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Change and Continuity: Euro-American and Native American Settlement Patterns in the St. Joseph River Valley

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CHANGE AND CONTINUITY: EURO-AMERICAN AND NATIVE AMERICAN
SETTLEMENT PATTERNS IN THE ST. JOSEPH RIVER VALLEY

by

Allison M. Kohley

A thesis submitted to the Graduate College
in partial fulfillment of the requirements
for the degree of Master of Arts
Department of Geography
Western Michigan University
June 2013

Thesis Committee:
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Gregory Veeck, Ph.D.
Michael Nassaney, Ph.D.
In recent years there has been a particular interest in the fur trade and colonialism through identification and investigation of Fort St. Joseph. This fort was an 18th century French trading post in the St. Joseph River valley located in southwestern Michigan and northwestern Indiana. This study expands our current understanding of the change and continuity of the Euro-American and Native American settlement patterns in the valley during the periods immediately prior to, during, and after the abandonment of Fort St. Joseph through the use of geographic information systems (GIS) and statistical analyses.
ACKNOWLEDGMENTS

I would like to thank my committee members, Kathleen Baker, Ph.D., Gregory Veeck, Ph.D., and Michael Nassaney Ph.D., for their immeasurable amount of intellectual insight and guidance on this project. Without your assistance I would still be editing, running statistical analyses, or lost aimlessly in the data of the St. Joseph River valley. I would also like to thank the Michigan State Historic Preservation Office at the Michigan Library and Historical Center as well as the Indiana Department of Natural Resources Division of Historic Preservation and Archaeology for the information on the archaeological sites in the St. Joseph River valley. Additionally, I would like to thank the Geography Department at Western Michigan University for their support and the necessary skills to complete such a project. Finally, I have to thank fellow graduate student Karl Schrantz for technical solutions. Hopefully, the question being asked by everyone for the past nine months has finally been answered. Which will come first, completion of the thesis or baby Francis?

Allison M. Kohley
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CHAPTER I

INTRODUCTION

In areas such as the St. Joseph River valley in southwest Michigan and northwest Indiana, efforts to identify and analyze settlement patterns remain of paramount importance to archaeologists; see Figure 1.1 (Bevan & Connolly 2006; Beynon 1984; Cremin 1992; Hinsdale 1931; Kowalewski 2008; Nassaney 2007, 2008; Parsons 1972; Schurr 1992, 2010; Tanner 1987).

Figure 1.1. Counties of interest in Michigan and Indiana.
In recent years there has been a particular interest in the fur trade during the colonial era with the identification and investigation of Fort St. Joseph, an 18th century French trading post along the banks of the river in Niles near the Indiana state line (Figure 1.2) (Nassaney 2007, 2008). However, a regional spatial-temporal analysis of the relationship between the archaeological settlements and the fort in the St. Joseph River valley could not have been done until the location of Fort St. Joseph was known. This problem was solved in 1998 when the fort’s exact location was discovered outside of the City of Niles (Benston 2010:56; Nassaney 2007, 2008).

Figure 1.2. St. Joseph River valley with Fort St. Joseph.
Source: Cartographic design by Allison Kohley.

After the rediscovery of the fort, a regional spatial-temporal analysis between the archaeological settlements and the fort in the St. Joseph River valley would be
desirable to understand the fort's influence in the valley. This relationship is of interest because the goals of the Fort St. Joseph Archaeological Project (FSJAP) are to examine the impact of colonialism and the fur trade on native populations. This analysis of settlements in the St. Joseph River valley helps to understand these cross-cultural interactions and their influence upon the habitation patterns of the people.

To aid in this research, the distributions of settlements have been categorized into three distinct time periods. The Pre-Fort period was from A.D. 600-1690 and included the Late Woodland period. The Fort period was from 1691-1781 and included the time of occupation for the fort. The last period was the Post-Fort period from 1782-1850 and included the time after the occupation of the fort and the Removal period of Native Americans in the United States (1795-1840). Table 1.1 shows the different periods used for this study and their associated years.

Table 1.1. Time periods and associated years.

<table>
<thead>
<tr>
<th>Time Periods</th>
<th>Years (A.D.)</th>
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<tbody>
<tr>
<td>Pre - Fort: Late Woodland and Contact Period</td>
<td>600-1690</td>
</tr>
<tr>
<td>Fort: Fort Occupation Period</td>
<td>1691-1781</td>
</tr>
<tr>
<td>Post - Fort: Fort Abandonment and Removal Period</td>
<td>1782-1850</td>
</tr>
</tbody>
</table>

Through the differentiation of these periods, this research may address a further issue related to understanding the St. Joseph River valley. An issue of continuing interest is the location of the “core” areas of the settlements’ distributions and range for the Native American and Euro-American settlements through the three
time periods. This includes how the settlements’ proximity to other settlements is affected by the construction and placement of the fort or other factors, such as the St. Joseph River and Lake Michigan.

There are several possible theories as to settlement patterns in the valley through space and time. The first possibility is that after the construction of the fort and the emergence of cross-cultural trade, the Native American settlements were attracted to the fort as an economic center. Many argue that the fort had a significant impact upon the lifestyles of the Native Americans and the Euro-Americans that inhabited the St. Joseph River valley (Brandão and Nassaney 2008; Nassaney 2008; Nassaney et al. 2002, 2003, 2007; Nassaney and Brandão 2009). This impact from the fort could have expanded the acquisition of goods and trade in the landscape and perhaps, increased or decreased the distance of the settlements from these areas. Another possibility is that the fort did not impact the distribution of settlements and that the Native Americans retained their traditional settlement choices without much impact from the trade of goods. The final possibility is that the settlements were centrally located around the fort during its occupation, but after it was abandoned, the indigenous groups returned to former settlement patterns characteristic of the Late Woodland period.

Research Questions

The purpose of this research is to increase the current comprehension of change and continuity of Native American and Euro-American settlement patterns in the St. Joseph River valley in the periods immediately prior to, during, and after the
abandonment of Fort St. Joseph through the use of GIS and spatial analyses and the collection of distributional data. All of these data are used to answer the following questions:

1. How are the Native American and Euro-American settlements distributed during each time period?
2. Do the Native American and Euro-American settlement distributions exhibit change?
3. How are the Native American and Euro-American settlements distributed in relation to the main portion of the St. Joseph River, Fort St. Joseph, and Lake Michigan?
4. Does Fort St. Joseph have an impact upon the Native American settlement distributions?

This research contributes knowledge about the Native American and Euro-American archaeological sites as well as creates a digitized database of the sites and their associated variables that may be easily utilized for future studies. Through the use of tools such as geographic information systems (GIS) a more detailed understanding of existing archaeological settlement meta-data is possible.

This research has four remaining chapters. The literature review (Chapter 2) is divided into three sections including the history of the St. Joseph River valley. Methods (Chapter 3) follow, including specific analyses used to answer the research questions stated above. Chapter 4 (Results) details the outcomes of the analyses, and
Chapter 5 summarizes the findings of this research by a detailed interpretation of each time period. Methodological considerations of the study and directions for further research are also discussed in this final chapter.
CHAPTER II

LITERATURE REVIEW

This literature review is divided into three sections. The first section reviews the use of spatial analysis and geographical principles in archaeological studies; this includes some of the standards and uncertainties that are inherent in archaeological research. The next section discusses the importance and assumptions of archaeological studies, and the last section gives an overview of the history of the people inhabiting the St. Joseph River region with a focus on Fort St. Joseph.

An Overview of Spatial Analyses and Geographical Principles in Archaeological Studies

Many examples of spatial analyses and geographical principles have been applied to archaeological studies. This close relationship is exemplified through many books and articles related to the integration of spatial studies and geospatial technology with archaeology (Hodder 1976; Clarke 1977; Conolly and Lake 2006; Jones 2006; Lock and Molyneaux 2006; McCoy and Ladefoged 2009; Wheatley and Gillings 2002). This section addresses the spatial studies and geographical principles that are relevant to this research.

There are many benefits associated with the combination of spatial studies and geographic technologies from geography with archaeological research (Hodder 1976; McCoy and Ladefoged 2009). Some of these benefits can be distinguished by the
region that they have been implemented in. Old world archaeology tends to focus on how people orient themselves across the landscape due to economic and cultural factors. An example is Hodder’s work (1976) that details the past uses of spatial studies with archaeological data including the use of Christaller’s spatial organization theory. In contrast, the new world archaeology is more interested in the spatial aspect of people’s orientation across the ecological landscape, another important faction discussed within geography (Silbernagel et al. 1997).

Today's GIS programs have expanded the range and accessibility of standard applications of geographic techniques which makes them more beneficial to archaeological studies (Hodder 1976:225). The simplest benefit from the use of GIS with archaeological data is the ease with which sites can be visualized across the landscape (McCoy and Ladefoged 2009: 264). Other benefits include a database attached to visualized sites and available for queries, interpolation, and other types of analysis. Advanced operations such as cost path analyses and distances to features at varying scales, have also become easily accessible to researchers.

After reviewing the literature, some of the most common applications of the integration of geography with archaeology are related to, artifact density analyses, predictive modeling, regional settlement pattern analyses and landscape studies (Benston 2010; Fitting and Cleland 1969; Howey 2007; Silbernagel et al. 1997; Wescott & Brandon 1999). Artifact density analyses work on the intra-site scale and are not used with this research but have been done with previous studies (Benston 2010). Another application, predictive modeling is useful for cultural resource
management but is not utilized in this research due to the large number of confirmed sites. However, landscape studies and regional settlement pattern analyses are utilized and are detailed below.

Interpretation of landscapes is one of the basic geographical principles that are associated with archaeological studies. Archaeologists such as Anschuetz, Wilshusen, and Scheick (2001:159) state that, "we suggest that a landscape approach is relevant to archaeology’s goal to explain humanity’s past through its ability to facilitate the recognition and the physical, social, and cultural dimensions of their environments across space and over time". The concept of landscape that is used in this study is entirely geographical in nature and is originally defined by Carl Sauer. It is exemplified most clearly through this definition,

"The cultural landscape is fashioned from a natural landscape by a cultural group. Culture is the agent, the natural area is the medium, and the cultural landscape is the result. Under the influence of a given culture, itself changing through time, the landscape undergoes development, passing through phases, and probably reaching ultimately the end of its cycle of development. With the introduction of a different— that is, alien— culture, a rejuvenation of the cultural landscape sets in, or a new landscape is superimposed on the remnants of an older one" (Sauer 1925:46).
The aspects of landscape that are used in this research include the studying of the St. Joseph River valley through the three periods with ecological and cultural factors. The ecological factors include details such as the soils, topography, and land cover associations associated with the settlements. Cultural factors include the proximity to other settlements due to social and economic reasons. Each of these factors is common to landscape data that may be used with archaeological studies and GIS (Conolly and Lake 2006:42).

The importance of these factors is their influence over the decisions that people made in where to locate their settlements in the St. Joseph River valley’s landscape. For example with ecological factors, some soils and particular types of drainage patterns are more suitable for agricultural practices. Elevation would be another valuable factor due to landscape characteristics such as the fluctuations in the height of the river and water tables (Wheatley and Gillings 2002:107). Land cover associations or vegetation related to the soil groups upon which they grow, may be indicative of the land uses people are engaging in across the area (Schurr 1992:21). Cultural factors could include the presence of a village or trading post. Large settlements such as these impact the local economy or organization of other settlements in the area. This impact would be from trade and the exchange of goods between the people of the settlements and whether or not they wanted to be associated with such practices.

Another common method of using GIS with archaeology is regional settlement pattern analysis. Settlement pattern analysis may be described as the study of
settlements and the variables that contribute to creating patterns for a certain period in time. Much is written about this form of analysis (Parsons 1972; Kowalewski 2008). Kowalewski’s (2008) review of the literature on settlement pattern analyses around the world is a fundamental article for the structure of regional studies.

There are many approaches that Kowalewski (2008) discusses in his article on regional settlement pattern studies. These include regional studies comparing regions globally, macro regionally, and micro regionally. Each study depends upon the researcher and also the focus of research for the area. The variation in scale and scope allows for the varying studies to focus upon different aspects of the region. These aspects include the landscape or political atmosphere that impacts the people that inhabited the area. For example, he mentions that regional studies in Mesoamerica may have a different focus than those in the southeastern United States because the cultures and their physical landscapes are different.

This variation across regions of the world is why regional studies have always been a fundamental part of the study of geography. The combination of ecological, historical, and cultural factors allows a more in depth understanding of a region. These factors in combination with archaeological and historical data contribute to more in-depth and further understanding of a region’s development. In conclusion, spatial analyses and geographical principles have been used with archaeological studies many times before and their integration will continue to develop into the future.
The Importance and Assumptions of Archaeological Studies

There are numerous reasons for why archaeological studies are invaluable. The importance of archaeological studies is only briefly discussed here, but much more has been argued and written about the subject (Sharer and Ashmore 2006; Marquardt 1996; Rockman and Flatman 2012). Archaeological studies will continue to impact people through public awareness and furthering understanding about people and their regions’ past. Stubbs and McKee’s (2007:516) hold the view that, “interpretation and protection of cultural heritage resources are as critical as conservation of our natural resources”. These resources can be destroyed and the knowledge possible from them may be forever lost with their destruction. This section begins with a discussion of the significance of archaeological studies and then follows with the assumptions and deficiencies associated with them.

The knowledge gained from studying a region’s past with its archaeology reveals much about its development both ecologically and culturally. This new comprehension leads to a more complete understanding of the anthropological processes in a region. Archaeological studies can help explain the reasons behind people’s settlement patterns across a landscape and which factors play important roles in their habitation decisions as studied in this research. Additionally, studies in the region may reveal unknown cultural and environmental changes across the landscape through time (Lewis 2002; Schurr 1992).

Many of the assumptions in archaeological studies have to do with the visualization of the sites across a region. One common assumption is that sites are
limited to being only a point in space for research purposes. Obviously, sites are of varying sizes across the landscapes from a single artifact to an entire village. This assumption allows the sites to represent a pattern across the valley that is consistent and easier to measure. Another assumption is the placement of the sites into time periods based on historical events to simplify the temporal domain and allow the sites to relate to those of the same relative time occupation and duration, as in this research (Crema, Bevan, and Lake 2010:1118). These assumptions are fundamental for studying spatial distributions across time because they allow for research to continue until better methodology or information surfaces that may explain the deficiencies that are inherent with such research.

Finally, the limitations that are common to this type of research are the temporal uncertainty, redundancy, the lack of exact locations, and missing data. Temporal uncertainty may be due to the lack of evidence at a site. Redundancy, on the other hand, can be from the confusion of historical sources and the misinterpretation of geographic locations resulting in two of the same historically named sites in varying locations. Such disparity between sources occurs because of the variability in records, such as historical and verbal accounts and may have an impact on the lack of exact locations. The lack of exact locations can be due to natural and anthropogenic factors. Soil can be washed out, removing the archaeological data from its former context or humans can physically alter the landscape due to destruction and development of the sites’ areas as well. The last limitation is missing data. Current
reconnaissance of sites may be difficult due to sites’ locations that have not yet been discovered.

In conclusion, in light of the many ambiguities that are inherent with archaeological studies there is still much knowledge that may be gained. Critical assumptions are used to account for these deficiencies and allow research such as this to be conducted. The importance of archaeological studies will continue to be apparent as further research improves methods to reduce or control for such uncertainties.

A Brief History of the St. Joseph River Valley

Michigan and Indiana have very rich cultural histories. Both states have been influenced by many different Native American and Euro-American cultures and each culture had an impact upon the landscape of the area. The purpose of this section is to address the current understanding of the populations that occupied the St. Joseph River valley from the Late Woodland period until 1850. The Native American groups of primary interest include the Miami and Potawatomi tribes, and the Europeans that explored and colonized the valley, originally French but later Euro-Americans. The objective is to determine how the cultures distributed their settlements within the valley before, during, and after Fort St. Joseph’s occupation. The utilization of historical maps, documents, and archaeological records contribute to a broad understanding of the people and their interactions that inhabited the valley over time.

Native American cultures flourished for thousands of years before European arrival in the western Great Lakes region. Many river valleys, such as the St. Joseph,
supported a “river-oriented economy [that] included hunting in the winter, maple sap collecting in spring, fishing in both spring and summer, collecting riverine resources, and harvesting nuts in the fall” prior to European settlement (Holman and Brashler 1999:215). Much research has been done on the Native American groups that inhabited the valley (Cremin 1992, 1996; Holman and Brashler 1999; Hinsdale 1931; O’Gorman and Lovis 2006; Secunda 2006; Schurr 2006, 2010; White 2011).

This resource-rich river valley supported many different cultures from the Late Woodland period and Berrien phase (Pre-Fort Period) into the Fort and Post-Fort Period times with the indigenous groups such as the Potawatomi and Miami. However, it is hard to distinguish who lived in the valley before the Europeans visited because there are no written records that document the Native groups’ names. To clarify, the Late Woodland period is temporally placed between A.D. 600-1600 (O’Gorman and Lovis 2006). The Berrien phase is part of the Late Woodland period and is temporally placed around ca. A.D. 1400-1600 with certain ceramic characteristics and prior to European contact (Cremin 1996; Nassaney et al. 2012). Both make up the Pre-Fort Period for this research.

The historical settlements of people (primarily in the Fort and Post-Fort Periods) are documented through many different sources such as maps and archaeological remains. However, information for such a period can be problematic and incomplete. Native Americans did not keep written histories, and most of the details available about their lifestyles are derived from the Europeans that explored and inhabited the Great Lakes region in the 17th and 18th centuries. Kinietz (1965:167)
states it well with, “in considering all of their characterizations of the Indians, it should be borne in mind that most of the Europeans wanted something: the missionaries sought converts, the traders were after furs, and the military men wanted warriors”. For these reasons, the combination of historical maps, documents, and archaeological remains are useful for obtaining information about a time and people that have few complete records.

Historical maps and documents are essential for research into the 17th and 18th centuries but they must be used appropriately. Heidenreich (1978) presents the best methods to interpret the information of 17th century maps. Some of his objectives include the understanding of French knowledge of Canada, Native American geographical knowledge of an area, and the locations of settlements and navigational routes (Heidenreich 1978:10). This is useful because each cartographer and country had a specific purpose in mind for each map (Petto 2007:2).

The French dominated the cartography of the Great Lakes region for many years. There are numerous reasons for this superiority, but the primary reason is their approach to claiming the Americas. They laid claim to New France through the use of few people but with the prolific production of maps for trade and navigational purposes. This tactic varied greatly from the Spanish and British who believed in increased populations for land claims.

The French superiority in maps of North America also came from their close relationships with the Native Americans (Heidenreich and Dahl 1982). Traveling voyagers and missionaries either collected the data themselves or learned the specific
details of the waterways in the Great Lakes region from the tribes that they contacted. Examples of early French travelers include Champlain, the Jesuit missionaries, Jolliet and Franquelin, and Delisle.

Another aspect with the use of historical maps is their appearance, which can subtract or add to the interpretation of an area such as the St. Joseph River valley (Heidenreich 1978). Many maps have shape distortions that would alter the appearance of the land’s area. Others have illustrations on the maps that contain important information regarding the Native American lifestyles in the area through which a traveler might pass. While these additional illustrations may seem distracting or obscuring to landscape features, the information is often critical to the maps’ usefulness. Many maps that make reference to the valley in this research contain such aspects as shape distortion and illustrations.

During the 15th to 18th centuries, maps provided valuable information on travel throughout the area including location of portages, forts, and characteristics of the inhabiting Native Americans. In most of the maps, the waterways were the most accurate information because navigable waters were the transportation for the explorers. The earliest map with the St. Joseph River accurately located in its correct position is in 1688 by Coronelli (Tucker 1942). However, it is not labeled as the St. Joseph River in many of the historical maps; rather, it is given the name of the “Riv des Miamis” (Tucker 1942).

This labeling of the river indicates the presence of the Miami tribe in the St. Joseph River valley during this time. This location by the tribe was mentioned by
Hennepin and La Salle as early as 1679 (Kinietz 1965:165). Kinietz (1965:162) has explained that this move by Native groups back into the valley was supported by the French and other incentives including the vacancy after the Iroquois aggressive movement westward into the area in 1641 (Cremin 1992; Nassaney and Cremin 1999:13; O’Gorman and Lovis 2006; White 2011:1). The Iroquois were moving west to replace their people lost by disease and for more fruitful areas in the fur trade. After the intrusion started, many Native groups moved westward and were displaced (Cremin 1992; Nassaney and Cremin 1999:13; White 2011:1). However, some historians have posited that some of the original Native groups remained in the region (Cremin 1996:408). This supposed population was minimal and soon many different people, including the French, were moving into the valley once more.

In 1695, the Potawatomi were believed to have started moving back into the valley with 200 warriors (Hutchins 1762; Kinietz 1965:309). For a period, both the Potawatomi and the Miami resided in the valley and took advantage of the geographical location for trade and other resources (Tucker 1942). Both tribes practiced a similar subsistence strategy that involved a seasonal round including maize agriculture and hunting and gathering resources off the landscape (Nassaney et al. 2012). The presence of both Native groups and their settlements in the valley, may be seen from the historical maps by Delisle 1718, Hutchins 1762, Huske 1755, Mitchell 1755, Bowen & Gibson 1763 and Bellin 1774 (Tucker 1942).

The French traveled through the valley much earlier than they established permanent settlements. Hennepin and La Salle in 1679 were two of the earliest
explorers to report on the valley at the mouth of the St. Joseph River and the Native Americans residing there (Kinietz 1965:165). This included the short-lived establishment of Fort Miami.

Around the 1680s, a mission was built alongside the St. Joseph River in today’s Niles, Michigan by the French. A key point about the functionality of missions was that they were built in close proximity to where the Native Americans lived (White 2011:23). Usually, the Native Americans did not usually seek out the missionaries but it was the missionaries that sought out the Native Americans. However, Native American groups did move to this location with Fr. Allouez in the 1680s (Nassaney et al. 2012). This mission would later become Fort St. Joseph around 1691 and would continue to impact the St. Joseph River valley for many years through trade and cultural interactions (Nassaney et al. 2003; Nassaney 2007, 2008).

Fort St. Joseph would soon shift from its core missionary ideals to function as a trading post to build alliances with the Native American groups. It is important to note that Natives lived at Fort St. Joseph and also resided in a large settlement across the St. Joseph River and the fort. At some periods, it even functioned as a garrison and was essential in the fur trade network throughout New France until the 1760’s when the British took it over. The purpose of the fort was as a store house of goods and staging area for the aggressions against the Fox and Chickasaws from the 1720s to 1740, but most of the relations with the Natives were civil, focusing on trade and not hostility (Nassaney 2008).
At one point it was New France’s fourth most important fur trading post in New France (Nassaney 2008). Throughout the fort’s history there were people inhabiting the area for the trade benefits with the Native Americans. Through this trade, the Native Americans and the fort occupants developed intimate relationships with one another. This included the exchange of daily activities and the intermarriage between the cultures that has been evidenced through archaeological research at the fort site (Nassaney et al. 2012:66). The Fort was inhabited at different times by the French, British, and even the Spanish, for varying amounts of time throughout the Fort’s history (Nassaney 2008) see Table 2.1. The value that the fort had for the Native Americans in the region was the ability to trade for goods such as guns, metal, and cloth.

<table>
<thead>
<tr>
<th>Cultural Occupation</th>
<th>Years (A.D.)</th>
</tr>
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<tbody>
<tr>
<td>French</td>
<td>1691-1760</td>
</tr>
<tr>
<td>British</td>
<td>1761-1763</td>
</tr>
<tr>
<td>British-American</td>
<td>1764-1781</td>
</tr>
<tr>
<td>Spanish</td>
<td>1781</td>
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</tbody>
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As indicated by Table 2.1, the fort was operational with many different European cultures for different expanses of time. The French established and inhabited the fort for the longest. The British controlled the fort from 1761-1781 but they did not garrison it after 1763. Also, Fort St. Joseph was located in American territory after 1781. During this time the Spanish took control of the fort but for a very limited duration and it was finally abandoned and never fully operational, although
Native Americans and Euro-Americans continued to inhabit the area (Cunningham 1961).

The cultural relations between the Native American groups with the Europeans varied as the European cultural affiliation changed. The French and the Native Americans had the best relations, and the area representing their close relationship has been termed in the Great Lakes region as the “Middle Ground” by Richard White (2011). Two observations of the French and Native relationships may be drawn from White’s work. One is that the populations and lifestyles of the French in the region did not upset a balance of power with the Native Americans (White 2011). The other observation is that alliances had been created due to marital relations between the Native Americans and the voyagers for trading benefits (White 2011). Sometimes, the conflicts with other cultural groups in the area including the British and Iroquois would help to reinforce and strengthen these relationships.

The clear indication that the balance between the cultures’ influences would not last is best seen in the archaeological records. From 1691 (about the time that Fort St. Joseph was built) onward, the Euro-American population began to increase in the area. During the late 18th and early 19th centuries, the British and subsequently the Americans, pushed into the St. Joseph River Valley and shifted power away from the Native Americans. This unseated the previous stability that had weathered the confrontations with the Native Americans because the French settlements had practiced the preferred policy of giving many gifts to the Native American groups to
maintain civility. This policy was not endorsed by the British or later by the Americans in the region.

Due to the importance of the navigable St. Joseph River, the European settlements had spread out from the river from the 17th to the 19th centuries and found the St. Joseph River valley to be quite habitable. To the Euro-Americans, the Native lands were enticing prospective areas. Treaty after treaty, the Native Americans would see their land disappearing until the pressure move westward would occur once more.

This would become known as the Removal period of Native Americans in the United States (1795-1840) and it affected the Native American groups that had resided in the St. Joseph River valley (Bollwerk 2006; Dulong 2001:13; Santer 1977:46; Schurr 2006, 2010; Secunda 2006). The movement of the Native American groups differed slightly. Faced with similar situations and issues, the Miami and some of the Potawatomi were relocated to lands out west by force. Others, such as the Pokagon tribe of the Potawatomi would remain in the valley (Schurr 2006: 5-19).

The results were different due to many complex factors in a very volatile time. Many of these factors were related to adaptability. This was a period where the Native Americans were expected to become “Americanized” and to fit into the Euro-American cultural practices. This concept included modern day agricultural practices, land ownership, and most importantly the conversion away from pagan gods towards the Christian faith. Out of spite, some Native groups started to embrace their heritage and to reject this new way of life. Other tribes adapted many of these practices and were able to avoid removal from their land (Bollwerk 2006). The groups that didn’t
conform were eventually forced to leave the St. Joseph River valley and look westward.

Numerous changes continued to occur in the 19th century in the valley. These changes included the continual influx of Euro-Americans into the area. This would lead to the creation of the Michigan Territory in 1805 (Dulong 2001:13; Santer 1977:46). The county that Fort St. Joseph had resided in, Berrien County of Michigan was organized around 1836 (Santer 1977:63). Such historical events had a profound impact upon the landscape. After the beginning of the 19th century there was an increase of population and the practice of large-scale agriculture which would alter the landscape dramatically.

Indeed the St. Joseph River valley was advertised during the 1820s as being a great location for Americans to relocate to live and farm (Lewis 2002:76). The advertising was necessary due to the extremely wet nature of much of southern Michigan. The territory had been avoided by early westward expansion in favor of Ohio, Indiana, and Illinois. However, after the construction of the Erie Canal in 1825, movement from people from the Eastern portion of the state began to increase.

The St. Joseph River and other transportation routes, such as trails, made the valley an easily accessible location. Two of the most influential trails were the St. Joseph Trail and the Sauk Trail (Cunningham 1961; Lewis 2002). Both trails had been in use for hundreds of years and helped to move people to the St. Joseph River valley. The St. Joseph Trail had begun as a Native American trail across the state
travelling east from Niles to Detroit (Lewis 2002:26). The Sauk trail ran south of Niles, but it also had an east to west orientation.

As people moved into the valley enticed by the supposedly uninhabited lush land, they began to establish cities such as Niles (Lewis 2002). In a usual central place theory method, Lewis points out that Niles was a leading frontier town and that St. Joseph was merely a secondary market center on its periphery (Lewis 2002:210). As an example, “Niles had a population ten times larger than that of neighboring Berrien Springs in 1838” (Lewis 2002:214). The population continued to increase and this led to subsequent changes in the transportation and habitation of people and corresponded to further changes upon the landscape.

Such changes in transportation included the construction of railroads and also the alteration of the St. Joseph River. Railroads and post roads began to appear more steadily in the St. Joseph River valley in the 1830’s (Lewis 2002). Another factor to increase this form of transportation was to make changes to the river. In order to make it more navigable, the valley inhabitants began to alter the way the river flowed. These alterations included many artificial dams that would manage its seasonal flooding and control its water flow.

From the Late Woodland period to the early 19th century, the St. Joseph River valley has seen many changes in its inhabitants, their lifestyles, and the landscape of the valley. This section has told the story of the movement of people into the St. Joseph River valley after it was predominantly deserted in the 17th century until 1850. To summarize, although there are conflicting accounts, Native Americans returned to
the valley first and followed later by the French. Later, at the end of the 17th century, the French set up a mission, trading post, and fort known as Fort St. Joseph. The valley became alive with missionaries, Native Americans, and traders all working to sustain themselves. These people helped to create this area described by White (2011) as the quintessential “Middle Ground.” However, great changes had only begun to start and Native American control over the valley was being altered.

The balance between the Native Americans and Euro-Americans was placed on unstable ground and the cultural influence had begun to swing in another direction. The French moved out and the British moved in. Eventually trade led to questionable treaties and then the land hungry Americans arrived to find and claim their United States of America. Continuing in a similar manner as their British counterparts, more treaties were made. These treaties forced many tribes to move west, leaving only those willing to adapt in the wake of change. Stuck in a continual process of creating and filling new cultural roles in the St. Joseph River valley, the inhabitants of this area watched the valley rapidly change through the centuries.

Summary

Archaeological studies have a long history of association with geographical principles. Research, such as this, has much to benefit from the integration of spatial analyses with computerized programs, such as GIS. This new technology has expanded the knowledge and study of archaeology through studies utilizing spatial analyses. The potential for further studies in archaeology will only grow with the integration of geographical principles and technologies.
It is hoped that this integrated spatial study increases the understanding of the history of the people in the St. Joseph River valley through an examination of their settlement patterns across the landscape. For the first time, a distribution analysis of the Native American and Euro-American sites and their spatial relationship with Fort St. Joseph, Lake Michigan, and the St. Joseph River is carried out. This research will help comprehend the influence of the Euro-American occupation of the valley on the Native settlements in the region, and furthering the understanding of how Native people made active decisions in locating themselves on the landscape to cope with their new neighbor. There are assumptions about the uncertainties in the data, but the benefits of applying these spatial methods to explore how the sites are distributed will be substantial to our understanding of the history of the settlements and their associated cultures that inhabited the St. Joseph River valley through time.
CHAPTER III

METHODS

Integration of geospatial technologies allows for new interpretations of regional archeological data through improved access to advanced spatial analysis techniques. These resources have come to play an important role in the preservation and expansion of archaeological knowledge. Many books and articles have been written in the last decade on the application of geographic information systems (GIS) to archaeological studies because of the extensive need for spatial analyses (Conolly and Lake 2006; Knowles 2008; McCoy and Ladefoged 2009; Wheatley and Gillings 2002). The application of these technologies within archaeological studies will continue to increase over time. Hopefully, this research project helps to explore some of the many methods, with application to archaeological studies.

In following this trend, the research in this thesis combines the use of GIS and statistics to reveal new information about the distribution of archaeological sites in the St. Joseph River valley in southwestern Michigan and northwestern Indiana. This chapter details the specific methods used to answer the research questions posed in the introduction. The sections in this chapter include a discussion of the development of an archaeological site database for the St. Joseph River valley, application of GIS methods to these data and the statistical methods.
Development of an Archaeological Site Database for the St. Joseph River Valley

There are many different ways to collect archaeological data for research. These collection methods vary with the spatial and temporal scope of a given research project. Some research may require field work and primary data collected from each archaeological site. For this larger-scale research project, it was deemed adequate to collect secondary information on the sites in the St. Joseph River valley through the Michigan State Historic Preservation Office and the Indiana Department of Natural Resources, Division of Historic Preservation and Archaeology. Data for a total of 153 sites were collected from the state of Michigan and information for 62 sites was collected from the state of Indiana. Out of the 215 possible sites identified for the study, 177 sites were used for this study. Thirty-eight sites were removed from analysis due to a lack of complete information. In most cases, rejected sites could not be identified temporally, spatially or culturally as explained more thoroughly below.

The archaeological site data derived from the Michigan and Indiana state archaeological site files were assigned to three classes or magnitudes based on the size of the settlement. A magnitude of 1 is the lowest weighting and includes settlements that are identified as “isolates” and/or “scatters”. These types of sites are least likely to inform our hypotheses because of their paucity of material. A magnitude of 2 is given to settlements that reflected signs of temporary habitation. These settlements included classifications such as, “camps”, and/or “agricultural fields.” A magnitude of 3 is awarded to all larger settlements that presumably had the
most influence on other nearby settlements in the region. This magnitude is reserved for sites classified as, “villages”, “forts”, “missions”, and/or “trading posts”.

The total numbers of settlements by their magnitudes are as following: 73 for a magnitude of 1, 92 for a magnitude of 2, and 50 for a magnitude of 3, with a grand total of 215. Consideration of several key factors during this analysis resulted in the removal of some sites. One such factor included the division of the archaeological sites into three distinct time periods. These periods are the Pre-Fort, Fort, and Post-Fort periods. This historical distinction made the temporal identification of each site key to the analysis. Another factor was the division of sites by their cultural affiliation. This made the identification of each site to a culture of relative importance in the study as well. Table 3.1 illustrates the breakdown of the sites by time periods and cultural affiliation.

Table 3.1. Sites by time period and cultural affiliation.

<table>
<thead>
<tr>
<th>Time Periods</th>
<th>Cultural Affiliation</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre-Fort</td>
<td>Euro-American</td>
<td>2</td>
</tr>
<tr>
<td>Pre-Fort</td>
<td>Native American</td>
<td>105</td>
</tr>
<tr>
<td>Fort</td>
<td>Euro-American</td>
<td>12</td>
</tr>
<tr>
<td>Fort</td>
<td>Native American</td>
<td>9</td>
</tr>
<tr>
<td>Post-Fort</td>
<td>Euro-American</td>
<td>24</td>
</tr>
<tr>
<td>Post-Fort</td>
<td>Native American</td>
<td>25</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td>177</td>
</tr>
</tbody>
</table>

Thirty-eight sites did not fit into clearly identifiable periods or cultures and are removed from the study. The 177 sites that were used for this research were geocoded
using ArcMap version 10.1, which allows for spatial analysis in order to determine influences of the landscape variables and settlement patterns of the sites through time.

GIS Methods

Most of the analyses for this research were conducted through the use of ESRI's ArcMap version 10.1 (ESRI 2012). The analysis was conducted in four steps. The first step included the location and conversion of the sites' township and range data. Afterwards, the attachment of topographical features to the sites and the determination of the central feature locations of the sites and area of interest were completed. The central feature locations represented the most central settlement of the distribution of settlements across the landscape as classified by each time period and cultural affiliation. Lastly, the determination of the proximity of the sites to the features of the St. Joseph River, Fort St. Joseph, and Lake Michigan was completed.

Most of the sites included in the research were previously assigned locations (township and range coordinates) by the various archaeologists working in the states of Michigan and Indiana. These coordinates, however, required verification before they could be spatially referenced in ESRI's ArcMap. This section will detail the steps required to accurately locate the Public Land Survey System (PLSS) sites including the use of Google Earth (Google 2012) and Earthpoint.us (Earthpoint 2013).

Township and range are a part of the Public Land Survey System (PLSS) utilized in a majority of the continental United States, which allowed for geometric measurements of areas by township, section and range as the country expanded. Earthpoint.us was used to isolate each section identified in the primary data in Google
Earth (Clark 2012; Google Earth 2012). The software assisted in the determination of the quarter by quarter location of the sites. This location was then used to place a central location marker to represent the archaeological site in a kml layer. The placement of this location marker was determined by the notes and descriptions in each archaeological site file. A kml file is useful because it saves the latitude and longitude of each site’s location in a format that may be imported into ArcMap. Following this, the kml files were imported as ArcMap feature class layers and given additional information in their attribute tables.

Yet, not all of the sites were georeferenced in this manner. The Indiana State Historic Architectural and Archaeological Research Database (SHAARD) included some sites that are only identified by the Universal Transverse Mercator (UTM) geographic coordinate system but they represented a minority of the total number of sites. These sites were marked directly onto Google Earth by their associated east and north coordinates and brought into ArcMap feature class layers and given appropriate information in their attribute tables. After placing all 215 sites, including both the PLSS and UTM sites on Google Earth, the file are then exported as a kml file and imported into ArcMap. This allowed the sites to be uniquely identified and accurately placed in the area of interest so that additional topographical and cultural features could be derived for the sites.

These topographical features included site elevations, slope, and aspect which are key landscape features for archaeological sites. Through the use of GIS, a digital elevation model rendered the elevations associated with each site and allowed the
determination of slope and aspect. However, the validity of these characteristics may vary due to the information available. The slope and aspect were derived from current elevation models from the USGS National Map Data Source (USGS 2012). The resolution of the digital elevation model (DEM) utilized from the USGS National Dataset was nine meter by nine meter grid resolution. This is the smallest resolution possible for the area of interest in this research.

Although it may be assumed that many archaeological sites have similar topographical features such as elevation, slope, and aspect vis-a-vis their present locations, in most cases this knowledge cannot really be proven. Some sites may have encountered drastic erosion, agriculture, and river degradation over the past hundreds of years. For the purpose of this research, these topographical features are used to gain a general idea of the relative landscapes of the sites rather than an exact snapshot of the characteristics of each site. An explanation of these topographical features follows.

Elevation and slope may have played an important factor in the decision of settlement location. While the definition of elevation is not included here due to the fact that it is widely recognized, a brief explanation of slope and aspect are discussed. Slope can be defined as, “the calculated maximum rate of change in value from one cell to its neighbors” (ESRI 2012). The slope is then calculated as percent rise for this research, which means that it is the rise divided by the run and multiplied by 100. The value of finding slope is to see how steep the terrain is at a given site.
To understand the direction of the slope, aspect was found for the sites. Aspect may be defined as, “direction of the maximum rate of change from one area to another” (ESRI 2012). It is measured in degrees from 0-359.9 and -1 is designated to completely flat areas. These degree values were then divided up between 0-90 degrees (northeast), 91-180 (southeast), 181-270 (southwest), and 271-359.9 (northwest). This designation was used to determine the preferred orientation of sites. These distinctive features of the sites were then attached to each individual site for further comparison.

The next step was to find other attributes of the sites including the site cultural characteristics, their soil types and distances to the St. Joseph River, Fort St. Joseph, and the Lake Michigan shoreline. The purpose of this was to build further landscape variables to help describe the change and continuity from the different time periods and cultural affiliations in an extensive database. The site data came from a number of sources including the Michigan Geographic Data Library for the Michigan archaeological sites’ soil information. The Indiana SHAARD and the National Cooperative Soil Survey Characterization Database were used for the Indiana archaeological sites’ soil information. Both used the Soil Survey Geographic Database (SSURGO) soil assignments at a scale of 1:12,000. The distances to the features of the St. Joseph River, Fort St. Joseph, and Lake Michigan from the sites were determined by using proximity tools in ArcMap. To visualize the change and continuity, each site was separated by time period and cultural affiliation.

These newly identified distances and variables allowed for the further analyses of central features and visualized distance proximity lines to represent the average
distances of sites to the river, fort, and lake. There are several different ways to measure the most average or central parts of a distribution or area. These methods include determining the median centers and central features. For the purpose of this research, central features were determined for the varying time periods and cultural affiliations. Central features may be defined as the identification of the most central feature (point) of a distribution (ESRI 2012, ArcGIS Help 10.1). In this research study, the central features represent the most central settlements out of the distribution of settlements. These may be of varying magnitudes such as a village or more temporary habitation.

It should be noted that a median feature was also determined for the research area as a tool for comparison between the median of the area of interest with the central features identified for each cultural affiliation in each time period. This allowed the visualization of the central area to be compared with each distribution for further understanding of the St. Joseph River valley. A median center may be defined as the location that minimizes overall Euclidean distance to the features in a dataset and weighted by the sites’ magnitudes (ESRI 2012, ArcGIS Help 10.1).

Finally, the distance from each site to major landscape features was measured in GIS. Average Euclidean distances are visualized as proximity lines to represent the distances of the Native American and Euro-American settlement distributions from the St. Joseph River, Fort St. Joseph, and Lake Michigan. The purpose of this was to see how and where the average distances of the two cultural affiliations lay with
respect to broad landscape features during the three time periods. Analyses such as these, aid in understanding the changing distributions of the archaeological sites.

Statistical Methods

In the course of this research, a variety of statistical methods were employed in order to give insight into the significance of the archeological landscape and site variable combinations in this research. Variables included in the analyses were the distance measurements to the St. Joseph River, Fort St. Joseph, and Lake Michigan, as well as the adjusted aspect of the sites, their cultural affiliations, magnitudes, time periods, and soil classifications. Due to the different qualities of these variables, different statistical methods were used for comparisons between the groups of variables. IBM's Statistical Product and Service Solutions (SPSS) was used for the statistical methods. These statistical methods included descriptive statistics and Pearson's product moment correlation coefficient. Other statistical methods were the chi-square analyses and one-way analysis of variance (ANOVA) analyses with Fisher's Least Significant Difference (LSD) tests for post-hoc comparisons.

Descriptive statistics may be defined as, "the procedures for summarizing a group of scores or otherwise making them more comprehensible" (Aron and Aron 1999:679). These were used to determine the frequencies of particular values for each of the variables used in the statistical analyses. In addition to frequencies, other descriptive statistics including standard deviation, minimum, maximum, mean, median, and mode were also collected. Descriptive statistics are calculated for all of
the variables except for nominal values such as cultural affiliation, soils, and time periods. The purpose of using the descriptive statistics is to gain a better understanding of the distribution of values for each group.

Correlation Statistics

The Pearson’s product moment correlation coefficient measures the strength and direction of linear correlations between two interval/ratio variables. The Pearson’s product moment correlation analysis was used in this research for the ratio-scale data including the sites’ distances from the St. Joseph River, Fort St. Joseph, and Lake Michigan. This value determined if a linear relationship existed between the sites’ distances to each of the features on the landscape and added to our understanding of the spatial distribution of sites within the St. Joseph River valley.

Chi-Square Analysis

The Chi-Square analysis was used to compare the soil characteristics of the sites. This analysis is designed to determine whether or not group proportions match the theoretical values (Cronk 2008). This is helpful because a variable does not require an interval or ratio number, nor must it be equally distributed. This was ideal with the arbitrary groups used for the soil descriptions.

To run this analysis each soil was given a representational number corresponding to soil type and aggregated into three different groups. A total of five tests were run using this method after the soil groups were simplified into three groups including: 1. loamy sand, 2. sand, and 3. all other categories. The dependent
variable was soil texture and the independent variables included magnitude, time periods with groups of three and four, adjusted aspect, and cultural affiliation.

ANOVA Analyses

ANOVA or analysis of variance is a test of comparison of means across two or more groups using the F distribution and is carried out through SPSS. One-way ANOVAs are used to test the many variables about the sites. Due to the large number of groups in this research, ANOVA’s are more effective and efficient that simple t-tests because they control for the multiple groups without altering the power of the test. “The ANOVA produces an F-statistic, the ratio of the variance calculated among the means to the variance within the samples. If the group means are drawn from populations with the same mean values, the variance between the group means should be lower than the variance of the samples, following the central limit theorem. A higher ratio therefore implies that the samples are drawn from populations with different mean values” (Howell 2002:324-325). ANOVA was used in this research to determine the differences among the sites of varying groups of adjusted time period (3) and magnitude (3) in respect to their distances to the St. Joseph River, Fort St. Joseph, and Lake Michigan. These tests were further explored with the Fisher LSD post-hoc tests as well.

To complete the statistical analyses, the ANOVA tests include post-hoc Fisher’s LSD tests for post-hoc comparisons. Post-hoc tests “take into account all possible comparisons that could be made” during the analyses such as ANOVA (Aron and Aron 1999:431). The LSD test was developed by Fisher to understand all possible
pair-wise comparisons of means using the equivalent of multiple t-tests (Stevens 1999).

Summary

Although there are many analytical techniques that could be used, these methods were deemed best for this particular data set given the constraints in spatial and temporal accuracy and detail. Each method reveals additional information about the characteristics of the archaeological sites in the valley. Further development in geospatial technologies and added data collection will doubtless add to the methods and results for these variables in the St. Joseph River valley.
CHAPTER IV

RESULTS

Given the multi-method approach adopted in the study and the diversity of tests employed, some interesting patterns were identified that are used to address the research questions listed in the introduction. This chapter is arranged similarly to Chapter 3. It begins with the results from spatial analyses (GIS) and the results of the statistical tests follow. Each of these sections, the GIS results and the statistical analyses results, are organized into smaller sub-sections for clarity.

GIS Results

The mapping of the cultural sites across time periods enabled an analysis of the spatial distribution, central feature locations, and the proximity of sites to all other features. For further explanation of these analyses please refer to Chapter 3. Query capabilities provided for the comparison of cultural affiliations associated with the sites during each time period. The first result to be examined from this method is an assessment of the spatial distribution of the archaeological sites across the study area of southwest Michigan and northern Indiana.
The first pattern identified in the analysis is the change in the number of Native American and Euro-American settlements over time from A.D. 600 to 1850 (Figures 4.1, 4.2, and 4.3).

Considering the Pre-Fort period, the initial great disparity between Native American sites and Euro-American sites is immediately apparent. There are 105 Native American sites dispersed across the study area in comparison to the two Euro-American sites at the mouth of the St. Joseph River. During the Fort and Post-Fort periods, there is an increase in the Euro-American sites and a decrease in the Native
Figure 4.2. Fort Period with both Native American and Euro-American site distributions.
Source: Cartographic design by Allison M. Kohley.

Figure 4.3. Post-Fort Period with both Native American and Euro-American site distributions.
Source: Cartographic design by Allison M. Kohley.
American sites to the degree that the disparity between the two cultural affiliations decreases (Figure 4.4). The Fort period has 12 known Euro-American sites and 9 Native American sites and the Post-Fort period has 24 known Euro-American sites and 25 Native American sites.

![Number of Sites by Time Period and Cultural Affiliation](image)

**Figure 4.4.** Number of sites by time period and cultural affiliation. Source: Calculated by Allison M. Kohley.

Other patterns that can be observed include the changes in the spatial distributions of the sites by cultural affiliation. The Pre-Fort period has a wide distribution of Native American sites with varying magnitudes across the landscape, in contrast to the two large magnitude Euro-American sites at the mouth of the river. In the southwestern corner of the study area (Figure 4.5), there is also evidence of a historical portage from the Kankakee and St. Joseph Rivers which might explain the linear arrangement of the Native American sites from river to river (Cunningham 1961:41).

There were slightly more Euro-American sites across the landscape and less Native American sites during the Fort period. However, for this era many of the Euro-
American sites were of a lesser magnitude in comparison to the Native American sites. These sites were spatially oriented around the river close to Fort St. Joseph. In contrast, the Euro-American sites were more widely dispersed across the landscape than the Native American sites. Although the Euro-American sites were more dispersed, both cultural affiliations have a majority of their sites on the main portion of the river.

Figure 4.5. Pre-Fort period with the portage between the Kankakee and St. Joseph rivers circled. Source: Cartographic design by Allison M. Kohley.

This dispersal of the Euro-American sites across the landscape appears to have continued into the Post-Fort period with another increase in the amount of Euro-American sites. This period also exhibited an increase in the Native American sites and some interesting spatial distributions. The Native American sites were centered
on the Fort St. Joseph area in contrast to the Euro-American sites that were spread widely across the landscape. Also during the Post-Fort period, there were Native American sites in close proximity to Euro-American sites in areas where Native American sites had never been before (Figure 4.6).

Figure 4.6. Post-Fort period showing a new area for Native American settlements in the red circle. Source: Cartographic design by Allison M. Kohley.

An important consideration for these changes in the distributions of the sites is the difference in duration of the time periods. The Pre-Fort period spans a vast amount of time, A.D. 600-1690 or 1090 years. In comparison, the Fort period covers 90 years from 1691-1781, and the Post-Fort period but 68 years from 1782-1850. The
number of sites in each time period corresponds to the number of years within each period.

Central Feature Locations

Because of the confusion with the visualization of many sites in close proximity to one another, central feature locations were determined to illustrate the site distributions in a simplified manner. Central feature locations were used to visualize the center of each cultural affiliation distribution of sites during each time period. A central feature, “identifies the most centrally located feature in a polygon feature class” (ESRI 2012, ArcGIS Desktop Help 10.1).

The central features identified from the distributions are differentiated by different colored triangles. These showcase the differences between the cultural affiliations during the adjusted time periods. For example, site # 20BE23, otherwise known as Fort St. Joseph, is identified as the central feature for the Euro-American sites during the Fort time period. This means that Fort St. Joseph was the most central settlement of the Euro-American distribution during the Fort Period. However, this does not explain its impact upon the other settlements during this time period.

The most revealing aspect of the central feature analysis with the Pre-Fort period was related to the Native American sites. This is because there were a large number of Native American sites in comparison to the two Euro-American sites at the mouth of the river. Results show that the most central feature for the Native American sites was site # 20CS026. This site was a village with a mound with the site name Bright. It is recorded by Garland as a Late Woodland site (Garland 1981; Michigan
State Archaeological Site Files). Because there were only two Euro-American sites in Pre-Fort period both were determined to be the central features. These sites were #20BE213 and 20BE215. One was Fort Miami (20BE213) and the other was a mission (20BE215) relatively close to the fort; both were occupied by the French (Figure 4.7).

![Pre-Fort Period Map](image)

Figure 4.7. Pre-Fort period with central features.
Source: Cartographic design by Allison M. Kohley.

The Euro-American and Native American central features converged closely at Fort St. Joseph during the Fort period, when the fort was in occupation, in comparison to the more diffused central feature positions identified for the Pre-Fort period. The Native American central feature was identified as site #20BE218. This site was a Miami village from 1720-1749 and it was about 1,400 meters from Fort St.
Joseph (Figure 4.8). The Euro-American central feature was Fort St. Joseph for this time period; its history is described in great detail in the literature review chapter.

During the Post-Fort period there was a shift of movement further into the valley. The Euro-American sites moved upstream the St. Joseph River as indicated by the Euro-American central feature but this was not the case for the Native American central feature. The Native American central feature remained in a relatively similar location during both the Fort and Post-Fort periods although different sites were selected as the central features. During this period, the Native American central feature was identified as site # 20BE391. This site was a Potawatomi camp a bit further away from the fort than the Miami village identified during the Fort period.
For the Euro-American sites, an American brickyard site, site # 20CS096, was identified as the most central feature (Figure 4.9).

The results from the central feature analyses indicate that there appeared to be some structural shifts in the location of central features for both the Native American and Euro-American archaeological settlements. The change in the Native American central features does not appear to be very significant because of the minimal distance between the different central feature locations for each period (Figures 4.7 through 4.9). It appears as if the Native American settlements were usually located in close proximity to the median center of the area of interest. Although the Native American
central features move closer to Fort St. Joseph during the Fort and Post-Fort periods, they remain within a relatively small distance from each other and the portage area over time.

This varies greatly with the Euro-American settlements' central features. These show a more dramatic shift across the area, moving further up the river over time. This could represent less dependency on the portage, mentioned previously, toward other routes/mechanisms for the movement of goods. It is important to note once more that during the Fort period both the Native American and Euro-American central features were within close proximity to each other (Figure 4.8). These results must be interpreted carefully, because the number of settlements within each particular time period varied greatly.

Proximity of Sites to Features

The last two research questions are related to the Native American and Euro-American settlement distributions vis-a-vis the main portion of the St. Joseph River, Fort St. Joseph, and Lake Michigan. To help discern further details about the landscape features and the proximity of archaeological sites to these features, buffers or proximity lines were created to visualize the changes of each cultural affiliation for each time period.

Beginning with the consideration of changes in distances from specific sites to the St. Joseph River, the main portion of the river had a large influence upon the settlements. This effect was accentuated by the relatively close proximity of the sites during all periods (Figures 4.10, 4.11, and 4.12). The mean distance from any site to
the St. Joseph River was just less than 10,052 meters (6.25 miles). Table 4.1 shows the distances of the mean proximity lines through the different time periods and by cultural affiliation. As shown by the figures and table, the Euro-American sites moved further out from the river during the Pre-Fort and Fort periods and then slightly inward towards the river during the Post-Fort period. The Native American sites represented an opposite movement in response to the river. The sites’ generally moved closer to the river during the Pre-Fort period and to a similar distance as the Euro-American sites during the Fort period. After Fort St. Joseph’s occupation they move slightly further away during the Post-Fort period.

Figure 4.10. Pre-Fort period with average distances of sites to the St. Joseph River. Source: Cartographic design by Allison M. Kohley.
Two different patterns are observable from the Fort St. Joseph proximity lines results (Figures 4.13, 4.14, 4.15 and Table 4.1). The Euro-American sites were located further from the fort during all time periods. The average distance of the Euro-American sites decreased during the Fort period and then increased in the Post-Fort period. In contrast, the Native American sites shifted, on average, closer to the fort during its occupation and then reverted to being further away from the fort and perhaps, the portage, during the Post-Fort period. The change in the proximity of the Native American sites to Fort St. Joseph exhibited less change from the Fort to the Post-Fort periods than from the Pre-Fort to the Fort periods.

Figure 4.11. Fort Period with average distances of sites to the St. Joseph River. Source: Cartographic design by Allison M. Kohley.
The average distances of the Euro-American and Native American sites to Lake Michigan were also different (Figures 4.16, 4.17, 4.18 and Table 4.1). The average distance of the Native American sites to Lake Michigan did not change much from A.D. 600 to 1850 with a variation of only 2,000 meters.

Figure 4.12. Post-Fort Period with average distances of sites to the St. Joseph River. Source: Cartographic design by Allison M. Kohley.
Table 4.1: Measurement of average distance from major landscape features by time period, cultural affiliation, and analysis.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Pre-Fort</th>
<th>Fort</th>
<th>Post-Fort</th>
</tr>
</thead>
<tbody>
<tr>
<td>St. Joseph River</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro-American</td>
<td>517.5 m</td>
<td>6,315.6 m</td>
<td>5,663 m</td>
</tr>
<tr>
<td>Native American</td>
<td>10,052.1 m</td>
<td>6,425.1 m</td>
<td>8,089 m</td>
</tr>
<tr>
<td>Fort St. Joseph</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro-American</td>
<td>37,589.5 m</td>
<td>36,059.7 m</td>
<td>44,813.3 m</td>
</tr>
<tr>
<td>Native American</td>
<td>41,798.4 m</td>
<td>19,429.4 m</td>
<td>28,706.4 m</td>
</tr>
<tr>
<td>Lake Michigan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Euro-American</td>
<td>126.5 m</td>
<td>46,048.7 m</td>
<td>59,805.1 m</td>
</tr>
<tr>
<td>Native American</td>
<td>47,360 m</td>
<td>44,485.1 m</td>
<td>45,159.9 m</td>
</tr>
</tbody>
</table>

Figure 4.13: Pre-Fort period with average distances of sites to Fort St. Joseph.
Source: Cartographic design by Allison M. Kohley.
Figure 4.14. Fort Period with average distances of sites to Fort St. Joseph. Source: Cartographic design by Allison M. Kohley.

Figure 4.15. Post-Fort Period with average distances of sites to Fort St. Joseph. Source: Cartographic design by Allison M. Kohley.
This was different for the Euro-American sites. The average distance of the Euro-American sites to Lake Michigan increased greatly from the Pre-Fort (126.5 meters) to the Post-Fort period (59,805.1 meters). Further explanation to the proximity of features results is presented in the discussion chapter.

Figure 4.16. Pre-Fort period with average distances of sites to Lake Michigan. Source: Cartographic design by Allison M. Kohley.
Figure 4.17. Fort Period with average distances of sites to Lake Michigan. Source: Cartographic design by Allison M. Kohley.

Figure 4.18. Post-Fort Period with average distances of sites to Lake Michigan. Source: Cartographic design by Allison M. Kohley.
Results of Statistical Analyses

Statistical tests were used to comprehensively examine the data collected on the sites and their location vis-à-vis the St. Joseph River and Lake Michigan as they changed over time. Similar to the methods chapter, this section is organized into subsections for further clarity. Descriptive statistics were used to determine mean values and other univariate measures for the variables used in the statistical analyses. Descriptive measures included standard deviation, minimum value, maximum value, and mean, median, and mode. The variables of the sites included the magnitude, adjusted time period, adjusted aspect, adjusted cultural affiliation, and the distances to Fort St. Joseph, the St. Joseph River, and Lake Michigan. These variables will be described in further detail in the following paragraphs.

To draw more information from the data, values for each of these variables were calculated for each cultural affiliation and each time period. When site magnitudes were examined with respect to cultural affiliations and time period, the most frequent magnitude of the Native American sites increased from a value of 1 with 56 out of 159 sites in the Pre-Fort period to a value of 3 for the Fort period with 6 out of 9 sites and Post-Fort period with 17 out of 25 sites of larger aggregates. This may be due to the difficulty in identifying smaller sites in the later periods. In comparison, the Euro-American site magnitude remained at 3, albeit with fewer sites overall, during the Pre-Fort period with 2 out of 2 sites, Fort period with 6 out of 12 sites, and the Post-Fort period with 14 out of 24 sites of larger aggregates.
Cultural affiliations are those from the generalized groups of Euro-Americans and Native Americans. For example, during the Fort and Post-Fort periods the Native American sites most common cultural affiliation is with the Potawatomi culture, dominating 7 out of 9 sites during the Fort period and 23 out of 25 sites for the Post-Fort period. There was no agreement in the data as to the cultural affiliation of the Pre-Fort period Native American sites. The Euro-American sites were dominated by the French culture in the Pre-Fort period with 2 out of 2 sites and then it became less influential with the Fort and Post-Fort periods. There was no consensus on which specific culture dominated the Fort period and the American culture was the most prevalent for the Post-Fort period with 11 out of 24 sites.

Physical characteristics for each site included their elevation, aspect, slope, and soils. Each site was also examined across cultural affiliations and time periods. Elevation of the landscape was described in meters. The Native American sites were located in places with a similar mean elevation through all three time periods. The Pre-Fort period had a mean elevation of 232.4 meters, the Fort period of 223.5 meters, and the Post-Fort period of 233.9 meters. This relatively minor change through time shows that they maintained a similar elevation for their sites. The distribution of the elevations of the Native American sites varies from a minimum of 177.8 meters to a maximum of 284.7 meters. On average, Native American sites were located on higher ground but also with a larger amount of variation. This may be due to the large amount of isolate sites that were used for special purposes, such as hunting, in the Pre-Fort period.
These results contrast with those of the Euro-American sites. The location of the Euro-American sites actually increased in elevation through the time periods. In the Pre-Fort period the mean elevation was about 182 meters, the Fort period mean elevation of Euro-American sites was 224.5 meters, and the Post-Fort period mean was 240 meters. There was a cumulative increase of almost 60 meters, representing the movement of Euro-Americans from the immediate shore of local water networks. This may be indicative of the settlements moving away from the river and toward more upland, agricultural areas. The distribution of the elevation of the Euro-American sites also varied significantly, from a minimum of 180 meters to a maximum of 363.9 meters. This large variation in elevation may imply a lack of knowledge about the area or a lack of prime available locations. These results reveal that prime locations for habitation might have been at an elevation around 200-250 meters as evidenced by the average elevation for both Native American and Euro-American sites throughout the time periods.

Elevation may reveal the height of the land above sea level, but it is the slope that reveals the rise and fall of the terrain. Beginning with the Native American sites, the average slope for all three time periods was approximately 3-5% with a slight increase from the Pre-Fort to the Post-Fort periods. This slight grade means that Native American sites were typically located on relatively flat terrain. The overall distribution of slope for the three time periods for this cultural affiliation varied from 0% to 24%. A slope of 24% is quite steep and not as desirable for habitation as more level areas.
The Euro-American sites exhibited a decrease in the slope percent rise from the Pre-Fort (15%) to the Post-Fort (4.4%). The 15% slope during the Pre-Fort period is quite unusual due to the difficulty it would be to inhabit such a terrain. However, the distribution of Euro-American sites for the three time periods varied from 0% to 34%! This was a larger variation than that of the Native American sites through the three time periods. Further discussion on the method for extracting these values is available in the methodological considerations section of the discussion.

The aspect, or the direction in which the land tilts or slopes, was also derived using elevation and slope data. Aspect describes the land as being oriented to northeast, southeast, southwest, or northwest as established by the measurement of degrees. Northeast is limited to 0-90 degrees, southeast to 91-180 degrees, southwest to 181-270 degrees, and northwest to 271-360 degrees. From this classification it is noted that the Native American sites changed from a predominantly southwest average aspect (189.3 degrees) in the Pre-Fort period to a southeast aspect during the Fort (165.7 degrees) and Post-Fort (160 degrees) periods. The variation of the Native American sites' aspect was from a minimum of -1 degrees, which implies that the land is completely flat and without aspect, to a maximum of 348 degrees or a northwest orientation. Therefore, the Native American sites exhibited a large variation of aspect orientation across the three time periods. The Euro-American sites were slightly different with a mean northwest aspect (313.5 degrees) in the Pre-Fort period, a southwest aspect (225.3 degrees) in the Fort period, and a southeast (148.7 degrees) aspect in the Post-Fort period.
The last physical characteristic employed in this study was the soil type found at the location of each site. Due to the nominal nature of the soil descriptions, the most prevalent soil description of each group was defined for the three time periods. There was a large range of soils in the area of interest with almost 30 different classifications, yet the soils found at the majority of sites for both cultural affiliations were predominantly from just two soils series.

The Native American sites were located in areas with Coloma-Spinks-Oshtemo soil, loamy sand, at 26 out of 105 sites during the Pre-Fort period (Soil Survey NRCS). The other 79 sites were composed of the previously mentioned 30 different soil textures. During the Fort period, 6 out of 9 sites have a Riddles-Crosier-Oshtemo soil, a sandy loam. The Post-Fort period had both types of the above soils, Coloma-Spinks-Oshtemo at 8 out of 25 sites and Riddles-Crosier-Oshtemo at 8 out of 25 sites (Soil Survey NRCS). Again, the other 17 sites were composed of many different soil textures without consistency.

The Euro-American sites were also dominated by the same two soil descriptions. The Pre-Fort period had both sites on Riddles-Crosier-Oshtemo soil series and the Fort period had 5 out of 9 sites on the same series (Soil Survey NRCS). The Post-Fort period was different, with a majority of sites including 8 out of 24 sites with the Coloma Spinks-Oshtemo (Soil Survey NRCS). Further analysis of the soil descriptions is discussed in the Chi-Square section.
Correlations

As described in the methods section, two types of correlation analyses were used in this study. Pearson’s product moment correlation coefficient was used for ratio scale data including the distances of each site to the St. Joseph River, to Fort St. Joseph, and to Lake Michigan. The results for the Pearson product moment correlation analyses with a two tailed test at the 0.01 significance level revealed significant correlations between the sites’ distances to Fort St. Joseph and the sites’ distances to the St. Joseph River (r=0.269) and Lake Michigan (r=0.755) (Table 4.2).

Table 4.2. Pearson’s product moment correlations between both cultural affiliation sites.

<table>
<thead>
<tr>
<th>Distance to St. Joseph River</th>
<th>p</th>
<th>Distance to Fort St. Joseph</th>
<th>p</th>
<th>Distance to Lake Michigan</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance to St. Joseph River</td>
<td>1</td>
<td>0.269*</td>
<td>0.000</td>
<td>0.095</td>
<td>0.164</td>
</tr>
<tr>
<td>Distance to Fort St. Joseph</td>
<td>0.269*</td>
<td>0.000</td>
<td>1</td>
<td>0.755*</td>
<td>0.000</td>
</tr>
<tr>
<td>Distance to Lake Michigan</td>
<td>0.095</td>
<td>0.164</td>
<td>0.755*</td>
<td>0.000</td>
<td>1</td>
</tr>
</tbody>
</table>

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

Chi-Square Analysis

Chi-square tests of association were used to analyze the nominal variables in the study. The chi-square analysis was particularly helpful with the soil analyses comparing soils with settlement types and cultural affiliations. A total of five chi-square tests of association were conducted after the soil groups were simplified into three groups including loamy sand (1), sand (2), and all other types of soils (3). It is ideal to lump the soils into three groups due to the large distribution of soil
descriptions across the area. Loamy sand and sand were separated from the rest of the soil descriptions because of their high reported frequency of association with the archaeological sites. Once more, the dependent variable is the soil textural classes and the independent variables including the magnitude of the settlements, the time periods of occupation, the adjusted aspect of the settlements, and their cultural affiliation.

A comparison of soil groups by site magnitude revealed some statistically significant results ($\chi^2 = 11.428, p = 0.022$) (Table 4.3). This table shows that sites of low habitation were significantly less likely to have loamy sand substrates and significantly more likely to have other substrates than sites of higher magnitude. A magnitude of 1 was the lowest weighting and included settlements that were identified as “isolates” and/or “scatters”.

Table 4.3. Cross tabulation of soil groups by sites’ magnitudes.

<table>
<thead>
<tr>
<th>Soil Groups</th>
<th>Magnitude</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>32*</td>
<td>47</td>
<td>35*</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>20</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>21</td>
<td>17</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(38.7)</td>
<td>(48.8)</td>
<td>(26.5)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(20)</td>
<td>(25.2)</td>
<td>(13.7)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(14.3)</td>
<td>(18)</td>
<td>(9.8)</td>
</tr>
</tbody>
</table>

*This indicates groups with a significant interaction. *1. 0 cells (0%) have expected count less than 5. The minimum expected count is 9.77.

A magnitude of 2 was given to settlements that reflected signs of temporary habitation. A magnitude of 3 was awarded to all larger settlements that presumably
had the most influence. This may be due to the particular characteristics of these soils and further discussion is provided in the next chapter.

Table 4.4. Cross tabulation of soil groups by time periods with four groups.

<table>
<thead>
<tr>
<th>Soil Groups</th>
<th>Time Periods</th>
<th>( \chi^2 )</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>1</td>
<td>48*</td>
<td>14</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>(54.6)</td>
<td>(12.2)</td>
<td>(37.6)</td>
</tr>
<tr>
<td>2</td>
<td>28</td>
<td>6</td>
<td>24*</td>
</tr>
<tr>
<td></td>
<td>(28.3)</td>
<td>(6.3)</td>
<td>(19.5)</td>
</tr>
<tr>
<td>3</td>
<td>27*</td>
<td>3</td>
<td>8*</td>
</tr>
<tr>
<td></td>
<td>(20.1)</td>
<td>(4.5)</td>
<td>(13.9)</td>
</tr>
</tbody>
</table>

*. This indicates groups with a significant interaction. * 3 cells (25%) have expected count less than 5. The minimum expected count is 3.52.

During the Pre-Fort period (time period 1), sites were less likely to have a loamy sand texture (soil group 1) and are more likely to have other soil texture characteristics (soil group 3). In the Post-Fort period (time period 3), sites were less likely to have other soil texture characteristics (soil group 3) and more likely to have sand texture characteristics (soil group 2).

The last two chi-square tests were conducted to compare soil groups by settlement aspect and cultural affiliation. Neither test showed any significant results. The number of sites by adjusted aspect did not differ by soil groups \( \chi^2(6, N = 212) = 3.951, p = 0.683 \). Also, the number of sites by adjusted cultural affiliation did not differ by soil groups \( \chi^2(4, N = 215) = 5.156, p = 0.272 \).
ANOVA Analyses

ANOVA or analysis of variance is a test of comparison of means across two or more groups using the F distribution and is carried out through SPSS. One-way ANOVAs were used to test the many variables about the sites including the sites’ magnitudes, time periods, and adjusted aspects of each site by their relationships with the sites’ distances to the St. Joseph River, their distances to Fort St. Joseph, and their distances to Lake Michigan. This analysis includes post-hoc tests with each of the one-way ANOVAs using Fisher’s LSD.

Distance to the St. Joseph River

Distance to the St. Joseph River by the sites’ magnitudes was tested at all three significance levels from 0.10 to 0.01 (Tables 4.5 and 4.6).

Table 4.5. ANOVA test of sites’ distances to the St. Joseph River by the sites’ magnitudes.

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>953900991.3</td>
<td>2</td>
<td>476950495.6</td>
<td>5.169</td>
<td>0.006</td>
</tr>
<tr>
<td>Within Groups</td>
<td>19560644465</td>
<td>212</td>
<td>92267190.87</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>20514545456</td>
<td>214</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Results showed that sites identified as “isolated object” locations with, at most, brief habitation (site magnitude 1) were located at significantly greater distances from the St. Joseph River than those sites of a higher magnitude that represented camps (site magnitude 2) or settlements (site magnitude 3).
Table 4.6. Post-Hoc Fisher’s LSD test of sites’ distances to St. Joseph River by sites’ magnitudes. A magnitude of 1 is the lowest weighting and includes settlements that are identified as “isolates” and/or “scatters”. A magnitude of 2 is given to settlements that reflected signs of temporary habitation. A magnitude of 3 is awarded to all larger settlements that presumably had the most influence.

<table>
<thead>
<tr>
<th>(A) Magnitude</th>
<th>(B) Magnitude</th>
<th>Mean Difference (A-B)</th>
<th>Std. Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3381.209*</td>
<td>1505.602</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>5453.499**</td>
<td>1763.314</td>
<td>0.002</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-3381.209*</td>
<td>1505.602</td>
<td>0.026</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>2072.29</td>
<td>1687.675</td>
<td>0.221</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-5453.499**</td>
<td>1763.314</td>
<td>0.002</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>-2072.29</td>
<td>1687.675</td>
<td>0.221</td>
</tr>
</tbody>
</table>

* p<0.10 and p<0.05. ** p<0.01.

The distance to the St. Joseph River results show that settlements with occupation during the Pre-Fort time period were significantly further from the St. Joseph River than during the Fort (time period 2) and Post-Fort (time period 3) periods.

Table 4.7. ANOVA test of sites’ distances to the St. Joseph River by the sites’ time periods with three groups.

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>498347723</td>
<td>2</td>
<td>249173861.5</td>
<td>2.570</td>
<td>0.079</td>
</tr>
<tr>
<td>Within Groups</td>
<td>18810328455</td>
<td>194</td>
<td>96960455.95</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>19308676178</td>
<td>196</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The last set of ANOVA tests compared the distances of the settlements to the St. Joseph River and their associated cultural affiliations and the sites’ adjusted aspect.
Table 4.8. Post-Hoc Fisher’s LSD test of sites’ distances to St. Joseph River by sites’ time periods with three groups.

<table>
<thead>
<tr>
<th>(A) Time Period</th>
<th>(B) Time Period</th>
<th>Mean Difference (A-B)</th>
<th>Std. Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>4381.058*</td>
<td>2270.911</td>
<td>0.055</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>2539.650*</td>
<td>1518.882</td>
<td>0.096</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-4381.058*</td>
<td>2270.911</td>
<td>0.055</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>-1841.408</td>
<td>2362.480</td>
<td>0.437</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-2539.650*</td>
<td>1518.882</td>
<td>0.096</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>1841.408</td>
<td>2362.480</td>
<td>0.437</td>
</tr>
</tbody>
</table>

*. p<0.10.

There was not a significant effect of the adjusted aspect on the distance to the St. Joseph River at the p<.10 level for the four aspect groups [F (3, 208) = 0.199, p = 0.897]. Also, there was not a significant effect of the sites’ cultural affiliations on the distance to the St. Joseph River at the p<0.10 level for the four aspect groups [F (2, 212) = 1.707, p = 0.184].

Distance to Fort St. Joseph

The distance to Fort St. Joseph from the sites of different magnitude at the 0.01 significance level revealed some significant results (Tables 4.9 and 4.10). These results are similar to the previous results of the distance of the sites to the river and the sites’ magnitudes.

Table 4.9. ANOVA test of sites’ distances to Fort St. Joseph by the sites’ magnitudes.

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>13780544211</td>
<td>2</td>
<td>6890272105</td>
<td>12.660</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.154E+11</td>
<td>212</td>
<td>544258843</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.292E+11</td>
<td>214</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Table 4.10. Post-Hoc Fisher’s LSD test of sites’ distances to Fort St. Joseph by sites’ magnitudes. A magnitude of 1 is the lowest weighting and includes settlements that are identified as “isolates” and/or “scatters”. A magnitude of 2 is given to settlements that reflected signs of temporary habitation. A magnitude of 3 is awarded to all larger settlements that presumably had the most influence.

<table>
<thead>
<tr>
<th>(A) Magnitude</th>
<th>(B) Magnitude</th>
<th>Mean Difference (A-B)</th>
<th>Std. Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>14897.684*</td>
<td>3656.7</td>
<td>0.000</td>
</tr>
<tr>
<td>1</td>
<td>3</td>
<td>19428.925*</td>
<td>4282.613</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-14897.684*</td>
<td>3656.7</td>
<td>0.000</td>
</tr>
<tr>
<td>2</td>
<td>3</td>
<td>4531.242</td>
<td>4098.906</td>
<td>0.270</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-19428.925*</td>
<td>4282.613</td>
<td>0.000</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>-4531.242</td>
<td>4098.906</td>
<td>0.270</td>
</tr>
</tbody>
</table>

* p<0.01.

Sites identified as isolated object locations with brief habitation (site magnitude 1) were located at significantly greater distances from the Fort St. Joseph than sites of higher magnitude that represented camps (site magnitude 2) or settlements (site magnitude 3) (F= 12.660, p = 0.000).

Comparing the distance from settlements to Fort St. Joseph by time periods across the three types of settlements also yielded significant results (F = 4.399, p = 0.014) (Tables 4.11 and 4.12).

Table 4.11. ANOVA test of sites’ distances to Fort St. Joseph by the sites’ time periods with three groups.

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>5128800358</td>
<td>2</td>
<td>2564400179</td>
<td>4.399</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.131E+11</td>
<td>194</td>
<td>582891755.8</td>
<td>0.014</td>
</tr>
<tr>
<td>Total</td>
<td>1.182E+11</td>
<td>196</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Time periods 1 and 2 or Pre-Fort and Fort periods have significant mean differences. Settlements during the Fort period (time period 2) were significantly closer to the fort than during the Pre-Fort era (time period 1). Further, Fort period sites were significantly closer to the fort than those during the Post-Fort period (time period 3) (Table 4.12).

Table 4.12. Post-Hoc Fisher’s LSD test of sites’ distances to Fort St. Joseph by sites’ time periods with three groups.

<table>
<thead>
<tr>
<th>(A) Time Period</th>
<th>(B) Time Period</th>
<th>Mean Difference (A-B)</th>
<th>Std. Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>16007.837**</td>
<td>5567.968</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-1538.522</td>
<td>3724.095</td>
<td>0.139</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-16007.837**</td>
<td>5567.968</td>
<td>0.004</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>-10469.314*</td>
<td>3724.095</td>
<td>0.072</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-5538.522</td>
<td>3724.095</td>
<td>0.139</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>10469.314*</td>
<td>5792.483</td>
<td>0.072</td>
</tr>
</tbody>
</table>

* p<0.10. ** p<0.01.

While not significant (F = 1.253, p = 0.292) across all categories, the post-hoc test performed on aspect by the sites’ distances to Fort St. Joseph did show one significant result. Southeast facing sites were significantly closer (p = 0.068) to Fort St. Joseph than northwest facing sites. These results revealed line-of-sight implications with the distance of a site to Fort St. Joseph (Tables 4.13 and 4.14). Such implications could relate to the view from a site to the fort to monitor its activities. The importance of a site’s aspect was previously discussed in Chapter 3. Existing literature suggests that a southeastern orientation was typically preferred.
Table 4.13. ANOVA test of sites’ distances to Fort St. Joseph by the sites’ adjusted aspect.

<table>
<thead>
<tr>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>2259377202</td>
<td>3</td>
<td>753125733.9</td>
<td>1.253</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.250E+11</td>
<td>208</td>
<td>601144091.8</td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>1.273E+11</td>
<td>211</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>


<table>
<thead>
<tr>
<th>(A) Adjusted Aspect</th>
<th>(B) Adjusted Aspect</th>
<th>Mean Difference (A-B)</th>
<th>Std. Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3544.277</td>
<td>4742.4</td>
<td>0.456</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>-2787.832</td>
<td>4742.4</td>
<td>0.557</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>-5233.463</td>
<td>4856.269</td>
<td>0.282</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-3544.277</td>
<td>4742.4</td>
<td>0.456</td>
</tr>
<tr>
<td>3</td>
<td>4</td>
<td>-6332.109</td>
<td>4675.445</td>
<td>0.177</td>
</tr>
<tr>
<td>4</td>
<td>-8777.740*</td>
<td>4790.905</td>
<td>0.068</td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>2787.832</td>
<td>4742.4</td>
<td>0.557</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>6332.109</td>
<td>4675.445</td>
<td>0.177</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>-2445.631</td>
<td>4790.905</td>
<td>0.610</td>
</tr>
</tbody>
</table>

*. p<0.10.

There was not a significant difference between the two cultural affiliation categories and the distance to Fort St. Joseph \( F(2, 212) = 1.084, p = 0.340 \). The final issue to be examined was the distance of the sites to Lake Michigan vis-à-vis the relative size of the sites (magnitude of site).

**Distance to Lake Michigan**

Distance of the sites to Lake Michigan were different by magnitude of the site \( F = 5.104, p = 0.007 \) see Tables 4.15 and 4.16.
Table 4.15. ANOVA test of sites’ distances to Lake Michigan by the sites’ magnitudes.

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>Between Groups</td>
<td>9308051642</td>
<td>2</td>
<td>4654025821</td>
<td>5.104</td>
<td>0.007</td>
</tr>
<tr>
<td>Within Groups</td>
<td>1.933E+11</td>
<td>212</td>
<td>911846826.2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>2.026E+11</td>
<td>214</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.16. Post-Hoc Fisher’s LSD test of sites’ distances to Lake Michigan by sites’ magnitudes. A magnitude of 1 is the lowest weighting and includes settlements that are identified as “isolates” and/or “scatters”. A magnitude of 2 is given to settlements that reflected signs of temporary habitation. A magnitude of 3 is awarded to all larger settlements that presumably had the most influence.

<table>
<thead>
<tr>
<th>(A) Magnitude</th>
<th>(B) Magnitude</th>
<th>Mean Difference (A-B)</th>
<th>Std. Error</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>14079.242**</td>
<td>4733.121</td>
<td>0.003</td>
</tr>
<tr>
<td>3</td>
<td>1</td>
<td>-14079.242**</td>
<td>4733.121</td>
<td>0.003</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>-13534.179*</td>
<td>5543.283</td>
<td>0.015</td>
</tr>
<tr>
<td>3</td>
<td>2</td>
<td>-545.063</td>
<td>5305.499</td>
<td>0.918</td>
</tr>
</tbody>
</table>

* p<0.05. ** p<0.01.

Table 4.16 shows that sites identified as isolated object locations with, at most, brief habitation (site magnitude 1) were located at significantly greater distances from Lake Michigan than sites of a higher magnitude that represented camps or settlements.

However, the distance of the sites to Lake Michigan by the three time periods revealed no significant differences between the groups [F (3, 194) = 0.902, p = 0.408]. This means that sites of each time period were not significantly different from each other in their distances to Lake Michigan.

The last two tests related to the distance to Lake Michigan were by adjusted aspect and by cultural affiliation. There was not a significant difference of the sites’
adjusted aspects on the distance of the sites to Lake Michigan for the four aspect
groups \[F (3, 208) = 0.569, p = 0.636\]. Additionally, there was not a significant
difference of the sites’ cultural affiliations on the distance of the sites to Lake
Michigan for the two cultural affiliation groups \[F (2, 212) = 1.474, p = 0.231\].

These results conclude the one-way ANOVA tests used in this research. The
one-way ANOVA tests showed a large range of variation between the tests. The F
values vary from 0.199 to 12.660 and significant differences also vary across time
periods and settlement types. Overall, results of these tests raise interesting questions
related to the differences between the groups and across the time periods.

Summary

Through the use of many different methods of analysis including GIS and
statistics, some interesting results have emerged. The spatial relationships between
sites and the landscape features reveal new information about the St. Joseph River
valley and how it was inhabited through time. The statistical analyses reveal the
correlations between the many variables of the sites. Interpretations of these results
will be comprehensively synthesized in the following chapter.
CHAPTER V

DISCUSSION

The rich historical context joined with the multi-method approach adopted in this research calls for an integrated discussion of the results presented in the previous chapter. To create a better synthesis, this discussion is broken down by the three time periods including a summary of the qualities that appear important in explaining settlement location during each of the time periods. This chapter then turns to a discussion of the methods employed in this study, including their benefits and limitations as along with the potential for further research.

The Pre-Fort St. Joseph Period

Results from the analysis yielded some interesting locational patterns of settlements in the St. Joseph River valley. Results of interest arise from an interpretation of the distributions, central features, and the proximity of sites to the features across the landscape. Specifically, the distributions of the Euro-American and Native American sites allow for further spatial analyses about their relationships to both the physical and anthropomorphic features in the area of interest for each time period.

The Pre-Fort period was distinguishable by the wide distribution of sites clearly influenced by access to the St. Joseph River. There were 105 Native American sites of varying magnitudes ranging from "isolates" to villages, spanning more than a
millennium (A.D. 600 to 1690). Although there were many sites of this age, most of the early Native American sites were small, with magnitude 1 sites accounting for just over 50 percent of all sites (56 of 105). This compares to the two Euro-American sites, which were both large settlements. Both of the Euro-American sites were located at the mouth of the St. Joseph River (517.5 meters average distance) and in close proximity to Lake Michigan (126.5 meters average distance).

In contrast, the average distances of the Native American sites to the St. Joseph River, Fort St. Joseph, and Lake Michigan were significantly greater. It may be concluded that the river played a large role in the placement of settlements in the valley. Native American sites’ average proximity was much closer to the St. Joseph River than to Lake Michigan or Fort St. Joseph with an average distance of 10,052.1 meters. Fort St. Joseph and Lake Michigan were of a much smaller influence, with distances from these features to settlements averaging 41,798.4 meters to Fort St. Joseph and 47,360 meters to Lake Michigan.

This also coincides with the wide distribution of the Native American sites across the area of interest, as most were inland, away from Lake Michigan. The river would have been the main form of transportation and an invaluable resource throughout the valley, however, when both cultural affiliations were combined, ANOVA results revealed that the Pre-Fort time period settlements were significantly further from the river than during the Fort and Post-Fort periods. Perhaps the residents were not utilizing the St. Joseph River as frequently as in the later periods when
increased cross-cultural trade within the area served to attract settlements closer to the river.

The St. Joseph River and its tributaries played a key role in the movement of people throughout the St. Joseph River valley. The most revealing result from the distributions of the sites in this period is the evidence of the portage between the Kankakee and St. Joseph rivers during the Pre-Fort period. This portage served as a vital transportation conduit between the St. Joseph River and the Mississippi River valleys. The presence of Native American site locations along the land connecting these two rivers verifies this portage as an economically important corridor in the valley during this period. Although some studies have been conducted on this portage, these results support the importance of further research into the sites and their role as a link between two major areas of transportation for the Native Americans within this region (Cunningham 1961:41).

Due to the limited number of Euro-American sites and their close proximity to Lake Michigan and the St. Joseph River, it stands to reason that the Pre-Fort period was a time of exploration by such people into the valley. Both recorded sites are French with one being a fort and the other a mission to establish a “permanent and defensible” presence at the mouth of the rich St. Joseph River valley. In contrast, Native American groups had been living in the valley for a much longer period of time and are more established. As a consequence, Native American groups were more widely distributed across the valley.
A comparison of the attributes of the two cultural affiliation sites during this time period also supports the idea that the Native Americans held preferred locations within the valley. The mean elevation of the Native American sites was 232.4 meters which was greater than the 182 meters average of the Euro-American sites. Higher elevation would have been attractive in the St. Joseph River valley due to the seasonal flooding from the river. Also, the Native American sites were sited on more flat terrain with an average slope of 3% versus the average slope of 15% for the Euro-American sites. Again, settlements with larger areas of flat land would have been the ideal areas for habitation.

Other interesting characteristics of the habitation areas of the two cultural affiliations include the aspect and soil characteristics of each location. The Native American sites had an average aspect of southwest orientation and fertile soils of the Riddles-Crosier-Oshtemo soil series of a sandy loam texture. Contrastingly, the two Euro-American sites were found to have an average aspect of northwest orientation and a preference for soils of Coloma-Spinks-Oshtemo series of a loamy sand texture make-up. Both soils appear to have a similar drainage. However, the Pre-Fort period sites were less likely to have loamy sand texture characteristics, but rather more likely to have other soil texture characteristics as indicated in the chi-square analyses associated with this portion of the research. This reveals that many of these locations were not chosen for soil characteristics that were beneficial to farming which was common before A.D. 1200. In addition, the northwest orientation of the Euro-
American sites is surprising given that a southeast orientation is believed to be preferred due to sun radiation and vegetation growth.

Finally, the central feature analyses helped to identify the more influential sites in the valley. The most central feature or site for the Native American sites was a village located in a relatively central area of the valley (site # 20CS026) as indicated by the area of interest median. Another area of research potential that warrants exploration is that the river’s U-shape may have influenced the distributions of the settlements, particularly the Native American settlements. This U-shape may have helped to develop a central area within the region along the major curve in the most southern portion of the main river. On the other hand, there were only two Euro-American sites in the Pre-Fort period. As a consequence, both were selected through ArcMap version 10.1 as the most central features.

In sum, the Pre-Fort period reveals much about the period before Native American and Euro-American interactions were widespread. The extensive distribution of Native American sites throughout the valley as compared to the isolated Euro-American sites reveals much about the movement of the French into the valley by use of the river. The river may have been the most influential characteristic upon the landscape with the close proximity of sites and the indication of the historical portage between the St. Joseph and Kankakee rivers. The data found on the portage suggests that a more nuanced exploration of this area would be important. To conclude, this period allows for a more interpretative comparison with the Fort and
post-Fort time period to understand the impact and influence of Fort St. Joseph within the St. Joseph River valley.

The Fort St. Joseph Period

This period was defined by the establishment and abandonment of Fort St. Joseph in the St. Joseph River valley. Originally established by the French, this fort was occupied for 90 years by several different cultural groups as previously discussed in the literature review. Although the total number of sites for both the Native American groups and Euro-American groups was relatively small (n=21), some interesting changes in settlement patterns could be identified when compared to settlements from the Pre-Fort period.

The distribution of sites across the St. Joseph River valley clearly changed during this time period, with increased Euro-American settlements distributed across the landscape. Both Native American and Euro-American settlements seem to have been spatially oriented around the river and the fort area with larger settlements being the norm. The most common magnitude for both the Euro-American (6 of 12 sites) and Native American sites (6 of 9 sites) was a magnitude of three, but there were also many small magnitude sites for the Euro-American group.

Other similarities between the settlements of the two cultural affiliations during this time period were their proximities to the St. Joseph River and Lake Michigan. The average distance of the Native American sites to the main portion of the St. Joseph River is 6,425.1 meters while the average distance of the Euro-American sites to the river is 6,315.6 meters. There was a slight difference between
the two groups' average distances to Lake Michigan but they were still similar. The Euro-American group's average distance to the lake was 46,048.7 meters and the Native American group's average distance was 44,485.1 meters. This reveals that the Euro-Americans were moving into the valley and away from Lake Michigan, but were still assured of adequate access to the river during this period. In comparison, the Native American sites were moving slightly closer to the river but maintaining a similar distance from Lake Michigan.

Other details about the archaeological sites were their most prevalent cultural identification, average elevation, and slope, aspect, and soil descriptions. Some of these details were very similar between the two groups while others indicate that more subtle changes are occurring. The most prevalent cultural affiliation for the Native American group was Potawatomi and for the Euro-American group there was no overtly prevalent group. This lack of delineation of the Euro-American group may reveal more research opportunities at specific sites in the valley.

The topographical features of settlements revealed more about the changes occurring in the valley. Surprisingly, during the Fort Period both groups shared similar elevations with only a 10 meter difference and most sites were sited in areas with the same soil group, Riddles-Crosier-Oshtemo. The slope of the Native American sites remained relatively the same vis-à-vis the first period but the average slope of the Euro-American sites decreased to a more habitable, flat terrain.

The only difference between the two cultural affiliations' sites during this period was a difference in the most typical aspect of the sites. The Native American
sites were established in locations with a southeastern orientation and the Euro-
Americans favored a southwest orientation. Besides the differences in aspect, both
cultural affiliations shared many other qualities in their site selection. This indicates
that the Euro-Americans now inhabited similar areas as the Native Americans who
had existed in the valley for a much longer period of time.

The most intriguing result is the average proximity of the Euro-American and
Native American sites to Fort St. Joseph. The Euro-American sites maintained a
similar average distance of 36,059.7 meters to the fort as in the Pre-Fort period.
Interestingly, the Native American sites moved drastically closer with an average of
19,429.4 meters to the fort during this period. This is less than half of the distance to
the fort that was exhibited in the Pre-Fort period. Results of ANOVA tests indicated
that the Fort period sites for both cultural affiliations were significantly closer to the
fort than during the Pre-Fort and the Post-Fort periods. This analysis showed that the
interactions with the fort residents had a significant influence on locational choices. It
is important to note that Natives lived at Fort St. Joseph and also resided in a large
settlement across the St. Joseph River and the fort. This trade relationship may have
magnetized some of the other results such as the central feature locations. During Fort
St. Joseph's occupation, both cultural affiliations' central features were extremely
close to the fort. It is important to note that the Euro-American central feature was
Fort St. Joseph, site # 20BE023.

It's possible that Fort St. Joseph was intentionally located with close
proximity to the central feature of the Native American groups and the portage
between the St. Joseph and Kankakee rivers during the Pre-Fort period. If so, it was situated in an ideal setting for its varying functions, including its role in alliance-building with the Native American groups. This may have been the result of a variety of factors including the number of settlements for each period, the proximity of the fort to the Native American central feature from the Pre-Fort period, and other reasons yet unknown.

In contrast to the Euro-American central feature, the Native American central feature does not move very far from its Pre-Fort location during the Fort's occupation. Located around 1,400 meters from the fort, the Native American central feature was a Miami village, site # 20BE218. It is important to remember that this centralized area was close to the Native Americans central feature from the Pre-Fort period and perhaps it was an already preferred location.

Location is always important in spatial and temporal studies. This holds true for Fort St. Joseph, as its location assured its expanding influence in the 17th and 18th centuries. The fort influenced Native American sites during this time period whether by sheer proximity to the other important Native American sites or through trading alliances with the Native American groups. This time period also revealed the changes that are occurring in the St. Joseph River valley as Euro-Americans continued to move into the valley in greater numbers for purposes other than trade.

The Post-Fort St. Joseph Period

The Post-Fort St. Joseph period marked further changes for the St. Joseph River valley. Besides the great historical changes that were taking place during this
time, as discussed in the literature review, the 68 years of this period show further expansion of Euro-Americans into the valley and alterations in the Native American group’s habitation areas. The most common Native American group was the Potawatomi and for the Euro-Americans, it is the Americans. This change in the most common cultural group for the Euro-Americans reveals the changing political environment of the valley as the area became territory of the United States of America.

Although both cultural affiliation groups had an increase in the number of sites from the Fort period, the Euro-American sites showed greater dispersal across the landscape. This is in contrast to the Native American sites that were located specifically in close proximity to Fort St. Joseph. Many of these settlements were established after the fort’s occupation, suggesting that the central area remained influential. The prominence of this area could indicate continuity from the previous periods in nearby sites such as the Lyne site # 20BE10. This is an important detail because many of the Native American sites were a magnitude 3 (14 of 24 sites). The Euro-American sites were also mostly a magnitude of 3 (17 of 25 sites) but again they were distributed more widely across the landscape.

This wide distribution of the sites across the valley is best represented by the sites’ proximity to the landscape features. The Euro-American sites maintained a similar average distance of 5,663 meters to the main portion of the St. Joseph River during this period in contrast to the slightly outward movement of the Native American sites with 8,089 meters from the river. This outward movement may
indicate that the increased contact is leading to conflict but further research would be necessary to discern such details.

It is apparent with the Euro-American average proximities to the fort and Lake Michigan that these populations were moving further into the valley. The Euro-American sites’ average distance from Fort St. Joseph is 44,813.3 meters while the Native American sites’ average distance from the fort was only 28,706.4 meters. This is a good indicator that the influence of the fort had ended with its occupation, but that the area maintained a certain appeal even after the fort was no longer operational. In regards to the sites’ distances to Lake Michigan, the Native American settlements maintained a similar average distance as with the other time periods at 45,159.9 meters, while the Euro-Americans continued to move further away with 59,805.1 meters.

The other revealing aspect found from the spatial distributions of the sites is the movement of Native American sites into an area that they had never inhabited before, in the central northern portion of the valley. Perhaps this movement during the Post-Fort period was due to the expansion of the Euro-American sites in that particular area. This may be evidence of the growing trade relationship that had developed as the Euro-American presence continued to grow in the valley.

During this final period any difference between the settlements of the Euro-American and Native American groups is difficult to pinpoint. The topographical features of the sites are almost identical. The average elevations of both cultural affiliations’ settlements vary by a mere 7 meters. This could be indicating that most of
the inhabitants during this period were farmers and tied into a similar political economy. The preferred terrain was nearly flat with less than 5% for the slope and the average aspect was a southeastern orientation. Similar to the Fort St. Joseph period, settlements of both groups share a preference for soil groups as well, with Coloma-Spinks-Oshtemo or a loamy sand texture being the shared common type. However, the chi-square analysis indicates that there is a difference in the preference of soils. During this period both cultural affiliations’ settlements were less likely to have other groups of soil texture characteristics and more likely to select locations where soils had sand textures.

The two cultural affiliations’ site characteristics may have grown in similarity from the Fort St. Joseph period but the central features showed some disparity. The two central features identified were no longer influential sites as with earlier periods, but rather small sites with a magnitude of 1. The Native American central feature was identified as site # 20BE391, a Potawatomi camp in the central area where the fort had been. The Euro-American central feature was identified much further to the east and past the study area’s median center. This site was site # 20CS096 and was an American brickyard. This brickyard may indicate the increase in Euro-American people into the valley and their creation of more permanent settlements but further research will be necessary.

In continuation from the former time periods, the Post-Fort St. Joseph period was marked by further movement of the Euro-Americans across the landscape and other revealing features. Contrastingly, the Native American settlements seem to have
remained close to the area once occupied by the fort. Perhaps this continued closeness represents the area being a “homeland”. This supports the earlier stated idea that the bend in the river and central portion of the St. Joseph River was a preferred location. The presence of the Native American sites in an area that they had not inhabited before is also indicative of the important trade relationship that developed between the two cultural affiliations.

All Time Periods

The purpose of this section is to synthesize the statistical tests that were used to understand the data more fully without a separation into specific time periods and cultural affiliations. Once more, switching the organization around from the results and methods chapters, this section will discuss the independent variables together with their corresponding dependent variables. It is important to remember with this part of the discussion that a site’s distance to Fort St. Joseph was found to be significantly correlated to its distance to the St. Joseph River and to Lake Michigan as through the correlation tests.

Beginning with the magnitudes of settlements, a site’s distance to the St. Joseph River, Fort St. Joseph, Lake Michigan and even some soil descriptions are all found to be significantly correlated with any given settlement’s magnitude. ANOVA tests across these variables reveal that sites identified as isolated object locations with, at most, brief habitation (site magnitude 1) were located at significantly greater distances from the St. Joseph River, Fort St. Joseph, and Lake Michigan than sites of higher magnitude that represented camps (site magnitude 2) or large settlements (site
magnitude 3). This is interesting because a magnitude 1 site is an isolate in comparison to a camp (magnitude 2) or a fort or village (magnitude 3). These sites’ similar pattern with respect to the distances to such features explains how certain people inhabited the landscape in proximity to the river, the fort, and Lake Michigan.

Another result relating to a site’s characteristics is the soil descriptions based on the chi-square analysis results. Sites of low habitation were significantly less likely to have loamy sand substrates and significantly more likely to have other substrates than sites of higher magnitude. The location and siting of villages and forts reflect a preference for the loamy sand soil perhaps because such soils are ideal for agriculture. This information combines with the soil preference of each cultural affiliation during each time period allowing for a more complete understanding of the soils that sites are located upon by the groups in the St. Joseph River valley. One independent variable that was not correlated with a site’s distance to Fort St. Joseph is cultural affiliation. More information will be needed to draw further conclusions.

The last independent variable to be discussed is the adjusted aspect. Aspect is significantly correlated with a site’s distance to the fort. According to the ANOVA tests, southeast facing sites were significantly closer ($p = 0.068$) to Fort St. Joseph than northwest facing sites. However, adjusted aspect and magnitude are not found to be statistically significant. This indicates that there was not a preferred aspect by sites of a certain magnitude. However, there appears to be a preferred aspect to sites of a similar distance from the fort and with a particular emphasis on a southeast over a northwest orientation.
Although there are many different variables incorporated in many different types of analyses, these results help us to deduce the smaller details about what occurred in the St. Joseph River valley. Combined with information from the specific time periods, a more complete landscape and its geographical history may be recreated for the time periods incorporated in this research. Many relationships have been identified but further research will be necessary and in greater detail to discern specific explanations for some of the results presented.

Methodological Considerations

Every research has methodological considerations that must be addressed. For this research, two main considerations warrant discussion, the limitations of archived archaeological data for large scale studies and the combination of present day landscape data with prehistoric and historical information. Inherently, most research has underlying assumptions and pitfalls that must be acknowledged as limitations and explained as necessary. Regardless of such issues, the importance of conducting such studies remains.

The largest consideration in the research for this study is the nature of archived archaeological data. The assumptions of archaeological studies are not entirely unique to the archaeological field but their qualities must be addressed. The deficiencies identified in similar research hold true here as well, including the temporal uncertainty, the lack of exact locations, and missing data due to destruction. The disparity between sources of information and the actual archaeological sites occurs because of the variability in records, such as historical and verbal accounts.
Most records of this kind do not have exact locations, and current reconnaissance of such sites may be difficult due to destruction and development of the sites' areas.

Such difficulties were encountered with the research for this study and for these reasons 38 archaeological sites could not be used. Specific examples include the variability of detailed information about the sites in the archaeological records. This factor left many sites without a temporal or cultural affiliation identifier and made them unusable for this research. Possible causes for this variability include past sources of information and loss of data over time. Another example is that some of the GPS coordinates associated with the archaeological data from Indiana and Michigan site files are incorrectly transcribed and placed the sites outside of the study area. This also led to the removal of many sites from the database.

The final consideration in dealing with archaeological data is that of the discovery of sites. Most landscape studies with such data may be deemed incomplete due to multiple factors. Archaeological sites may be destroyed through natural and anthropogenic factors or may have not even been discovered yet. As with any study of this nature, a picture built upon incomplete data may yet reveal many characteristics and important information about the history of an area. However, it should never be deemed complete, because new information may be found that could alter the results of previous research.

In conclusion, in light of the many ambiguities that are inherent with archaeological studies there is still much knowledge that may be gained from the multi-method approach used in this research. Critical assumptions may be used to
account for these deficiencies and allow further research to be conducted. The importance of archaeological studies will continue to be apparent as methods improve to lower and control such uncertainties.

The other main methodological consideration for this research is the use of present day elevation information in conjunction with archaeological data. The topography of a landscape may change drastically over time from both natural and anthropogenic processes. These changes subsequently alter the elevations, slope, and aspect of archaeological sites. This leaves a degree of ambiguity about these details attributed to the archaeological sites. For this research, the data from the archaeological records were reviewed to compare information when it was available, but comparative information is not easy to obtain. Therefore the results of this research with these particular site attributes must be kept in perspective. Until further historical information is available this is the best way to derive this information but it does have its fallacies.

To summarize, such methodological considerations are fundamental for studying spatial distributions across time because they allow for the research to continue until better methodology or information surfaces that may compensate for such deficiencies. Additional archaeological knowledge may become apparent and perhaps new methods for reconstructing past landscapes will become available. Until such advancements occur, this research has attempted to evaluate the data collected in the most comprehensive manner possible.
Summary and Conclusion

To summarize, it seems that spatial and temporal analysis of the St. Joseph River valley can contribute much to further historical and archaeological knowledge regarding the change and continuity of different cultural groups’ locations in the region. Through the use of tools such as geographic information systems (GIS) and statistical analyses a more detailed understanding of existing archaeological settlement meta-data is possible. Each time period exhibits unique arrangements to the Native American and Euro-American settlement distributions. These changes in the distributions from the Pre-Fort to the Post-Fort periods also display differences between the two cultural affiliation groups in relation to their habitations within the valley. Furthermore, the distribution of the sites implies an influence of Fort St. Joseph and its associated area on the Native American groups. It also indicates a dependence upon the St. Joseph River by both groups and reveals that Lake Michigan does not seem to be a large contributor in settlement decisions. Further research will be needed but the compilation of these sites and their spatial locations will aid additional studies.

There are many different research projects that may come from further studies into this area. A settlement pattern analysis of the other forts in the Great Lakes Region may reveal more at a larger scale. Also, further exploration into the use of the trails, river, and portage in the valley could impact the results of this study. As more archaeological data becomes available, the research potential in the St. Joseph River valley grows and this study has been but a small example.
APPENDIX

Experimental Gravity Model

This analysis was used experimentally to see how a gravity model would work with archaeological data. Due to the isotropic plane of the landscape in this model it was not used with the results of this research. After much consideration, the importance of the St. Joseph River and the absence of more detailed trade data on the archaeological sites left the results too questionable for inclusion.

Gravity Model Methods

A detailed analysis of these distributions allowed for a more nuanced understanding of potential factors in this settlement analysis. However, it is important to note that this method was used experimentally. In order to explicate these specific factors a gravity model was also used in ArcMap 10.1. A gravity model is a method of measuring the attractiveness of any point to other points or areas in a distribution. For the purpose of this thesis, a Huff model tool was downloaded and utilized to find the most desirable site for each period from one cultural affiliation to another. “It is based on the principle that the probability of a given consumer visiting and purchasing at a given site is a function of the distance to that site, its attractiveness, and the distance and attractiveness of competing sites” (Flater, ESRI 2010). The distance friction
coefficient used for this model was a value of two. This allowed for standard inverse distance weighting to be applied to the distances between the sites.

It is evident that the Huff model was originally constructed for business and consumer dynamics with its sales potential and probability results (Flater, ESRI 2010). However, its useful properties were ideal for this thesis as well. This was because it combined different measurements to configure a site’s attractiveness to the other sites around it. The different measurements used in this research were the sites’ magnitudes or influence in the surrounding area, which could also be described as attractiveness. These magnitudes represented both the site’s length in occupation and the probability of their influence upon the other sites in the area due to the site’s relative magnitude. Both measurements were used to determine the overall probability of each site being drawn to the other sites around it. In addition, this model allowed the probabilities to be measured between different groups such as the Native American sites and the Euro-American sites.

The Huff model had an output of three different results, only two of which were utilized. The first result was the prediction of sales potential for each site. This result was not used. It was unnecessary due to the fact that there were no sales being measured with the sites, although it may have yielded interesting results had trade data been available. The next result was the probability of each site of one cultural affiliation distribution being attracted to the other, such as a site from Native American being associated with a Euro-American site and vice versa. In detail, this attraction described the pull of each site from one cultural affiliation to another during
a certain time period. This was represented as a probability from 0 to 1 and was
determined from their magnitudes and distances between each other.

The use of this method was alike that in consumer theory because the
comparison of the attractiveness between stores and their customers was similar to
that of archaeological sites with the people inhabiting the area. By dividing the
cultural groups, this method estimated the probability that each archaeological site
would be attracted to a site of the opposite cultural affiliation. This was similar to
comparing the probability that different population demographics would be attracted
to different stores.

Lastly, the most attractive site of the opposite cultural affiliation distribution
was selected. This was done by the probabilities. The sites most desired by probability
were determined from a combination of the sites’ magnitudes and distances to sites of
the other cultural affiliation. This analysis allowed for a quick interpretation of the
most attractive site from each cultural affiliation during each time period.

This result was also akin to consumer theory because it can be used to
determine the most probable desirable store for a demographic of consumers in an
area. This allowed the measurement of sales and competition to make better informed
decisions as to where to locate a new store and so forth. In this archeological research,
this result allowed the determination of the most probable desirable site for each
cultural affiliation from the opposite cultural affiliation by specific time period.
Although this thesis was not concerned with determining an optimal location for a
new site, the gravity model method did help to visualize and understand the value of
the sites in the St. Joseph River valley and their influences upon the other sites in
area. Overall, the gravity model was a surprisingly useful method for highlighting the
attraction of certain sites in the St. Joseph River valley to other archaeological sites in
the area during the same time period. This allowed a further understanding into both
the placement of the sites and their geographic location in the region.

Gravity Model Results

The Huff Gravity Model was a useful tool for determining which sites were
the most attractive in each time period to each cultural affiliation. To reiterate, the
attractiveness of each site was determined by distance proximity to the opposite
cultural affiliation sites and magnitude. Due to the large size of the gravity model
outputs, tables for this section only show a maximum of three sites and the highest
probabilities for no more than three sites of the other cultural affiliation’s. For
example, Table A.1 shows two Euro-American sites on the left and the probabilities
they have of being attracted to the Native American sites on the right. Below this is
listed the most probable site chosen as being the most attractive of the Native
American sites by the Euro-American sites.

At the lower right side of the figures there are odds given that represent how
many of the Euro-American sites on the right were most attracted to that specific
Native American site. Due to the presence of only two Euro-American sites during the
Pre-Fort period, the odds were simply 2 out of 2 sites. These odds were the number of
sites that were most attracted to that site out of the total number of possible sites for
that time period and cultural affiliation. Other tables showed similar results but in
reversal from one cultural affiliation to another. Tables A.1 and A.2 show the results of the gravity model for the Pre-Fort period by the attractiveness from the Euro-American sites to the Native American sites and vice versa.

Table A.1. Pre-Fort period from Euro-American sites to Native American sites.

<table>
<thead>
<tr>
<th>Euro-American Sites</th>
<th>Site Name</th>
<th>Site Type</th>
<th>Magnitude</th>
<th>Probability That 20BE172 Would Have Held Highest Attractiveness To Native American Population Based On Location And Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE213</td>
<td>Fort Miami</td>
<td>Fort</td>
<td>3</td>
<td>0.35</td>
</tr>
<tr>
<td>20BE215</td>
<td>Mission</td>
<td>Mission</td>
<td>3</td>
<td>0.36</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Most Probable Site</th>
<th>Most Probable Site Name</th>
<th>Site Type</th>
<th>Odds 2/2 Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE172</td>
<td>Smith B-71</td>
<td>Village</td>
<td></td>
</tr>
</tbody>
</table>

These results indicated that for the two Euro-American sites, the most attractive Native American site # 20BE172, a Native American village during the Late Woodland period. For the reversal, as seen in Table A.2, the most attractive Euro-American site was Fort Miami (site # 20BE213) with a 61 out of 105 odds.

Following in the same pattern as before, the Fort period gravity model results from the Euro-American sites to the Native American sites revealed that the Moccasin Bluff site (site # 20BE008) was the most attractive by 3 out of 12; see Table A.3.
Table A.2. Pre-Fort period from Native American sites to Euro-American sites.

<table>
<thead>
<tr>
<th>Native American Sites</th>
<th>Site Name</th>
<th>Site Type</th>
<th>Magnitude</th>
<th>Probability That 20BE213 Would Have Held Highest Attractiveness To Euro-American Population Based On Location And Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE413</td>
<td>Jean Klock Park</td>
<td>Lithic Scatter</td>
<td>1</td>
<td>0.54</td>
</tr>
<tr>
<td>20BE450</td>
<td>Benton Harbor Airport Site 1</td>
<td>Camp</td>
<td>2</td>
<td>0.52</td>
</tr>
<tr>
<td>20BE451</td>
<td>Benton Harbor Airport Site 2</td>
<td>Camp</td>
<td>2</td>
<td>0.52</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Most Probable Site</th>
<th>Most Probable Site Name</th>
<th>Site Type</th>
<th>Odds 61/105 Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE213</td>
<td>Fort Miami</td>
<td>Fort</td>
<td></td>
</tr>
</tbody>
</table>

Table A.3. Fort period from Euro-American sites to Native American sites.

<table>
<thead>
<tr>
<th>Euro-American Sites</th>
<th>Site Name</th>
<th>Site Type</th>
<th>Magnitude</th>
<th>Probability That 20BE008 Would Have Held Highest Attractiveness To Native American Population Based On Location And Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE065</td>
<td>Bluff Park</td>
<td>Cemetery</td>
<td>2</td>
<td>0.20</td>
</tr>
<tr>
<td>20BE214</td>
<td>Burnett Trading Post</td>
<td>Trading Post</td>
<td>3</td>
<td>0.20</td>
</tr>
<tr>
<td>20BE215</td>
<td>Mission</td>
<td></td>
<td>3</td>
<td>0.20</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Most Probable Site</th>
<th>Most Probable Site Name</th>
<th>Site Type</th>
<th>Odds 3/12 Sites</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE008</td>
<td>Moccasin Bluff</td>
<td>Burial Mound, Camp, Village</td>
<td></td>
</tr>
</tbody>
</table>

This Potawatomi site consisted of a camp and village with burial mounds. Much research has been done on this site by varying researchers (Michigan State Archaeological Site Files). The Native American sites were most attracted to Fort St.
Joseph (site # 20BE023) by 5 out of 9, see Table A.4. Again, further detail on the history of the fort was previously mentioned in the literature review chapter.

After the fort’s occupation the Euro-American sites were most attracted to site # 20SJ012, a Potawatomi village. This was determined by the odds of only 5 out of 24, which, while low, are the highest odds obtained for this period, see Table A.5.

Table A.4. Fort period from Native American sites to Euro-American sites.

<table>
<thead>
<tr>
<th>Native American Sites</th>
<th>Site Name</th>
<th>Site Type</th>
<th>Magnitude</th>
<th>Probability That 20BE023 Would Have Held Highest Attractiveness To Euro-American Population Based On Location And Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>12L0114</td>
<td>Mongoquinong Village</td>
<td>Village</td>
<td>3</td>
<td>0.53</td>
</tr>
<tr>
<td>20BE002</td>
<td>Plym</td>
<td>Village</td>
<td>1</td>
<td>0.46</td>
</tr>
<tr>
<td>20BE218</td>
<td></td>
<td>Village</td>
<td>3</td>
<td>0.52</td>
</tr>
</tbody>
</table>

**Most Probable Site**

<table>
<thead>
<tr>
<th>Most Probable Site</th>
<th>Most Probable Site Name</th>
<th>Site Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE023</td>
<td>Fort St. Joseph</td>
<td>Camp, Mission, Fort, Trading Post</td>
</tr>
</tbody>
</table>

Odds 5/9 Sites

Table A.5. Post-Fort period from Euro-American sites to Native American sites.

<table>
<thead>
<tr>
<th>Euro-American Sites</th>
<th>Site Name</th>
<th>Site Type</th>
<th>Magnitude</th>
<th>Probability That 20SJ012 Would Have Held Highest Attractiveness To Native American Population Based On Location And Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>20SJ013</td>
<td>Fort Hogan</td>
<td>Fortification</td>
<td>2</td>
<td>0.36</td>
</tr>
<tr>
<td>20SJ055</td>
<td>Branstner Bh41</td>
<td>Brickyard</td>
<td>2</td>
<td>0.40</td>
</tr>
<tr>
<td>20SJ056</td>
<td>Branstner Bh42</td>
<td>Brickyard</td>
<td>2</td>
<td>0.45</td>
</tr>
</tbody>
</table>

**Most Probable Site**

<table>
<thead>
<tr>
<th>Most Probable Site</th>
<th>Most Probable Site Name</th>
<th>Site Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>20SJ012</td>
<td>Village</td>
<td></td>
</tr>
</tbody>
</table>

Odds 5/24 Sites
As for the Native American sites, these were most attracted to the Euro-American site # 20BE009, otherwise known as the Carey Mission, with the odds of 11 out of 25, see Table A.6. The Carey Mission was a Baptist mission from 1823-1830 (Michigan State Archaeological Site Files).

Table A.6. Post-Fort period from Native American sites to Euro-American sites.

<table>
<thead>
<tr>
<th>Native American Sites</th>
<th>Site Name</th>
<th>Site Type</th>
<th>Magnitude</th>
<th>Probability That 20BE009 Would Have Held Highest Attractiveness To Euro-American Population Based On Location And Magnitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>20BE392</td>
<td>Weesemos Village</td>
<td>Village</td>
<td>3</td>
<td>0.96</td>
</tr>
<tr>
<td>20BE033</td>
<td></td>
<td>Village</td>
<td>3</td>
<td>0.90</td>
</tr>
<tr>
<td>20BE391</td>
<td></td>
<td>Camp</td>
<td>2</td>
<td>0.82</td>
</tr>
</tbody>
</table>

Summary

The gravity model reveals some interesting results in the St. Joseph River valley. Although their relevance will require further work, the value in the use of such a model with archaeological data may be seen. It is recommended that this model be used in area more similar to an isotropic plane and with extensive detail about the trade network between sites. Additionally, a more detailed analysis with this method in the St. Joseph River valley may be possible with the addition of cost path analyses between all of the sites through use of the St. Joseph River.
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