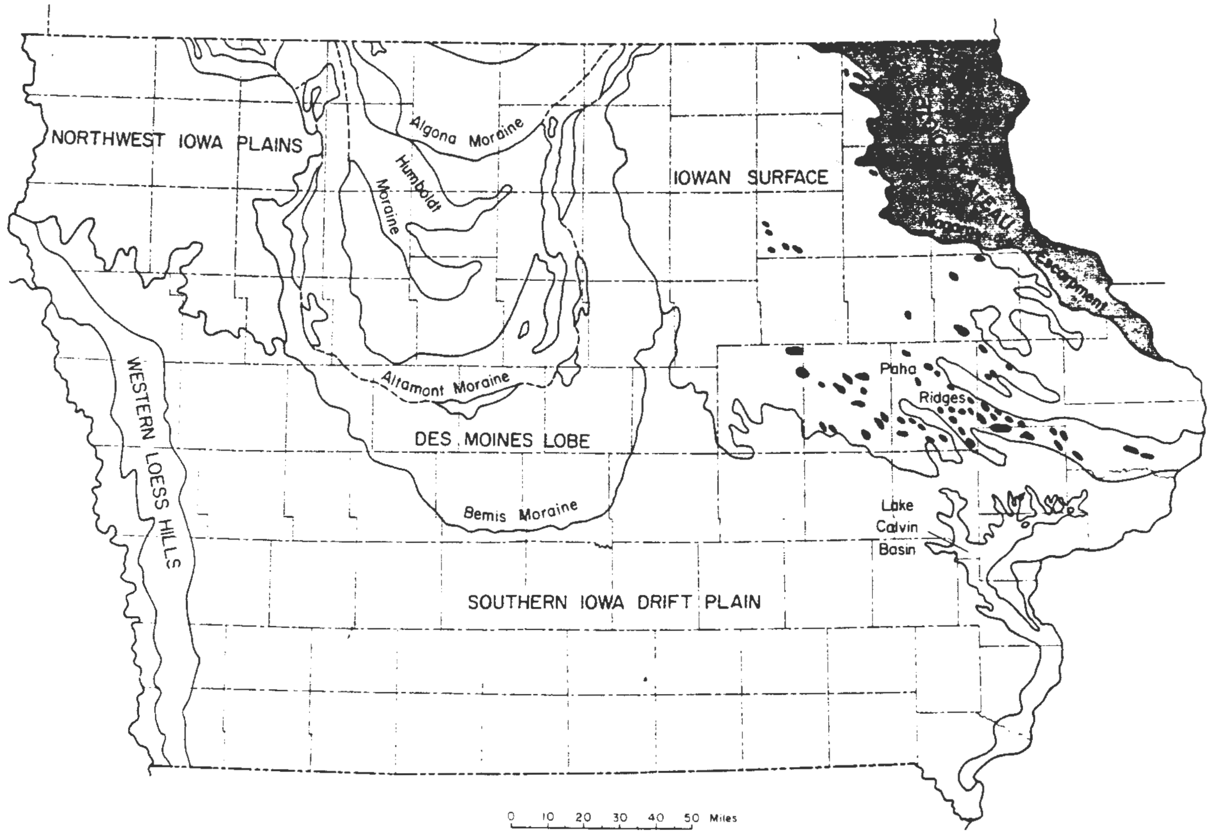


Figure 5. Landforms of Iowa. From Prior (1979:23).

BP, the ice had retreated back to a position known as the Altamont moraine (Benn and Bettis 1985:8). This temporary slowing of the ice retreat occurred four times in the history of the Des Moines lobe, and the subsequent moraine formations (Figure 6) from south to north are known as: Bemis, Altamont, Humbolt and Algona (Ruhe 1969:54).

The Algona Moraine, the youngest of the moraines associated with the Des Moines Lobe, is of particular interest. It was the ice melt during its formation that created the Des Moines Valley (Benn and Bettis 1985:8). From roughly 12,600 to 11,000 BP, active drainage of glacial melt water over the open, easily erodible and newly exposed glacial till surface now present where the ice had been caused a tremendous amount of down cutting and formed the Des Moines Valley and the study area. It was at this time that several of the bench formations were created with the upper side walls of the newly formed Des Moines Valley in the study area (Benn and Bettis 1985:8). At approximately 11,000 BP, the massive discharge of water form the retreating glacier ceased, and the down cutting or formation of small and moderately sized tributaries to the Des Moines Valley began (Benn and Bettis 1985:13). The Des Moines River also began to down cut in its channel, leaving Late Wisconsinan terrace remnants from its

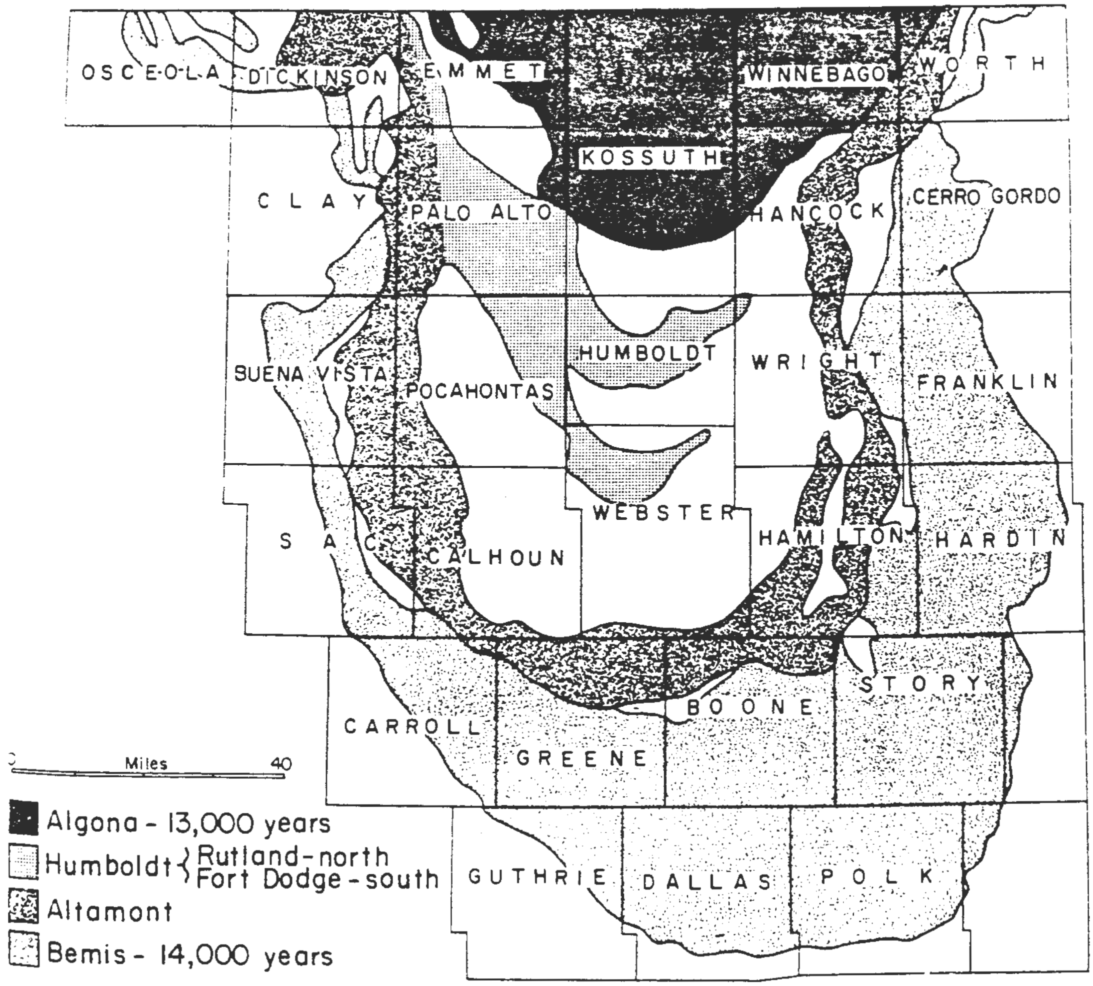


Figure 6. Location of major end moraines of the Des Moines Lobe. From Ruhe (1969:55).

melt water creation along its upper valley walls. As the down cutting of the Des Moines River continued, the High Holocene terrace was formed at 10,000 BP. The development of the tributary drainage system of the Des Moines Valley continues at present. Sediments have accumulated at the mouths of the side valleys and larger drainages that now feed surficial water in into the Des Moines River system, creating the many alluvial fans currently found on the surfaces of the Holocene terraces formed by the Des Moines River. Accumulation of these fans is variable and depend on a number of factors including the climate. During Middle Holocene times, many side valleys and tributaries were literally scoured clean of sediments which were deposited on numerous developing alluvial fans (Benn and Bettis 1985:13).

Around 4,000 BP, the Des Moines River experienced another episode of down cutting of 2 to 3 meters. This left a new terrace system exposed along the Des Moines River, the Intermediate Holocene terrace (Benn and Bettis 1985:14). With the water no longer rushing over its surface, deep, dark soils were able to form on this terrace as had occurred on the High Terrace (Benn and Bettis 1985:14). Further down cutting from 750 to 400 BP is responsible for the creation of the Intermediate terrace scarp, and since that time the Lower Holocene terrace has been in the process of formation (Benn and Bettis 1985:14). Because of these intermittent periods of dramatic down cutting, bedrock outcrops of Upper Mississippian limestone and Middle Pennsylvanian shales along with various limestones, and sandstones occur at periodic intervals along the Des Moines Valley walls (Gradwohl 1974:90). These rock formations were an important resource both prehistorically and historically in the Des Moines Valley because they exposed cherts in the bedrock that were an essential resource used by prehistoric peoples for the production of flaked stone tools as well as rock for grinding stones (Gradwohl 1974:90). During the Historic period, the bedrock and geologic resource exposed in the valley were mined for coal, clay for the construction of pottery and bricks as well as stone for the construction of buildings and aggregate for cement production (Gradwohl 1974:90).

Today, the assortment of floral and faunal species situated within the Des Moines River corridor are quite varied, and reflect a penetration of the eastern deciduous forest into the upland prairies (Raisz 1939; Fenneman 1938). Trees within the region include various species of oak, maple, hickory, walnut and ash (Kallmer 1967:8-16), which are characteristic of the Prairie-Plains transition zone, to which this region belongs (Aikman and Gilly 1948). Some of the dominant native grasses that were common in the upland areas prior to the onset of intensive agriculture were: big blue stem, little blue stem and wild dennet grass (Aikman and Gilly 1948). A wide assortment of faunal species is represented including among others: various migratory waterfowl, deer, beaver, raccoon, opossum, fox, skunk, rabbit, muskrat, squirrel, coyote and several species of freshwater fishes and mollusks (Gradwohl 1974:92; Osborn 1976:9; Scott 1937:43-44). Elk, bison, black bear, cougar, lynx, and porcupine were once common to the region but have since been exterminated. (Gradwohl 1974:92; Scott 1937:43-44). Historically, the area was characterized by upland prairie along the valley walls and sporadically on the High Terraces and Benches. Soils indicate a mosaic of forest, mixed prairie-forest and prairie within the valley walls.

CHAPTER 4. REGIONAL CULTURE SEQUENCE

Scientific archaeological investigations of Middle and Late Woodland manifestations in the midwest began with Atwater's (1847) research in Ohio. As early as 1881, T.H. Lewis and A.J. Hill were mapping mound groups and earthworks primarily associated with the Woodland tradition in the Upper Mississippi Valley (Logan 1976:1). During the later 19th century and early 1900's, F. H. Sterns conducted archaeological work at the Walker Gilmore Site, a Sterns Creek manifestation in Nebraska (Tiffany 1978). Following these and other pioneering efforts, research on Woodland archaeology in Iowa has increased dramatically (Benn 1980; Brown 1967; Gradwohl 1974; Hurt 1952; Kivett 1953; Logan 1976; McKern 1939; Osborn and Gradwohl 1981, 1982; Roper 1974; Theler 1987; Tiffany 1978, 1981, 1982; Tiffany et al 1988).

In the Central Des Moines Valley, archaeological work was initiated in 1908 when T. Van Hyning(1908; 1910a; 1910b) of the Historical Museum of Des Moines excavated the Middle Woodland Boone Mound (13BN29) (Gradwohl 1974:92). This excavation, featuring a photographer, an engineer and including field photographs and observations of stratigraphy was the only work to be done in the area until the 1920's (Gradwohl 1974:2). Archaeological investigations then resumed during the 1920's when Charles R. Keyes visited the area

(Tiffany et al. 1982). Keyes contributed greatly to the understanding of prehistoric occupations in this region (Gradwohl 1974:92).

During the 1960's and 1970's archaeological research in the Central Des Moines Valley intensified due to the proposed construction of two reservoirs: the Red Rock Reservoir, and the Saylorville Reservoir (Gradwohl 1974:92). The construction of these dams provided funding, that would for the first time, allow intensive archaeological research in the region.

Archaeological survey prior to the construction of the Red Rock Dam and Reservoir began in 1948, Richard P. Wheeler of the Smithsonian Institution conducted preliminary surface investigations within the area that would consequently be inundated by the flood control pool associated with the Red Rock Dam. When completed, the Red Rock Reservoir inundated 2,429 hectares (6,000 acres) of land at conservation level, and an additional 27,530 hectares (68,000 acres) during flood stage (McKusick and Ries 1962:17). The intent of these initial investigations was to discover the nature and amount of cultural material in the area, and to discern those sites considered to be of major importance warranting data recovery.

In 1962, the Red Rock archaeological project work was continued under the direction of Dr. Marshall McKusick of the

Office of the State Archaeologist and Joe Ries from The University of Iowa, and assisted by Anthropology students from that university. The intent of this fieldwork was largely similar to the earlier survey in that it concentrated on the location of additional sites, and assessed the importance of sites within the project area (McKusick and Ries 1962:3). These survey's resulted in the location of 42 new archaeological sites (Gradwohl 1974:93), and contributed early information regarding the prehistoric occupations of the impacted area.

The Saylorville Dam and Reservoir was authorized in 1958 by the Flood Control Act of Congress. This dam, to be built eleven miles north of the City of Des Moines, would flood 2,227 hectares (5,500 acres) of land in the Des Moines Valley at conservation pool stage, and 6,761 hectares (16,700 acres) at maximum flood stage (Osborn and Gradwohl 1981:3). As a result of this project proposal, in 1962 the National Park Service under the auspices of the Federal Antiquities Act (1906) and the Historic Sites Act (1935) contracted with The State University of Iowa (Office of the State Archaeologist) to conduct an archaeological survey of the area to be inundated by the Salyorville Reservoir (Gradwohl and Osborn 1973:4). This initial fieldwork (Ashworth and McKusick 1964) resulted in the discovery of a total of sixty-one new archaeological sites, 39 of which were located in Boone County. The remaining sites discovered during this survey were located in Polk (15) and Dallas Counties (7) (Gradwohl and Osborn 1973:4).

In order to augment and improve this initial study, the National Park Service in 1966 contracted with personnel from the Smithsonian Institution River Basin Surveys to conduct further archaeological fieldwork in the Saylorville Reservoir area. This second survey by Lionel Brown (1966) re-evaluated the previously recorded sites, and resulted in the discovery of five new sites including 4 in Boone County and 1 in Polk County (Gradwohl and Osborn 1973:4). Based upon the results of these two surveys, Brown (1966:23) recommended that further survey and excavation should be conducted.

Based upon this recommendation, the National Park Service contacted the newly-formed Iowa State University Archaeological Laboratory (ISUAL) for additional fieldwork. Between 1967 and 1970, a series of cooperative agreements were signed between the federal government and ISU that provided for the salvage of archaeological sites in the Saylorville project area (Osborn and Gradwohl 1981:3). These contracts were to enable ISUAL to locate, test and excavate archaeological sites, the latter selected on the basis of potential destruction by inundation, along with historical and scientific significance (Osborn and Gradwohl 1981:4).

Fieldwork in the region was re-instigated in 1973 as a result of stipulations within the Historic Preservation Act (1966), the National Environmental Policy Act (1969), and Executive Order #11593 (1971). This survey, conducted during the summer of 1973 under the auspices of a contract between Iowa State University and the Iowa State Historic Preservation Program, resulted in the location of twenty-six new archaeological sites (Osborn and Gradwohl 1981:4).

Subsequent fieldwork was conducted periodically in the area as a result of contracts between Iowa State University and the U.S. Army Corps of Engineers Rock Island District, until the completion of the Saylorville Dam. This fieldwork included: continued surface survey, monitoring of construction activities, shoreline patrol monitoring and tree removal operations. This survey by ISUAL personnel was the first of its kind in the state to utilize "Reconnaissance Units" in an attempt to document and control the spatial domains of sites and apparent non-sites in large project areas. All phases of this project were not finished however due to constraints placed upon it by the U.S. Army Corps of Engineers.

As a result of this multitude of fieldwork, the cultural resource inventory for the Saylorville project area included

455 archaeological sites, of which 199 were located in Boone County. The remaining sites were located in Polk (212), and Dallas Counties (44) (Osborn and Gradwohl 1981:5). As a result of these preliminary studies, the Saylorville National Historic Preservation District was established, the first of its kind in Iowa, and one of the largest archaeological preservation districts in the United States.

In more recent times, the Saylorville Reservoir area has been periodically studied by a number of individuals (Benn and Bettis 1981; Benn 1981, 1982, 1984; Bettis and Benn 1984; Benn and Harris 1983; Broihahn 1984; Emmerson et al. 1983; Emerson and Finney 1984; Mead 1974, 1981; Osborn 1976; Osborn and Gradwohl 1981, 1982; Stanley and Benn 1985; Timberlake 1981). Benn (1981, 1982) reported on newly acquired land south of the Saylorville Dam and extending into the City of Des Moines. This project resulted in joint studies by Benn and Bettis (1981), Bettis and Benn (1984) covering the archaeology and geomorphology of this downstream corridor. Testing the significance of nine prehistoric sites in the downstream corridor was the subject of Benn and Harris' 1983 report, while Benn (1984) reported on results of excavations at the Christensen Oneota site (13PK407). In 1982, field survey was conducted at 27 sites in the region by Patricia Emerson (Emerson et al. 1983; Emerson and Finney

1984) of Impact Services Inc., Mankato Minnesota. This work was necessitated by an impending flood pool rise from 833 to 836/838 ft. Benn (1985) reports on the reconnaissance of thirty-six sites in an attempt to determine their present condition and potential research value (Benn and Rogers 1985:12-23).

Because of these and other projects, the amount of knowledge regarding cultural manifestations in the central Des Moines valley was greatly enhanced by many individuals including Ashworth and McKusick (1964); Benn and Bettis (1985); Benn and Rogers (1985); Broihahn (1984); Brown (1966); Gradwohl (1974a, 1975, 1976); Gradwohl and Osborn (1973, 1974, 1975,1976, 1977); McKusick and Reis (1962); Thies (1979); Osborn et al. (1978, 1989); Osborn and Gradwohl (1981, 1982); Timberlake (1981). These previous works have provided a wealth of information for the present study, and make up the foundation from which it is derived.

Cultural Sequence

Paleoindian

The Paleoindian period is the earliest period of human occupation of the New World. While there has been much debate regarding the time frame for human incursion into the New World from Asia (Amato 1993; Dillehay and Meltzer 1991; Dixon 1993; Haynes 1988; Hoffecker et al. 1993; Krieger

1964; MacNeish 1971; Marshall 1990 Meltzer 1988), current information suggests that the Paleoindian period began as early as 18,000 years before present (BP) and ended around 10,000 years BP in most areas. Many of the sites that boast of great antiquity such as Lewisville and Pikimachay have not held up under rigorous scientific scrutiny (Fiedel 1992; Lynch 1983) although as Meltzer et al. (1997) indicate, Monte Verde meets the criteria. Paleoindian cultures are characterized by their distinctive stone tool technology and their reliance on big game hunting. These groups were oriented to upland areas where big game could be found, as opposed to later groups who were primarily adapted to riverine systems. The typical points of this period are lanceolate points such as Clovis, Folsom, Plano, Eden, Scotsbluff, and Dalton points. Clovis points and related forms are long, lanceolate-shaped, bifacially-flaked, fluted spear points, instrumental in killing the large mammals that made up the bulk of the Paleoindian diet (Jennings 1989:81; Fiedel 1992:68).

To date, there have been no Paleoindian sites excavated within the Des Moines Valley. It is likely as Benn and Bettis (1985) suggest, that the area was uninhabitable to early human populations due to the raging melt waters that periodically inundated the valley. The massive ice sheet that covered the area did not begin to recede until 13,000 years BP (Prior 1976:41), making habitation prior to that time impossible. As a result, the oldest point types found in the area date to around 11,200 BP. Other possible reasons for the absence of Paleoindian sites is that they are either deeply buried, and consequently very difficult to find, or that they have been completely destroyed by subsequent erosion and valley formation within the valley system. Another problem in locating Paleoindian sites in the Central Des Moines Valley is the aforementioned hunting orientation of Paleo hunters. Due to the large amounts of surficial water located in the upland areas, and the presence of large game animals there, neither Paleoindians or large game animals, would have had reason to venture into the dangerous environment of the river valley. In support of this, Gradwohl (1974), and McKusick (1964), indicate that Paleoindian points are commonly found in upland areas within the study area.

While Paleoindian sites are uncommon in Iowa, evidence for the Late Pleistocene hunters in Iowa does exist. Sites in the Des Moines Valley such as 13BN234 and 13BN233 have yielded diagnostic points of the Paleoindian period (Benn and Bettis 1985:15). Across the state as a whole, there have been numerous surface finds of Clovis points by archaeologists. Regionally, Gradwohl (1974), has documented Paleoindian artifacts from private collections from the Dunreath, Carlisle, Polk City and Boone localities. Additionally, Toby Morrow (personal communication, 1998) has knowledge of two to three fluted points from Webster County, as well as three from Polk County. Not as common as Clovis points, yet still found, are point forms such as Agate Basin, Dalton, and similar forms (Finney 1994:17). Folsom points, are perhaps the rarest of all Paleoindian projectile point forms found in the state. While surface finds of these points are relatively common, the *in situ* excavation of Paleoindian points is exceedingly rare. The only excavated Clovis site in the state remains the Rummells-Maske (13CD15) Find Spot, located in Cedar County (Anderson and Tiffany 1971). Rummells-Maske contained a storage pit of 11 Clovis points and associated flakes. This cache is one of the few such sites of its kind known in the United States. Due to this lack of excavated Paleoindian occupations, information regarding these Pleistocene hunters in Iowa is relatively sparse, and their presence in the Central Des Moines Valley is not strongly represented in the archaeological record.

Archaic

The Archaic period lasted from roughly 8,000 to 500 B.C for most of the Midwest. Conrad (1981) states that Archaic period manifestations are time transgressive throughout the

Midwest, resulting in the same manifestation yielding different dates across time and space. In accordance with this idea, Benn and Bettis (1985) indicate 8500 BP as the emergent date for the Archaic period in the Central Des Moines Valley. At this time, the Des Moines Valley was a dynamic Holocene environment resulting from the climatic shift that marked the end of the Wisconsin glacial advance around 14,000 BP. Because of this climatic shift, the plants and animals that were available to hunter gatherers changed dramatically as the Holocene period began. This dramatic change in available food sources made it necessary for human populations to switch to new methods of subsistence which included reliance on smaller game animals now available and to expand use of plants now present in the Holocene.

This shift in economic strategy was accompanied by technological changes that characterize the Archaic period. One of these changes was the shift from the larger lanceolate Paleoindian points, to smaller stemmed and side-notched projectile points. These smaller points were attached to darts and used in conjunction with another characteristic Archaic artifact, the atlatl. The use of ground stone tools such as bannerstones, full-grooved axes, manos and metates, are also previously unrecorded artifacts that serve to define the beginning of the Archaic period.

The Archaic period is well represented in Iowa and includes a diversity of material culture and site types dependent on function or inferred use of the site. Among these are open campsites and habitations, rockshelters, specialized plant and animal processing stations and large bison kill sites such as the Cherokee Sewer (13CK402) and Simonsen (13CK61) sites in western Iowa. The first evidence of human burials occurs during the Archaic period in Iowa at the Turin site in western Iowa (Fisher et al. 1985).

In the Central Des Moines Valley, sites dating to this period are relatively common, with the frequency of sites increasing through time towards the end of the Archaic period, circa 2350 BP (Benn and Bettis 1985:21). Archaic components in the area have been indicated at such sites as Darr-es Shalom (13PK149) (Timberlake 1981), and Logansport (13BN103) (Osborn and Gradwohl 1982). The majority of Archaic sites consist of surface manifestations containing mostly flaking debitage and an occasional finished point or tool. Gradwohl (1974), hypothesizes that these point forms, particularly medium-sized, side-notched points, are comparable to points diagnostic of the Logan Creek Complex represented by the Turin, Simonsen and Hill sites (Frankforter 1959; Agogino and Frankforter 1960; Fisher et al. 1985).

One reason for the lack of documented subsurface Archaic sites in the Des Moines Valley is that these sites are often deeply buried in the B horizon of developed soils on the High and Intermediate Holocene terraces or are buried in alluvial fans and consequently have no surface expression (Benn and Bettis 1985:21). Further, many sites in the Central Des Moines Valley are likely multi-component sites, a factor which may mask the expression of earlier cultures. When Archaic sites have been found, it is because modern farming or other activities have deflated the surficial soils present to the point where Archaic materials are exposed. Only in a very few instances (Timberlake 1981) have Archaic materials been found in context in extant soil solums or alluvial sediments.

Woodland

The Woodland period begins around 1,000 BC and lasts until 1,000 AD. This period is marked by a continuation of earlier Archaic hunting and gathering activities, and characterized by the systematic occurrence of pottery, burial mounds and agriculture. In addition, improvements in hunting technology occurred particularly with the introduction of the bow and arrow during Late Woodland times. Woodland habitation sites are generally located within the valleys of major river systems with mounds and mound groups located in the adjacent uplands, although in Eastern Iowa, rockshelter sites are common (Benn 1980; Logan 1976; Theler 1987). The Woodland period is broken down into three sub periods: Early Woodland, Middle Woodland and Late Woodland.

Early Woodland. Early Woodland sites are discernible from their later counterparts based upon several factors, pottery types and reliance on Archaic subsistence activities (Finney 1994; Benn 1985), chief among them. Some Early Woodland pottery types include: Marion Thick, Prairie Incised, and Black Sand Incised (Stoltman 1990). These types are primarily found along the Mississippi where pottery from this time period is more prevalent in the archaeological record (Anderson 1971; Tiffany 1982; Finney 1994). Pottery from the Early Woodland period is uncommon in the Central Des Moines Valley, however Benn (1985) has demonstrated the presence of McBride ware, and posits that it is a western extension of Munson's (1982) Black Sand Tradition (Benn 1985:37). McBride ware is a grit and sand tempered, sub-globular ware that is decorated with trailing, noding and punctating (Benn 1985:37). Currently, there are two types of McBride ware: McBride Cord Roughened and McBride Trailed (Benn 1985:B2).

Early Woodland sites have proven to be somewhat problematical in terms of identification, two main reasons are hypothesized for this difficulty. First, it has been previously stated that Early Woodland sites differ only slightly from the preceeding late Archaic period. The subtle changes that differentiate these two periods may not be apparent given the limits of current archaeological testing techniques. Without the discovery of ceramics or certain point types, an Early Woodland site could easily be misinterpreted as an Archaic site. Secondly, Benn (1985) indicates that within the Saylorville area, Early Woodland sites are clustered within a eight kilometer stretch of the Des Moines Valley near the mouth of Big Creek in Polk County (Benn 1985:37). It is possible that populations during this period were not large enough for settlements to expand throughout the entire valley, as seen in later times. Additionally, previous investigations in the area (Benn 1985; Fokken and Finn 1984; Fortier et al. 1984; Overstreet and Theler 1980; Ozker 1982; Warren and O'Brien 1982), have demonstrated that Early Woodland sites tend to be located on Fans, Benches or Uplands. This potential locational bias could explain the underrepresentation of Early Woodland sites in that they are deeply buried, difficult to find and located outside of the boundaries of earlier surveys. Additionally, because of the nature and extent of recent channel modifications to the Des Moines River, it frequently floods. These periodic flooding episodes have had a substantial negative impact on archaeological sites, as will be demonstrated, especially those located near the river.

Middle Woodland. Middle Woodland sites in general are characterized by distinctive pottery styles, increasing intensity and reliance on cultigens, and the extensive use of conical burial mounds that in many cases reflect a participation in the Hopewell Interaction Sphere (Arzigan 1987; Asch and Asch 1985 Caldwell 1964; Seeman 1979; Smith 1989; Struever and Houart 1972). These burial mounds sometimes include prepared floors, subsurface tombs or other features in them where the primary burials associated with the mound lie as well as exotic Hopewellian artifacts. In general, the Middle Woodland period dates from 200 AD to 400 BC (Stoltman 1974). Although, as with the Archaic, this period ends earlier in some localities, and persists for a greater duration in others.

Pottery styles from this period include Rowe Ware from southwest Iowa (Tiffany 1971, 1977, 1978), Havana Ware from Illinois, and Cedar from eastern Iowa (Benn 1985; Griffin 1952; Logan 1976). Among these two wares, there exist numerous types, identified primarily by decoration technique. The most common of these decoration techniques are: cord marking, punctating, trailing and stamping (Tiffany 1978:174).

In Central Iowa, Middle Woodland pottery is represented by High Bridge ware and Madrid ware, which are local versions of Havana ware (Gradwohl 1974:94), as well as Hopewell ware, which occurs in the Boone mound and at the adjoining Gracie Paulson site (Gradwohl 1974:94). Decorative techniques common of this ware include: punctates, cord-wrapped stick impressing, incising, trailing, and some dentate stamping (Osborn and Gradwohl 1982:280).

Lithic material diagnostic of the Middle Woodland period includes items such as 3/4 grooved axes, celts, sandstone abraders, drills, gravers, side and corner notched projectile points (Gradwohl 1974:94). Represented point types include Adena, Dickson, Tama, Manker Corner notched, and points that resemble Snyders and Norton. Some of these lithic tools are made from non-local material such as Knife River chalcedony and obsidian (Benn 1985:45; Osborn and Gradwohl 1982:283) which demonstrate some degree of participation in the Hopewellian Interaction Sphere (Struever 1964; Osborn and Gradwohl 1982)

Sites in the Central Des Moines Valley that belong to this time period include the mortuary sites of Mohler-Miller Mounds (13MA20), Saylorville Five (13PK144), Charles D. Johnson Mound (13PK33) as well as the Boone Mound (13BN29), which represents the largest mound west of the Mississippi

(Osborn and Gradwohl 1982:279; Benn and Bettis 1985:28). Among the Middle Woodland habitation sites in the area are Henry Woods (13PK20), Klein's Kleinezeit (13PK111), Darr-es-Shalom (13PK149), Bastille Bottoms (13PK175), Brassica Bench (13PK265) (Theis 1979), Carl Rose (13BN12), Logansport (13BN103), Hubby (13BN38), Blosser (13BN125) (Broihahn 1997), and the Sparks Site (13BN121) (Osborn and Gradwohl 1982:280).

Late Woodland. The transition from Middle Woodland to Late Woodland is a gradual transition without clear temporal boundaries. The early Late Woodland period begins around AD 400 and lasts until approximately AD 950. Changes include development of full-scale corn farming (Asch and Green 1992), the bow and arrow, the appearance of fortified villages and the use of globular grit-tempered pottery, without handles, that has cord, fabric-impressed, tool impressed decorations or both on the outer rims of the vessels. This pottery assemblage includes Hartley ware (Tiffany 1982), Allamakee ware, Loeske ware, Madrid ware, Weaver ware, Saylor ware, Held Creek ware and Sterns Creek ware (Finney 1994; Hass 1983; Tiffany 1977). Most of these features are not fully present until the end of Late Woodland times. In eastern Iowa, one unique aspect of this period is the construction of Effigy mounds in the forms of bears, birds and panthers as well as conical and linear forms (Benn 1985; Mallam 1976, 1984; Petersen 1979, 1984, 1986).

In the Central Des Moines Valley, the early Late Woodland period is represented at such sites as 13PK165, 13DA12 and 13DA110. Decoration techniques on the pottery from this period frequently include single-cord impressions, modeled nodes, and squared orifices (Osborn and Gradwohl 1982:280).

Lithics from this period reflect an increasing reliance on the bow and arrow as point forms are small and triangular and may either be side notched or unnotched (Osborn and Gradwohl 1982:280). Benn (1985:47) has identified several point forms from the Des Moines Valley for this period. These forms are Tama, Besant/Reed, Okoboji, Little Sioux and Lost Island.

In the Des Moines Valley, Benn (1985) lists 47 sites as belonging to the early Late Woodland period, and notices a clustering pattern around Big Creek in Polk County, Scandia Bottoms in Dallas County and Boone Bottoms in Boone County (Benn 1985:48).

Great Oasis

The Great Oasis aspect is a regional Late Woodland period pottery complex that is found in northwestern Iowa, southwestern Minnesota, South Dakota and the Central Des Moines Valley (Tiffany 1991:187). Great Oasis sites are characterized by ceramics with distinctive vessel forms and decoration (Tiffany 1991:188). These vessels are globular in shape with flared rims and are commonly decorated with trailed design elements reminiscent of Late Woodland period cultures (Tiffany 1991:188).

Typical Great Oasis lithic artifacts include triangular projectile points, sandstone abraders, side and end-scrapers as well as numerous ground stone tools (Gradwohl 1974:97; Finney 1997:24).

In the Central Des Moines Valley, the Great Oasis Aspect is represented at many sites including Hubby (13BN38), Logansport (13BN103), Meehan-Schell (13BN110), Blosser (13BN125), and Old Moser (13BN130) (Broihahn 1997; Osborn and Gradwohl 1982:281). These sites have yielded examples of Great Oasis Plain, Wedge Lip, and Great Oasis Incised ceramics.

Oneota

Oneota manifestations in the region are primarily south of the City of Des Moines and have been designated the Moingona phase (Gradwohl 1974; Osborn and Gradwohl 1982:281). These habitation sites are concentrated in the area of the Red Rock Reservoir approximately 16 kilometers (10 miles) to the south of the Saylorville Reservoir (Benn 1985:57). The Oneota tradition begins around AD 1200, facilitated by the demise of

Cahokia, and remains largely unchanged until the arrival of Europeans (Tiffany 1988, 1997; Wedel 1959). Within the Central Des Moines Valley, however, archaeological evidence has not been able to demonstrate this culture continuity. The calibrated radiocarbon dates for the Moingona phase fall in the mid 13th century, although some scholars do not accept mid 13th century as the total temporal frame for Moingona. Some very late Oneota manifestations, the Orr focus in the Paleozoic Plateu region of northeast Iowa, in particular have been associated with Chiwere-Winnebago Siouan speaking groups such as Iowa, Oto, Winnebago, and Missouri (Griffin 1937; Mott 1938; Henning 1970; Tiffany 1991).

The most characteristic artifact of the Oneota period is the shell tempered, globular and ellipsoid-shaped vessels with constricting mouths and rounded bottoms (Tiffany 1997:205). These vessels frequently exhibit large strap handles, and trailed decorations on the upper shoulder that include punctates, chevrons, circles and crosses (DeVore 1990:50; Osborn and Gradwohl 1982:281; Tiffany 1997:205). Other characteristic artifacts of this period include small traingular projectile points that may either be notched or plain end scrapers, scapula hoes, bone fishooks, along with miscellaneous shell and copper artifacts (DeVore 1990:50; Tiffany 1997:205).

Oneota subsistence activities are characterized by a mixed economy dependent on hunting, foraging, and farming (Tiffany 1997:205). The diet included major cultigens such as maize, beans and squash (DeVore 1990:50; Gradwohl 1974:95), supplemented with such faunal species as bison, deer, as well as a variety of fish, smaller mammals and birds (DeVore 1990:50). Excavations at the Christensen site (Benn 1991), a small Oneota habitation, have demonstrated that Oneota groups fragmented into smaller bands during the winter months, possibly in order to minimize environmental depletion (Benn 1991:42).

Several Oneota sites have been excavated within the Central Des Moines Valley. DeVore (1990) reported on excavations at the Cribb's Crib site (13WA105), a Moingona phase village site. The previously mentioned Christensen site (13PK407) was excavated in 1983 by David W. Benn (1991). Aside from these recent excavations, fieldwork has been conducted at 13MA30 (Mohler Farm), 13WA2 (Clarkson), and 13PK1 (Howard Goodhue) (Osborn and Gradwohl 1982:281). Oneota sites from other parts of the state are also widely reported (Finney and Hollinger 1994; Fischel and Van Nest 1994; Harvey 1979; Hollinger 1993; McKusick 1973; Straffin 1971; Schermer 1987; Slattery, Horton and Ruppert 1975; Tiffany 1979, 1988, 1997).

Protohistoric and Historic Period

During the time prior to, and immediately following the arrival of Europeans to the Central Des Moines Valley, the area was possibly occupied sporadically by transient Chiwere Siouan-speaking groups such as the Ioway and the Oto (Gradwohl 1974:98; Mott 1938:247-250). While these groups were primarily oriented towards the Missouri and Mississippi Rivers and their tributaries, Mott (1938): suggests that trading and hunting activities may have brought them east into the Des Moines Valley. In addition to the Ioway and the Oto, Mott (1938) indicates that during the second half of the 18th century, the Algonquian-speaking Meskawki were beginning to assert their hegemony over the area (Mott 1938:274). By 1830, all Native American lands in Iowa were ceded to the United States Government, although some indigenous groups remained in the area until 1846 (Gradwohl 1974:99).

While archaeological sites from the protohistoric and historic periods are presumed to exist in the Central Des Moines Valley, there has to date been one site, the Chesterfield Graves site that provides archaeological evidence of their existence. The Chesterfield Graves site was excavated by Van Hyning early in the 20th century and included such grave goods as silk cloth, glass beads, objects of copper, iron and brass, along with a lacquer snuff box (Gradwohl

1974:99). Aside from this work, however, sites dating to this period have not been demonstrated to exist.

Historic Euro-American

Historic settlement of the Central Des Moines Valley by Europeans and Euroamericans began primarily in 1845. At that time the area was officially open to settlement (Rogers 1985:64). Between 1845 and 1857 many immigrants settled in the area and the counties of Boone, Polk and Dallas were organized (Rogers 1985:64). Settlements in the Des Moines Valley were primarily organized around the Des Moines River as it was the major mode of transportation through this part of the state (Rogers 1985:67).

Several archaeological sites from this time period have been excavated in the central Des Moines Valley. The Coalport Kiln (13MA103) (Reynolds 1970), Noah Creek (13BN111) (Schulte 1974) as well as two sites in the Moingona area 13BN120 and 13BN132 (Schroeder 1979) are reflective of the pottery and coal industry that played a major role in the development of the area (Gradwohl 1974:100). The pottery produced by these kilns were primarily utilitarian wares intended for local consumption (Gradwohl 1974:101).

The archaeological database housed at the Iowa State University Archaeological Laboratory also includes information indicating the presence of many farmsteads, root cellars, abandoned towns, abandoned mines, as well as brick kilns that are related to this period. Nepstad-Thornberry (1997) includes information regarding the health and demography of the early settlers of this region from site 13PK20.

CHAPTER 5. RESULTS

As previously mentioned, this study examined a total of fifteen 24.7 hectare (10 acre) sample units. This amounts to roughly 15 percent of the some 5434 hectares (2200 acres) in the project area. Throughout the course of the survey, a total of five new archaeological sites were recorded: 13BN372, 13BN373, 13BN374, 13BN375, and 13BN376. Site record sheets for these sites have been filled out and are currently on file with the Office of the State Archaeologist in Iowa city, and the Iowa State University Archaeological Laboratory (ISUAL) in Ames. In addition to these new sites, six of the sample blocks chosen for survey contained archaeological sites that had been previously recorded. These previously recorded sites are: 13BN17, 13BN34, 13BN38 (The Hubby Site), 13BN133, 13BN254, and 13BN315.

13BN372

Archaeological site 13BN372 is located on an interfluve that extends off a Late Wisconsin bench on the east side of the Des Moines Valley. The site is situated in Section 10, Township 82 north, Range 26 west, Luther Quadrangle, Boone County, Iowa. The site is delimited to the north by a steep hill slope, and on the east, south and west by a steep drop off down to a drainage system. It lies between elevation levels 286.6 and 289.6 meters above sea level (940 and 950 feet). This area was likely tilled in the past, but is currently covered with wooded vegetation including a walnut tree farm that severely limits ground visibility. The soil on which this site is located has been mapped as Sattre loam, 2 to 5 percent slopes (Andrews and Didereksen 1981:32,73,74). Sattre loam belongs to the taxonmoic class of fine-loamy over sandy or sandy-skeletal, mixed, mesic Mollic Hapludalfs. This soil is a gently sloping well drained soil found on stream benches and is typically under cultivation (Andrews and Didereksen 1981:152). A records check with the Office of the State Archaeologist (OSA), shows that the site is previously unrecorded. There have been no previous archaeological investigations conducted at the site, and no previously recorded sites were on file at OSA.

Archaeological work at site 13BN372 consisted of hand auger testing of the A and AB soil horizons along with surface survey. Artifacts were recovered from the AB and B soil horizons as well as the surface, and consist of lithic debitage. Table 1 presents a listing of artifacts recovered from 13BN372. The specimens recovered are associated with secondary thinning or the resharpening of lithic tools. Even though no diagnostic materials were found, the site has been classified as Archaic in age based upon the absence of any ceramic material, the location of the site on a Late

Table 1. List of artifacts recovered from archaeological site 13BN372.

Item	Number	Provenience
Core	1	0-10 cm
Flaking Debitage	2	10-20 cm
	2	20-30 cm
	1	30-40 cm
	1	40-50 cm
Shatter	1	0-10 cm
	2	10-20 cm
	1	20-30 cm
	1	30-40 cm

Wisconsinan bench, and the depth at which artifacts were recovered in the soil solum. It is possible, however, that subsequent groups would have situated themselves at such a distance from the Des Moines River. It is probable that the archaeological integrity of the site has been compromised by past episodes of tilling as well as down slope erosion of sediment caused by the stream bed immediately adjacent to the site on the east.

13BN373

This site is located on the southern edge of an interfluve that extends towards the Des Moines river, on a Late Wisconsinan bench. This landform is situated on the east side of the Des Moines River. 13BN373 lies directly to the east of 13BN372. The site is situated in the west half of Section 10, Township 82 north, Range 26 west, Luther Quadrangle, Boone County Iowa. The site is bounded on the east, south and west by a steep hillslope that drops off onto a large Low Holocene terrace adjacent to the Des Moines River. On the north, the site is bordered by a narrow sliver of land that opens up onto the main section of the Late Wisconsinan bench. The elevation of 13BN373 is between 286.6 and 289.6 (MASL) (940-950 feet). As this site occupies the same landform as 13BN372, it is also likely to have been tilled in the past. Currently, however, the site is covered by natural vegetation and has limited ground surface visibility. The soil upon which this site rests has been mapped as Sattre loam, 2 to 5 percent slopes (Andrews and Didereksen 1981:32,73,74). As previously described, this soil is a gently sloping well drained soil found on stream benches and is typically cultivated. 13BN373 has not been previously recorded.

Site 13BN373 was discovered during auger testing of the interfluve upon which it lies. After a positive auger test was encountered, additional units were excavated, and surface survey of the area was conducted to determine the size of the site. Archaeological materials were recovered from an area roughly 10 meters east/west by 15m north/south. Archaeological materials were recovered on the surface, and in auger units at depths of up to 30 centimeters below the surface. These artifacts consisted of a moderate amount of lithic debitage. Table 2 presents a listing of all materials recovered from the site. The lithic material recovered from 13BN373 are suggestive of secondary thinning or the resharpening of stone tools. Based upon the absence of any ceramic material, the location of the site on a Late Wisconsinan Bench and the depth at which artifacts were recovered, this site has been identified as Archaic in age, even though no diagnostic artifacts were found. This classification is tenative as it is possible that subsequent groups could be responsible for the artifacts discovered at 13BN373. Based upon the amount of artifacts recovered, it is highly likely that this site was once larger. The interfluve upon which the site sits is extremely narrow as a result of continued weathering and erosion. These forces have caused a high degree of down slope movement of sediments and the artifacts contained within them reducing the remaining cultural expression of the site.

13BN374

This site a probable Woodland period burial mound that was discovered during surface survey. This mound is located

Table 2. List of artifacts recovered from archaeological site 13BN373.

Item	Number	Provenience
Core	1	Surface
End Scraper	1	31-40 cm
Flaking Debitage	3	0-10 cm
	13	10-20 cm
	5	20-30 cm
Retouched Flake	1	10-20 cm

at the northwestern edge of a Late Wisconsin bench overlooking the east bank of the Des Moines River, the mound is conical to slightly linear in shape. An historic roadbed cuts directly in front of the mound on its west side. The site is bounded to the east and south by a large Late Wisconsinan Bench that is currently covered with dense timber and vegetation. To the north of the mound is a deeply incised drainage system that runs east to west and empties into the Des Moines River. To the west of the mound, the land slopes away steeply down to the river. The mound is located right on the 304.8 (MASL) contour (1000 ft.). In the center of the mound there is a large irregular circular depression that provides evidence of a past looting episode(s). Since excavation on or around a burial mound is forbidden by Iowa state in additon to federal law, no testing or excavations were conducted by Iowa State University students or personnel in the vicinity of 13BN374.

13BN375

13BN375 is located on a slight rise in the middle of a true upland landform. The land upon which this site lies is currently in row crop cultivation. It is situated at the head of a long, deep ravine that drains into the Des Moines River. The area is in the north half of Section 10, Township 82N, Range 26W, Luther Quadrangle, Boone County, Iowa. The site is bounded to the north, west and east by a large area that is currently in row crop cultivation. To the south, the site is bordered by a drainage system that lies approximately 200 meters away across open field. The elevation of the site is listed as 304.8 plus meters above sea level (1000 ft.). As a result of continued cultivation, surface visibility at the site is excellent. As with other sites reported here, 13BN375 has not been previously recorded. The soil upon which this site lies has been recorded as Hayden loam, 2 to 5 percent slopes (Andrews and Dideriksen 1981:17, 18, 65, 66). This soil is well-drained, moderately permeable soil located on upland areas. Vegetation on this soil is typically wooded pasture.

13BN375 was discovered during a surface survey of the field in which it lies. Subsequent auger testing at 15 meter intervals revealed additional artifacts at depths of anywhere up to 30 centimeters below surface. Lithic flaking debris was the most common artifact type recovered from 13BN375. In addition to this material, a biface fragment was located on the surface of the site. This fragment is not complete enough to make generalizations with respect to cultural affiliation. Table 3 presents a summary of all cultural material recovered from 13BN375. Based upon the location of the site with respect to landform unit and the absence of any ceramic material, this site has been identified as an Archaic site. It is entirely possible that Woodland groups would have been in the uplands for periodic hunting episodes as well as resource procurement. The lack of material evidence however makes classifying this site as Woodland difficult. 13BN375 is not currently in danger of destruction from erosion, however years of continued plowing has destroyed most of its context.

13BN376

Archaeological site number 13BN376 is located on an interfluve to the south of the 4-H Center main grounds. It is situated in the south 1/2 of Section 10, Township 82 north and Range 26 west, Luther Quadrangle, Boone County, Iowa. The site is bounded to the north by a widening interfluve that eventually opens onto the main grounds of the 4-H Center. On the east and west, the site is bounded by steep hillslopes

Table 3. Artifacts recovered from 13BN375.

Item	Number	Provenience
Biface Fragment	1	Surface
Flake	1	Surface
	1	20-30 cm
	1	30-40 cm
Shatter	1	0-10 cm
	1	10-20 cm

that lead down to Richardson Creek and the Des Moines River respectively. To the south of the site, the interfluve continues to its terminus near the confluence of Richardson Creek and the Des Moines River. The elevation of the site is listed as above 304.8 meters above sea level (1000 ft.). The soil upon which 13BN376 lies is recorded as Hayden loam, 5 to 9 percent slopes (Andrews and Dideriksen 1981:16). This soil is a moderately sloping, well drained soil on convex upland ridgetops, near major streams and is typically wooded pasture (Andrews and Dideriksen 1981:16).

Artifacts were discovered on the surface of 13BN376 during the course of subsurface survey of the interfluve on which it lies. Artifacts recovered were limited to a surface expression of lithic flaking debitage. Auger testing was conducted in the area in an attempt to locate additional artifacts. No artifacts were found in any of the test units excavated at 13BN376. It is probable that the soil in this area is deflated due to erosion. The current floral assemblage is indicative of secondary growth, and provides evidence that this area was clear cut during the early historic period, a factor that would greatly facilitate erosion. Further, much of the site is likely to have been lost due to this erosion. An ephemeral scatter of lithic material is likely all that remains of 13BN376. The minute amount of cultural material recovered from 13BN376 make cultural designation difficult. 13BN376 is located roughly 100ft (250m) from archaeological site 13BN17. 13BN17 consists of two conical Woodland period mounds that were originally reported by Ashworth and McKusick in 1964. The close proximity of these mounds to 13BN376 is further evidence that it is an Archaic site as Woodland peoples tended not to locate habitations near their burial sites.

13BN254

Archaeological site number 13BN254 is located on a High Holocene terrace on the east bank of the Des Moines River. It is situated in the SW 1/4 of Section 4, Township 82 north, Range 26 west, Madrid NW quadrangle, Boone County, Iowa. The site is bounded to the north by a drainage ravine that empties into the Des Moines River. On the east the site is delineated by a slope that leads to a section of a Wisconsinan Terrace. To the south and west, the site is bounded by another slope that leads down to the Des Moines River over a series of terraces. The elevation of 13BN254 is listed as 274.4 meters (900 ft.) above sea level. The soil upon which this site sits has been recorded as Jacwin loam, 3 to 9 percent slopes. This soil is a gently and moderately sloping, somewhat poorly drained soil on concave terraces (Andrews and Dideriksen 1980:26). Jacwin soils are formed in glacial till, or colluvium derived from glacial till (Andrews and Dideriksen 1980:66).

Site 13BN254 was relocated during surface survey of the field in which it lies. Artifacts recovered were limited to flaking debris on the surface only. Auger tests at 15m intervals across the entire terrace did not yield any cultural material within the soil solum. Continued episodes of mechanized plowing have likely destroyed any context at this site. Due to the lack of diagnostic material, classification of 13BN343 with respect to cultural affiliation is difficult.

13BN17

As previously mentioned, archaeological site 13BN17 consists of two confirmed Woodland period conical mounds. The possibility exists that a third mound is present in the area, although this has never been confirmed archaeologically.

Given the limits of archaeological testing around burial mounds it is likely that the existence of this third mound will remain unconfirmed.

13BN17 is on an interfluve that is located to the south of the 4-H Center main grounds. The site is bounded to the north by a widening interfluve that eventually opens onto the main grounds of the 4-H Center. On the east and west, the site is bounded by steep hillslopes that lead down to Richardson Creek and the Des Moines River respectively. To the south of the site, the interfluve continues to its terminus near the confluence of Richardson Creek and the Des Moines River. The elevation of the site is listed as above 304.8 meters above sea level (1000 ft.). The soil upon which 13BN376 lies is recorded as Hayden loam, 5 to 9 percent slopes (Andrews and Dideriksen 1981:16). This soil is a moderately sloping, well drained soil on convex upland ridgetops, near major streams and is typically formed under forest vegetation(Andrews and Didereksen 1981:16).

13BN17 was originally recorded by Ashworth and McKusick in 1964. Since previous studies, the mound group recorded as 13BN17 has been relocated and its correct location is as previously mentioned. Gradwohl and Osborn(1976:51) indicate that these mounds were previously excavated around 1950 by persons said to be affiliated with Iowa State University. No records of this event are on file with the Iowa State University Archaeological Laboratory, and further, no archaeologists were on staff at Iowa State at the time of the alleged excavation (Gradwohl and Osborn 1976:51).

As the excavation of burial mounds is strictly prohibited by Iowa state as well as federal law, no fieldwork was conducted in this area by any Iowa State University students or personnel. Archaeological fieldwork in this area was limited to reconnaissance and verification of the location of the mounds.

13BN34

Archaeological site 13BN34 is located on an Intermediate Terrace, on the east bank of the Des Moines River. The site is currently situated in a plowed field located in the NW 1/4 of the NE 1/4, Section 9, Township 82 north, Range 26 west Madrid NW Quadrangle, Boone County, Iowa. The elevation of the site is listed as between 265.2 and 271.3 (MASl) (870-890 ft). The site is bounded to the north by a system of terraces that lead to upland areas. On the east, the site is bounded by a well-developed drainage system that empties into the Des Moines River. To the south and west the site is bordered by a large section of a Low Terrace that leads to the Des Moines River. The soil upon which the site sits has been mapped as Buckney fine sandy loam, 1 to 3 percent slopes (Andrews and

Dideriksen 1981:30). This soil is typically formed under forest vegetation.

13BN34 was originally recorded by field crews from The University of Iowa. Additional surface survey was conducted at 13BN34 by ISUAL personnel during the previously mentioned Saylorville Dam and Reservoir survey (Gradwohl and Osborn 1976:55-56). The site was relocated during the summer of 1997 during surface survey of the terrace upon which it lies. Artifacts recovered during this survey included materials representing a prehistoric component as well as a historic component. Artifacts representing the prehistoric component included: pieces of debitage, an abundance of heat cracked rock, and the basal half of a side notched projectile point. This initial survey of the area was made prior to the arrival of the archaeological permit, issued by the U.S. Army Corps of Engineers, Rock Island District and as a result, these materials were observed, and not collected in accordance with federal law. A drawing was made of the projectile point in the hopes of later identification, but it was not collected. Tentative classification of the point fragment found at 13BN34 was based upon the artifact drawing as well as the form of the biface. Based on the convex base, and the expanding stem, the point could be a Steuben point (Perino 1968:94). Steuben points are small to medium dart points that are associated with early Late Woodland sites in Illinois, Missouri and Iowa (Perino 1971:77). They commonly have an expanding stem with straight to slightly convex bases (Perino 1971:77) The point fragment recovered from the surface of 13BN34 resembles a Steuben point in many attributes, however this classification is tentative, as the actual point was not recovered for proper analysis. Artifacts indicative of the historic period that were observed by the field crew included several pieces of whiteware, aqua flat glass, as well as numerous pieces of unidentified metal.

Subsequent to the arrival of an archaeological permit, issued to Dr. Joseph A. Tiffany, fieldwork was permitted at 13BN34. Unfortunately, the permit was not received until late in the summer, and as a result, the ground surface visibility at the site was greatly reduced due to soybeans that had been planted over the entire area. Because these soybeans had not been planted in rows, further surface survey was not possible. Instead, bucket auger testing was conducted along transects placed over the area at fifteen meter intervals. These test units were excavated to depths of up to 100cm, or well into the C Horizon of the soil solum. While these test excavations did not reveal any artifacts, cultural material was found on the surface during excavation. These artifacts include pieces of whiteware indicative of the historic component of the site, and lithic flaking debris and heat cracked rock, portion of the prehistoric aspect of the site which is of undetermined cultural affiliation.

While the site is in a field that is at this time used for row crop agriculture, the site is not in danger of erosion. Repeated plowing episodes have likely destroyed any context present at the site, however based upon the initial surface survey in the spring of 1997, a moderate concentration of artifacts remains at 13BN34.

13BN38

Archaeological site 13BN38 is located on a large Low Holocene Terrace on the east bank of the Des Moines River. It is located in the western half of Section 10, Township 82 north, Range 86 west, Luther Quadrangle, Boone County, Iowa. The site is bounded to the north, west and south by sections of the large terrace upon which it lies and eventually, the Des Moines River. To the east of the site is a steep hill slope that leads to the Uplands. The elevation of the site is listed as between 274.3 and 286.5 meters above sea level (900-940 ft.). The soil upon which this site lies is recorded as Hanlon fine sandy loam, 0 to 2 percent slopes. This is a moderately well drained, moderately rapidly permeable soil that occurs on natural levees and bottom lands (Andrews and

Dideriksen 1981:63). Native vegetation typical of Hanlon soils was forest or trees with some prairie species.

Archaeological fieldwork was initiated in 1964 by the Office of the State Archaeologist after reports by a collector indicated the presence of points in the area (Ashworth and McKusick 1964:10). Based upon these reports, archaeological investigations were conducted in the area. Dense vegetation however prohibited crews from the Office of the State Archaeologist and the Smithsonian Institution River Basin Surveys from locating the site (Brown 1966:13). In 1967, individuals from the Iowa State University Archaeological Laboratory visited the spot as part of a contract with the National Park Service to conduct archaeological survey in the Saylorville Reservoir (Osborn and Gradwohl 1982:116). This survey resulted in the discovery of at least three components at the site, Middle Woodland, Great Oasis and historic Euro-American (Osborn and Gradwohl 1982:116). During the summer of 1967, ISUAL personnel began excavating 13BN38. These excavations consisted of seven 3 meter square test units. The excavation of these units was temporarily halted due to landowner complications (Osborn and Gradwohl 1982:116). Between 1967 and 1980, archaeological testing was limited to episodes of surface collection and the monitoring of tree removal. In 1980 and 1981, archaeological excavation was resumed in earnest by ISUAL personnel. These excavations consisted of trenching, coring and the opening of test pits. This stage 3 fieldwork resulted in the discovery of numerous Middle Woodland pottery and chipped stone artifacts, with the Great Oasis component being less clear (Osborn and Gradwohl 1982:124, 127).

Archaeological testing at 13BN38 during the fall of 1997 consisted of surface survey and Seymour auger testing. Surface survey was impeded by dense brush and very tall grass that covers the entire surface of the site reducing visibility to roughly 20 percent. Auger transects were placed fifteen meters apart, and oriented in an east/west direction, with test units excavated at a fifteen meter interval over the entire area. Additional test units were positioned near previous excavations in the hopes of finding diagnostic artifacts of either the Great Oasis occupation or the Woodland occupation. A summary of artifacts exhumed from 13BN38 during the summer of 1997 appears in Table 4.

The bulk of material collected from 13BN38 is in the form of lithic flaking material, although several small pieces of pottery were also found. These artifacts were located on the surface, as well as in auger units at depths of up to 30 centimeters below the surface. The lithic material is characteristic of secondary thinning, or the resharpening of

Table 4. Artifacts recovered from 13BN38.

Item	Number	Provenience
Ceramic Sherd (grit tempered)	5	2-25 cm
	3	20-30 cm
Flake	1	0-10 cm
	2	20-30 cm
	1	40-50 cm

stone tools. No stone tools diagnostic of either prehistoric cultural tradition represented at 13BN38 were discovered during the 1997 field season. Pottery recovered from the site includes several small pieces, the largest being 1.5 cm in length. These pieces are grit tempered, and although they are quite small, their globular shape is suggestive of Woodland Period pottery as later Great Oasis pottery is very uniform in thickness, and is much thinner than Woodland pottery.

13BN38 lies on a broad Intermediate Holocene Terrace that has experienced intermittent episodes of flooding in the past, the most recent being the floods of 1993. This flooding has likely caused a moderate amount of damage to the site through the removal of surface sediment and cultural material. This is evidenced by the fact that the 1997 field season discovered significantly fewer artifacts than previous investigations by ISUAL personnel. Numerous auger units revealed no evidence of a buried soil, or any redeposition of alluvial sediments during recent flooding episodes.

13BN133

Archaeological site 13BN133 is located on an alluvial fan that superimposes a Low Holocene Terrace on the east bank of the Des Moines River just to the south and west of the Iowa 4-H Center main lodge. It is situated in Section 10, Township 82 north, Range 26 west, Luther Quadrangle, Boone County, Iowa. The site area is bordered to the north and east by steep hillslopes that lead to upland areas. To the west, the site area is bounded by the Des Moines River which currently runs about twenty meters from the site. On the south, the site is bordered by a large section of Low Holocene terrace that is intermittently inundated by the river. The elevation of 13BN133 is recorded as between 259 and 262 meters above sea level (850-860 ft.). The soil upon which the site sits has been recorded as Buckney fine sandy loam, channeled, 0 to 2 percent slopes (Andrews and Dideriksen 1981:35). This soil is a nearly level, excessively drained soil that occurs on slightly raised areas on flood plains of major rivers and streams (Andrews and Dideriksen 1981:35).

Archaeological site 13BN133 was first reported in 1976 by Dr. David M. Gradwohl as part of the Saylorville Dam survey (Gradwohl and Osborn 1976:67). During this project artifacts were recovered from 13BN133 during surface survey conducted by ISUAL personnel. These include Woodland pottery, a side notched projectile point, one biface, several utilized and retouched flakes, shatter, cores and core fragments (Gradwohl and Osborn 1976:67-68). Based upon these artifacts, the site was designated as Woodland in age, and subsequent testing was recommended (Gradwohl and Osborn 1976:67-68).

During the 1997 survey, the survey unit containing archaeological site 13BN133 was drawn at random, and fieldwork was conducted in the hope of relocating this Woodland period site and conducting further surface and subsurface survey. A surface survey was conducted over 100 percent of the area previously defined as 13BN133. While this survey did not yield any cultural material, it did lead to the belief by the field crew that recent flooding episodes had deposited a thick layer of alluvial sediment over the entire terrace, obscuring or perhaps destroying the site. To compensate for the possibility that the site had been buried, auger units were placed over the entire survey unit at 5 meter intervals. These auger units were excavated to depths of 100 centimeters, or well into the C horizon of the soil. In addition, several auger units were extended to the water table to gain a better understanding of the stratigraphy, and guard against the possibility of a buried A horizon. No cultural materials or any evidence of an intact A horizon were found in any of the test units. Six mechanically excavated trenches were then opened in an attempt to gain a better understanding of the stratigraphy in the area. While these test trenches did not reveal any cultural material, they did demonstrate quite definitively the effects of flooding on this terrace.

The soil in the entire 10 hectare unit containing 13BN133 was highly disturbed. The soil profile in this area consisted of intermittent bands of a very dark brown silty sediment and a very coarse yellowish brown clay sediment. This profile, extending to the water table in all test units, contrasts greatly with the soil profile that has been mapped for the area by Andrews and Dideriksen (1981). The soil profile should have included 54 centimeters of a very dark brown fine sandy loam grading into a very dark grayish brown fine sandy loam. The very dark grayish brown coloring of the lower levels of this profile are the result of gleying, occurring in soils deprived of oxygen as a result of prolonged inundation. The observed soil horizon did not exhibit any evidence of gleying, indicating that it is a recently deposited soil.

The type of sedimentary layering mentioned above, is consistent with the process of turbulent flow, and it is probable that turbulent flow, and not burial by alluvial action is responsible for the destruction of 13BN133. A detailed summary of turbulent flow and its properties appears in Appendix A, so it will not be discussed in detail here. River channel flow becomes turbulent when the velocity and inertial force of a channel increases to the point where it surpasses a critical Reynolds number (Brown 1997:320). Several factors contribute to a channel flow becoming turbulent. Narrowing of the channel, as well as an increase in the volume of water are the most crucial. Turbulent flows are characterized by a more complicated eddy structure where large fluid masses move at different velocities and in different directions (Goncharov 1964:4).

There are three main aspects of turbulent flows that provide evidence that this phenomenon is at work on the Low Terrace occupied by 13BN103. The first of these is the nature of the sediment deposited by a turbulent flow. Work on sediment deposition in turbulent flow currents (Bagnold 1954; Middleton 1967; Walker 1977, 1978; Lowe 1982), has demonstrated that turbidity currents mostly produce sharp-based beds, which generally fine-grade upward, and within which there are successions of intermittent sedimentary structures suggesting waning flow conditions through time (Martinsen 1994:134). A second important aspect of turbulent flow is the nature of the flow on floodplains and at times when flow discharge exceeds bankfull (Allen 1977:21).

Additionally, turbulent flows have been shown to have a more damaging effect on floodplain areas than the channel proper (Sellin 1964; Yen and Overton 1973; Ghosh and Kar 1975; Myers and Elsawy 1975). Finally, turbulent flows have been shown to exhibit spatially varying effects. Thornes (1977) has shown that within a river channel, certain areas that conform to the above properties, will be more adversely affected by turbulent flow than other areas where conditions for turbidity are not met.

13BN133 meets all of the requirements for turbulent flow defined above. It lies in a floodplain area, and is located in a stretch of the Des Moines Valley where the channel walls narrow from 1800 feet up river, to 1000 feet at the site. The stratigraphy in the area, as defined above, is characteristic of sediment deposited by a turbulent flow. Further, evidence of beaver activity on the tops of trees in the area indicate that the water was calm on the surface, a characteristic of turbulent flows. Beaver activity would not be expected in an area where the currents were rapidly churning the surface. Additionally, trees in the area have died as a result of rings of silt deposited around them. The destruction of archaeological sites resulting from the impact of reservoirs has been document by Thomas Witty (1973), and similar results have been predicted for the Saylorville area by Gradwohl and

Osborn (1977). Because of these many factors, turbulent flow and not burial by alluvial sedimentation is indicated for the destruction of 13BN103.

13BN159

Archaeological site 13BN159 is located on an Intermediate Terrace on the east bank of the Des Moines River. The site is situated adjacent to a steep embankment that leads down to a drainage stream. 13BN34 lies to the north of 13BN159, on the same Intermediate Terrace, across the drainage system. The site is situated in Section 9, Township 82 north, Range 26 west, Madrid NW Quadrangle, Boone County, Iowa. As mentioned, the site is bounded to the north by a ravine that drains the uplands into the Des Moines River. To the east, the site is bounded by a system of terraces that lead eventually to true upland landforms. On the south and west, the site is bordered by a large section of Low Terrace, and eventually the Des Moines River. The elevation for 13BN159 is listed as between 265 and 274 meters above sea level (870-900 ft.). The soil upon which the site sits has been mapped as Buckney fine sandy loam, 1 to 3 percent slopes (Andrews and Dideriksen 1981:30). this soil is typically formed under forest vegetation.

13BN159 was first recorded during the Saylorville Dam and Reservoir survey. At that time, both prehistoric artifacts (flakes), as well as numerous historic artifacts were loam, 1 to 3 percent slopes (Andrews and Dideriksen 1981:30). this soil is typically formed under forest vegetation.

13BN159 was first recorded during the Saylorville Dam and Reservoir survey. At that time, both prehistoric artifacts (flakes), as well as numerous historic artifacts were discovered. Fieldwork during the summer of 1997 consisted of a 100 percent surface survey of the area on two different occasions, as well as bucket auger testing at 15 meter intervals over the entire terrace. The first surface survey was conducted prior to procurement of the previously mentioned archaeological permit. As a result, artifacts were observed but not collected in accordance with federal law. During this observance survey, however a heavy concentration of lithic flaking material was noted in the extreme northern end of the terrace, adjacent to the drainage. Once a permit was obtained, subsequent surface survey in the fall of 1997 was largely unsuccessful due to the dry condition of the soil, and the recently harvested soybean detritus that littered the ground. One bucket auger unit did contain a flake at a depth of 20 to 30 centimeters below the surface. Further auger testing proved negative however. Because of the limited extent of artifacts recovered from this site, cultural affiliation is impossible to determine. Given the density of artifacts observed during the first surface survey, however, it is likely that future surface survey, under better conditions could lead to the discovery of diagnostic artifacts.

CHAPTER 6. SITE DISTRIBUTION

The archaeological sites presented in chapter four comprise a statistically viable representative sample. This sample, distributed across a variety of landforms, is the database from which the represenativeness of known sites in the region will be evaluated. This evaluation will include multiple levels of analysis. Initial evaluation will be based on the direct comparison of the distribution of sites across the landscape between the two samples. This type of evaluation provides an initial indication regarding the degree of represenativeness of the existing site database. The second level of evaluation involves Chi-square testing of the distribution of archaeological sites per landform as a more sophisticated means of testing the representativenes of existing data. Following statistical analysis of the data, conclusions will be drawn regarding the represenativeness of the distribution of known sites in the area, settlement patterns and other interpretations will be made, in addition, site distributions from other regions will be evaluated.

Benn (1985) lists the distribution of known archaeological sites in the Saylorville lake area (from Saylorville Dam to the town of Frasier). This distribution, composed of 419 archeological sites over seven landforms excludes any historic manifestations, as they do not fall within the scope of this project. Additionally, information regarding hillslopes was discarded. As a result of these modifications, some of the calculations in this study differ slightly from those reported by Benn (1985). The exclusion of historic sites and hillslopes will not overly bias any conclusions. However, the exclusion of these two categories of data means that no statements regarding the amount, or distribution of historic sites or any sites on hillslopes may be made. Justification for this exclusion has been explained elsewhere in this paper and will not be reiterated here.

Landforms designated as Fans comprise about 4 percent of the valley floor, and contain 23.6 percent of the prehistoric archaeological sites. Low Holocene Terraces in contrast, make up thirty percent of the valley and do not contain any prehistoric sites. Intermediate Terrace landforms comprise thirty-five percent of the total area, and contain 5.5 percent of all the relevant archaeological sites recorded in the valley. High Holocene Terraces make up roughly 31 percent of the Saylorville area, and contain 18.6 percent of the archaeological resources pertinent to this study. Information regarding the amount of land occupied by such landforms as Benches, Uplands, and Wisconsinan Terraces is not currently available (Benn 1985:101).

Previous surveys in the area (Benn 1985; Bettis and Benn 1985; Gradwohl and Osborn 1975, 1976; Osborn and Gradwohl 1981, 1982) did not differentiate between Uplands and Interfluves as the research conducted during the summer of 1997 did. Thus, in order to obtain a more accurate means of comparison, the results regarding the number of archaeological sites on Upland areas and Interfluves have been combined. This should not bias the results in any way, as Interfluves and Uplands occupy similar landscape positions within the greater Des Moines valley and are likely to have experienced similar exploitation by prehistoric peoples.

At the 4-H Center, and adjoining Federal property, archaeological sites were observed on five of the seven identified landforms, with the following distribution. Upland areas (including interfluves) make up 40.6 percent of the total project area, and contain 40 percent of the archaeological sites. Wisconsinan Bench features contained the next highest percentage of archaeological sites, 30 percent, while only constituting 1.6 percent of the total land area. Low Holocene Terraces make up 17.5 percent of the 4-H Center, and were not observed to contain any archaeological manifestations. Intermediate Holocene Terraces have been largely scoured from the valley walls in the project area, and as a result, they represent only a small fraction, .09

percent, of the total area. Despite this small percentage, Intermediate Terraces contained 10 percent of all archaeological sites found. High Holocene Terraces constitute 1.1 percent of the area and were observed to contain 20 percent of the archaeology. Table 5 shows the distribution of sites across landforms for both samples.

The distribution of sites observed by the present study differs slightly from the distribution observed by Benn (1985). The most marked differences regarding the distribution of sites between the two samples concerns Uplands, Benches and Fans. Uplands and Benches, based upon this preliminary analysis appear to be under-represented in the earlier surveys. The lower percentages of archaeological sites in these areas is likely a direct result of confinements placed upon the original surveys by the U.S. Army Corps of Engineers. Survey work conducted prior to the flooding of Saylorville lake predominantly involved only those areas below the 259 (MASL) (850 ft.) take line. As a result, many Upland and Bench landforms were not reached during any of the surveys conducted prior to the construction of the Saylorville Dam as they occur above 274(MASL) (900 ft.). While many of the upland areas were in cultivation, some of these Bench and Upland areas were overgrown with vegetation, making the surface identification of archaeological sites extremely difficult (Nepstad-

Table 5. The distribution of archaeological sites per landform unit.

Landform	Previous Investigations	1997 Fieldwork	1997 Known Sites
Upland	128	4	2
Wisconsinan Bench	151	3	0
Wisconsinan Terrace	34	0	0
High Holocene Terrace	60	2	2
Intermediate Holocene Terrace	36	1	1
Low Holocene Terrace	1	0	0
Fan	75	0	0

Thornberry and Tiffany 1996:4). A direct result of these factors is an apparent under-representation of archaeological sites on these landforms.

of

With respect to fans, two the three fans located within the 4-H center survey area are located in a side valley associated with Richardson Creek. It was determined, during survey of units selected from within the Richardson Creek drainage, that meandering along with periodic intense flooding have destroyed much of the archaeological material that may have been located at the lowest levels within this side valley. While neither of these two fans were randomly selected for survey, it is believed by the author that the amount of erosion and redeposition that has occurred within the Richardson Creek drainage has likely destroyed much of the archeological resources in this area. The entire surface of the valley floor is covered by a thick deposit of sand and stream cobbles, extending to the water table, indicating that the stream has continually changed direction over time and scoured much of the valley from wall to wall. Further, the only documented archaeological site within the drainage valley is 13BN343, a historical site, that is located on a small colluvial apron, above the level of Richardson Creek, a factor that is likely responsible for its preservation. The third fan in the area is recorded as the location of archaeological site 13BN103. As previously mentioned, 13BN103 has been destroyed by turbulent flow. As a result of the continued bio-turbation occurring near the Des Moines river and its tributaries, there were no observed archaeological sites on fans within the project area. Further, it is believed that in areas similar to 13BN103 in terms of channel dimension at flood stage, archaeological resources are likely to have suffered a similar fate.

While this type of comparison allows for some preliminary comparison of the two samples, it is not sufficient enough to definitively determine one way or another whether or not the assemblage of known sites in the region is representative. Further statistical analysis is indicated.

Chi-square Test

The Chi-square test of significance is a statistical method with which to evaluate whether or not a sample is independent of a given population (Drennan 1996; Freund and Wilson 1997). While the goal of this thesis is to test whether or not the population (previous investigations) is representative of a sample (1997 fieldwork), the Chi-square statistic still applies (Drennan 1996; Stephen C. Lensink and Frederick O. Lorenz personal communication, 1988).

The formula and calculations for this test are presented in Appendix B. In order to calculate the Chi-square statistic, the number of sites per landform was tabulated for the population. These data were obtained from Benn (1985). Next, the number of sites per landform was calculated for the sample. These data were obtained from fieldwork previously described. From these data, the expected frequencies were tabulated, and the test statistic was generated. This number was then compared to a Chi-square table, with 6 degrees if freedom at the .05 level. The results of Chi-square analysis yield a test statistic of 5.97. With 6 degrees of freedom at the .05 confidence level, the critical value or cut-off is

12.592 (Freund and Wilson 1997:639). This value indicates that at a ninety-five percent confidence level, the distribution of known archaeological sites in the Saylorville Reservoir is statiscally representative.

Because the distribution of sites in the Saylorville Lake area is considered a representative sample, the known sites may now be used for analysis of almost any archaeological question. The remainder of this chapter will be devoted to several different types of analysis based upon this new representative sample. This analysis will include: the distribution of sites by culture; a calculation of the number of sites per 1.6 square kilometer (1 square mile) as well as defining those areas that show potential for under-representation; estimates regarding the number of artifacts per 1.6 square kilometer as well as within the entire Saylorville Reservoir area; and finally the distribution of Middle and Late Woodland sites will be evaluated against other similar studies in order to determine any similarities or differences that may be present.

Sites Per Square Kilometer

Determining the number of archaeological resources per 1.6 kilometer^2 is a very useful tool in gaining a better understanding of the amount of sites in a given area, the settlement preferences of prehistoric groups, potential threats to those resources as well as how to attempt to mitigate those threats, and preserve a valuable finite resource.

The United States Army Corps of Engineers (USACE) currently manages roughly 11,055 hectares (27,319 acres) of land from the Saylorville Dam to Frasier (Nepstad-Thornberry and Tiffany 1996:1). This is the equivalent of roughly 68.7 kilometer^2 of real estate. In this area, there are 521 known archaeological sites (Benn 1985:101). This translates into approximately ten sites per 1.6 kilometer^2 that can be expected in any given segment of 1.6 kilometer^2.

In order to determine whether or not the distribution of sites in the region is reflective of this site distribution density, the area was divided into polygons, each with a surface area of 1.6 kilometer^2. Because the sample area is 68.7 kilometer^2, it was not possible to make one of the units exactly 1.6 kilometer^2. The units were then assigned a number between one and forty-three, and a twenty percent sample (9) of these units was chosen at random with the use of a table of random numbers. The study area was divided into 1.6 kilometer^2 sample units, and the random sample chosen on USGS maps that contained no information regarding the location of archaeological sites, in order to eliminate any potential bias in the sampling process. Once the nine sample units were selected, the number of sites in each unit was tabulated. Table 7 lists the units, and the number of sites in each unit. None of the selected units in the sample contained the expected amount of archaeological sites. Three of the units contained 9 sites, one contained a total of 17, while one unit contained only one site. On average, the nine sample units contained 7.5 sites, the range was 1 to 17 and the standard deviation was 4.82. This standard deviation indicates that 34 percent of the sample units should be expected to contain 13 or more archaeological sites. The implication of this with respect to the entire Saylorville area is that even though the sample is representative, an astounding number of archaeological sites may remain undiscovered. Two of the sample units contained one site, and two sites respectively, as further evidence in support of the conclusion that many sites remain unearthed in the Saylorville area.

While this indicates that additional sites in the area are probable, it does not guarantee that sites exist in these numbers everywhere. There are a myriad of factors that could explain this distribution, ranging from cultural values to environmental conditions. The fact that numerous sites are located in some areas and not in others, could be a factor of choice. Areas where certain resources were abundant such as tillable soils and large well-drained high terraces would certainly have been selected for over those areas that were less productive. Some examples are Noah Bottoms, and Boone Bottoms. These resources could range from soil type, proximity to lithic resources, topography, hydrology, the distribution of plant communities and wildlife or even simple human preference (Schermer and Tiffany 1985; Tiffany and Abbot 1982). Sites or areas that contained one or more of these desired attributes are likely to have been visited repeatedly throughout prehistory by numerous culture groups.

Of those areas that contained significantly fewer sites than expected, there are several possible explanations. First, these areas could be lacking in any of the above attributes to the point that they were deemed undesirable to prehistoric hunter gatherers (Schermer and Tiffany 1985; Tiffany and Abbot 1982). Given the extent of bio-turbation as seen in the area of the 4-H Center, erosion, turbulent flow, burial by alluvium or inundation could also explain the scarcity of sites in some areas. Finally, development during the historic period in the form of recreational areas, housing and the general urbanization that has occurred in the area, many of the sites that at one time were present, may have since been destroyed.

Despite these factors, it is clear that while a great many of the sites have been recorded, the potential exists for the discovery of many more archaeological sites in the area. If each sample unit were to contain the maximum number of sites as seen in the sample, the potential exists for a total of roughly 728 sites between the Saylorville Dam and Frasier alone within federally managed lands.

Settlement Patterns

Archaic

The settlement system of Archaic peoples in the Central Des Moines Valley is, as expected, largely contingent upon the water level in the Des Moines River. The majority of all Archaic sites (Figure 7), as classified by Benn (1985), are located either on Upland (21.1 %) or Bench (26.6%) landforms. The remainder of Archaic sites are distributed as follows: High Holocene Terrace 13.7 percent, Wisconsinan Terrace 8.3 percent, Fan 19.2 percent, Intermediate Terrace 3.7 percent, and Sidevalley 6.4 percent.

As Roper (1979) illustrates, choice of landform for site location is an important factor in prehistoric settlement patterns (Roper 1979:77). In order to determine whether or not the sample of Archaic sites in the Central Des Moines Valley is a portion of a population of sites in which there was no preference for locating sites in any particular environmental setting, the sample was subjected to a χ^2 test (Drennan 1996:200). This test was based upon the difference

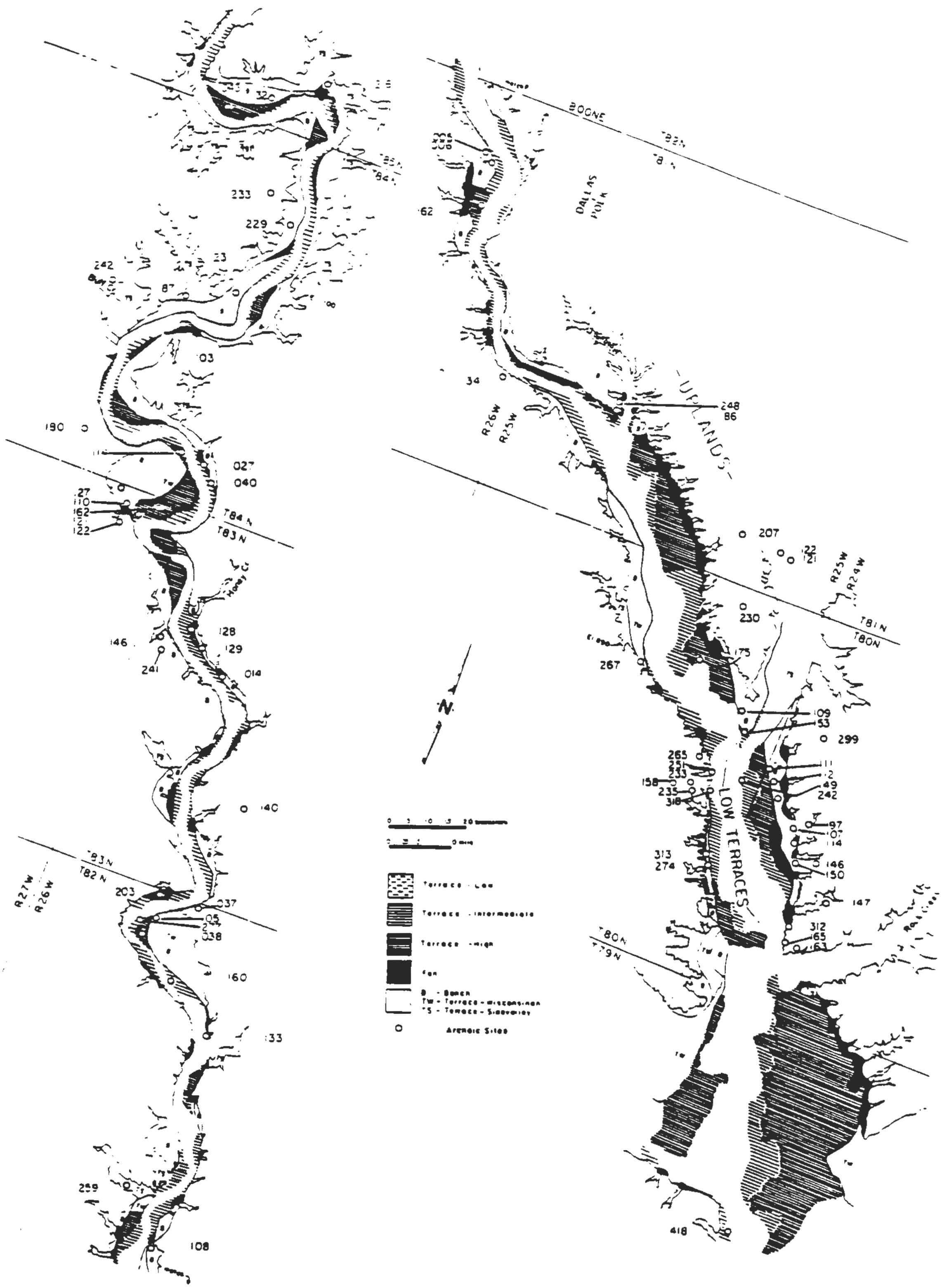


Figure 7. Distribution of Archaic sites. From Benn (1985:32).

between the observed frequency (number of Archaic sites per landform), and the expected frequency. The expected frequency was calculated on the assumption that if there was no landform preference in site location, sites should be distributed evenly over the landscape (Drennan 1996:200). Therefore, a given landform would be expected to contain a proportion of sites equal to the percentage of the total area that landform represents (Drennan 1996:200). Because previous investigations in the study area concentrated on those areas below the 254 meter (833 ft.) pool elevation, Upland and Bench landforms have been excluded. The χ^2 test for Archaic sites resulted in a χ^2 value of 231.85. The critical value at the .05 level, with 3 degrees of freedom for this test is 7.81 (Freund and Wilson 1997:639). Therefore, the null hypothesis that there is no preference for locating sites in any particular environmental setting is rejected.

Further analysis of the distribution of these sites indicates that Archaic sites are generally located adjacent to, or at the head of a drainage system. This is not surprising given that the Des Moines River during this time would have been a wide, unpredictable, rapidly moving volume of water. By locating along the drainages, Archaic groups were also closer to game animals in the Uplands and emerging forested areas of the valley.

Through time, towards the latter stages of the Archaic period, the sites tend to drift downward, from the Uplands and Benches, to the Wisconsinan Terraces, as well as the High Holocene Terraces and Fans. This shift in settlement is likely to be a direct result of downcutting of the Des Moines River. As the river channelized, and moved deeper into the valley, Archaic peoples followed in search of water and game.

Middle Woodland

Middle Woodland settlement exhibits a somewhat different distribution (Figure 8) than the earlier Archaic period, although Middle Woodland groups were still utilizing the Uplands (15.2%) and Benches (23%). The increased reliance on native plants and incipient agriculture during this time is evidenced in an increased percentage of sites located near the valley floor. Of all Middle Woodland sites, 24 percent are located on High Holocene Terraces, 3.2 percent on Intermediate Terraces, and 24 percent are located on Fans.

In order to ascertain whether or not Middle Woodland groups in the Central Des Moines Valley exhibit any landform preference with respect to site location, the same χ^2 test described above, was performed. The χ^2 test for Middle Woodland sites in the Saylorville Reservoir area resulted in a χ^2 value of 258.51. The critical value for this test at the

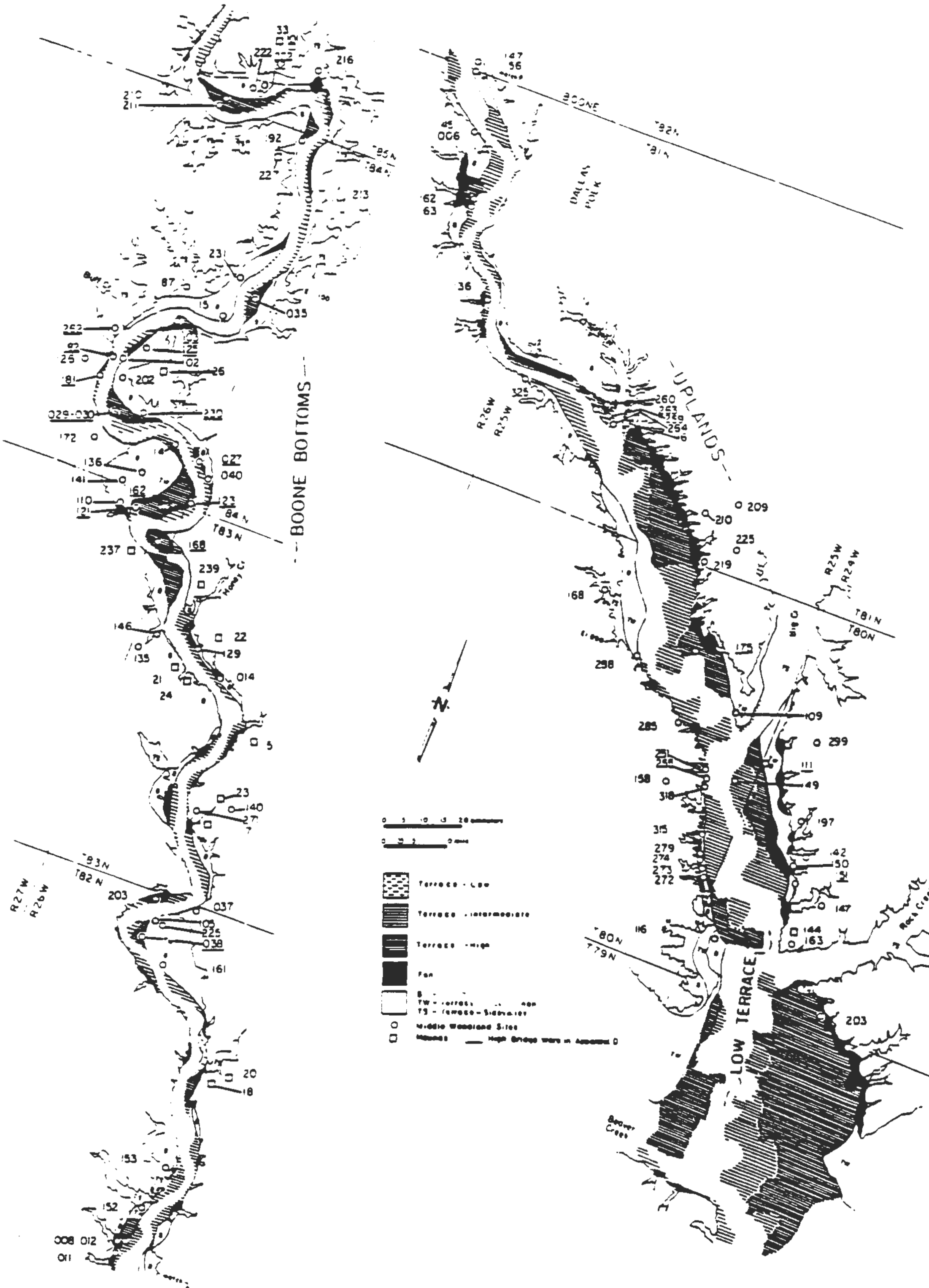


Figure 8. Distribution of Middle Woodland sites. From Benn (1985:42).

.05 level, with 3 degrees of freedom is 7.81 (Freund and Wilson 1997:639). Therefore, the null hypothesis that there is no preference for locating sites in any particular environmental setting is rejected.

Similar settlement pattern studies by Donna C. Roper (1974, 1975) concerning the distribution of Middle Woodland sites in the Sangamon River drainage of central Illinois, have reached conclusions that warrant evaluation with respect to the Central Des Moines Valley. Roper (1974), Munson and Harn (1971), and Farnsworth (1973), have all indicated that Middle Woodland sites in the Sangamon, American Bottom and Macoupin Valley's tend to be located in one of two distinct areas within the Valley. The majority of sites observed in these reports were located at the base of a bluff, near the confluence of tributaries or drainages with the principal river of the region. Sites not conforming to this model were located directly along the main river itself rather than along one of its tributaries. In these instances, the continued meandering of the Sangamon river had removed any linear terraces resulting in the sites being located adjacent to the main channel rather than a tributary confluence (Roper 1974:9).

In order to gauge the degree of correlation between Middle Woodland sites in the Des Moines Valley, and Middle

Woodland sites in other regions of the midwest, the Des Moines Valley data was evaluated against this hypothesis. This was accomplished by recording the location of each site known to have produced artifacts diagnostic of the Middle Woodland period, and evaluating the position of each site with respect to: proximity to confluences with side valley drainages as well as proximity to the Des Moines River. Of the 79 Middle Woodland sites (excluding mounds) evaluated in the Central Des Moines Valley 63.3 percent were located near the base of a bluff, either immediately adjacent, or less than 100m from a confluence of a drainage and the Des Moines River. The remaining 36.7 percent of Middle Woodland sites, not located near a confluence were then evaluated to see whether or not they conformed to Roper's second conclusion. Of these 29 sites, roughly 66 percent were located on segments of bottom land that were immediately adjacent to the Des Moines River. The remaining 34 percent of sites not adjacent to a confluence were located on Bench or Upland features higher up on the valley wall.

These results indicate that the distribution of Middle Woodland sites within the Central Des Moines Valley correlates highly with the results of similar studies from other regions, namely: Roper (1974), Munson and Harn (1971) and Farnsworth (1973). It should be noted, that while the results of these surveys are largely similar, the previously mentioned studies are not based upon representative samples. This factor likely accounts for some of the disparity between the samples in terms of the number of sites observed on Bench or Upland landforms. Because the Central Des Moines Valley is a represenative sample, other systems of comparable environment and resources, should exhibit similar distributions.

Other studies regarding the settlement systems of Middle Woodland period groups have defined a relationship between the location of mounds and mound groups and habitation sites (Asch et al. 1979; Bareis and Porter 1984; Barth 1982; Green 1993; Styles 1979). In general, permanent habitation or village sites have been shown to be predominantly located on terraces within large river valleys in association with mound groupings situated above the habitation on an Upland landform. On the Mississippi River, these mound groups tend to be large clusters of conical Middle Woodland, Late Woodland linear and effigy mounds that overlook large habitation sites.

Comparison was made between the relationship of habitation sites and mounds within the Saylorville Reservoir area and the Mississippi Valley in northeastern Iowa.

There are currently 19 known mounds or mound groups within the Saylorville Reservoir area. Four of these mound or mound group sites were not considered as part of this evaluation as they are not believed to be prehistoric in origin. Most of these suspect mounds are closely associated with modern gravel quarry operations, and are not believed to be Woodland period burial mounds.

The remaining 15 mounds or mound groups were plotted, and a site records check conducted to determine whether or not there were any large habitation sites associated with them. If the distribution of Middle Woodland sites in the Central Des Moines Valley is similar to the distribution seen in the Mississippi Valley of northeastern Iowa (Green 1993)and central Illinois (Styles 1979) mound and habitation sites should be expected to show a high degree of correlation. Of the fifteen sites recorded as either mound groups or mounds, 80 percent were located on bluffs or Upland areas immediately above at least one site designated as Woodland. Several of these mound groups: 13BN239, 13BN29, 13BN33 were associated with three Woodland period sites, while 13BN101 overlooks five sites. Of these mound sites, one potential anomaly is the Middle Woodland Boone Mound (13BN29) which was located on a High Terrace within the boundaries of the Gracie Paulson village site (13BN30). The Boone Mound was the only mound observed within the project area that was not located in an Upland area. One of these mound groups, 13BN17 located on the 4-H Center grounds has only one site associated with it. This site is the previously described 13BN133, that has since been destroyed by turbulent flow. The three remaining mounds and mound groups including a large cluster of seven mounds designated 13BN239 did not have any Middle Woodland period habitation sites associated with them. Site 13BN239 is associated with 13BN189, but this site is a small lithic scatter, and it was not deemed significant enough to be classified as a habitation site. 13BN18 is not within one mile of any site located on a river terrace except for 13BN255 which is an historic site. Conversely, some known large habitation sites in the area such as the Hubby site (13BN38), and Logansport (13BN103) are not associated with any known mounds. In both of these instances modern land use practices, gravel quarrying and coal mining respectively, have dramatically altered the upland areas around both of these sites. It is entirely possible that there once were mounds associated with these large sites, but they have since been destroyed. Further, as 13BN133 illustrates, some sites on the lower terraces of the Des Moines Valley have been destroyed- a factor that potentially explains why some mound groups have no associated habitation sites.

While the distribution of mound sites and habitation sites in the Central Des Moines Valley closely resembles that of the Mississippi Valley in northeastern Iowa, some differences are apparent. Overall, the habitation sites associated with mounds and mound groups in the Central Des Moines Valley are smaller to those habitation sites associated with large mound groups in the Mississippi and Illinois Valleys. There does not seem to be evidence for the large aggregation of people as seen to the east. Further, mound groups are much smaller, often containing only one or two conical mounds. It is possible that this distribution of mounds and small habitation sites is the work of a small population that moved up and down the valley over a period of generations, burying important individuals in mounds in the vicinity of a then active habitation site. This apparent discrepancy could be the result of either cultural factors, or local environmental conditions with respect to the availabilty of resources.

Despite some incongruities, Middle Woodland settlement systems in the Central Des Moines Valley correlate highly with the settlement systems seen for the same time period in other regions.

Late Woodland

Archaeological sites associated with the Late Woodland period have the following distribution in the Saylorville Reservoir area (Figure 9). Of the 109 sites identified as Late Woodland by Benn (1985), the highest percentage of sites are

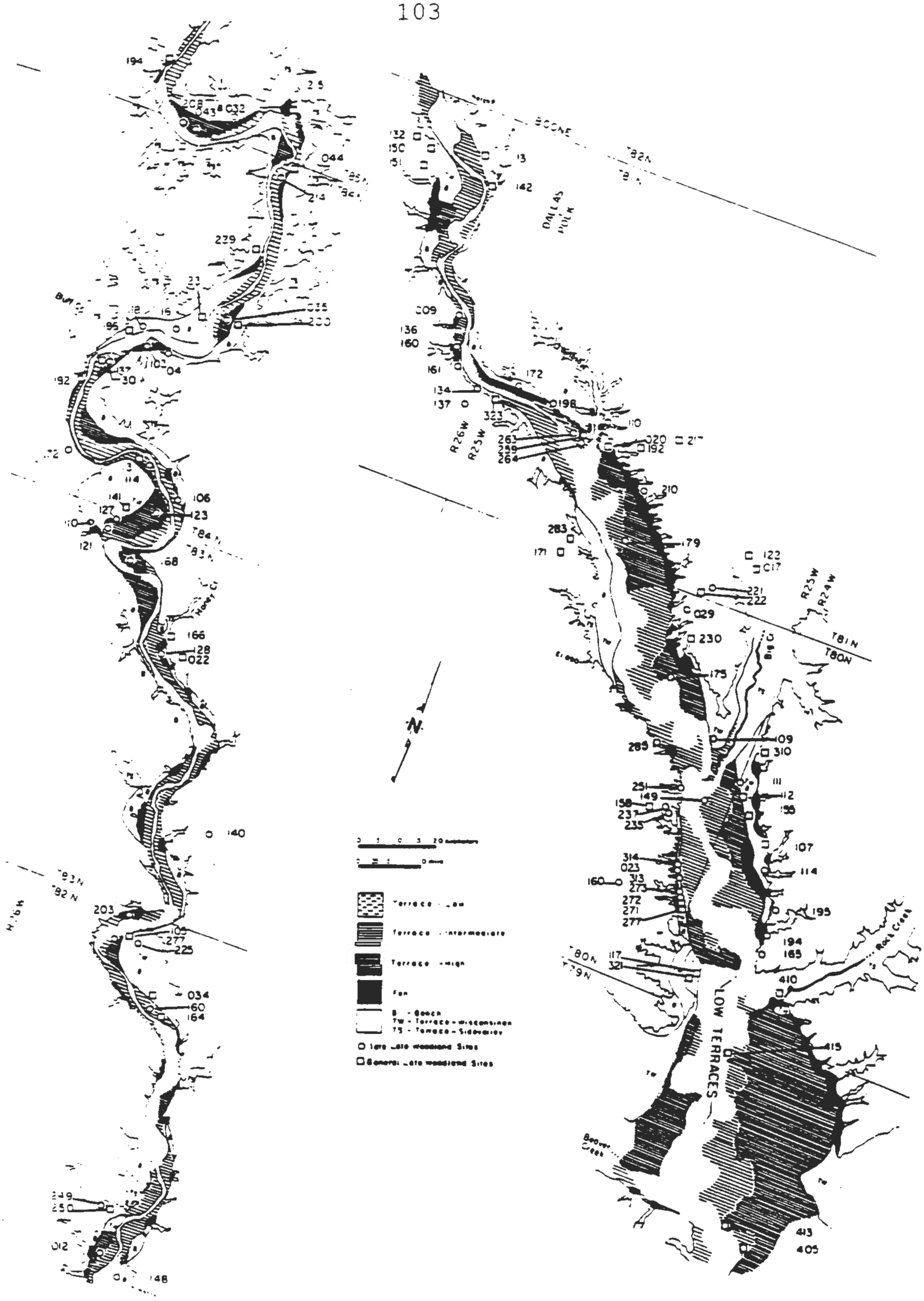


Figure 9. Distribution of Late Woodland sites. From Benn (1985:54).

found on Fans (30.2 percent). The next highest percentage of sites are found on Benches (21.1 percent). High Holocene Terraces contain 20.1 percent of all Late Woodland sites. 13.7 percent of Late Woodland sites are located on Upland landforms. Wisconsinan Terraces contain 8.3 percent of the sites, while Intermediate Terraces are recorded as containing 5.5 percent of sites. A minuscule .9 percent of Late Woodland sites are located in sidevalleys.

The distribution of Late Woodland sites in the Central Des Moines Valley was tested using the previously described χ^2 test. This test resulted in a χ^2 value of 436.8. The critical value for this test at the .05 level, with 3 degrees of freedom is 7.81. Therefore, the null hypothesis that there is no preference for locating sites in any particular environmental setting is rejected.

Late Woodland sites are commonly believed to have a different settlement distribution than those sites associated with the earlier Middle Woodland period. Because of this, the distribution of Late Woodland sites with respect to proximity to a confluence of a tributary with the Des Moines River will be evaluated. Only 41 percent of the sites classified as Late Woodland were located adjacent to a confluence of a stream or drainage with the Des Moines River, compared to the 63 percent of Middle Woodland sites located in the same landscape position. 38 percent of Late Woodland sites were located in the uplands at the head of a drainage or somewhere along a drainage a considerable distance from the Des Moines River. This figure contrasts sharply with the 12 percent of Middle Woodland sites that were located away from the Des Moines River. 21 percent of Late Woodland sites are found deep in the valley on the lowest terraces, similar to the 24 percent of Middle Woodland sites occupying the same geographical position. χ^2 analysis indicates that this shift in site distribution is not significant, at the .05 level, to reject the null hypothesis that Late Woodland settlement is independent of Middle Woodland settlement. Previous studies (Asch et al. 1979; Bareis and Porter 1984; Barth 1982; Conrad 1981; Esarey 1982; Green 1976; Kuttruff 1974; Roper 1979; Schermer and Tiffany 1985; Warren 1982; Wilson 1961; Winters 1967;), have demonstrated Late Woodland site abundance on bluff tops and in uplands near main valleys, whereas Middle Woodland sites tend to be located on terraces and floodplains near major rivers (Green 1993:201). Two explanations may account for the disparity between Middle and Late Woodland site distribution in the Central Des Moines Valley, and the distribution of sites from the same period in other regions. First, it is possible that environmental factors causing settlement systems in other regions to become oriented towards upland areas, and away from major stream terraces, were not acting upon groups within the Central Des Moines Valley. A second hypothesis is that Late Woodland groups within the Central Des Moines Valley were oriented primarily towards upland areas, yet this shift is not represented archaeologically because most of the research in the study area has focused on areas below 254 meters above sea level (833 ft.).

Great Oasis

Sites positively identified as belonging to the Great Oasis aspect are very few in number within the Saylorville Reservoir area (Figure 10). There are only 22 such sites in the entire area, with several other areas exhibiting points, but not confirmed sites. Great Oasis sites in this area are predominantly located on High Holocene Terraces (54.5%), that are adjacent to the main channel of the Des Moines River. The remainder of Great Oasis sites are distributed on Intermediate Terraces 18 percent, Wisconsinan Terraces such as Meehan-Schell 9 percent, and an additional 18 percent occur on Bench landforms.

The Great Oasis sites in the project area show a unique distribution that warrants further evaluation in future research. 45.4 percent of all the confirmed sites are clustered within an eleven kilometer stretch of the Des Moines

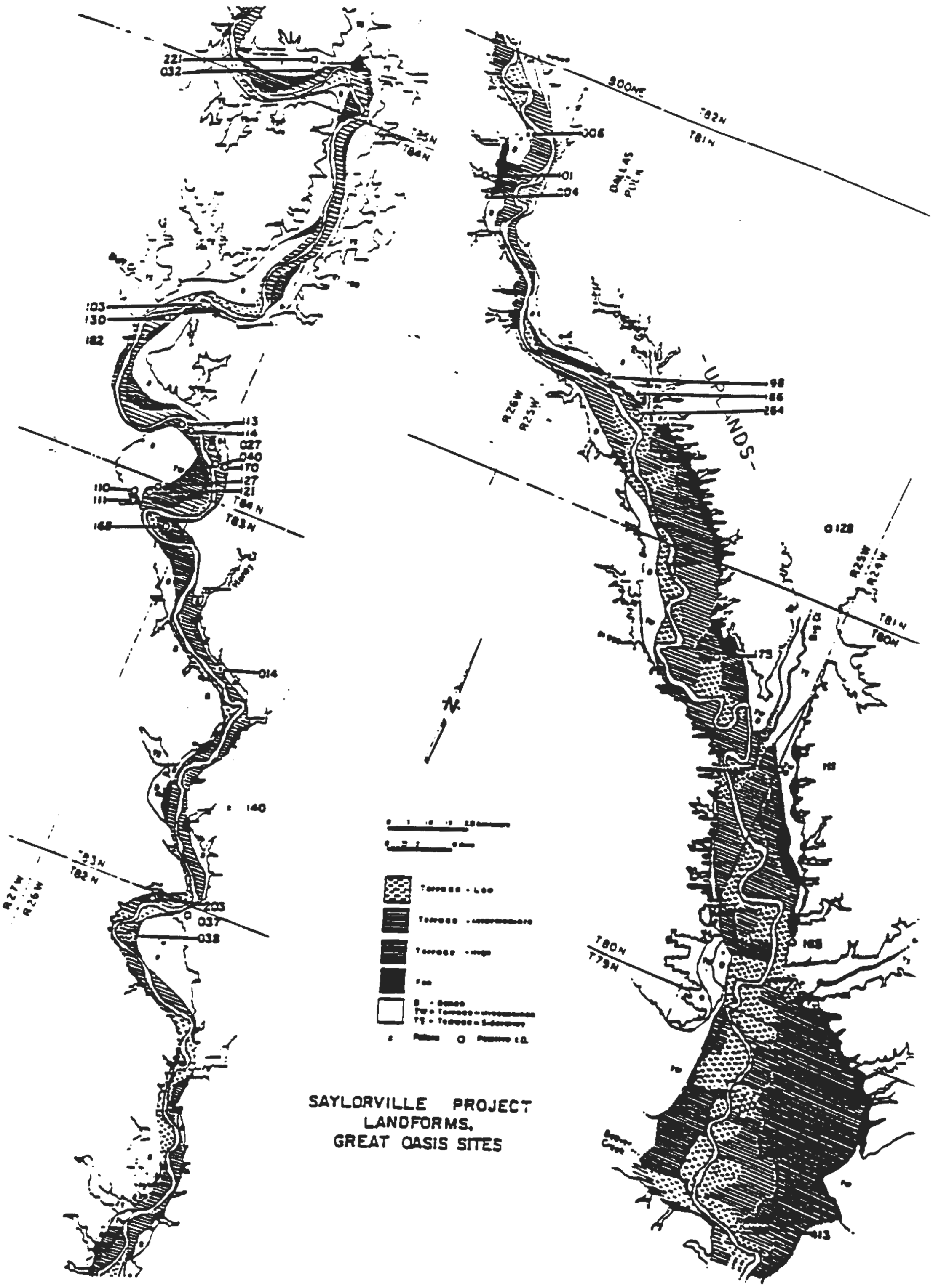


Figure 10. Distribution of Great Oasis sites. From Benn (1985:55).

River, in and around a large Wisconsinan Terrace feature that is located just south and west of the City of Boone. The remainder of Great Oasis sites are scattered up and down the valley to the north at such sites as Logansport (13BN103), as well as to the south Hubby site (13BN38).

While the number of hypothesis and tests that may be generated and conducted with this now representative data is seemingly endless, five have been presented for the purposes of this thesis. The fact that the assemblage of archaeological sites in the Saylorville Reservoir area is representative is highly significant with respect to future research as well as the potential for understanding the prehistory and prehistoric cultures of the Central Des Moines Valley.

CHAPTER 7. ARCVIEW GIS PREDICTIVE MODELING

Computer based predictive modeling is a method that is relatively new to archaeology. Geographic Information Systems (GIS), has traditionally been used by other disciplines for such projects as floodplain land uses (Anderson 1996), Wildlife management (Bednarz 1979; Pereira and Itami 1991), as well as landscape management (Anderson 1980).

The potential of GIS for generating archaeological predictive models was not fully recognized until studies by Kvamme (1990, 1992) demonstrated its effectiveness. Since Kvamme's work, others have utilized GIS as a tool to predict archaeological site locations including: Anderson (1996), Krist (1994), and Carmichael (1990).

Arcview GIS involves the use of logistical multiple linear regression (logit modeling) techniques in order to identify regions, or areas within a region that have a high potential for archaeological sites (Anderson 1996:1). GIS predictive models summarize the geographic characteristics of known archaeological sites and use this information to locate areas with similar characteristics (Anderson 1996:7). By selecting a random sample of known non-sites in a given area, the results of the GIS model may be tested in order to determine the percentage of improvement over chance (Anderson 1996:6).

The present study, as it was based upon a statistically representative sample, provided an opportunity to evaluate the effectiveness of archaeological predictive models generated by GIS. Because the location of archaeological sites was known, the model generated by GIS could be tested to determine whether or not those areas with high potential for archaeological sites actually contained sites. Additionally, GIS modeling provides more detail than predictive models generated upon archaeological survey alone.

Several procedures are necessary in order to generate a predictive model with Arcview GIS. In order to build a database from which to generate a predictive model, soil maps must be scanned in and normalized with the use of a Geotransformer program to eliminate the distortion in an aerial photograph. The soil map must then be digitized so that the program will recognize the mosaic of soils represented. Spatial Analyst was also utilized to generate buffers and distances, while AutoCad Reader and Map Calculator were also necessary components.

Variables deemed as important determinants were then selected, and entered into the GIS program. For the purposes of this model, distance to water, landform position and native vegetation were selected (Craig 1989; Schermer and Tiffany 1985). These variables were deemed appropriate as indicators of archaeological sites for several reasons. Proximity to water has been demonstrated to be a crucial factor in prehistoric locational behavior (Tiffany and Abbott 1982; Tiffany 1982; Schermer and Tiffany 1985). Landform position as well as native vegetation are also important in that they reflect the amount of bio-diversity present in a given area. As Tiffany and Abbot (1982), Tiffany (1982) and Schermer and Tiffany (1985) have shown, prehistoric groups commonly located themselves in areas that are rich a variety of resources. Because of these factors, the variables of distance to water, landform position, and native vegetation should return a fairly accurate model.

These variables were then assigned a number from 1 to 5 based on their perceived value with respect to prehistoric locational behavior, with 1 being low potential and 5 representing high potential. While it will never be possible to fully understand why prehistoric groups located themselves in some areas as opposed to others, some fairly accurate estimates may be made. Terraces were given a rating of 5, alluvial Fans were rated 4, upland were given a rating of 3, active floodplains (Low Holocene Terrace) were rated 2, while rivers and hillslopes were rated 1. Proximity to water was delineated by creating a buffer of 100m around all available water sources in the area. Those areas within the 100m radius were rated 5, with the number decreasing by 1 for every 100m further away from an available water source. Prairie and mixed prairie-forest areas were rated the highest in terms of native vegetation.

Arcview GIS does not differentiate between High, Intermediate or Low Terraces. Because of this limitation to the program, all terraces must be lumped together for purposes of modeling except for the Low Holocene Terrace, which is defined as the active floodplain. While this is not an ideal situation, it is not believed that the sample will be overly biased, as terraces generally contain similar amounts of bio-diversity, as opposed to uplands, benches or floodplain landforms.

Based upon the variables described above, a map of the project area was created using Arcview GIS showing areas with varying degrees of potential for archaeological sites (Figure 11). Areas with a rating of 15 were deemed highest potential, while areas that had a rating of 3 were deemed lowest potential.

Once the model had been generated, the locations of all known sites in the area were digitized into the program, so that the model could be compared to a random sample of non-sites in the area. These models were then evaluated using measures of mean, significance, cumulative percentage

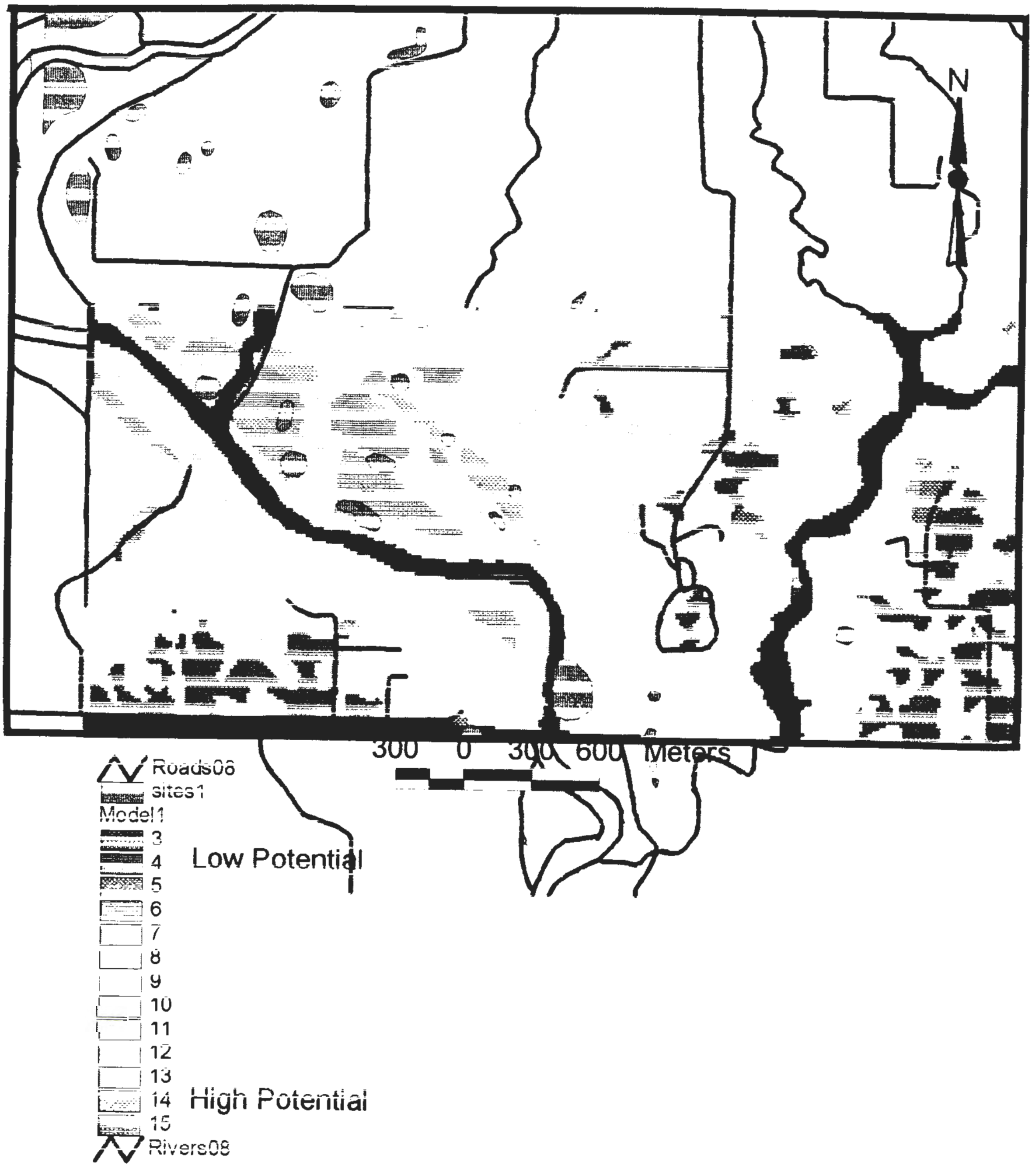


Figure 11. Arcview GIS distribution of potential for archaeological sites at the 4-H Center, Boone County, Iowa.

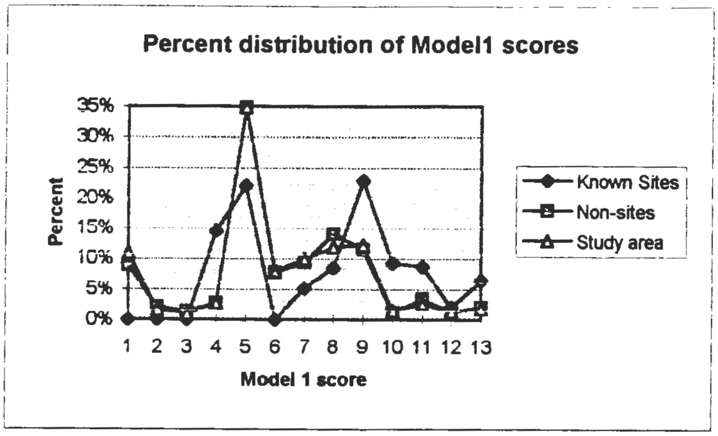
percentage correctly classified, and improvement over chance. This aspect of the model is particularly informative in that the effectiveness of the predictive model can be directly compared against archaeological survey techniques. The results of these calculations are presented in Table 6. As Table 6 indicates, the model generated by Arcview GIS returned a 30 percent improvement over chance, demonstrating its effectiveness as a tool in archaeological predictive modeling, and the importance of the variables in terms of site location, from which the model was derived. According to the GIS predictive model, those areas that are within 100m of potable water, located on terrace landforms, and that were not densely forested have the highest probability for archaeological sites. Several of these known sites are clustered in or immediately adjacent to the high probability area, supporting the model.

From this GIS model, and the distribution of known archaeological sites in the Central Des Moines Valley, which has been demonstrated to be representative, predictive models may be generated with respect to archaeological site location. As this model, and other similar research (Tiffany and Abbott 1982), demonstrate, archaeological resources are inherently tied to the distribution of environmental resources,

Table 6. Logit modeling of known sites versus known non-sites.

Score	Known Sites	Non-sites	Study area
3	0	42	4245
4	0	10	613
5	0	6	372
6	70	13	1050
7	106	163	13580
8	0	36	3076
9	25	44	3847
10	41	64	4656
11	110	54	4767
12	45	5	548
13	42	16	1018
14	10	6	525
15	31	10	717
Totals	480	469	39014

Score	Known Sites	Non-sites	Study area
3	0%	8.90%	10.90%
4	0%	2%	1.60%
5	0%	1.30%	1%
6	14.50%	2.70%	2.70%
7	22%	34.80%	34.80%
8	0%	7.70%	7.90%
9	5.20%	9.40%	9.90%
10	8.50%	14.10%	11.90%
11	22.90%	11.50%	12.20%
12	9.30%	1.10%	1.40%
13	8.70%	3.30%	2.60%
14	2.00%	1.20%	1.30%
15	6.45%	2%	1.80%
Totals	100%	100.00%	100.00%



Score	Known Sites	Non-sites	Study area
3	0%	8.90%	10.90%
4	0%	10.90%	12.50%
5	0%	12.20%	13.50%
6	14.50%	14.90%	16.20%
7	37.30%	49.70%	51.00%
8	37.30%	57.40%	58.90%
9	42.50%	66.80%	68.80%
10	51%	80.90%	80.70%
11	73.90%	92.40%	92.90%
12	83.20%	93.50%	94.30%
13	91.90%	96.80%	96.90%
14	93.90%	98.00%	98.20%
15	100%	100%	100%
Totals	100%	100%	100%

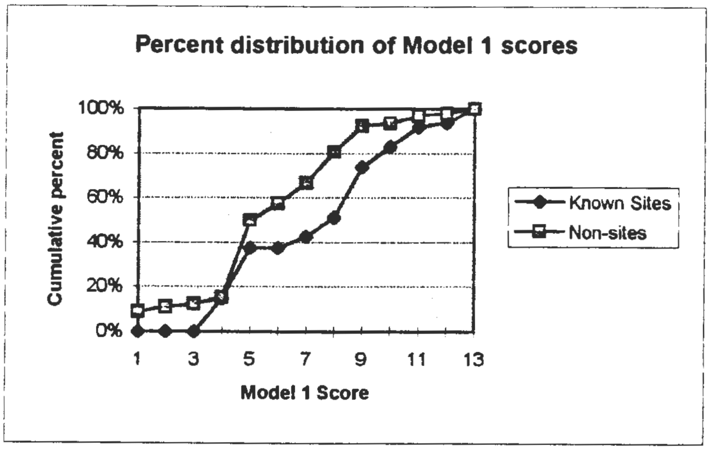
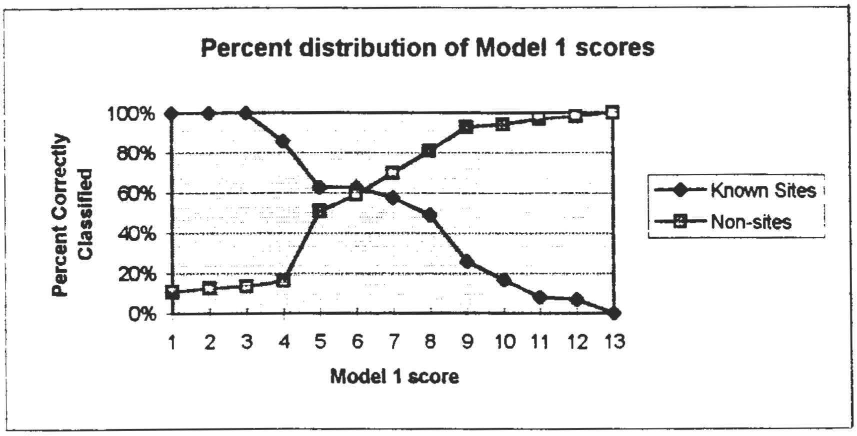
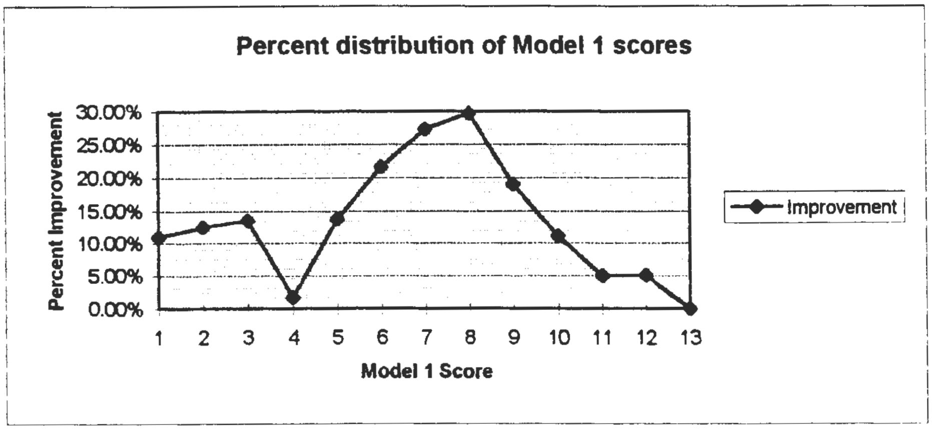


Table 6. (continued)

Score	Known Sites	Non-sites
3	100%	10.90%
4	100%	12.50%
5	100%	13.50%
6	85.50%	16.20%
7	62.70%	51%
8	62.70%	58.90%
9	57.50%	69.80%
10	49%	80.70%
11	26.10%	92.90%
12	16.80%	94.30%
13	8.10%	96.90%
14	6.90%	98.20%
15	0.00%	100%
Totals		



Score	Improvement
3	10.90%
4	12.50%
5	13.50%
6	1.70%
7	13.70%
8	21.60%
9	27.30%
10	30%
11	19.00%
12	11%
13	5.00%
14	5.10%
15	0.00%



especially proximity to water and plant resources. Comparison with the available archaeological data that was presented in Chapter 6 for the project area corroborates this assumption. Further, based upon the representative distribution of sites in the Saylorville Reservoir area, the following distribution of sites per landform should be expected in other areas of the valley, assuming all environmental variables to be equal. Low Terraces should be expected to contain the least amount of archaeological sites, .001 sites per .4 hectare (1 acre). Intermediate Terraces yield the next lowest expectation ratio: .01 sites per .4 hectare, followed closely by the expectation of .016 sites per .4 hectare for Upland areas. Benches can be expected to contain .08 sites per acre. High Terraces should exhibit .36 sites per hectare. Fans were observed to have the highest sites per hectare expectancy of .7 sites per .4 hectare.

While predictive models can be useful aids in structuring a research design, or when considering an area for a cultural resource management survey, they should not replace sampling, or be treated as 100 percent accurate representations of reality. There are too many factors that cannot be controlled affecting the preservation and location of archaeological sites. However, as much of the Central Des Moines Valley has undergone roughly similar amounts and types of flooding, erosion, development and exhibits relatively homogenous climate, flora and fauna, the predictive model presented here should be a fairly accurate estimation of the amounts and distribution of archaeological resources since the sample is represenative statistically.

CHAPTER 8. SUMMARY AND CONCLUSIONS

This study has been based upon information derived from a statistically represenative sampling of the Iowa 4-H Center and adjoining federal property managed by the United States Army Corps of Engineers, Rock Island District. The data presented was obtained from fieldwork conducted by the author and Iowa State University students enrolled in Anthropology 429/529. Additional fieldwork was conducted by Iowa State Unversity students enrolled in Anthropology 308. This fieldwork was conducted during the summer and fall of 1997.

The general geomorphological setting, prehistoric cultural sequence, methods utilized, as well as a description of newly recorded archaeological sites was discussed in the first half of this study. These sections provided the necessary data and background from which the main focus of this report could proceed.

The central goal of this study has been the development of predictive models of settlement patterns in the Central Des Moines valley specifically as they pertain to the Middle and Late Woodland periods. In order to accomplish this goal, a statistically viable represenative archaeological survey was needed. A secondary goal of this project was to quantitatively evaluate previous archeological investigations within the Saylorville Reservoir Historic Preservation

District in order to ascertain whether or not these surveys were also represenative. A database from which to quantify the distribution of archeological sites with respect to landform, as well as predictive models for site location within the Central Des Moines Valley were also developed.

Based upon the information collected during the 1997 field season, a model of predicted site distribution was created. Previous research in the area from the Saylorville Dam to the City of Frasier, was then evaluated with the use of Chi-square analysis. This previous research was determined to be a representative sample of archaeological resources. This "new" database was then analyzed with respect to the distribution of archaeological sites, particularly those sites representing the Middle and Late Woodland period. The distribution of these sites was compared to similar research from other regions, and shown to be highly correlated with the site distributions from these areas. Additionally, the Saylorville Reservoir area was evaluated in order to generate an expectation of the number of archaeological sites per 1.6 kilometer^2. A random sample of the project area was then drawn, to determine: whether or not the expected amount of sites were observed, and whether or not this distribution was due to either underepresentation, lost sites, or culture preference. Both the predictive modeling and Chi-square testing presented here suggest the latter. Finally the database was used to construct a predictive model of site location that can be applied to any transect of the Central Des Moines Valley.

This research has enhanced the amount of available knowledge regarding the nature, distribution and extent of prehistoric occupations in the Central Des Moines Valley. This research has addtionally opened new avenues for future research in the project area and adjacent regions by creating a statistically representative database from which this research may be based. An example of which is the apparent clustering of Great Oasis sites observed within the Central Des Moines Valley.

APPENDIX A. TURBULENT FLOW

Rivers, as dynamic systems of nature, are constantly changing and affecting the surrounding environment. While the effects of turbulence in river systems have been known since before the renaissance (Nezu and Nakagawa 1993), interest and the amount of available evidence regarding sediment transport and river flow have increased in recent decades (Gregory 1977:3). Work in this field has included among others: the effects of reservoir construction (Blench 1957; Gregory and Park 1974; Komura and Simmons 1967; Meade and Trimble 1974), river morphology and conservation (Coates 1970, 1976; Morisawa 1973; Schumm 1972), and paleohydrology (Schumm 1969,1971). Applications for this research have included channel degradation assessments for maritime shipping and formulas of sediment transport for civil engineering construction projects. Flow velocity and sediment transport activity directly affect the stability of archaeological sites, yet this phenomenon is largely unknown among archaeologists.

There are two main types of channel flow that have an impact on sediment and the archaeological resources contained within them. These two types are plane, or steady laminar flow and turbulent channel flow (Goncharov 1964:2-3; Brown 1997: 320). In both of these models, the character and behavior of the river system are ultimately determined by climatic variables operating over the river drainage basin, particularly the precipitation, temperature and a complex of physiographic and geological variables (Allen 1977:16-17). Most important among these physiographic and geological variables are: the local elevation and the lithology, geological structure and tectonic status of the basin respectively. Together, these variables determine the basin-wide hydrological regime that will prevail (Allen 1977:17).

Planar or steady flow as it will hereafter be referred, is the normal state of water in a given riverine system (Rouse 1938; Chow 1959; Sellin 1969). A plane laminar flow is considered to be open, that is, the only retarding surface is the rigid channel bed. The force behind such a flow is the component of the force of gravity in the direction of motion (Goncharov 1964: 2). The behavior of water in these channel beds is controlled by viscosity and inertia because these forces control the resistance of the fluid to acceleration caused by slope. The inertial resistance of water is controlled by mass density, and the ratio of inertial to viscous forces is described by the dimensionless Reynold's number:

$$Re=VR/v$$

where V is velocity (m^2s^{-1}), R is hydraulic radius of flow (m) and v is kinematic viscosity (m^2s^{-1}) (Brown 1997:320). When this Reynold's number is low, viscous forces prevail and the flow of the river or stream is said to be laminar. Laminar flow can be conceptualized as parallel layers of water shearing over one another at the same velocity (Brown 1997:320). In these various parallel bands, there is no turbulence, and water does not have enough energy or velocity to begin the process of sediment transport on a massive scale.

The second major type of river flow of concern here is turbulent flow. Turbulent flow is generated out of the normal laminar flow. When the velocity of the flow increases, the inertial forces also increase, and above a critical Re number fluid motion becomes turbulent (Brown 1997:320). The velocity of flow may be increased by several factors, narrowing of the channel, and an increase in the volume of water moving through the channel among them. As a consequence of this turbulence, the flow assumes a different, more complicated, eddy structure in which a mass-exchange resistance is produced where a mixing of large fluid masses moving at different velocities in different directions occurs (Figure A1)(Goncharov 1964:4). A unique aspect of turbulent flow, and one of central importance to this report, is the nature of the flow on floodplains and at times when flow discharge exceeds bankfull

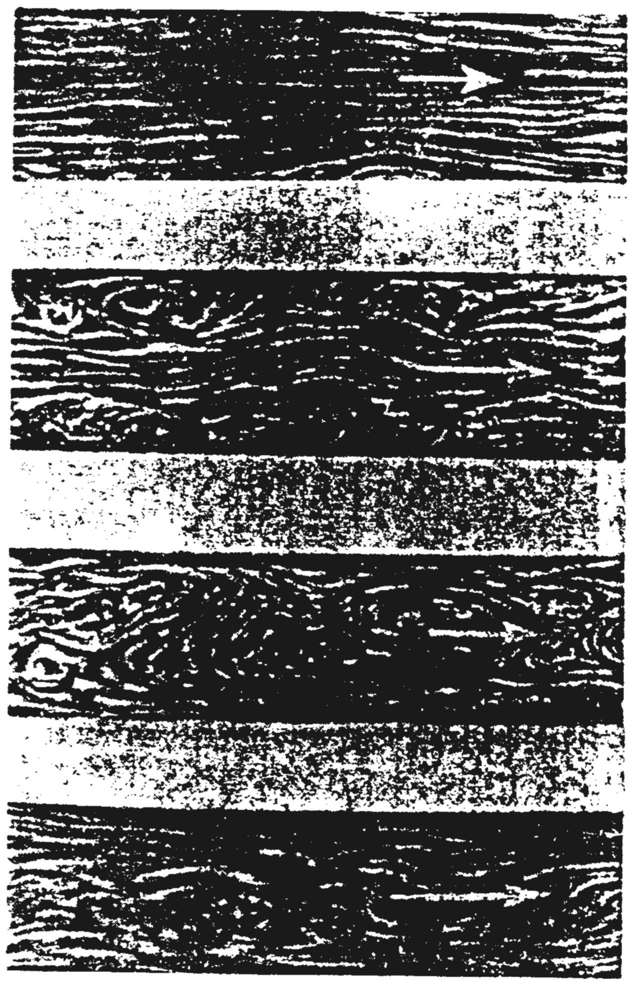


Figure A1. Secondary flow pattern in the interior of a turbulent flow. From Goncharov (1961:5).

(Allen 1977:21). Numerous studies have demonstrated that there exists significant interaction between the flow in the drowned channel and that on the bordering floodplain lands (Sellin 1964; Yen and Overton 1973; Ghosh and Kar 1975; Myers and Elsawy 1975). Velocities and shear stresses are greater on the floodplain, while the flow in the drowned-out channel is less vigorous than it would have been without the floodplain (Allen 1977:21). These vortices, which are seen to arise between the floodplain and the inundated channel, represent an important lateral flow of momentum and are significant in dispersing sediment away from the line of the drowned out channel (Allen 1977:21). A second aspect of turbulent flow that bears directly on this report is the length and duration of a turbulent flow. If a turbulent vortex were to extend the length of a given riverine system, the affects on the archaeological resources would be devastating. It has already been stated however that a turbulent flow requires an increase in velocity that may be caused by an increase in water volume, as in a flood, or by a narrowing of the channel width. As a result of these factors, Thornes (1977) has shown that a hierarchy of flow types is created where the effect of a particular flow of a given frequency and magnitude has spatially varying effects. In other words, in any given stretch of a river system, there would exist areas where turbulent flow were the prevailing regime, and other areas where plane laminar flow was dominant.

A final characteristic of turbulent flow deals with the nature of the sediment that is redeposited after a given mass turbation event. Work on sediment deposition in turbulent currents (Bagnold 1954; Middleton 1967; Walker 1977, 1978; Lowe 1982), has shown that turbidity currents mostly produce sharp-based beds, which generally fine upward, and within which there are successions of sedimentary structures suggesting waning flow conditions through time. (Martinsen 1994: 134).

APPENDIX B. CHI-SQUARE TEST

Computation for Chi Square statistic.

H_o: Sample 1 is independent of sample 2.

H_a: Sample 1 is not independent of sample 2

Landform	Population Observed	Population Expected	Sample Observed	Sample Expected	Total
High H. Terrace	60	60.5	2	1.5	62
Intermediate H. Terrace	36	36.1	1	.88	37
Low H. Terrace	1	.98	0	.02	1
Upland	128	128.8	4	3.1	132
Bench	151	150.3	3	3.7	154
Wisconsinan Terrace	34	33.1	0	.8	34
Total	410		10		420

.004+ .0003+ .0004+ .005+ .003+ .024+ .167+ .016+ .02+ .26+ .132+ .8= 1.4317

With 5 degrees of freedom, at the .o5 level, the critical value= 11.2.

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