VISIBILITY ANALYSIS OF THE RICE LAKE BURIAL MOUNDS AND RELATED SITES

A Thesis Submitted to the Committee on Graduate Studies
in Partial Fulfillment of the Requirements for the Degree of Master of Arts
in the Faculty of Arts and Science

TRENT UNIVERSITY

Peterborough, Ontario, Canada

Anthropology M.A. Graduate Program

January 2010

Your file Votre référence
ISBN: 978-0-494-53559-2
Our file Notre référence
ISBN: 978-0-494-53559-2

ABSTRACT

Visibility Analysis of the Rice Lake
Burial Mounds and Related Sites

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Visibility analysis and particularly Geographic Information Systems (GIS) based viewshed analysis is a relatively new avenue of interest in archaeology. This study applies viewshed analysis to the burial mounds constructed on Rice Lake during the Middle Woodland period of Southern Ontario, to determine whether visual relationships between the mounds and their surrounding landscapes were factors for site selection. Viewsheds to and from these mound sites are generated and compared to viewsheds for contemporaneous nearby non-mound Middle Woodland sites as well as sites from the Early Woodland and Archaic periods. Comparisons are also made between Rice Lake site viewsheds and a randomly generated sample. Site groups are compared statistically and through the use of descriptive analysis. Through these analyses I conclude that visibility was a factor in the placement of mound sites and that the selection of these site locations relates to territorial and ideological interests of the mound builders.

Keywords: Ontario Archaeology, Burial Mounds, Rice Lake, Viewsheds, Visibility, Geographic Information Systems, GIS, Environmental Modeling, Landscape Archaeology, Middle Woodland, Point Peninsula, Serpent Mounds, Territoriality, Ideology, Site Selection

Acknowledgements

I would like to thank my supervisor, Dr. James Conolly, for suggesting this topic to me over three years ago and for his assistance in designing and implementing the methodology for this thesis. Additionally, the lab facilities and equipment he has provided for my analysis have made much of this research possible. I wish also to thank the other members of my committee, Dr. Susan Jamieson and Dr. Marit Munson. Dr. Jamieson's feedback and advice have been invaluable for the interpretations of my analysis. Dr. Munson's edits and suggestions have provided a valuable perspective for this thesis. I wish also to thank the external committee member, Dr. David Smith, Department of Anthropology, University of Toronto.

A number of funding sources made this research possible. External funding for this thesis was generously provided through an Ontario Graduate Scholarship. Internal funding was provided by Trent University's graduate funding, as well as an entrance scholarship bequeathed by the family of Eugene Kuzmin, to whom I wish to extend my thanks.

A great deal of thank is also owed to Elizabeth Sonnenburg, Doctoral candidate, Department of Earth Sciences, McMaster University, for her willingness to share and exchange data of the Rice Lake area. Her bathymetric models of the lakebed have provided a highly accurate model for comparison with my own lake level model.

I wish also to thank Kate Dougherty, Department Demonstrator, Trent University, for sharing with me her Masters thesis on the skeletal analysis of Mound C at Cameron's Point. I also wish to express my gratitude for the many conversations we have had about the Middle Woodland occupation of Rice Lake, and for letting me barge into her office whenever a new idea popped into my head.

Brent Stonefish, former manager of Serpent Mounds Provincial Park, and Peter Burnett, current Tourism Operations Manager of the park, have been incredibly helpful and supportive, allowing us to conduct surveys around the Serpent Mounds site. While the particular application of those surveys was dropped from this research it will certainly be very useful for future research and analysis of the mounds site.

I wish also to extend my thanks to Cathy Schoel, former secretary, Department of Anthropology, Trent University, for all of her support and assistance. I wish also to thank Kristine Williams, graduate secretary, Department of Anthropology, Trent University, who not only provided administrative support in getting myself and my fellow grad students through the Masters program, but was also willing to listen to us complain when things were not unfurling as they should.

Thanks are owed to everyone who has assisted with my field research over the past three years, Chelsee Arbour, Jarret Boyd, Chris Carlton, James Conolly, Carrie Dennett, Kate Dougherty, Jordan Downey, Patrick Hoskins, Zach Knox, Caylanne Lyall, Mike Stringer and Elaine Young.

I wish to thank my family for their constant encouragement and support, particularly my parents Jim and Shelia. I would especially like to thank my father Jim for the use of his canoe, and my mother Shelia for lending her editorial expertise to my thesis.

All of my colleagues in the graduate program have been very supportive providing their opinions and insights regarding my thesis work, and in particular I would like to express my gratitude to Zach and his partner Laura and Teresa and her partner Dave for their friendship over the past two years. I wish also to thank my friends, especially Mike and Mary, who have ensured I have not gotten too stressed over the past two years. Finally I wish to thank Elaine for all of her love and support. I could not have done this without her.

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Chapter 1
Introduction

1.1 Purpose

The purpose of my research is to understand the regional patterning of the Rice Lake burial mounds in the context of their landscape setting, with particular emphasis on the relationship between site location and visibility. Through the analysis of where the mounds were situated in the landscape, interpretations of the ideological and cosmological reasoning for the placement of the mounds are suggested. A number of interpretive possibilities for the situating of the mounds are tested through a combined quantitative and descriptive analysis of landscape visibility; these include territoriality, proximity to subsistence resources, and the sacredness of local geography. Through the use of modern theoretical frameworks and methodologies a more humanized examination of the Rice Lake mound builders is developed compared to studies that have been conducted on the mounds in the past.

This concept was first addressed as part of my honours undergraduate thesis (Dillane 2007). That preliminary study identified no significant visibility relationship between the mounds and their surrounding landscape, but did provide a number of avenues for improving the analysis process including reconstructing the palaeo-environment and changes in the application of visibility analysis. In this study, a thorough re-analysis of the burial mounds of Rice Lake, which were constructed during the Point Peninsula cultural period and date to between 360 BC and AD 590, is conducted in order to extend the current archaeological understanding of the mounds into a modern theoretical framework. Due to the sensitive nature of First Nations burials, neither excavation nor invasive analysis of burial remains was undertaken. This study encompasses an extensive examination of existing archaeological data acquired from past excavation of the mounds and the analysis of site visibility and landscape through Geographical Information Systems (GIS) analysis based on topographic surveys.

My research provides a new approach to the Rice Lake burial mounds, which combines a number of quantitative and qualitative techniques to better understand the interrelationship between mortuary sites and their surrounding landscapes, and provides a more humanized social approach to mortuary studies in Southern Ontario. In addition, new techniques developed through this research could provide new methodology for future archaeological analysis and therefore contribute to the discipline as a whole.

1.2 Hypotheses

The hypothesis central to this study is that, for the builders of the Rice Lake burial mounds, visibility was a significant factor for site location selection. Generally, this hypothesis is tested with regards to the visibility of the mound sites to the surrounding landscape, as well as to specific features of the landscape, visibility of the sites from the lake, and intervisible relationships amongst sites. These factors are examined largely through the comparison of different datasets, and are inferred from statistically significant results.

However, a number of hypotheses can also be put forward regarding what particular visual relationships led to the mounds being placed where they are. One of the main hypotheses to be tested is that the mounds are situated where they are to act as territorial markers. This concept relates mortuary sites to the control of important but restricted resources, and the need for lineal groups to maintain control of such resources through ancestral claims (Goldstein 1981:61). If the mounds were territorial markers they would likely have an immediate association with particular restricted resources, and a clear visible relationship to the physical landscape would reinforce such control.

Another hypothesis is that the mounds were constructed in locations related to the cosmology of the mound builders. This idea is much more difficult to demonstrate. However, in other cases such linkages have been put forth based on a combination of ethnographic and ethnohistoric information and the archaeological record (e.g. Buikstra and Charles 1999). For this study the interpretations of such relationships are kept somewhat general in order to maintain the integrity of the analysis. Visibility relationships between mound sites and important landscape features are considered through cautious application of the ideological systems of Northeastern First Nations.

1.3 Region of Study

Rice Lake lies approximately 15 km south of the City of Peterborough in southern Ontario, Canada (Figure 1.1). The lake is part of the Trent River drainage, which runs from the Kawartha Lakes, located at the southern extent of the Canadian Shield, down to the Bay of Quinte, which empties into Lake Ontario (Chapman and Putnam 1984:104). Rice Lake is a large shallow lake that extends approximately 37 km in a southwest-trending depression (Chapman and Putnam 1984:104-105). The depression of Rice Lake is part of a pre-glacial valley, and was partly flooded by Glacial Lake Iroquois at the end of the last ice age (Chapman and Putnam 1984:195). The Rice Lake region itself is made up of a number of unique geographic features. Southwest of the lake lies the eastern end of the Oak Ridges Morraine, while the lake itself and the areas north of it comprise the Peterborough drumlin field, perhaps the most extensive drumlin field in North America (Chapman and Putnam 1984:17). The exact formation process of these drumlins is

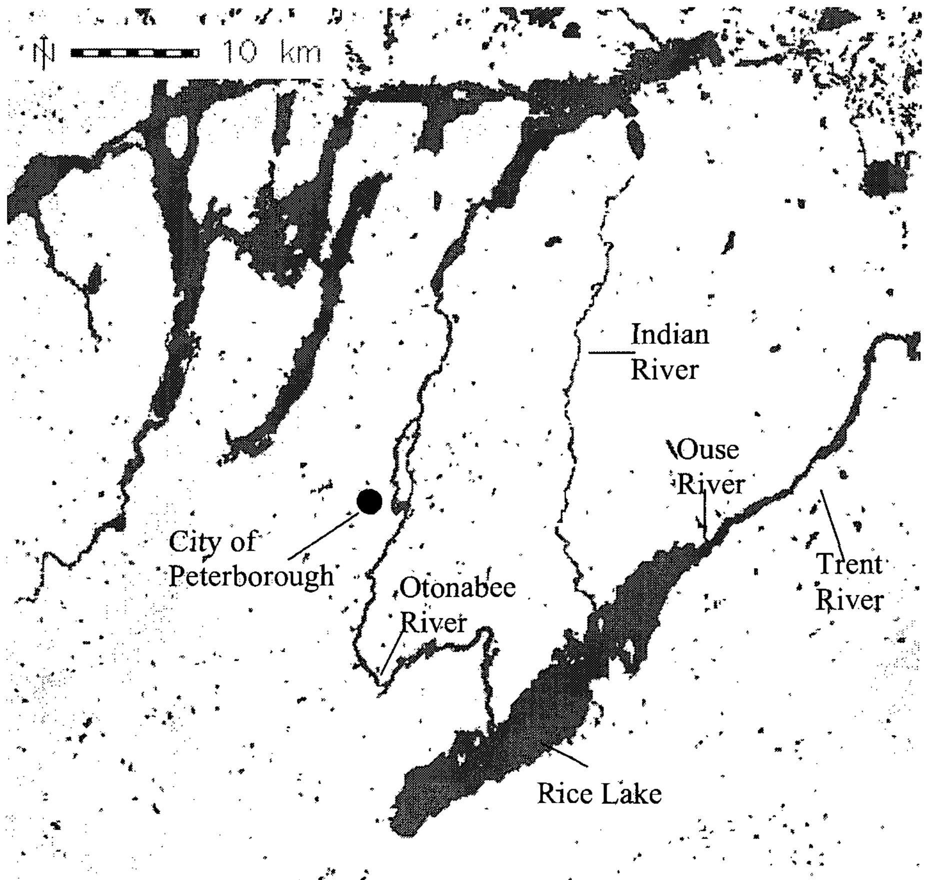

Figure 1.1 Rice Lake and surrounding region

unclear. They are made up of medium-textured stony till and are oriented in the direction of glacial movement (Chapman and Putnam 1984:16). They are an important feature of the Rice Lake region, as many of the islands in Rice Lake are drumlins (Chapman and Putnam 1984:17). Most important, however, is the fact that many of the mound sites sit atop drumlin features.

The Rice Lake burial mounds are a component of the Point Peninsula Culture, an archaeological grouping based on similar artifact assemblages and settlement patterns. Point Peninsula extends throughout much of southeastern Ontario, western New York and southwestern Quebec (Spence et al. 1990:157). Numerous burial mound sites have been identified over the past 120 years on Rice Lake and up the Trent River into the Bay of Quinte. A rough inception date of between 300 and 200 BC has been estimated for the Middle Woodland Period in southern Ontario, with the fluorescence of the Rice Lake Point Peninsula Phase occurring between AD 1 and 800 (Spence et al. 1990:164). The majority of mound construction is believed to have taken place during the early half of that period. In some areas of the province, the Point Peninsula phase seems to extend as late as AD 1000, but for the Middle Trent Valley a date range of 200 BC to AD 800 is suggested.

A total of five mound sites are included in this study, including the Miller Mounds, Harris Island Mound, Serpent Mounds, East Sugar Island Mounds and Cameron's Point Mounds (Figure 1.2). The Rice Lake burial mounds vary in size and form. Serpent Mounds is the largest of the mound sites, consisting of nine mounds (Figure 1.3), as well as a habitation area and a shell midden. The Harris Island Mound site on the other hand consists of only one large mound (Figure 1.4), and the East Sugar Island Mounds site consists of two mounds and a shell midden. The mounds themselves vary in height and form ranging from under 1 m to 2 m and from conical (Figure 1.5) to elongated (Figure 1.6). The burial types within the mounds also vary, including single burials, group burials and partial cremation. The variation that occurs in the mounds likely reflects cultural change occurring over the time the mounds were constructed.

1.4 Overview of Sample and Methodology

This study applies a comparative model between different Rice Lake area site sets in order to provide statistically relevant results on which to base interpretations. The sites being considered include the five positively identified Rice Lake mound sites, a set of 14 non-mound Middle Woodland sites, a set of 11 Archaic and Early Woodland sites, and a

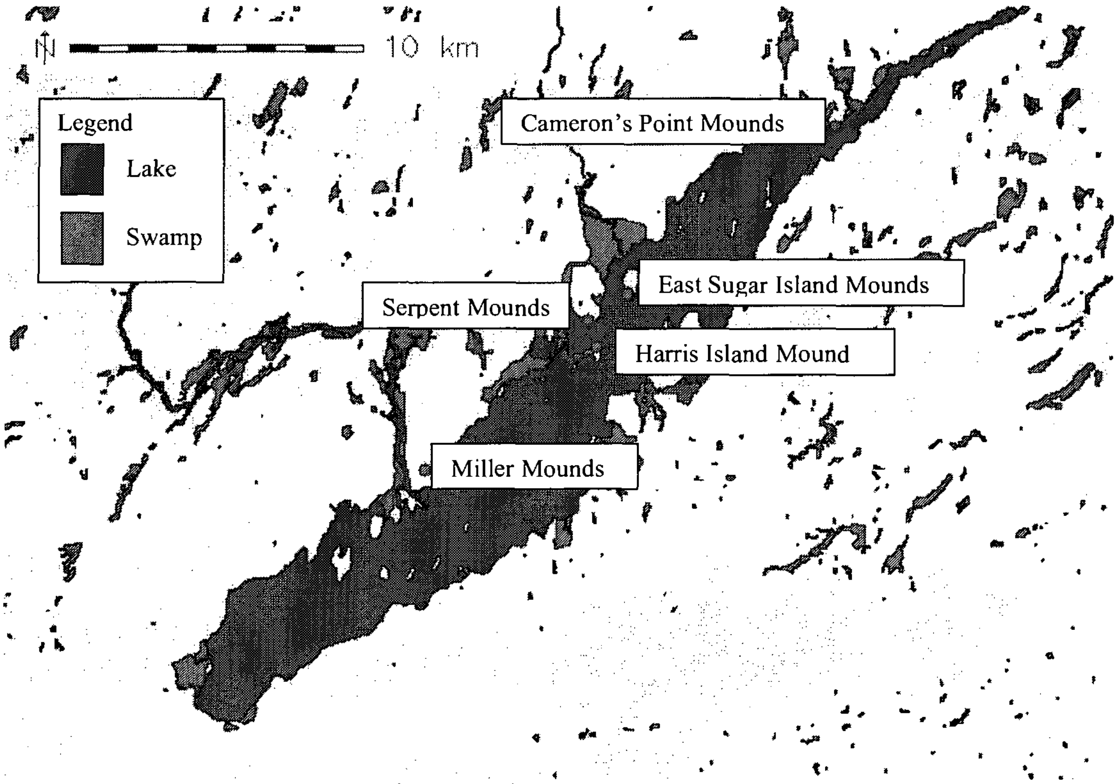

Figure 1.2 Rice Lake Mound Sites

Figure 1.3 The large irregular Mound E at Serpent Mounds Site

Figure 1.4 The Harris Island Mound

Figure 1.5 Conical mound (Mound H) at Serpent Mounds site

Figure 1.6 Elongated mound (Mound F) at Serpent Mounds site

set of 50 randomly generated sites. The general locations of all the sites, save the random sites, in this study are available in the form of point data from the Ontario Ministry of Culture. The random sites are generated in a GIS platform using specific criteria based on the existing sites around Rice Lake.

A key element to examining site visibility and establishing the interrelationships of the mound sites and their surrounding landscapes is the reconstruction of the landscape in approximation to how it would have been when the mounds were built. While it is impossible to know exactly what the landscape looked like 1500 to 2000 years ago, a number of changes that have occurred since then are recognized. The most significant change in the Rice Lake area has been to the water levels of the lake itself. Between approximately 3000 years age and the construction of the dams and locks for the Trent-Severn Canal during the mid nineteenth century, Rice Lake was little more than a swampy river area (Yu and McAndrews 1994:142). The construction of the Hasting dam in AD 1838 caused a 1.8-m increase in the water level of the lake (Yu and McAndrews 1994:142). Considering the current maximum depth of the lake is approximately 7 m, a 1.8-m increase is very significant. In order to recreate the pre-1830s water levels, modern lake depth charts are used. A number of factors of landscape change cannot be clearly corrected for, only roughly estimated. It is also necessary to reconstruct palaeo-vegetation using pollen core data collected for the Rice Lake area (McAndrews 1984).

Most viewshed analysis used in archaeology is largely quantitative focusing on how much is seen, referred to as total viewshed, versus a more qualitative analysis of what is visible. My preliminary research, conducted as part of my honours thesis (Dillane 2007), tested three different quantitative relationships: the total viewshed from each mound site, the visibility of the mounds from the water, and the intervisibility between the mound sites. In all three forms of analysis no significance was found against a randomly generated control sample. This research, while incorporating the fundamentals of total viewshed analysis, focuses largely on the qualitative aspects of what is visible. In particular, emphasis is placed on the relationship of the mounds and the lake and swamplands visible from them and vice versa. This relationship is emphasized due to the important role the lake and swamps played in the subsistence and transportation methods employed during the Middle Woodland period, as well as possible symbolic significance of water as it relates to the burials. Therefore the significance of the visibility relationships of the mounds is more specific and precise than my preliminary research. Field-based observations also are utilized to provide a real world perspective on visibility from Rice Lake as well as from the remaining mound sites. The purpose of incorporating such perspectives is to assess the validity of the viewsheds generated for this thesis.

1.5 Chapter Breakdown

The structure of my thesis is broken down into seven chapters including this one. Chapters Two and Three provide background into different aspects of this research. Chapter Two provides an overview of landscape and visibility in archaeology. It includes discussion of a number of different methods and theories applied to the study of archaeological landscapes. It also provides an overview of how visual characteristics of sites have been utilized in archaeological research, and provides background into the strengths and weaknesses of GIS-based viewshed analysis. Chapter Two concludes with an overview of the way in which concepts of territoriality and ideology are analyzed within a landscape concept. Chapter Three provides an overview of the cultural background of the Rice Lake Middle Woodland occupation. The definitions and descriptions of the Middle Woodland period and the Point Peninsula culture that occupied the study region are outlined. Additionally, the background and history of archaeological research relating to the Middle Woodland period on Rice Lake is discussed, including a number of the problems with past research. Discussion of the mound sites included in this study is presented, including a history and description of past excavation at those sites. Finally, an overview of the ideological contexts of certain aspects of the Middle Woodland occupation of Rice Lake is discussed.

Chapter Four outlines the methodologies applied in this research. This chapter includes an overview of the sample datasets included in this study, as well as discussion of the approaches to environmental modeling, quantitative and descriptive visibility analyses and some of the methodological shortcomings identified prior to analysis. Chapter Five presents the results of the analyses. It begins with a discussion of the quantitative results and then presents the results of the descriptive analyses and the findings of the field observations made on Rice Lake. The problems encountered during the analyses are presented and discussed after each section. Chapter Six then discusses the results and provides interpretations in relation to the hypotheses about site visibility related to territoriality and ideology considered in this thesis. The suitability of visibility analysis to the Rice Lake burial mounds, and future research directions also are presented in Chapter Six. Chapter Seven concludes the thesis with an overview of what the analyses entailed, the results and interpretations, and a number of the problems encountered and the potential of the methodologies for future application.

Chapter 2
Landscape and Visibility in Archaeology

2.1 Landscape Archaeology

The archaeological study of 'landscape' has changed significantly due to the changing theoretical climate of the discipline. While people began incorporating concepts of 'space' into the study of past people early in the twentieth century, it is only recently that such concepts have come into their own from a theoretical perspective (Tschan et al. 2000:36). Much of the past work in landscape archaeology focused on site identification, environmental reconstruction and placed emphasis on subsistence resources and their relationship with human economic and political systems (Knapp and Ashmore 1999:1). Out of the postprocessual movement of the 1980s and 1990s a more qualitative approach to landscape archaeology developed. This current perspective focuses on the experiential aspect of the landscape as people live in it and criticizes strictly analytical approaches for relying on abstractions of the real world such as maps and plans which fail to incorporate the sensual experience of landscape (Chapman 2006:14). Despite fundamental differences in method and interpretation of the landscape, there are a number of commonalities between the varying approaches, however, few attempts have been made to bring them together in any meaningful way (Geary and Chapman 2006:171).

'Landscape' may be defined in a number of different ways. Ingold (1993:153) differentiated landscape from concepts such as 'land', 'nature', and 'place'. He defines landscape as "...the world as it is known to those who dwell therein, who inhabit its places and journey along the paths connecting them" (Ingold 1993:156). It is conceptually distinct from the concept of environment in the same way the concept of body is distinct from organism, the former implying form and the latter implying function (1993:156). Likewise, Tilley (1994:10) differentiates his concept of landscape or 'space' from what he considers to be the abstract idealist perspective taken by the new geography and new archaeology, arguing that while they consider space to be a container in which human activity occurred, space is in fact a social production continually created by social experience. Both these definitions of what landscape is and means contrasts the concept to functional environmental perspectives. Bender (2002:104) modified such definitions arguing, "[h]uman interventions are done not so much *to* the landscape as *with* the landscape, and what is done affects what can be done. (original emphasis)" Robert Johnston (1998:7, cited in Knapp and Ashmore 1999:7) goes as far to argue that there is no single definition as to what landscape is, that the definition is dependent on the way it is applied.

Accepting that the definition of landscape itself varies contextually, we can still define the way in which landscape archaeology differs from other approaches to archaeology. Chapman (2006:11) defines landscape archaeology as "...a term commonly used to characterize those areas of archaeological research and interpretation that consider the landscape as opposed to the site, the interrelationship between sites, and the physical spaces separating them." Chapman's definition provides a very basic starting point for examining landscape and is inclusive of multiple theoretical perspectives. The importance of a landscape approach is the shift from examining the archaeological record beyond the site level. Traditionally, archaeologists have focused exclusively on 'hot spots' of past cultural activities or sites, and paid little attention to the areas that connected these sites to one another (Knapp and Ashmore 1999:2). Landscape archaeology recognizes that human interaction extends beyond the notion of place and that there is significance to the spaces that separate places. While it must be noted that the concept of place, as something separate from space, is a culturally relative dichotomy (Knapp and Ashmore 1999:6), the use of such a binary opposition is necessary in order to approach non-site space from an archaeological perspective. Simply put, the separation of space from place gives archaeologists a framework for understanding how people lived beyond simply where they resided.

As has been demonstrated through the difficulties in defining what landscape is, landscape has been addressed through many different theoretical perspectives and it has been looked at in many different contexts. It has been applied to analysis of prehistoric monuments (Scarre 2002), naturally occurring landmarks (Molyneaux 2006), mortuary sites (Buikstra and Charles 1999), prehistoric petroglyphs (Bradley 1994), settlement selection (Zubrow 1994), and numerous other topics in archaeology. The subject of this research is the relationship between visibility and landscape and how that relationship tied into the worldview of the people who built the Rice Lake burial mounds. The following sections examine the different ways in which visibility has been applied to archaeological research and some of the fundamental problems encountered in these approaches. This chapter concludes with a discussion of the relationship between ideology and landscape and how visibility ties into establishing and interpreting that relationship.

2.2 Visibility in Archaeology

Like landscape, the concept of visibility has had a long and varied history in archaeology, although it is only recently that it has been formalized as an approach in itself. It also potentially has a number of meanings that could be applied even within an archaeological context. Visibility in the context used in this research refers to "past cognitive/perceptual acts that served to not only inform, structure and organize the location and form of cultural features, but also to choreograph practice within and around them" (Wheatley and Gillings 2000:3). The earliest manifestations of visibility studies in archaeology were the informal observations of antiquarians as to what they could see from specific sites or structures (Wheatley and Gillings 2000:1). These informal studies include passing references to visibility from and between "...prehistoric hillforts, Roman Signal Towers, and medieval castle walls" (Lake and Woodman 2003:690). The development of formal visibility studies that incorporated statistical testing of viewsheds were largely the product of the European style of processualism modeled on the new geography (Lake and Woodman 2003:690). Most of these formal studies focused on monumental structures such as cairns from the Mesolithic and Neolithic in Great Britain (See Renfrew 1976; Fraser 1988). Like modern viewshed analysis, these early formal studies looked at total viewshed from site locations and compared these to non-site locations, in order to determine whether viewsheds were statistically significant (Wheatley and Gillings 2000:2).

The introduction of GIS technologies to archaeology as a discipline occurred in the early 1990s. Initial studies that used GIS to perform visibility analyses were largely informal like the initial non-GIS visibility studies (Lake and Woodman 2003:692). While novel in their application of the new technology to visibility analysis, these studies were heavily criticized for their failure to statistically test whether the results of their analyses were meaningful (Lake and Woodman 2003:692). A commonly cited example of this is the Krist and Brown (1994) study that argues Palaeoindian sites were constructed in locations that had a visible relationship to caribou migration routes. Because they fail to test their site locations against non-site locations in the landscape, it thus is possible that caribou migration routes were visible from a multitude of locations and that there were other factors that determined actual Palaeoindian site locations (Fisher and Farrelly 1997:583). This problem was quickly identified and corrected in later studies (Wheatley 1995; Fisher and Farrelly 1997).

While GIS methodologies were becoming the predominant form of analytical approaches to visibility analysis, another approach to landscape and visibility was being adopted by another group of archaeologists. The postprocessual movement which emerged in the 1980s in archaeology saw the emergence of a number of new intellectual perspectives, including Marxist, structuralist, feminist, and postmodern (Trigger 2006:444). Amongst the key interests of the postprocessual movement in archaeology were the interest in human agency and how the individual related to his world. Visibility as an individual and cultural experience emerged as a subject of great importance. This approach to the study of visibility in landscape is interested in how the individual viewed the world and focuses on subjective insights and experiences.

Over the last twenty years, quantitative studies have been replaced by GIS visibility analysis, while at the same time the development of experiential studies of visibility have arisen. The co-development of these two methods of understanding how past people visually experienced their landscape has been detrimental to the study of past visibility. These two approaches have been polarized against one another in a false dichotomy, suggesting that they cannot be integrated. Archaeologists therefore tend to take one approach and ignore the other, with little effort being made to integrate the two (but see the discussion of Hamilton et al. 2006 below). The following subsections examine the differing methodologies and theoretical perspectives of these two divergent approaches to visibility. The final subsection examines the criticisms of visibility analysis in archaeology shared by both the analytical and experiential approaches.

2.2.1 Analytical and GIS Approaches to Landscape Visibility

Analytical landscape analysis developed alongside the development of settlement archaeology, and originally focused largely on demographic, social interaction and economic resources (Knapp and Ashmore 1999:7). As already mentioned, what separates these methodologies from experiential and other non-analytical methodologies is the use of rigorous testing to establish visibility relationships. Such methods predate the introduction of GIS technologies into the discipline but have recently become increasingly reliant on their use. Theoretically speaking, much of the analytical interest in visibility has been carried out under another divergence from the new archaeology generally referred to as cognitive or cognitive processual archaeology (Lake and Woodman 2003:692). Unlike the relativist perspectives adopted by many of the post processualists, cognitive archaeologists wished to maintain the scientific rigour of the processualist movement (Renfrew 1994:4). Cognitive processualists differ from the functional processualism of the new archaeology in two fundamental ways; they sought to consider the role of the ancient mind in the past, and to move away from the purely positivist science of their predecessor (Renfrew 1994:3). It was from this base that some of the earliest statistical GIS visibility studies in archaeology emerged (Lake and Woodman 2003:692).

The development and application of GIS technology in archaeology has had a significant impact on a number of sectors of the discipline. From a strictly data management perspective, GIS technologies provide a large-scale spatial database in which a rich variety of data can be stored and accessed with relative ease (Conolly and Lake 2006:34). Archaeologically, such a database can be extended not only to site data information stored at a government database level but also to site level data obtained through excavation or regional data collected through survey. Beyond basic management, GIS has provided archaeologists with an array of tools for conducting spatial analysis and provides a platform for the production of visual representations to assist in the presentation of data.

Visibility functions in GIS analysis are generally carried out through the raster data structure as opposed to the vector data structure. The former consists of a grid of cells, each with a single value (Conolly and Lake 2006:27), whereas the latter is essentially an empty universe which the user populates with discrete geometrical primitives: points, lines, and polygons which act as abstractions of real world forms (Conolly and Lake 2006:25). Rasterized digital elevation models (DEM) in which each grid cell is given an elevation above sea level value are used as the basis for visibility analyses. The resolution of the raster model depends on the area contained within its cells: the smaller the area of each cell the greater the resolution of the map (Conolly and Lake 2006:28). Site locations, which are often used as the source of a viewshed, are represented through vector points. Vector points are defined by x/y-coordinates and can hold unlimited amounts of tabular data including qualitative and quantitative data

(Conolly and Lake 2006:25). Thus a site point can not only hold the geographic location of the site itself, but also an abundance of site data.

While a number of different techniques exist in GIS visibility analysis, they are all fundamentally based on a line of sight (LoS) function. Line of sight is the presence or absence of a visual relationship from one point to another. Viewshed analysis in GIS is an extension of this principle. All raster cells surrounding the source point are tested for the presence or absence of a line of sight, based on the topographic values contained in the DEM and a raster map is generated showing all those that demonstrated a positive result (Fisher and Farelly 1997:582). If, for example, an area higher then the source point is present, the cells behind the high area will be obstructed and therefore produce a zero value indicating non-visibility. Cumulative viewshed analysis (CVA) works in the same way as viewshed analysis but uses multiple source points to determine which locations are highly visible from surrounding sites and which are significantly less visible (Chapman 2006:135). Intervisibility, like viewshed analysis, is a function of line of sight analysis. However, unlike the basic line of site, intervisibility is used to determine a visual relationship between two viewpoint cells. If the line of sight is unobstructed from both cells they are said to be intervisible (Conolly and Lake 2006:226).

Analytical visibility analysis has been used in a wide range of contexts to address a number of different themes. The majority of these studies have been based in Great Britain and Europe, while comparatively few visibility studies have been conducted in North America. Aside from the aforementioned study by Krist and Brown (1994), two other studies that have been conducted on sites in northeastern North America (Waldron and Abrams 1999; Jones 2006) suffered from seriously methodological problems. Frank

Dieterman's (2001) doctoral dissertation, however, provides a methodologically sound application of viewshed analysis in the North American arena. Dieterman (2001:21) incorporates viewshed analysis into an elaborate site catchment model. The purpose of his dissertation is:

> ...to model the variation present within the surrounding landscape: to model settlement systems through a substantive approach as demonstrated by the location of sites in the natural landscape, and to demonstrate, via an inferential approach, the variation in settlement systems through viewshed and isochron analysis (Dieterman 2001:269).

Essentially, he uses viewsheds as a kind of social catchment whereby the viewshed from the site functions less as an experiential motivator for site selection, but instead as a social boundary or cognitive barrier for the range of activities undertaken by the site inhabitants partake in. The only major shortcoming of Dieterman's model is his failure to address palaeovegetation in his analysis.

Aside from the example of Dieterman's (2001) analysis, most North American applications of viewshed analysis are methodologically unsound and lack the statistical authority of their European counterparts. Fisher and Farrelly (1997) for example, use GIS cumulative viewshed analysis to test the significance of viewsheds from Bronze-Age cairn sites on the Island of Mull. Comparing these sites to a randomly generated set of sites as well as existing non-cairn Bronze-Age sites they test a number of hypotheses related to visibility (Fisher and Farrelly 1997:587-590). Statistical comparisons between their various datasets result in a number of conclusions. They determine that the viewsheds from the cairn sites are larger then those of other sites on the same part of the island as well as of sites situated the same distance away from the coastline (Fisher and

Farrelly 1997:590). However, they also determine that the views from the cairns were typical of sites in their immediate vicinity (Fisher and Farrelly 1997:590). Finally, they establish that cairns have a greater proportion of sea in their view, compared to land, than do other sites, and in particular the cairn sites share a view of a certain area of the sea compared to other sites (Fisher and Farrelly 1997:590-591). From these results they are able to develop interpretations that explain the results including the importance of trade relations over the highly visible water routes and the ritualistic importance of the sea for a coastally adapted people (Fisher and Farrelly 1997:591). A number of shortcomings remain in the methods employed by Fisher and Farelly (1997:587), including failure to account for palaeovegetation and edge effect, which are described in greater detail below.

Another good example of an analytical approach to visibility is that conducted by Lagerås (2002) on Bronze Age burial mounds in western Scania, Scandinavia. His study performed viewshed analysis on over 390 mound sites and analyzed both the views to the mound from surrounding areas and the views from the mounds (2002:184). Through his analysis, Lagerås (2002:186-187) determines that the views from the mounds far exceeded the prominence of the views of the mounds from the surrounding areas. Like Fisher and Farrelly, Lagerås tests his analysis against random points in the landscape to determine the statistical validity of his results. He also is able to compensate for the problem of edge effect by excluding those sites that would have had their viewsheds cut off by the edge of the DEM (Lagerås 2002:181-182). Finally, he also considers the effect of palaeovegetation on his results by considering pollen core evidence for the region. He determines that the vegetation of the period being considered was largely low grassland and would therefore have had a minimal impact on visibility. Though he admits that he is generalizing the vegetation patterns somewhat, he concedes he could not do anything more (Lagerås 2002:182). In his results he discusses the potential role the mounds could play in delineating territory and considers the potential cosmological significance of a view that incorporates large quantities of sea and sky into the burials (Lagerås 2002:188). These examples provide a general overview of the sort of visibility analysis currently being utilized in archaeology.

2.2.2 Experiential Approaches to Landscape Visibility

Experiential approaches to archaeology, as mentioned, made up some of the earliest approaches to visibility and landscape studies. However, the theoretical paradigms that developed in the mid twentieth century demanded greater scientific rigour than straightforward individual observations. Experiential approaches to landscape were virtually abandoned until the end of the twentieth century. With the emergence of a suite of theoretical paradigms that emerged in association with the postprocessual movements experiential and narrative approaches to archaeology reappeared. Perhaps the most cited example of experiential visibility analysis is Christopher Tilley's (1994) *Phenomenology of Landscape*. Tilley's (1994:12) idea of phenomenology is derived from the works of Heidegger and Merleau-Ponty. He defines it as the relationship between 'being' and 'being in the world' (Tilley 1994:12). More recently, Tilley (2008:21) has focused heavily on Bergson's (1991) work *Matter and Memory*. In particular, the concept of embodied experience is central to Tilley's approach to understanding the past. As he writes:

> ...through the perceiving and moving body, past and present interpenetrate each other. Perception draws the past into the present and reworks it; sense and

> significance form part of each other through their embodied mediation. Memory may consist of sensory 'images' produced in the mind or worked through habitually in the movements of the body which remembers itself without sensory images. The self is a combination of perception and memory, always reworking embodied perception in a creative and generative process, creating at any particular moment a new self in relation to the old selves that preceded it (Tilley 2008:22-23).

Essentially, Tilley's phenomenology attempts to place the human body as the intermediary between thought and world, creating a dialogue between the object (natural world) and subject (human consciousness), constantly recreating self through both memory and bodily experience (Tilley 1994:14). While this concept suggests an immediate relationship between the individual and nature, other phenomenological approaches in landscape archaeology have argued for perceptual frameworks that act as intermediaries between the two (Hamilton et al. 2006:34). In both cases, however, the human body remains the focal point for the dialectic, regardless of whether or not a perceptual framework exists to generate codes of interaction between people and space (Hamilton et al. 2006:34).

While not all forms of experiential archaeology are necessarily based in phenomenology, it has become the most used approach for examining past human experience of the landscape over the past 15 years. The phenomenological approach sits between the extreme objectivism of the functionalist processualists and the hyper relativism of much of the postprocessualist movement. As a result this approach has been widely criticized from both sides. The critiques from the processualist perspective centered on the lack of statistical verification of significance and the failure to compensate for palaeoenvironmental factors (Chapman and Geary 2000:318). On the other hand much of the critique from the postprocessualists argue that the alleged universalism of the human body is overly general and that the concept of being varies in different contexts; therefore, there is no common concept of being through which to experience the world (Hamilton et al. 2006:34).

Tilley's groundbreaking work set the stage for the development of phenomenological approaches in landscape archaeology. However, it also set him up to take the brunt of the criticism for his approach. In terms of landscape visibility one section of his book is of particular importance. During this analysis, Tilley made observations on site intervisibility between barrows on Cranborne Chase (1994:156). He observed the surrounding landscape from each barrow and determined which barrows had a high level of intervisibility and which had low levels. Furthermore, he observed the visual relationship between where the barrows were built and the surrounding landscape. Based on these observations he interpreted that barrow intervisibility was not of importance to the builders; rather the barrows appear to emphasize the margins of Cranborne Chase, and therefore ritualize the landscape (Tilly 1994:166). In general he has been criticized for failing to account for multi-vocality in his study since he carried out his observations alone (Hamilton et al. 2006:35). The extension of this is his supposed presumption that the experience of the body in the present is isomorphic with the experience of people who lived thousands of years ago (Hodder and Hutson 2003:119). However, to say that experience of the landscape is subjective does not inherently imply absolute cultural relativity, but rather a consciousness of historical particularism (Bender 2002:104).

Methodologically, such issues of multivocality have been addressed in more recent phenomenological approaches to landscape and visibility. Hamilton et al.

(2006:34) have argued in favour of phenomenological methods, suggesting that phenomenology is in fact an universalist approach to the past as it seeks to understand the past through the sensory experiences of the universal human body. They argue that the shortcomings of prior phenomenological studies lie not at their theoretical core, but rather in the methodological weaknesses of their approach. First and foremost, they incorporate the experiences of multiple individuals of mixed genders and ages into their observations (Hamilton et al. 2006:35). Furthermore, the methodology that they employ expands phenomenology from a dependence on vision alone, extending their observations to sound and smell as well (Hamilton et al. 2006:35). Whereas most prior phenomenological studies focused on sites of ritual importance, they approach a number of settlement sites where a range of daily activities would occur (Hamilton et al. 2006:35). The focus of their study was to understand the relationship between the Tavoliere plains and the mountainous Gargano Promontory, Italy. The research included multi-scale surveys using GIS and phenomenological survey, as well as the revisiting of past survey work in the area (Hamilton et al. 2006:35). Their research provides an excellent example of an integrative approach, which combines both experiential and non-experiential techniques to explore landscape as well as developing a standardized system for making phenomenological observations through the use of standardized forms.

A final problem that has emerged in experiential studies of landscape is a bias towards sites considered to be ritually important. Hamilton et al. (2006) provide one of the few studies that apply experiential techniques to the study of 'normal' settlements for the cultural period of their study. Perhaps the best example of an experiential approach to the daily lives of past peoples is Edmonds' (1999) *Ancestral Geographies of the*

Neolithic. In his narrative, Edmonds takes archaeological evidence for the Neolithic in Britain and describes an interpretation of what life and death would have been like in such societies. He describes the ancient landscape as one encapsulated by memory and reconstruction of meaning as people go about their day to day lives (Edmonds 1999:16). What is most important about Edmonds' descriptive approach to the lives of Neolithic people in Britain is his emphasis on the complexities of meaning and activity that are ascribed to their world. For example, he writes of death:

> There were many ways of dying. There were good deaths and bad, there was death out of place, and the dead were an important presence in the land. Earlier generations imposed themselves upon the consciousness of the living...Placed in pits they might speak of ties that bound a community to an earlier generation and to a place where kin had lived before (Edmonds 1999:58-59).

This passage speaks of a multiplicity of ways in which people in the past may have viewed death and the dead all at once. Such an emphasis is important because much of archaeology seeks only a single meaning for archaeological remains in certain contexts. Edmonds' experiential interpretation provides a humanistic account of the cultural landscape of the Neolithic. While he does take some creative license in his narrative style, he continuously binds his account to the extant archaeological evidence.

2.3 Problems In Approaching Visibility Archaeologically

While GIS platforms provide a framework within which to construct visibility models and even the ability to test some aspects of visibility statistically, a number of problems with such methodologies must be addressed. Some of these are unique to GIS based visibility studies while others persist in all forms of analysis concerning reconstruction or construction of past visibility. It should be noted that while there are solutions to some of these problems a number of them are unavoidable. The sections that follow outline some of these inherent problems with particular emphasis on those that have the greatest impact on visibility studies. Problems that are particularly detrimental to this research are discussed in detail below. The solutions employed to correct these in this research are discussed in detail in Chapter Four.

A number of methodological shortcomings of visibility analysis have been addressed over the years and their solutions are now commonly implemented in visibility studies. Viewer offset, for example, is used to replicate the height of an average person at the source of a viewshed. A height amount such as 1.5 m is added on to the source point, so that the view is not extended from ground level (Conolly and Lake 2006:232). However, the problem of observer offset is one of the more obvious problems for approaching visibility. Wheatley and Gillings (2000:2) break down the problems encountered in visibility analysis into three categories: pragmatic, procedural and theoretical. Pragmatic issues concern the material basis of visibility. Procedural issues refer to those that relate to those errors that are specific to computational errors in measuring visibility (Wheatley and Gillings 2000:2). Finally, theoretical issues encompass the fundamental difficulties of recovering past visibility in the present regardless of the means (Wheatley and Gillings 2000:2-3).

2.3.1 Pragmatic Issues

Pragmatic problems are those which apply to both GIS and non-GIS visibility analysis and include factors such as reconstructing the palaeoenvironment, the visibility and contrast of an object depending on its physical parameters in relation to its background, the mobility of the viewer, changes over short and long periods of time, and view reciprocity between objects (Wheatley and Gillings 2000:5).

2.3.1.1 Changes in the Palaeoenvironment

The most commonly cited difficulty in all types of visibility analysis is the problem of reconstructing the environment of past landscapes. A number of changes in palaeoenvironment can dramatically alter landscape, and therefore visibility, over time. Factors such as erosion, flooding, river-course changes and isostatic rebound all work to continuously alter the landscape. Flooding is of major concern in the reconstruction involved in the current study. Ways of compensating for this issue will be discussed in Chapter Four. Of all the possible problems regarding palaeoenvironment, palaeovegetation has been one the most controversial elements of visibility analysis. Archaeologists engaging in visibility analysis tend to admit it as a shortcoming and move on, ignore it completely, or dismiss it as impossible to reconstruct (Chapman and Geary 2000:317). The reason palaeovegetation is so often dismissed or ignored is the difficulty in attempting to replicate it. It is impossible to know where individual trees once stood unless they burnt down and left a root-burn feature in the soil, let alone to identify the extent and date of an entire forest. To confound things further, temporal changes in vegetation both seasonally and over the long term would have a massive impact on visibility at a local scale (Wheatley and Gillings 2000:6). In an area such as Rice Lake, seasonal changes in vegetation impact visibility greatly with visibility increasing dramatically as the trees lose their leaves through the fall. Methods such as pollen core analysis have been utilized to identify specific types of vegetation that occur in various regions and some methods such as pollen rain analysis have been used to attempt to analyze the possible distribution of plant sources (Geary and Chapman 2006:173). However, reconstruction of the exact location of vegetation is fraught with difficulties and as the presence of vegetation would clearly impact human existence and interaction in past environments some form of accommodation is clearly necessary (Geary and Chapman 2006:173). A number of studies that have attempted to integrate palaeovegetation into visibility and landscape studies have met with mixed receptions (Geary and Chapman 2006:174). Methods of compensating for palaeovegetation tend to involve the addition of extra height values to the raster cells of the DEMs used for the viewshed analysis. The height values added are often based on local palaeovegetation data and are applied in various densities to incorporate aspects of seasonality and human activity (Wheatley and Gillings 2000:6). More specific discussion of how palaeovegetation is to be addressed for this study is presented in Chapter Four.

2.3.1.2 Object Background clarity and Temporality

This section combines a number of the pragmatic problems discussed by Wheatley and Gillings (2000). These problems all tie into the physiological or environmental limitations of human visibility. The physiological limits of human visibility clearly affect the amount that is actually visible to any given individual. While many studies implement a cut off distance given the maximum distance an individual can see, a number of studies do not (e.g. Jones 2006). However, even though an individual can see to a certain distance, this does not mean that everything within the range of view can be seen clearly (Wheatley and Gillings 2000:6). The farther away an object is the less clearly visible it will become. On top of this the contrast between the object and its surroundings will also have an impact on its visibility (Ogburn 2006:407). A green mound on a green hill will be much less visible than a red mound on a green hill. Currently, GIS visibility analysis is either performed with a binary output, what is seen versus what is not seen, or indexically, meaning the degree of visibility is rated on a scale of what is clearly visible, somewhat visible, and not visible (Tschan et al. 2000:33-34). The latter is applied in order to compensate for these aforementioned difficulties by scaling the quality of view within the total viewshed.

However, other factors do influence how visible objects are in the landscape. An individual moving across an area will see a landscape in a much different way than a static individual, and most visibility studies use static points (Wheatley and Gillings 2000:7). This particular problem has been addressed in a few studies through the use of multiple points along a pathway or the integration of virtual reality modeling (Wheatley and Gillings 2000:7).

Temporal issues also are a factor. During the course of a day lighting and atmospheric conditions change extensively. From morning to night overall visibility fluctuates through a number of extremes, with little to none at night to optimal conditions around noon (Wheatley and Gillings 2000:7). Add to this the effects of seasonality and weather conditions, which can fundamentally alter total visibility, making it very difficult to reconstruct. While indexical approaches could be applied to compensate for some of these natural obstacles, archaeologists tend to favour the use of ideal condition models for the environments being considered.

2.3.1.3 Presumed View Reciprocity

The problem of view reciprocity applies when considering intervisibility and occurs when analysts assume that because one point is visible from another the opposite also is true (Wheatley and Gillings 2000:7). This is not always the case. This problem can be solved by running line of sights from both points to determine intervisibility, instead of only from one of the points.

2.3.2 Procedural Issues

Procedural issues consist of problems associated with studying visibility using a digital reconstruction (Wheatley and Gillings 2000:9). Some issues, such as the lack of quantitative rigour, have already been addressed in earlier sections and therefore are not covered here. However, there are a number of others procedural issues are discussed below. These include problems such as the sensitivity and scale of the DEM and the algorithms used to generate the viewshed, which are issues related to the abstraction of reality in the digital model. Two other procedural issues that are also addressed below include the robustness and sensitivity of the viewshed analysis and the edge effect.

2.3.2.1 Abstraction

One of the most adamant criticisms of GIS based visibility analysis is the level of abstraction involved in the digital model. The DEM, for example, simplifies the topography of the landscape to a degree dependent on its scale (Wheatley and Gillings 2000:9). If for example each raster cell represents a 5-m area, all topographic variation within those 5 m is simplified to a single above sea level measurement. This could radically affect the viewshed outcome if a small prominence is removed during the generalization, or is taken as the value for that entire 5-m area. Another related problem is that of the algorithms used to produce the viewshed output because these do not produce uniform outputs (Fisher 1993). In other words variation exists in the production of a viewshed due to the algorithm applied (Fisher 1993:332). This problem can be extremely detrimental to the statistical outcome of viewshed analysis. Fisher (1993:344) therefore recommends the use of a probable viewshed model whereby multiple simulations are run from the same point in order to generate a statistically likely output.

2.3.2.2 Robustness and Sensitivity

This issue relates to the need to run repeated viewsheds from a single point in order to test different outcomes related to height of the viewer and target and vegetation patterns (Wheatley and Gillings 2000:11). As previously discussed vegetation patterns can have a major impact on visibility and must be accounted for. Viewer height is usually tested at a perceived average like 1.5 m though this could vary depending on the population being considered. Other factors must also be considered; for example, in this study, one of the variations of the test for visibility from the lake will set observer offset at 1 meter above water level in order to account for the person sitting or kneeling in a canoe.

2.3.2.3 Edge Effect

Edge effect or rim effect occurs when part of the viewshed is cut off by the edge of the DEM (Wheatley and Gillings 2000:11). This can be particularly detrimental when applying cumulative or multiple viewsheds, because the severing of viewsheds could adversely affect the statistical validity of the study (Wheatley and Gillings 2000:12). As has already been seen in the Lagerås (2002:181-182) example, the easiest solution is to generate a buffer around the project area, thus avoiding the cut off.

2.3.3 Theoretical Issues

Theoretical issues are those that apply to the concept of visibility analysis as a whole and are generally grounded in the postmodern/poststructural critiques (Wheatley and Gillings 2000:12). As many of the fundamental issues with the study of visibility have been touched on already, only one such critique will be discussed here: the issue of visualism.

2.3.3.1 Visualism

Visualism refers to the bias placed on the sense of sight above all other senses in the study of landscapes. Many argue that the preferential treatment of sight above the other senses places a modern bias on such studies that does not necessarily reflect the reality of past peoples who may have placed as much or more emphasis on the other senses (Wheatley and Gillings 2000:13). Although vision is clearly the easiest and most testable sensory faculty, methodologies are gradually being considered to study the role of the other senses in a landscape context (Tschan et al. 2000). However, currently the best way to incorporate the senses other than sight into the study of visibility is through experiential approaches as applied by Hamilton et al. (2006:52) who included experiments of sound and smell as well as sight into their study.

2.4 Burial Sites as Territorial Markers

The association of formal cemeteries with territorial and resource control has a long lineage in archaeological thought (Morris 1991:150). However, the popularity of this association in modern archaeological theory can be widely credited to Arthur Saxe's PhD dissertation on the social dimension of mortuary practices (Saxe 1970). Saxe (1970) based his hypotheses on ethnographic data on mortuary practices. Most relevant here is his hypothesis 8, in which he asserts that:

> [f]ormal disposal areas exclusively for burial of the dead (i.e., a cemetery) are maintained by corporate groups legitimizing through descent from the ancestors their rights over crucial but restricted resources, and conversely (Saxe 1970, summarized by Parker Pearson 1999:30).

This hypothesis essentially asserts that the function of formal burial sites is the demarcation of ownership over resources through a lineal connection to the dead interred within such sites. This hypothesis was modified by Goldstein (1981) due to its

> ...unintentional implication that cultures will ritualize a particular aspect of their social organization in the same form, i.e. by maintaining formal specialized disposal areas when corporate group rights to restricted resources are legitimized by lineal descent (Goldstein 1981:61).

Goldstein therefore modified Saxe's hypothesis 8 to incorporate the way in which ideological variability among cultures impacts mortuary ritual and resource inheritance/control (Morris 1991:148). Specifically she states that there is utility to Saxe's hypothesis:

> ...if there is a formal bounded disposal area, used exclusively for the dead, then the culture is probably one which has a corporate group structure in the form of a lineal descent system. The more organized and formal a disposal area is, the more conclusive this interpretation (Goldstein 1981:61).

Morris (1991:149) reviewed the utility of what he termed the Saxe/Goldstein hypothesis, in reference to the modifications made by Goldstein (1976), by examining the historic examples of cemeteries in classical Athens and Rome. He determined that the hypothesis could be applied to the cemeteries of both cities, but that the language of the cemeteries, especially in the case of the Athenian cemeteries, expresses a great deal more than simple property rights and resource control (Morris 1991:163).

> ...such ideological statements mediate competition and conflict. Property relations are relations between people; one person's freedom of access is another's unfreedom. The links between ancestor cult, mortuary rituals, and inter-generational transmission of power are very largely determined by the outcome of struggles...(Morris 1991:163).

The relationship between formal burial sites and resource inheritance is also dependent on the economic structure of a given culture. One would expect differences among the ways agriculturalists, pastoralists, and hunter-gatherers manifest control and inheritance through formal cemeteries. However, economic structure does not necessarily determine cultural practices (Morris 1991:152). Ultimately, generalizing models like the Saxe/Goldstein hypothesis are only effective when examined within the culturally specific level of the society being examined.

Of paramount importance to Morris' critique of the Saxe/Goldstein hypothesis is the division between mortuary rituals and ancestor cults (Morris 1991:150). The former refers to the rite of passage ritual that separates the dead from the living, while the latter are those rituals that maintain a relationship with the dead and the world of the living. These two concepts are interconnected in many ways but they are not identical or interchangeable, especially regarding how they affect the transmission of powers between generations. Morris (1991:153) notes that in the case of a number of Southeast Asian examples, ancestor cults reinforced lineage unity and communal property inheritance, whereas mortuary rituals functioned as competitive displays.

In an example more closely related to this study, Buikstra and Charles (1999:207-208) have suggested that the ancestor cult model fits well with Middle Archaic bluff top burial mounds in the Lower Illinois Valley. Such mounds, situated atop very prominent bluffs, likely functioned as territorial markers amongst groups becoming increasingly sedentary in that region. In contrast they identify a different kind of Middle Archaic burial site located on flood plains that include very high amounts of artifacts associated with the burials. They conclude that such burials are indicative of the competitive displays associated with mortuary rituals (Buikstra and Charles 1999:212). They argue that such variation in burial structure and location are the product of transitions likely resulting from the increase in sedentism and the negotiation of cosmological beliefs with significant social and hierarchical changes that accompany such a transition (Buikstra and Charles 1999:222).

There are a number of significant concepts included in the above summary. Most relevant here is the idea of formal cemeteries representing displays of territorial and/or resource control. This idea has been used repeatedly in viewshed and visibility analysis often with very little discussion of its theoretical underpinnings. Lagerås (2002) for example, discusses the potential of the mound sites to act as territorial markers but does not provide any social context for such a function. While territoriality was one of several possible interpretations Lagerås (2002:182) puts forward, such generalizations have been the subject of postprocessual critique of Saxe's hypothesis 8, and processualism as a whole, since the early 1980s (Pearson 1999:32). As highlighted by both Morris's (1991) review and Buikstra and Charles' (1999) analysis, it is crucial to provide a thorough context of the individual culture before applying a model such as the Saxe/Goldstein hypothesis to the archaeological record.

2.5 Ideology and Landscape

The idea of a sacred or ritualized landscape must be applied with caution in archaeological contexts. As Hawkes (1954:162) warned almost sixty years ago, spirituality is often superficially visible but meaningfully elusive. While Hawkes' recommendation to avoid such topics in archaeological investigation all together may have been throwing the baby out with the bath water, he was right to point out the difficulties in determining very specific meanings. Terms such as sacred or ritualized also carry with them the idea that other sites are not sacred, that they are profane. However, such a dualism is a very western concept. Most cultures do not recognize any division between sacred and secular worlds (Edmonds 1999:8-9). Thus any study of landscape is a study of rich and diverse meanings written into the landscape by the cultures that interact with it over time and space as gleaned through continuity and change in the physical record (Crumley 1999:271).

Landscape features, both natural and man-made, are constantly being imbued with cultural meaning. Natural features like mountains, caves, rivers, and floodplains act as connections between people and the world around them (Crumley 1999:270). Therefore, people give meaning to such natural features in order to give their own lives meaning. However, the meanings applied to a space are not static or universal, as individuals and social groups are continually constructing and altering meanings applied to landscape and landscape features (Tschan et al. 2000:37). As Molyneaux (2006:68-69) points out, natural features like the footprint shaped hollow atop Sri Pada, a mountain on the coast of

Sri Lanka, have been interpreted by numerous cultures as part of their own cultural belief systems. On the other hand many of those cultures have indeed recognized it as a divine footprint (Molyneaux 2006:69) suggesting a common experience in the observation of the prominence of this feature's form.

The interpretation of the landscape's ultimate meaning to past peoples lies at the centre of both the experiential and analytical approaches to visibility and landscape. Both perspectives seek to decode the ways in which people in the past interacted with their landscape thereby defining it. While the analytical approach tends to depend on statistical quantification to determine relationships, such an approach can be inherently reduced to questions of why that settlement or structure was built here as opposed to somewhere else. Likewise, those who take an experiential approach seek to address the same question; however, they seek this by attempting to re-experience the landscape of the past inhabitant. Now many archaeologists are seeking ways to incorporate these distinct methodologies in order to better address their common questions. Hamilton et al. (2006) for example, incorporated both GIS analysis and phenomenological observations into their approach in order to better understand past settlement systems. Combining aspects of these methodologies can provide an important balance to visibility based research and can help to limit the critical gaps in both techniques. This study aims to help demonstrate the productivity of such an integrated approach.

Chapter 3
Cultural Background

3.1 The Middle Woodland Period in Southern Ontario

Ontario's Middle Woodland period runs from approximately 300 BC to AD 800, although these dates vary from region to region within southern Ontario (Ferris and Spence 1995:97). It is broadly defined by changes in ceramic and lithic technology, and in some regions the increased presence of exotic goods associated with the Hopewellian Interaction Sphere, and the elaboration of mortuary practices (Spence et al. 1990:143). In southern Ontario the Middle Woodland period is subdivided into three cultural groupings, Point Peninsula, Saugeen, and Couture (Spence and Fox 1986:33). These groups are distinguished by variation in material culture, specific cultural practices (mortuary practices in particular), and geography. The Saugeen complex and the Couture complex occupy southwestern Ontario, with the Couture complex occupying extreme western Ontario (Spence et al. 1990:145) and the Saugeen complex extending along the shores of Lake Huron, between London to the west and the Grand and Nottawasaga Rivers to the east (Spence et al. 1990:148). Along the eastern boundary of the Saugeen region there is some question as to whether the Middle Woodland sites are Saugeen or Point Peninsula. The Point Peninsula complex extends through western New York State, southern Quebec along the St. Lawrence and into south-central Ontario along the north shore of Lake Ontario (Spence et al. 1990:157). The Ontario occupation of Point Peninsula has been identified as far south as Hamilton and St. Catharines, but is most prevalent in the Trent Valley. The material culture remains that are commonly associated with the Point Peninsula complex at Rice Lake are similar to the other Middle Woodland complexes in Ontario. Vinette 2 ceramic vessels, which are thinner and more refined then their Early

Woodland counterparts and decorated differently, a variety of chert and ground stone tool forms, and a heavy utilization of antler and bone for the manufacture of items such as harpoons, fishhooks and combs, are all commonly associated with Point Peninsula occupations (Spence et al. 1990:159). It should be noted that the definitions of these complexes reflect only a broad spatial taxonomy and do not reflect actual group boundaries. Recently, overlaps between these groups and blurring of trait boundaries have led to a greater emphasis on more localized complexes (Ferris and Spence 1995:98).

3.2 The Middle Woodland Occupation at Rice Lake

The lands around Rice Lake have been occupied since the Palaeoindian period, though occupation intensified during the Late Archaic period (Johnston 1968b:6). A number of significant Late Archaic and Early Woodland sites have been documented on or near the lake, the most notable of which are the Dawson Creek Site (Jackson 1980, 1988), located at the western end of Rice Lake, and the McIntyre Site (Johnston 1984), located between the Indian and Otonabee Rivers. The Middle Woodland occupation of Rice Lake consists of a number of seasonally occupied sites predominantly located on the north shore and islands of the lake. These sites are generally divided into two classifications; base camps, containing extensive shell middens and burial mounds, and campsites, consisting of diverse artifacts and lacking burials. Due to the substantial interest in the burial mounds, the base camps have received much greater attention from archaeologists over the past seventy years, starting with Ritchie's excavations at the East Sugar Island shell midden in the 1940s (Ritchie 1949). Ritchie's work was followed by excavations of the shell midden at Cameron's Point by Harper (Harper and Spence 1968) and at the Serpent Mounds shell midden by Johnston (1968a) in the 1950s.

Johnston (1968b:3) followed this by conducting a wide scale survey throughout the Rice Lake area during the late 1950s, focusing on sites where cultural material had been identified by local residents and cottagers. He identified numerous small campsites dating to the Middle Woodland period throughout the Rice Lake area (Johnston 1968b:12-25). Unfortunately, few of these sites were test excavated and much of the information reported by Johnston is largely anecdotal. Since the Trent Surveys of the 1960s and 1970s, only occasional excavations have taken place at settlement sites around Rice Lake. In 1976 Jackson (1980) performed test excavations at the Dawson Creek site, an Early Woodland site on the western end of Rice Lake. Follow up to this excavation also revealed the presence of Middle and Late Woodland components (Jackson 1988). More recently Curtis (2003:85) has conducted excavations at the Spillsbury Bay site located approximately 2 km west of Cameron's Point. Her excavation revealed a seasonal resource procurement site with a shell midden (Curtis 2003:85). Aside from these studies a number of sites have been investigated through cultural resource management activities but with little formal publication.

3.2.1 Chronology of Middle Woodland Sites in the Rice Lake Region

The dating of the Middle Woodland in the Trent Valley is based predominantly on a combination of radiocarbon dates gathered mainly from mound sites, ceramic analysis and seriation, and limited settlement data. Table 3.1 lists the relevant dates for the sites included in this study. A rough inception date of between 300 and 200 BC has been estimated based on the appearance of diagnostic Middle Woodland ceramics. However, the most prominent manifestation of the Rice Lake Point Peninsula Phase has been estimated as dating between AD 1 and 800 with the majority of mound

Table 3.1: Radiocarbon dates for sites discussed in the text

Site	Subsite Component (Lab No.)	Radiocarbon Dates b.p. [a]	Calibrated Calendrical Date [b]
Serpent Mounds	Midden Base (M-1104)	2020 +/-75	111 BC to AD 63
	Mound 'E' East (M-850)	1830 +/-200	41 BC to AD 417
	Mound 'E' South (M-1105)	1660 +/-75	AD 259 to 530
	Serpent Pits (UGa-2488)	905 +/-60	AD 1041 to 1184
	Serpent Pits (UGa-2487)	510 +/-60	AD 1324 to 1345
Dawson Creek	(S-2238)	2170 +/-15	349 BC to 191 BC
	(S-2243)	1990 +/-80	93 BC to AD 86
	(S-2244)	1535 +/-75	AD 433 to 593
	(S-2207)	1405 +/-60	AD 588 to 669
	--------	835 +/-65	AD 1155 to 1268
East Sugar Island	Sub-mound floor of the Prince Mound	1890 +/-60	AD 59 to 213
Cameron's Point	(DIC-1072)	1850 +/-55	AD 87 to 233
LeVesconte Mound	(DIC-1071)	1830 +/-50	AD 126 to 243
	(DIC-732)	1720 +/-55	AD 255 to 386

[a] Data from Smith 1997:Table 2

[b] Generated using Calib Rev 5.1 based on Reimer et al. 2004

construction occurring in the early half of that period (Spence et al. 1990:164). Curtis (2002) has developed three revised temporal phases for the Rice Lake and Trent River Point Peninsula, based on ceramic typology and settlement patterns. The Trent phase dates to pre AD 1, the Rice Lake phase dates AD 1 to 800, and the Sandbanks phase dates from AD 700 to 1000 (Curtis 2002:15).

3.2.2 Settlement and Subsistence

Settlement data for the Rice Lake Middle Woodland period is limited. Sites that have been excavated have revealed only limited evidence suitable for reconstructing settlement patterns. While intensive excavation has been carried out at some of the large shell midden sites associated with the burial mounds, such sites likely represent ritual feasting activities (Jamieson 2008:16) and may not reflect the day-to-day subsistence of the Middle Woodland occupation of Rice Lake. Spence and Fox (1986:36) suggest large band agglomerations along major water routes during the spring-summer with a heavy reliance on aquatic resources and dispersion into smaller inland familial hunting groups during the winter. However, this pattern has yet to be demonstrated through intensive regional survey (Spence and Fox 1986:36). Maize horticulture as a basis for subsistence postdates the Rice Lake phase of the Middle Woodland by approximately 300 to 500 years. However, its introduction into the area may have occurred much earlier than its adoption as a staple subsistence resource. A carbonized maize kernel recovered by Jackson (1988:29) at the Dawson Creek Site returned a radiocarbon date of 220 BC, though this date is highly suspect, owing to the probability of mixed site occupation components. More recently, Katzenberg (2006:270) has demonstrated the presence of maize in the diet, albeit in small amounts, through carbon isotope analysis of skeletal remains from Serpent Mounds Mound E dating to between the fourth and fifth century AD. Harrison and Katzenberg (2003:241) suggest based on stable isotope findings that maize may have appeared in southern Ontario by around AD 500 as a result of trade from the south (but see Smith 1997 and Crawford et al. 1997 for alternative explanations). Their findings show a spike in the presence of maize in people's diets at about AD 1000 in areas throughout southern Ontario, suggesting it was not heavily utilized as a staple crop until that time (Harrison and Katzenberg 2003:241).

The seasonal patterning of settlement suggests a broad based subsistence economy focused mainly on freshwater resources. Spence et al. (1984:120) present a four-season breakdown of subsistence resources in the Rice Lake area. Due to the fact that most of the Rice Lake sites were excavated prior to the use of more refined excavation techniques, such as floatation, we lack evidence of a number of subsistence resources that may have been exploited such as wild rice and nuts (Spence et al. 1984:121). A number of subsistence resources have been identified through the archaeological record including deer, muskrat, and various fish species. In the Middle Woodland component of the Dawson Creek site, Jackson (1988:29-30) identified a number of animal and plant remains including deer, catfish, and charred nut remains (likely acorn). In the middens associated with the burial mounds, faunal patterns indicate a high utilization of aquatic resources, in particularly mollusks though small amounts of other animals are present. Johnston (1968a:43) notes for the Serpent Mounds midden that deer remains were found, though not in great abundance, and mainly consisted of long bones, which may have been cracked for their marrow. He mentions smaller amounts of small mammals like rabbit and beaver, while bird bones were extremely rare (Johnston 1968a:43). Fish and turtle remains occurred with relative frequency (Johnston 1968a:43). For the East Sugar Island midden, Ritchie (1949:5) reports the presence of a number of faunal remains including deer, beaver, porcupine, turkey as well as fish and turtle remains from one hearth feature. However, with the exception of the fish and turtle remains, none of the others appear prevalent outside that feature. Due to the apparent association of mound sites and aquatic resources, two of those resources will be discussed here in some detail: shellfish and wild rice.

Due to poor preservation and the lack of more refined recovery techniques when most of the Rice Lake sites were excavated, wild rice has yet to be identified within a cultural context. Rather, its use by the Middle Woodland occupants of the region is based on its likely presence in the environment as indicated by pollen core analysis (McAndrews 1984:185), and indications that the major Middle Woodland sites cluster around wild rice stands (Spence et al. 1984:119). The absence of direct evidence of wild rice harvesting has resulted in a reluctance to identify it as a central subsistence resource during the Rice Lake occupation of the Point Peninsula period. Spence et al. (1984:121) also note a discrepancy in dentition patterns between skeletal remains recovered from the LeVesconte mound compared to later populations from the upper Great Lakes who were heavily reliant on wild rice. They note in particular that the teeth from LeVesconte show heavy wear and a lack of caries, which contrasts with the finding for the Hungry Hall Mound 1 site, a Late Woodland occupation reliant on wild rice (Spence et al. 1984:121). These later groups likely had developed techniques for separating the husk from the kernel of the rice grain, as noted amongst historic wild rice harvesting groups (Stickney 1896:119), which may have reduced dental trauma. Wild rice would also serve to attract large amounts of waterfowl especially during the late summer and early fall when it is ripe (Steeves 1952:118). However, only very small amounts of waterfowl remains have been identified at Middle Woodland sites in the region.

Shellfish appears to factor substantially into the subsistence pattern of the Middle Woodland inhabitants of the area as indicated by the sizable shell middens found throughout the area. Little analysis of the significance of shell has been carried out for this region. This is not unusual as the importance of shellfish as a food resource is often undervalued (Spence and Fox 1986:38). Greater emphasis on the importance of shellfish as a food resource is certainly needed in the evaluation of the temporal changes in Rice Lake settlement and subsistence patterns. At Serpent Mounds, the shell midden consisted entirely of two species of mollusks, *Elliptio complanata* and *Lampsilis radiata siliquoidea* (Johnston 1968a:42). Both are native species to the region, though the latter is more prominent south and west of the region and only occurs intermittently within the Lake Ontario and St. Lawrence drainages (Clarke 1981:344). *E. complanata* lives in shallow water in permanent lakes, rivers, and medium sized streams living in clay, mud, sand or mud bottoms (Clarke 1981:266). *L. radiata siliquoidea* lives in all sizes of lakes and rivers, in water as shallow as 5 to 8 cm with any kind of bottom, but is especially plentiful along riverbanks (Clarke 1981:344). The analyst who examined the shell remains for Johnston noted that the absence of species like *Anodonta grandis* would suggest that the mollusks were harvested from a river or river-lake (Johnston 1968a:42).

While mussels cannot function as the sole food resource for a population due to the sheer volume that would be required per individual (Parmalee and Klippel 1974:433), they can certainly make up an important component of the diet. Though low in carbohydrates, mussels can act as a staple source of protein. Erlandson (1988:105-106) estimates that 7.5 individuals of the mussel species *Proptera alata*, a species with comparable size to those species identified at Serpent Mounds, can provide the daily protein requirements for an individual. This adds up to approximately 5625 individuals of that species being required to sustain the protein needs of a group of 25 individuals for an entire month (Erlandson 1988:106). In order to prepare mussels, they are dried or steamed and can be easily opened and cooked in small fires for as a little as six to seven minutes and can then be sun dried for storage (Henshilwood et al. 1994:107-108). It is likely that the extensive shell middens found at Serpent Mounds, East Sugar Island, and Cameron's Point were sites for gathering and shelling large numbers of mussels for consumption throughout the year.

3.2.3 Population Estimates and Social Structure

Spence has defined a seasonal settlement system involving the utilization of large base camps, generally accepted as those sites with extensive shell middens and burial mounds, and smaller campsites utilized to harvest various local resources (Spence et al. 1984:123). Spence argued that in the Rice Lake area bands with large populations up to between 100-200 individuals occupied territories surrounding the three river drainages into Rice Lake, the Otonabee River, the Indian River and the Ouse River (Spence et al. 1984:123). This interpretation has been adopted by a number of archaeologists working in the region despite a number of inconsistencies in the model. The population estimates generated by Spence were based on the assumption that Mound C at Cameron's Point was a single burial episode triggered by the death of a headman (Spence et al. 1984:124). The individual Spence believed to be the headman was a 28-year-old male interred with a large number of burial goods (Spence et al. 1984:124-125). Based on the age of the individual, Spence argued that he could only have been the local headman for ten years and therefore, the remains interred in Mound C represented all the dead of that group that had accumulated over the past ten years. Taking the number of dead in ten years and with an expected death ratio of 3.3 % Spence generated the 100-200 individuals estimate (Spence et al. 1984:125).

Jim Wilson (1993:21) has argued that Spence's population estimates far exceed the known number of burials throughout the region for the 500 or so years burial mounds were constructed during the Rice Lake phase. He argues instead that Mound C at Cameron's Point was a three stage burial as has been interpreted for Serpent Mound E and that a much smaller population size of between 25-50 individuals per watershed is much more consistent with the mounds and burial figures recorded throughout the region archaeologically (Wilson 1993:23). However, more recent reevaluation of the excavation reports seem to indicate continuity of burial remains suggesting that the interment was a single event (Dougherty 2003:126). Dougherty (2003:127) suggests instead that the accumulation of remains prior to the interment in Cameron's Point Mound C was a much longer period than the ten years originally suggested by Spence. This would allow for the accumulation of nearly 70 individuals identified in Mound C from a contributing population of 25-50 individuals. She also provides an alternative model to Spence's headman interpretation for the interment process at Cameron's Point (Dougherty 2003:128-130). This model suggests that instead of the burial event being triggered by the death of a headman, the triggering event was either cyclical or a special occurrence. At this time the dead were exhumed, those whose flesh was still present were treated specially because they were not considered completely dead. Their remains were placed in subfloor pits and the remains of those who were completely decayed were placed above them in the mound fill, possibly in lineage groupings (Dougherty 2003:128-130). The alternative then, to explain the number of individuals interred in Mound C, is either that the time of accumulation of remains ran much longer than the ten years estimated by Spence or the remains represented a larger regional contributing population. In all likelihood the answer is a combination of these possibilities.

3.3 The Rice Lake Burial Mounds

3.3.1 History of research

The Point Peninsula tradition is best known for constructing elaborate burial mounds, the largest and best known of which is the Serpent Mounds site on Rice Lake.

Numerous burial mound sites have been identified on Rice Lake and up the Trent River into the Bay of Quinte over the past 120 years. Due to their prevalence in the landscape the burial mound sites are the most heavily researched aspect of the Point Peninsula complex. Extensive excavations at Rice Lake mound sites, such as Serpent Mounds and Cameron's Point, occurred throughout the 1950s and 1960s. Treasure hunters and amateur enthusiasts have been digging in to the mounds in the area over the past 120 years and agriculture, construction, and erosion have also destroyed several of the mound sites. Aside from the Harris Island mound, which has not been excavated, the Serpent Mounds is sole Rice Lake mound group to be preserved.

Wallbridge carried out the earliest reported investigation of mounds in Ontario on the Bay of Quinte Mounds in 1860 (Wallbridge 1860, cited in Robertson 2001:38). The Bay of Quinte mounds consisted of two kinds of mounds, only one of which contained burials. The mounds consisted of large piles of fire cracked rock with little other culturally modified material included within the fill, the exact function of which is currently unknown (Robertson 2001:38). Of the over 100 of these mounds he excavated, Wallbridge did reportedly identify burials in one of the mounds, as did Boyle when he later reexamined the site. However, it is generally believed that these mounds date to later in the Middle Woodland period than the burial mounds in the region (Robertson 2001:39). The mound group closest in comparison to the Bay of Quinte mounds is the Perch Lake mounds in northwestern New York.

In the 1890s David Boyle (1897) investigated a number of burial sites in the Rice Lake Area, including the Miller Mounds, the Serpent Mounds, the East Sugar Island Mounds, the Cameron's Point Mounds, and the Preston Mounds, also called the Hastings

Mounds. Boyle excavated test trenches into many of the mounds he encountered and recovered numerous artifacts and skeletal remains. He identified the skeletons as either primary or intrusive burials. Boyle believed that a number of the skeletons, mainly those in the mound fill, were interred intrusively in the mound fill after the mound was built, while the primary burials, those on the ground surface floor or in sub floor pits, were the ones for whom the mound was originally erected. While it is possible intrusive burials were present, none have been identified since Boyle's excavation. This led Johnston (1968a:16-17) to suggest Boyle may have mistaken disturbed burials as intrusive. Boyle's premise of primary versus intrusive burials may also represent the modern concept of primary and secondary burials. Primary burials are those that were interred in the cemetery or burial area first without being buried elsewhere. Secondary burials are those which have been relocated from a primary interment elsewhere and reburied in the main cemetery. They are distinguished from primary interments by the absence of skeletal elements, in particular smaller bones, and general disarticulation of the remains.

In 1909 Montgomery (1910) began excavations at Serpent Mounds. He made four excavations into the large serpent shaped mound (Mound E) previously designated by Boyle. He estimated the construction of the mound as being approximately 1000 years old based on the decay of the remains (Montgomery 1910:10). While Montgomery had originally intended to excavate the site in its entirety, the lack of showpieces in the mound led him to abandon his endeavour after only the first season of excavation (Adams 1956:14). Over the following 35 years, no investigations of the Rice Lake burial mounds were carried out, except by pothunters searching for artifacts and human remains. William Ritchie of the Rochester Museum in New York carried out the next excavation.

Ritchie's excavation in 1948 focused on the shell midden located near the East Sugar Island Mounds (Ritchie 1949), but reported only on the ceramic content of the midden. In the 1950s, excavation of both Serpent Mounds and the Cameron's Point Mounds resumed. Harper (Spence and Harper 1968) excavated at Cameron's Point in 1952 focusing on both Mound C and the shell midden. Richard B. Johnston headed excavations of Serpent Mounds from 1955 until 1967 while also conducting archaeological examinations of other sites on Rice Lake (Johnston 1968a, 1968b). In 1969, Stothers (1974) conducted an excavation of the Prince Mound on East Sugar Island. The Harris Island Mound was not identified until 1976 during a large-scale survey of the Trent River Valley (O'Brien 1976).

Since that time no excavation has been carried out on any of the Rice Lake mound sites, but a number of individuals have since addressed aspects of the burial mounds in the surrounding region. Walter Kenyon (1986) wrote an overview of mound sites throughout both southern and northern Ontario. Michael Spence has revisited numerous aspects of the Rice Lake mounds including the social structure of the mound builders (Ferris and Spence 1995) and the relationship of the region to the Hopewell exchange network (Spence and Fryer 2006). Dougherty (2003) has reexamined the skeletal remains from Cameron's Point Mound C, paying particular attention to evidence of gender and social status markers. However, despite these individual efforts the lack of large-scale regional synthesis for the area has meant that research into the mounds has remained largely outdated.

3.3.2 The Mound Groups

The Miller Mounds

The Miller Mounds, originally reported by David Boyle (1897:28), were located on the eastern shore of the mouth of the Otonabee River on the property of James Miller. The following description is drawn from Boyle's (1897:28-30) discussion of the Miller Mounds. Boyle noted the presence of two mounds near the top of the slope about 24 to 30 m above the water. One of these mounds had been partially destroyed when a former tenant dug into it to construct a root cellar. During this process two or three skeletons were identified and removed. The second mound measured 10.6 m (35 ft) from east to west and 5.9 m (19 ft 6 in) from north to south and oval in shape. Boyle excavated this mound, which he reported had not been disturbed prior to this. He reported that at the southeast edge of the mound there had been a fire, though he noted the ash and red staining could have resulted from the burning of a stump. Boyle described the mound as very crude in terms of its construction, being constructed of clay and various sized rocks in no discernable pattern. He did note, however, that the largest stones were in immediate contact with the skeletal remains. The first skeleton identified was located approximately 61 cm (2 ft) below the centre of the mound. A second was found lying on its right side 30 cm (1 ft) below the surface, and a third near the northeast edge lying on its left side about 46 cm (18 in) below the surface, both heads were facing west. The artifacts within the mound consisted of two small celts, two tools made of deer horn, and a bone arrow or knife.

Following the excavation of the surviving mound atop the bluff Boyle turned his attention to a mound in a low-lying field 274 m (300 yd) from the Otonabee River, where the land owner had noted that human remains had been brought to the surface from ploughing. Boyle described his mound as a circular elevation approximately 22.6 m (74 ft) in diameter and only 80 cm (2.5 ft) in height, though having been repeatedly ploughed was likely originally much higher. A local informant from Hiawatha First Nations had told Boyle that he remembered that mound standing at about 1.8 m (6 ft) high and not as wide. The same person also informed Boyle that four other mounds had once stood in the low lying valley near the large circular mound but had since been destroyed by ploughing. Boyle attempted to identify where these other mounds had been located but to no avail.

Upon the landowner's request Boyle excavated the remaining mound in order to remove it and its contents (Boyle 1897:29). He noted an unusual structure to the mound, commenting upon lenses of black, brown, and yellow soil with intermittent layers of white marl. The first burial recovered was located half way between the centre and end of the mound (Boyle 1897:30), though Boyle does not identify which end. The body was poorly preserved and only the leg bones and some vertebrae remained. Accompanying this burial was a turtle effigy shell gorget, two small celts, and three bone harpoons (Boyle 1897:29-30). The remains of a calcareous material were also recovered, though not mentioned in Boyle's report. Johnston believed this to be the fossilized remains of a birch bark container (Johnston 1968b:13). In the centre of the mound, about 1.5 m (5 ft) below the surface, Boyle found evidence of a fire pit, but no additional human remains, which he found very perplexing because he could not figure out why the only remains were located off centre relative to the mound (Boyle 1897:30). Boyle concluded his examination of the Miller property by examining an extensive midden deposit along the mouth of the Otonabee stretching 305 m (1000 ft) long by 122 m (400 ft) wide. He describes large quantities of ceramics and ash (Boyle 1897:30). He makes no mention of shell being present in the midden and noted a complete absence of any flint throughout the area (Boyle 1897:30). However, field survey in the 1960s revealed little material including only a few chert flakes and two ceramic sherds with exterior dentate rocker stamping and interior striation (Johnston 1968b:14).

Harris Island Mound

The Harris Island mound was the most recently identified mound on Rice Lake and is the only unexcavated burial mound known on the lake. Harris Island consists of two drumlins connected by swampland and is located due south of the Serpent Mounds Site (O'Brien 1976). The dry areas of Prickly Point, the southern tip of the western most drumlin, were fairly rich in cultural material dating from the Early through Late Woodlands with a particularly rich Middle Woodland component (O'Brien 1976). The material remains consisted of ceramics, lithic debris, and faunal remains and was reportedly mixed over much of the point with a few midden concentrations.

At Rainy Point, the southern tip of the eastern most drumlin, several Middle Woodland pottery sherds and a few other remains were identified in an eroding bank and it is suspected that much of that site had been flooded (O'Brien 1976). At the northern end of the eastern drumlin a mound was identified. The mound is round or slightly oval measuring approximately 9.1 m (30 ft) in diameter and between 2.4 and 3 m (8 and 10 ft) in height (O'Brien 1976). The mound is undisturbed by ploughing or other human activities and was apparently constructed by "...digging around the point of an old beach line and using this earth, piled up in the centre, to form the mound proper" (O'Brien 1976).

Serpent Mounds

The Serpent Mounds Site is situated on the point of a large drumlin feature called Roach's Point (formerly Mizang's Point) on the north shore of Rice Lake immediately west of the mouth of the Indian River and East Sugar Island. Due to the significance of the mound site the area was made a provincial park in 1955 (Johnston 1968a:10). Given the extensive work done on the Serpent Mounds and the extent of the site itself, it would not be practical to attempt a summary of all work that has been done at that site. However, the description of the excavation and recovered artifacts can be found in a number of works (Boyle 1897; Montgomery 1910) and particularly in Johnston's extremely detailed site report 'The Archaeology of the Serpent Mounds Site' (Johnston 1968a). The skeletal biology of the human remains recovered during Johnston's excavation at the site have been analyzed and reported by Anderson (1968). This section provides a general overview of the site structure and the mortuary patterning of the various mounds.

The Serpent Mounds site consists of nine burial mounds, a habitation area, an extensive shell midden, and three Late Woodland burial pits, generally referred to as the Serpent Pits. When Boyle investigated the site in the 1890s he associated the large irregularly shape mound (Mound E) with the large Ohio Serpent Mound first identified by Squier and Davis in 1846 (Fletcher et al. 1996:107). He believed the large three-segmented mound to be a serpent effigy, and identified the mound (now Mound F) immediately north of the eastern segment of Mound E as the egg after a similar feature of the Ohio mound. However, Montgomery (1910:2) and Johnston (1968a:8) both suggest that Boyle over exaggerated the form of the mound in terms of its serpentine appearance, and argue against classifying the mound as a serpent effigy. Anyone who views Boyle's sketch of the mound would certainly agree that the mound is a serpent effigy; however, more realistic and accurate depictions of the mound show little evidence for the serpentine form recorded by Boyle. Instead the unusual form of the mound can likely be attributed to the accretion of three elongated burial mounds like the Mound C structure from Cameron's Point.

As a result of the amount of investigation and looting that has occurred at the Serpent Mounds site over the last 110 years it is very difficult to get a complete picture of the structure and distribution of the mounds and the burials interred within them. Mounds A, B, D, and H are unfortunately poorly reported. Mounds A through D were only briefly examined by Boyle (1897:24), who reported a few intrusive burials but gave little to no description of the mound structures. Mound H was also described by Boyle (1897:24), though he claims it was heavily damaged and did not bother to examine it. Mound H was excavated in 1955 under the supervision of William Adams (1956). He reported extensive disturbance of the mound including evidence of a deep pit that had been dug into the surface of the mound and evidence of utilization as a duck blind (Adams 1956:16). He noted that only a minimal amount of cultural material was recovered from the mound and that none of it held any diagnostic value (Adams 1956:16).

Mounds C, E, F, G, and I have been much more thoroughly documented, largely by Johnston (1968a). Within Mound F or the 'egg', Boyle identified a minimum of 6 individuals, likely more (1897:21-22). Two of the individuals identified by Boyle (1897:21) were found in a sitting position 61 cm (2 ft) below the mound surface and about 2.4 m (8 ft) from the northern edge of mound. Boyle reported another individual at the base of the mound about 1.5 m (5 ft) below the surface, found lying on its right side. Near the centre of the mound, approximately 1.2 m (4 ft) from the surface, Boyle (1897:22) reported the presence of a bed of black earth mingled with ash and mussel shell, below which was a circle of stones, which he states had been subjected to considerable heat but no charcoal or ash was present.

Mounds C, G, and I differed considerably in burial structure from the other mounds excavated at Serpent Mounds and at other sites on the lake. Mound C was the last mound to be thoroughly excavated at Serpent Mounds and this was done to create a display for the Serpent Mounds Provincial Park (Whate 1965:2). The burial structure of Mound C consisted of the remains of thirty individuals, both primary and secondary interments, concentrated in the center of the mound and half of which were children (Whate 1965:6). Whate (1965:6) states, "...it would appear that the majority of the burials were interred within the mound structure itself rather than on the original ground level." It is difficult to ascertain from this statement whether Whate believed this was a single burial event or whether this represented multiple acretional burial events. He notes the presence of shell lenses of various thicknesses up to about 8 cm (3 in) amongst the burials, which he suggests could be related to feasting events (Whate 1965:6). He also notes an artificial trench running east to west through the burial group, in which he identified nine separate burial features (Whate 1965:6-7). Only a small amount of artifactual material was recovered from the mound and included two groups of Point

Peninsula pottery and a side-notched bone point which was likely intrusive (Whate 1965:7).

Mounds G and I, like Mound C included large concentrated burial pits running along the central axis of mounds, containing both primary and secondary burials and very little artifactual material (Johnston 1968a:29). However, Johnston (1968a) makes no mention of distinctive features within the structure of the burial pit as noted by Whate for Mound C. Mound G contained approximately 18 individuals, a third of which were primary burials (Johnston 1968a:29-30). While it is noted that shell did occur within the mound (Johnston 1968a:30), the presence of distinct shell lenses, like those in Mound C, were not reported. Mound I contained at least 29 individuals a third of which were juvenile (Johnston 1968a:33). Mound I also contained the only total cremation identified in any of the burial structures at Serpent Mounds (Johnston 1968a:34). Like Mound G, Johnston notes the presence of shell along with other refuse within the mound fill but does not identify an formal shell lenses (1968a:34)

Mound E has been so intensively excavated at so many different times that it is well beyond the scope the current overview to assemble an accurate reconstruction of the mound's burials and structure here. The pertinent aspects of Mound E are that it was likely acretional burial events that led to its construction, as evidenced by its internal structure (Johnston 1968a:20), and the variation in dates from different sections of the mound that suggest a possible 200 year gap between burial events. The mound contained a wide distribution of burial forms including primary and secondary burials, as well as partial cremations. Primary burials tended to be located in subfloor burial pits or on the original ground surface, though a few did occur within the mound fill (Johnston

1968a:19-20). The majority of the grave goods found during excavation were associated with the primary burials; only three of the mound fill burials had grave goods associated with them (Johnston 1968a:21). It is difficult to estimate the number of burials that have been identified in Mound E by all the excavators who have investigated this structure over the years (Johnston 1968a; Montgomery 1910; Boyle 1897). However, Johnston (1968a:89) alone identified over sixty, and there was likely a much greater number than that encountered, and many more still within the mound.

East Sugar Island Mounds

East Sugar Island lies at the mouth of the Indian River about a mile east of Serpent Mounds Provincial Park. Boyle visited it during his survey of the area during the 1890s. He noted two mounds on the southern end of the island's western slope, which he considered to be almost indistinguishable from gravel knolls (Boyle 1897:33). The larger of the two was designated the Princess Mound. It was almost circular, measured 1.4 m (4 ft 7 in) in height and was about 11.6 m (38 ft) in diameter (Boyle 1897:33). The smaller of the two, the Prince Mound was located on a hillside approximately 91.4 m (100 yd) northeast of the Princess Mound. Boyle (1897:33) describes it as "so flat on the top that it presented no face to the north." It measured 9.5 m (31 ft) long and 1.2 m (3 ft 10 in) in height with a convex side to the south (Boyle 1897:33). An extensive shell midden was also identified by Ritchie (1949) on the southwestern shore of the island directly across from the shell midden at Serpent Mounds.

Boyle's excavation of the Princess Mound revealed seven burials that he identified as comparatively recent, two of which were on the south side and five of which were on the north side and none had artifacts associated with them (Boyle 1897:34).

Near the centre of the mound approximately one meter from the mound surface, a skeleton was found half seated, facing east (Boyle 1897:34). Accompanying this skeleton were three strings of copper beads and two with shell beads, as well as a stone tablet, and a copper axe or chisel sharpened at both ends (Boyle 1897:34-35). Boyle also notes a bark container of powdered hematite, which rested at the base of the skull (Boyle 1897:35). In the Prince Mound, two secondary burials were identified along with a broken gorget, and another burial, which Boyle presumed to be primary. The burial was found in the eastern half of the mound half sitting with its head to the southwest (Boyle 1897:33). Around its wrists were two copper bead bracelets. The body was sitting in a bed of stiff clay, and there were few stones in the mound fill (Boyle 1897:34).

In 1969, Stothers (1974:20) along with Ian Kenyon and Berry Newton returned to East Sugar Island in order to excavate the remains of the Prince Mound before looters destroyed it as the Princess Mound had been. Stothers (1974:22) reported that the mound's maximum depth at the center was 0.6 m with a submound floor composed of an ash/clay mixture and was white in colour. This floor was circular with a radius of approximately a meter and a maximum depth of 15.2 cm at its centre (Stothers 1974:22). Three fragmented burials were identified above the floor including two adults and one juvenile (Stothers 1974:22) and were accompanied by a copper bead with preserved twine, a broken bear canine, a discoidal conch shell bead, a bifacial grey chert scraper, two plain bodysherds, several chert flakes, and a few bone fragments (Stothers 1974:24).

Cameron's Point Mounds

Cameron's Point is at the eastern end of Rice Lake on the northern shore, immediately west of the Ouse River. The site consists of three burial mounds and an extensive shell midden. When Boyle first visited the site he reported that two of the mounds had partially eroded off of a steep bluff (1897:30). Boyle left the task of excavating Cameron's Point to W. G. Long who identified the three mounds as mounds A, B, and C (Boyle 1897:31). Cameron's Point was revisited in 1952 by J.R. Harper and again briefly in 1958 by Johnston and by Spence and Noble in 1964 (Spence and Harper 1968). By the time Spence and Noble visited the site in 1964 only Mound A remained and much of it had eroded over the bluff (Spence and Harper 1968:6).

Long's description of the excavation of the three mounds is very brief. He notes that Mound A was at the western end of the point and measured 21 m (70 ft) long, 5.5 m (18 ft) wide, and 1.2 m (4 ft) high (Boyle 1897:31). His excavations revealed four burials he identified as intrusive, and one he referred to as the mound builder. The latter was located at the base of the mound, bent and reclined on its side, resting in a bed of sand surrounded by a ring of fire treated rocks, with no other evidence of fire (Boyle 1897:31). He also stated that a piece of wood was recovered from the mound (Boyle 1897:31), though he provides no provenience for it. Mound A was reexamined by Harper who reported the presence of fragmented human remains and clam-shell pieces throughout the fill (Spence and Harper 1968:40). Harper also identified a copper awl with a slightly bent point end, and a flat end (Spence and Harper 1968:40). Johnston also briefly examined Mound A and recovered a single burial that had been exposed by pothunters. The remains were those of an adult male flexed on the left side facing west with traces of red ochre on and around the bones (Spence and Harper 1968:40).

Mound B was reportedly 20 m (66 ft) long, 6 m (20 ft) wide, 1.3 m (4.5 ft) high, and located 6 m (20 ft) east and a little south of Mound A (Boyle 1897:31). Long noted that the stones covering this mound appeared to have been placed intentionally in rows over the top of the mound (Boyle 1897:32). At the eastern end of the mound he reported encountering ten intrusive skeletons above the stone layer but surrounded and covered by stones as well (Boyle 1897:32). At the bottom of the mound, Long reported two primary burials surrounded by a ring of boulders and covered by other stones; he also noted that wood was found amongst the stone covering these two bodies (Boyle 1897:32). On his examination of Mound B Harper concluded Long had mistaken the natural stone inclusion in the fill as a formal stone layer around this mound (Spence and Harper 1968:41). Harper excavated the remains of one individual eroding from the side of the mound. This individual was lying flexed on his left side facing west (Spence and Harper 1968:41). A local man recovered a burial, accompanied by a number of shell ornaments, from Mound B in 1938 (Spence and Harper 1968:41).

The final Mound, C, was only partially excavated by Long due to time constraints (Boyle 1897:32). He reported this mound to be about 28 m (92 ft) east of Mound B, and 23 m (75 ft) long, 6 m (20 ft) wide and one meter (3.5 ft) high. Like Mound B Long reported the presence of stone layer across the mound (Boyle 1897:32). In total, Long excavated three individuals from this mound, two of which he identified as intrusive. The third was a partial cremation identified at the base of the mound surrounded by a ring of fire-cracked boulders (Boyle 1897:32). Mound C was thoroughly excavated in 1952 by Harper (Spence and Harper 1968). Mound C, like Serpent Mounds Mound E, consisted of a large number of primary and secondary burials, the former tending to be in subfloor pits, while the latter were placed within the mound fill (Spence and Harper 1968:14). The fill of this mound consisted of three types of soil, a black ashy soil with clamshell fragments, fish bones, and charcoal was used to cover the surface of the mound, while a golden brown soil was present in the primary fill and a light brown sandy soil was in the secondary fill (Spence and Harper 1968:27). Initially, Spence and Harper (1968:67) identified 41 burials in this mound. Reexamination of the skeletal remains from Cameron's Point by Dougherty (2003:69) has raised that number to 69 individuals.

3.4 The Hopewell Connection and the Rice Lake Burial Mounds

Great attention has been paid to the presence of certain artifact types found within the mound burials of Rice Lake. Artifact types such as panpipe cases and bands as well as other artifacts made of native silver and copper, stone smoking pipes, marine shell beads and pendants and an array of other materials are indicative of a long distance trade network spanning a large portion of Eastern and Midwestern North America. These artifacts in combination with the elaborate mound burials are associated with the Hopewell Interaction Sphere, a far reaching network of traits centered in the Ohio Valley during the Middle Woodland period (Carr and Case 2006:19). The nature of the Hopewell Interaction network has long been debated, and in all likelihood no single explanation for the type of interaction occurring through the far-reaching network is universally applicable. It is more likely that the nature of the interactions varied between regions (Carr 2006:619).

The widespread occurrence of certain fundamental ideological elements, such as the Earth Diver creation legend, may indicate a degree of cosmological continuity throughout North America and the Americas in general (Hall 1979:259). However, the individual expression of this ideology and the associative meanings of individual cultural elements would likely vary greatly both locally and inter-regionally. For example in their analysis of Hopewell panpipes and their relationship to various other artifact types in burials across Eastern North America, Turff and Carr (2006:665-666) found no over arching socio-symbolic patterning between panpipes and other artifacts interred in burials with them. In other words, while the artifact type itself does occur at sites throughout the Hopewell Interaction Sphere, the direct meanings or associations vary between regions.

The relationship of the Rice Lake and Trent River mound groups to Hopewell interaction has been addressed by a number of authors (Johnston 1968b; Spence et al. 1979; Spence and Fox 1986; Turff 1998; Spence and Fryer 2006). Johnston (1968b) commented very briefly on the association between Hopewell and the Rice Lake Mounds. He suggests that the Rice Lake sites should be viewed as loosely associated with the Squawkie Hill Phase of the Point Peninsula occupation of Western New York, which has a loose connection to the Hopewell core in the Midwestern United States (Johnston 1968b:29). Spence has suggested that the introduction of the Hopewell trade network triggered the appearance of a simple ranking system for the Rice Lake/Trent Valley Region (Spence et al. 1990:164). He argued that the Hopewell influence was not ideological, but rather economic, and that access and control of the flow of goods through the region allowed certain individuals to enhance their status and pass it on to their descendants (Spence et al. 1990:164). Penney (1986-1987:51) argued that parallel ideological frameworks existed between those participants in the Hopewell exchange network. More recently, Spence and Fryer (2006:724-725) have suggested other broad regional divides in terms of artifact associations, the association between native copper and silver in particular, which suggest wide reaching variation in specific ideological contexts.

The Hopewell association of the Rice Lake mound groups is something of a misnomer. While certainly cultural traits of Hopewellian influence, such as the construction of burial mounds and the presence of certain artifact types and motifs, are present, they are likely the result of diffusion of concepts through multiple intermediary groups. This process resulted in the replication of certain characteristics manifested in a regionally specific context that may only superficially resemble more distant participants in the exchange network. The large range of variability among mound forms, interment methods and artifact associations suggests a lack of uniformity and divergence of specific meaning even at the very local scale.

3.5 Ideology, Symbolism and Death in the Eastern Woodlands

The interpretation of symbolic and ideological meanings of prehistoric artifact assemblages has been one of the most debated issues in archaeology over the past 60 years. While much of early processualist thought argued that archaeologists could in fact move beyond the economic and technological elements of culture, the limitations of early processual analysis proved to be insufficient to do so (Von Gernet 1992:133). Even at burial sites like those in the Rice Lake area, authors have in the past focused largely on the quantitative attributes of the skeletal and artifact remains, with little to no attempt at interpreting meanings beyond the functional. This neglect was largely the result of the theoretical timing of the work that has been done dealing with the Rice Lake mound sites. As previously discussed, the bulk of the work on the Rice Lake mounds was conducted in the 1950s-1970s. During this time, archaeology, and in particular the archaeology of landscapes in the Americas, was largely focused on the ecology and settlement aspects of cultural occupations (Patterson 2008:77-78). It was not until the mid seventies, after the last excavation of any of the Rice Lake mounds, that archaeologists really began paying attention to the wider settlement-subsistence aspects of landscape beyond the individual site level (Patterson 2008:78). While a number of authors, Michael Spence in particular, wrote numerous articles dealing with regional settlement-subsistence systems in the Rice Lake area in the early to mid eighties (Spence et al. 1984; Spence and Fox 1986), little work on the mounds has followed. Since then ideology has become an area of interest in the landscape archaeology of the Americas (Patterson 2008:79), but has remained largely neglected for the Rice Lake region.

Due to the absence of ideological interpretation for the Middle Woodland period in the Rice Lake region, it is necessary to explore both spatial and temporal analogies to provide a framework for developing such interpretations. The remainder of this chapter provides a brief overview of the consideration that has been given to aspects of ideology in Ontario and related areas. Unfortunately, very little ideological interpretation has been generated for Ontario's Middle Woodland as a whole. The majority of the ideological studies in Ontario focus on the Late Woodland period and are primarily derived from ethnohistoric sources. Therefore, examples of contemporaneous Middle Woodland cultures from other areas of the Eastern Woodlands and the Midwestern United States are also discussed. This discussion is not meant to imply direct relationships between different regions, but rather to provide a wide breadth of interpretation in order to lay the groundwork for interpreting the Rice Lake burial mounds with particular emphasis on their location within the landscape. Likewise, the discussion of specific historically known ethno-linguistic groups and their cultural practices is not meant to imply an ancestral relationship to the Rice Lake mound builders but rather to demonstrate a certain degree of fluidity in the breadth of cultural, and in particular burial practices within southern Ontario. At this time the relationship between ethnicity and material culture within the study region is poorly understood and therefore any assertion of the ethnicity of the Rice Lake occupants during the Middle Woodland would be premature.

3.5.1 Symbolism, Death, Fertility, and Ideology

The association of the Rice Lake burial mounds with water in terms of both the aquatic subsistence resources utilized around these sites, and their immediate visible relationship with the lake and swamps appears to suggest an important relationship between water and the dead. The association of water within ideological and spiritual systems in cultures across the planet appears almost universal (Strang 2008:123). Amongst the ideological framework elements found throughout Eastern North America is the three-tiered structure of the universe consisting of the under(water)world, the earth, and the sky world, though regional and linguistic variations do occur (Brown 1997:476). Of importance here is the under(water)world due to the close association of the mounds with water and water resources. Thresholds into this world include caves, deep springs, whirlpools, rocky islands, and deep waters surrounding those islands (Hamell 1987:69). The beings that inhabit the underworld are those connected to powerful materials such as white shells, white and red stones, and white, red and black metals according to historically recorded cosmologies (Hamell 1987:70). Water also acted as a barrier between the dead and the living for a number of groups, as it was believed that the spirits of the dead were unable to cross the water to disturb the living (Hall 1976: 361). Archaeologically, it has been argued that artificial water features were constructed at Hopewellian sites such as Fort Ancient and could have been associated with purification rituals (Sunderhaus and Blosser 2006:141). Water, therefore, held, and still holds, considerable power in the cosmologies of the Eastern Woodlands.

The association of subsistence, death, and ideology has been well documented amongst native groups in the northeast. In the predominant Earth Diver legend of the world's creation an animal dives down to the bottom of the deep ocean that covered the world to return, in some accounts dead, with a handful of mud that is spread across the turtle's back to create the land world (Hall 1997:19). Therefore, the ultimate act of creation is associated with mud from the under(water)world. Such underwater mud and marls are often incorporated into burial mounds in other regions (Hall 1979:260). It is also likely that such aquatic sediments were used in the Rice Lake mounds. Boyle (1897:29), for example, noted the presence of white marl in the soil matrix of one of the Miller Mounds. The association of such mud with burial mounds suggests a close association for the burial of the dead with the underworld, and the creation and symbolic recreation or rebirth of the world (Hall 1979:260). It also suggests that there may be significance to shallow and swampy areas located near the mound sites where such mud and marls could be retrieved.

Germination of seeds is also tied to the underworld amongst many groups (Hall 1976:363). Thus among agricultural groups in the Northeast the underworld has influence over the fate of subsistence success. The Huron, for example called the Feast of the Dead the 'kettle'. If the feast was going to be delayed, they would speak of stirring up the fire beneath the kettle (Hall 1997:36). Likewise, the Mississippian Birger figurine, an effigy of a woman kneeling as if planting with her hand resting on a serpent and baring her teeth (a possible symbol of death) (Prentice 1986:243), seems to associate fertility and harvest symbolism with the 'earth-serpent', a symbol of death and the underworld as well as rebirth (Prentice 1986:262). Such associations are common across Eastern and Midwestern North America and are evident in various Hopewell and Adena mortuary rituals (Hall 1979:265). It is likely that the symbolism of death and the underworld preceded the advent of horticulture in southern Ontario, and that the association of the Rice Lake mounds with the surrounding lake and aquatic resources like shell and potentially wild rice represents an expression of similar ideas.

The extensive shell middens present at all the mound sites may represent an important element of the burial ritual. Across northeastern North America shell and shell artifacts occur in a number of ideologically laden contexts, especially in burials (Kerber 1999:59). George Hamell (1992:457) argues that shell artifacts were associated with ideological concepts of light due to their shiny white appearance. He suggests that white objects as well as black and red objects hold special ideological meaning within the wider First Nations' value system. Based on the value systems of Northern Iroquoian groups at the time of contact, and those trade items they held in greatest esteem, Hamell (1992:458) tenuously links many of the objects that occur within the Hopewell Interaction Sphere of the Middle Woodland period based on their colouring and their ritual context. This assertion presumes a continuity of meaning over thousands of years. While specific meanings are almost impossible to demonstrate archaeologically, the continuity of specific symbols and forms within ritual or sacred contexts can be used to support the continuity of ideological emphasis. While specific meanings may change over time, the symbolic forms or materials remain significant within the ideological systems of cultures. Shell, for example, held ritual importance in the Middle Woodland period in southern

Ontario and continues to be used in a ritual context by First Nations in Ontario today. While the specific meanings given to shell artifacts by the Middle Woodland inhabitants and their descendants may vary the object itself remains sacred.

Beyond the symbolism that shell may have held, the significance of subsistence resources in association with mortuary behaviour and ideologies of death is well founded for eastern North America. Subsistence resources should not necessarily be separated from other realms of meaning. The frequency of occurrence of mollusk shell remains within ritual contexts, for example, does not preclude the consumption of the meat in normal subsistence or vice versa (Kerber 1999:58). It is also likely that shellfish was consumed as part of mortuary feasts that occurred at the mound sites (Jamieson 2008:15). Such feasts would act to reaffirm and cement social relationships and social identities and build "...prestige and authority through acts of generosity and sharing" (Jamieson 2008:16). Feasts and other ritual activities need not have only occurred at the time of interment of the dead. Instead such events likely happened periodically, perhaps annually or semiannually, in order to both venerate the dead, and to reaffirm the bonds of the living with the sacred places in the landscape selected for the burial of the dead (Taçon 1990:28).

Chapter 4
Methodology

4.1 The Initial Analysis of Visibility of the Rice Lake Mounds

Visibility analysis for the Rice Lake burial mounds was first conducted as part of my undergraduate honours thesis in 2007 (Dillane 2007). During the course of this analysis, viewsheds were constructed for the Miller Mounds, Serpent Mounds, East Sugar Island Mounds, and Cameron's Point Mound sites. These viewsheds were then compared to 22 known Middle Woodland sites in the Kawartha Lakes region as well as to 30 randomly generated sites on the northern shore of Rice Lake (Dillane 2007:37). The viewsheds of these various site sets were compared to the other sets in terms of the total viewsheds, the view to the lake, the view to the swamplands around the lake, and the combined viewsheds to the lake and swamplands (Dillane 2007:37). Visibility of the mounds from the lake was also compared to the other sets. A total of 800 random points selected from the lake surface were created to examine whether the mound locations were built in locations of greater visibility compared to the 30 randomly generated points on the northern shore of the lake (Dillane 2007:38). Through both types of analysis, view to the mounds and view from the mounds, no statistically significant results were reached, indicating that the burial mounds were evidently not located in areas of enhanced visibility, either from the land or from the lake (Dillane 2007:39-40). Finally, intervisibility was examined between Serpent Mounds and the East Sugar Island Mounds sites, revealing that Serpent Mounds was visible from East Sugar Island but not vice versa (Dillane 2007:41).

Through this initial analysis, a number of significant methodological problems are identified that go far beyond the scope of an undergraduate honours thesis. The most significant of these problems was the failure to compensate for significant changes in the environment since the mounds were constructed (Dillane 2007:49). Two aspects of the palaeoenvironment in particular cause significant problems for viewshed analysis in the Rice Lake area: the changes in the lake levels and compensation for palaeovegetation. A number of other problems also were present in the initial study. A number of the random sites used to test against the mound sites were generated in the same locations as the mound sites, which potentially cancelled out any significance of the viewshed of the mounds (Dillane 2007:47). The final shortcoming of the initial study was an overemphasis on *how much* was visible as opposed to *what* was visible (Dillane 2007:52). The over-emphasis of quantitative testing of visibility limited the scope of interpretations of the mound locations to their prominence in the landscape and therefore failed to take into account the possible qualitative factors that led to their placement. This study will therefore correct a number of these problems, and introduce modified techniques for analyzing the visibility characteristics of the mounds and their relationship to the surrounding landscape.

4.2 Constructing the Palaeoenvironment of Rice Lake

To compensate for environmental changes that have occurred over the nearly 2000 years since the mounds were constructed, it is necessary to modify the digital representation of the contemporary landscape to reflect these changes. It is important to note, however, that the palaeoenvironmental reconstruction that I have developed is only a coarse approximation of the original environment. It should rather be thought of as a probabilistic model based on approximations of what is known of the original palaeoenvironment. There are simply not enough data available at present to fully reconstruct what the Rice Lake area was like 1500 to 2000 years ago. This is not meant to imply that the final product of this analysis will be inaccurate or will not reflect the reality of the places the mounds were built. Rather, it is mentioned to underscore the need for caution in interpreting the particulars of the results of the visibility analysis. Overall, the overarching generalities of the environmental model will reflect the realities of the palaeoenvironment of the region, even though many of the details, possibly even some important details, may be lost.

The construction of the palaeoenvironmental model for the visibility analysis is carried out using both the GRASS and ArcGIS platforms. Both applications have strengths and weaknesses in their handling of various data formats and it is therefore useful to incorporate the strengths of both platforms into the modeling process. The following sections outline the processes of constructing the regional palaeoenvironment of Rice Lake and provide an overview of the key steps involved in the construction as well as a number of the remaining shortcomings of the processes and some of the implications they could have on the final analysis.

4.2.1 Rebuilding the original lake levels

Constructing a model of the lake levels that existed at the time the mounds were constructed is of paramount importance for the assessment of the visual significance of the mound locations. The lake would not only have been an important resource area for food and water but would have also functioned as the major transportation route and potentially held great cosmological importance to the inhabitants of the region. The water levels of Rice Lake have fluctuated significantly over the past ten thousand years of postglacial conditions. Yu and McAndrews (1994:141-142) categorized the variant water levels into four major temporal periods. From 10000-6000 BP there was controlled rising of lake levels caused by postglacial palaeohydrological events (Yu and McAndrews 1994:141). This was followed by a period of water level decline, resulting from a warm/dry climatic event from 6000-3000 BP (Yu and McAndrews 1994:149). From 3000-120 BP, the time period in which the burial mounds fall into, water levels increased once again as a result of the climate shifting back to a wetter and cooler state (Yu and McAndrews 1994:142). Finally, the water levels were increased by 1.8 m and stabilized by the construction of the Hastings dam on the Trent River north of Rice Lake in AD 1838 (Yu and McAndrews 1994:142). While the lake levels likely have fluctuated as a result of isostatic rebound and other hydrological/geological factors over the 1500-2000 years since the mounds were built, there is no clear indication or even estimation of by how much. For the purposes of this study then, the 1.8-m figure was selected for the reduction of the levels of Rice Lake. Using the pre-flood level of the lake will provide a sufficient approximation of the level of Rice Lake when the mounds were constructed.

To model the reduction of 1.8 m for Rice Lake, depth data for the lake bottom was collected from the Canadian Hydrographic Service Rice Lake map (2004), published by the Ministry of Fisheries and Oceans. The spot depths were digitized into point data and those point data were interpolated to create a contiguous raster surface. The depth surface was then incorporated into a preexisting digital elevation model (DEM). The lake was then filled to the appropriate level by subtracting the 1.8-m drop from the known modern surface level of the lake. An additional level was created to represent swamplands surrounding the lake by dropping 0.8 m from the modern lake level. The 0.8-m amount was selected as a conservative estimation that any of the lake's surrounding shoreline within a meter of the lake level would likely be partially waterlogged and swamp-like. Figure 4.1 shows the resulting palaeo-lake level model compared to the modern lake levels.

While this approach provides an effective and functional model of the pre-dam lake level, there are a number of potential sources for errors to occur. First the lake depths utilized to build the lake model consist of regular depth points taken throughout

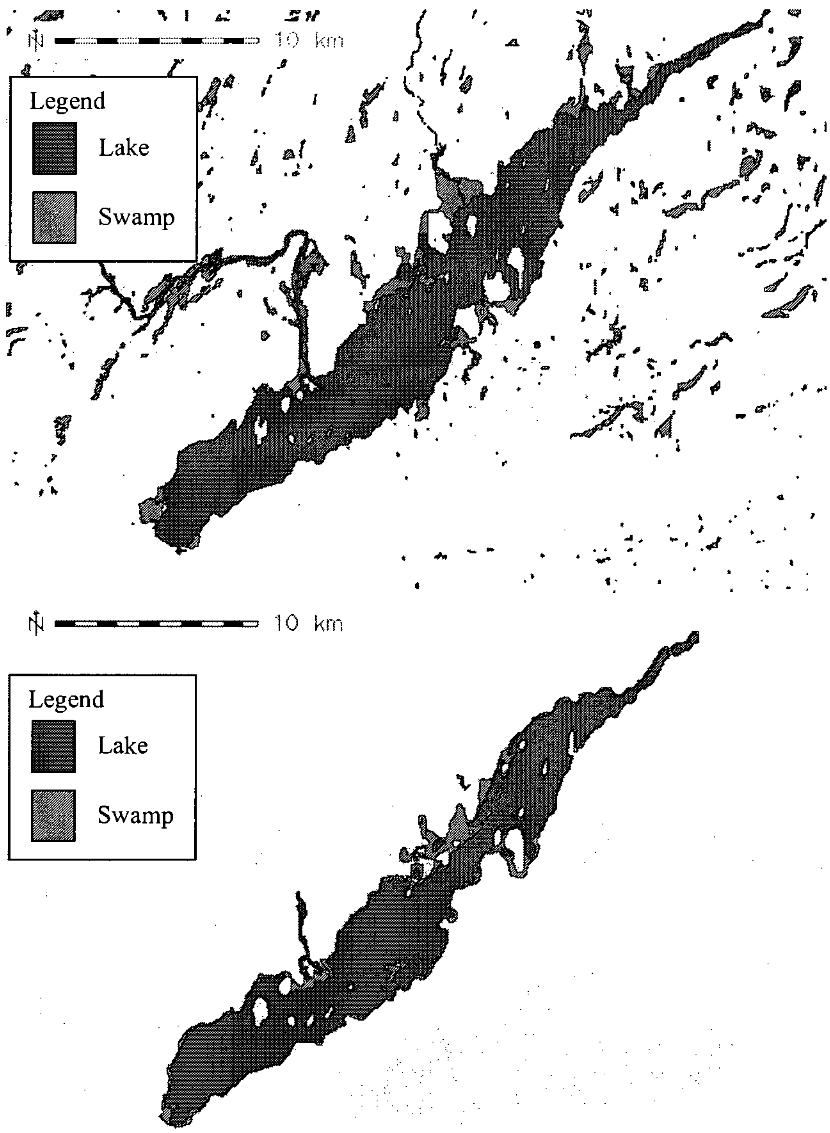

Figure 4.1. Modern water level of Rice Lake (top) compared to simulated pre-1830s lake level (below)

Rice Lake. While over 3000 depth points were used they potentially could miss nuances of the lake bottom and therefore provide inaccuracies when modeling the lakebed. Due to the size of the lake, generating high-resolution depth models would be an extremely laborious and time-consuming task. Small scale models are however possible. Elizabeth Sonnenburg (personal communication, 2009) has conducted extensive bathymetric analysis of Rice Lake in the area around the Serpent Mounds site. Figure 4.2 depicts the results of her more detailed model of the pre-1830s shoreline compared to that generated for use in this analysis. While hers unequivocally has greater precision, the model generated for this study is similar enough to carry out its required function.

Another problem encountered during the modeling of the pre-1830s shoreline was the combination of the depth data and the preexisting DEM. Initially the interpolated depth surface was subtracted from the lake surface of the DEM. This resulted in a wall effect for the shoreline area around where the lake depth surface was combined with the DEM. This meant there was an artificially steep gradient of up to 15 m between the raster cells of the original DEM and the modified area. Conceptually this would essentially equate to fifteen-meter high cliffs separating the land from the lake, which would not reflect the reality of the Rice Lake area. This problem was corrected by adding a zero value surrounding the point data prior to interpolation to smooth out the sharp edges of the generated model. As a result the sharp gradient was reduced to a tolerable level, when the interpolated depth map was added to the DEM.

4.2.2 Constructing palaeovegetation

Palaeovegetation is much more difficult to replicate. While species of plants are identifiable through methods such as pollen coring, the precise distribution of species and

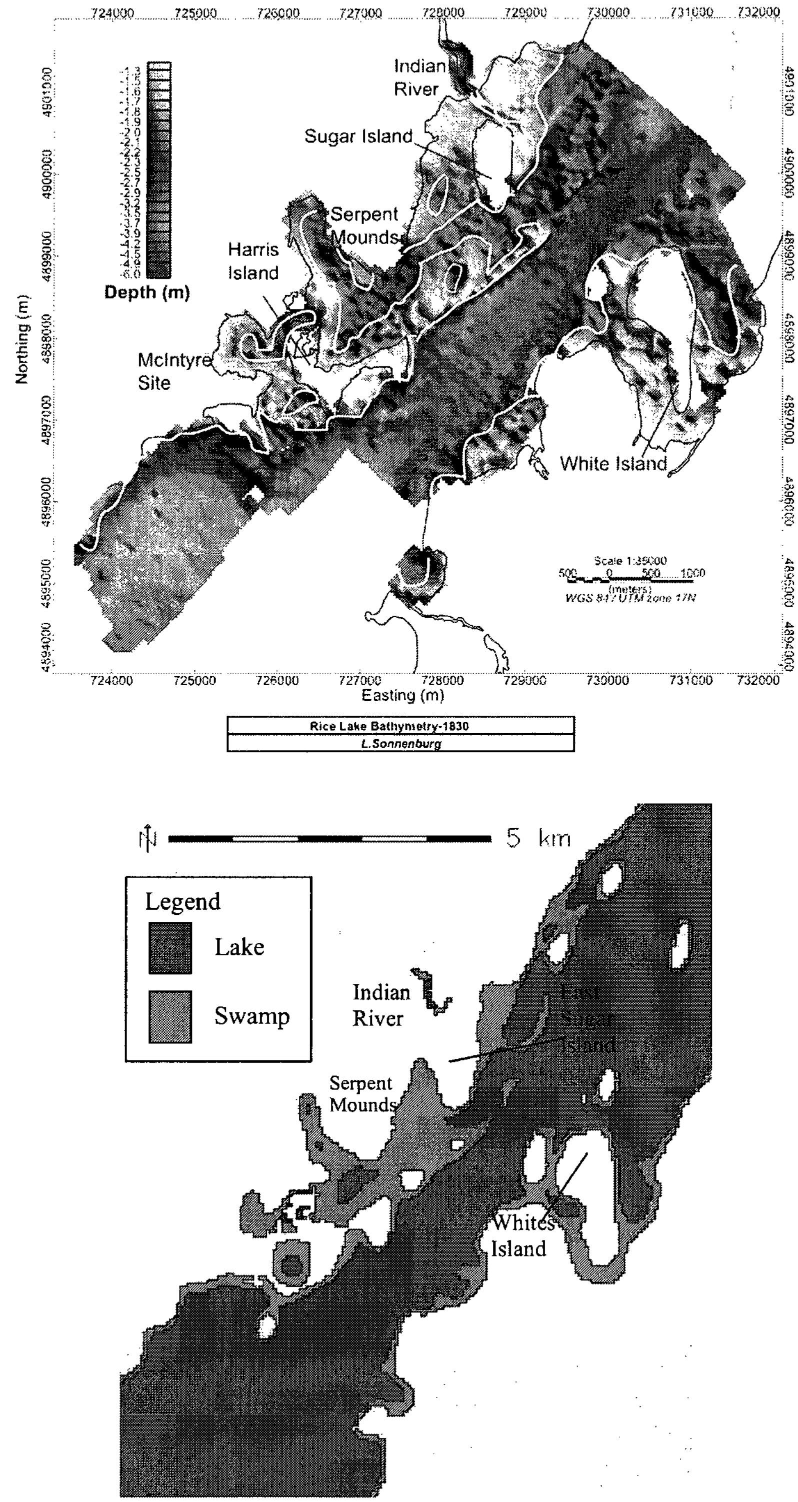

Figure 4.2. Sonnenburg's pre-1830s water level reconstruction (above) compared to that of this study's (below)

individual trees cannot be so easily modeled. The inability to reconstruct the location of individual trees means that visibility analysis will have inherent inaccuracies when dealing with areas that would have been wooded in the past. Although a precise reconstruction is not possible there are ways of incorporating aspects of palaeovegetation into the model for visibility analysis. Geary and Chapman (2006) applied a method they referred to as 'digital gardening'. They examined Sutton Common, an Iron Age enclosure north of Doncaster, United Kingdom (Geary and Chapman 2006:175). Instead of abandoning the incorporation of palaeovegetation in their analysis or alternatively guessing at the extent of the palaeovegetation around their site, they used alternative vegetation models to cover a range of possible palaeovegetation patterns around their site (Geary and Chapman 2006:175). Using pollen core data from around the enclosure and the surrounding area, they generated a minimum model with no attempt at reconstructing the palaeoenvironment (including both hydrology and palaeovegetation) and a maximum model that populated the surface of the model with vegetation and hydrologic features that would have impacted visibility and movement through the landscape (Geary and Chapman 2006:180). The use of alternative scenarios in analyzing the palaeo-landscape therefore affords the analyst what Geary and Chapman refer to as a 'probability envelope' (Geary and Chapman 2006:180).

To incorporate a 'probability envelope' into this analysis, two separate DEMs were created, on which to perform the visibility analyses. The first is a blank minimal model in which no modifications are made for palaeovegetation, referred from here on in as the 'empty model' (Figure 4.3). With this model it is as if all the vegetation was cleared from the study region and only the natural topography was present to impede visibility. The second model is a vegetation maximum model, here on in referred to as the 'vegetation model' (Figure 4.4), which is essentially equivalent to a massive block with the average height of the types of trees present in the region during the time the mounds were constructed. Using the tree block is visibly much more restricting than actual vegetation due to the fact that in reality an observer could see in between trees. An alternative is to randomly fill raster squares in the desired areas with tree height values to create an artificial forest. However, given the low resolution of the DEM being used, whereby each raster cell equals approximately 50 by 50 m, this method would have made very little difference. For this reason the block method was selected due to its simplicity in application.

To generate the height value to input into the vegetation model it was necessary to identify what the palaeovegetation of the region generally consisted of at the time the mounds were constructed. According to pollen cores taken in the swamps and lakes surrounding the McIntyre Site, several kilometers west of Serpent Mounds and the mouth of the Indian River, the forests of the region around 1500 to 2000 years ago consisted of mixed deciduous forest of oak, sugar maple, birch, beech, elm and basswood, as well as some pine and other conifers (McAndrews 1984:168-169). Examination of these species shows the majority fall into an average of between 18 and 24 m approximately in height (Petrides and Wehr 1998). While a few exceptions to this range exist including sugar maple, which average between 12 and 18 m (Petrides and Wehr 1998:206), and white pine, which average between 24 and 33 m (Petrides and Wehr 1998:159),an average height of 21 m was selected as the best representative figure for tree height in the region.

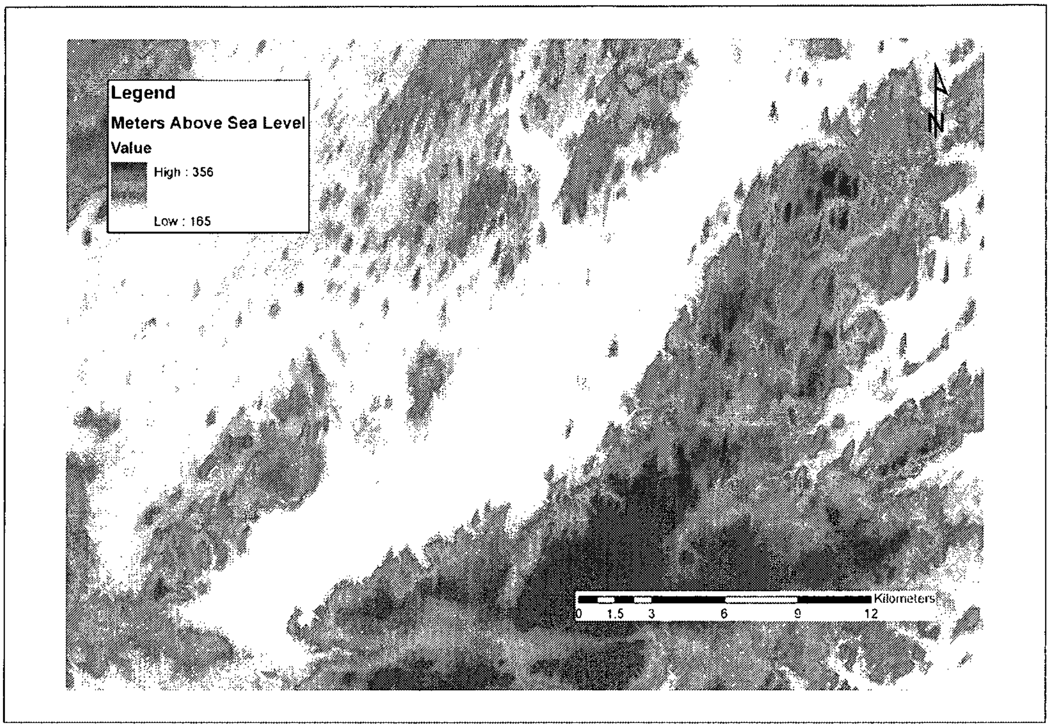

Figure 4.3. Digital elevation model showing the landscape without vegetation

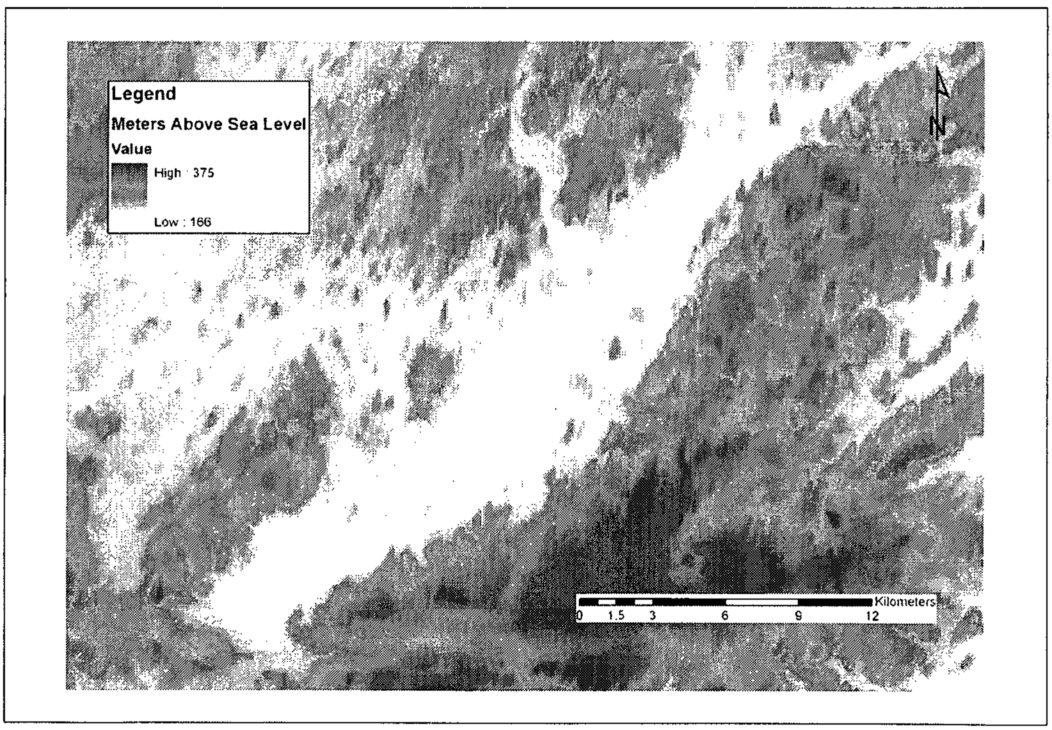

Figure 4.4. Digital elevation model showing the landscape with vegetation

The incorporation of the 21-m vegetation wall into the DEM was done by first generating a mask over the areas that were to be increased in height to represent the presence of vegetation. This included the majority of the map surface, excepting the area of swampland and lake discussed in the previous section. Also excepted were cells with a meters above sea level value of less than 190 m. This was done to preclude the increase of height in the river valleys of the Indian and Otonabee River farther inland than the lake level model covered. The mask area was given the value of 21 m and this layer was added to the surface of the original DEM. Figure 4.3 and 4.4 show the vegetation DEM compared to the original DEM. As mentioned above, an alternative method of simulating vegetation is to generate random values for height over the target area with a range of values, for example from 5 to 30 m. To properly implement such a model would require the creation of a number of different probability surfaces for vegetation and the viewsheds would be run for each one. This is an extremely time consuming process due to the amount of time it takes to generate and then combine the viewsheds for each dataset; therefore, the wall method was deemed most appropriate.

The final aspect of palaeovegetation to be incorporated into this study is probable areas of wild rice growth. The wild rice that was likely present in the Rice Lake area was of the species *Zizania palustris*. This variety is found across Canada including the Precambrian regions of Alberta and Saskatchewan, as well as Manitoba, northwestern Ontario, the rivers flowing into the Ottawa River, the Trent Canal System, the Grand River, Lake Eerie and Southern Georgian Bay, eastward to Nova Scotia and as far south as the northern United States (Aiken et al. 1988:34). The ideal requirements for wild rice to grow include shallow, moving, clear water in lakes and rivers with soft organic bottoms and little competition from other aquatic plants (Aiken et al. 1988:39). The ideal lake depth for wild rice is between 0.3 and 0.6 m with no sudden fluctuation in water levels during the life cycle of the plant (Aiken et al. 1988:39). Wild rice has been known to grow in water depth of between 0.2 and 1 meter (Steeves 1952:110). The rice seeds also require a good flow of water through the growth area to ensure they receive enough oxygen while in their submerged stage of development (Aiken et al. 1988:41-42). Unfortunately, very limited hydrological data is available for the pre-dam lake. This means it is difficult to determine what areas of the lake may have had adequate water flow for wild rice to succeed, though it is likely the areas around the river mouths would meet this requirement. Therefore, the criteria used to model wild rice stands on the lake is the ideal lake depth of between 0.3 and 0.6 m as well as the wider range of 0.2 to 1 m (Figure 4.5).

4.2.3 Considerations of past settlement in the landscape

Visibility analysis in archaeology has been conducted mainly as a point based form of analysis. In other words sites are reduced to a single point in the landscape and viewsheds are generated from those individual points. However, the reality is that archaeological sites are not single points but rather are areas of activity. It was therefore decided for this study that they be treated as such and that visibility be analyzed from the area of the site. Thus, an area with a radius of 300 m was buffered around the site point data and that area was populated with points every 50 m (Figure 4.6). Points were cut if they were on the lake surrounding the sites as these are improbable locations for settlement activity. Viewsheds were then generated from all of the points making up the site area and combined into a single site area viewshed. The generation and combining of

Figure 4.5. Model of high and low potential wild rice growth areas on Rice Lake

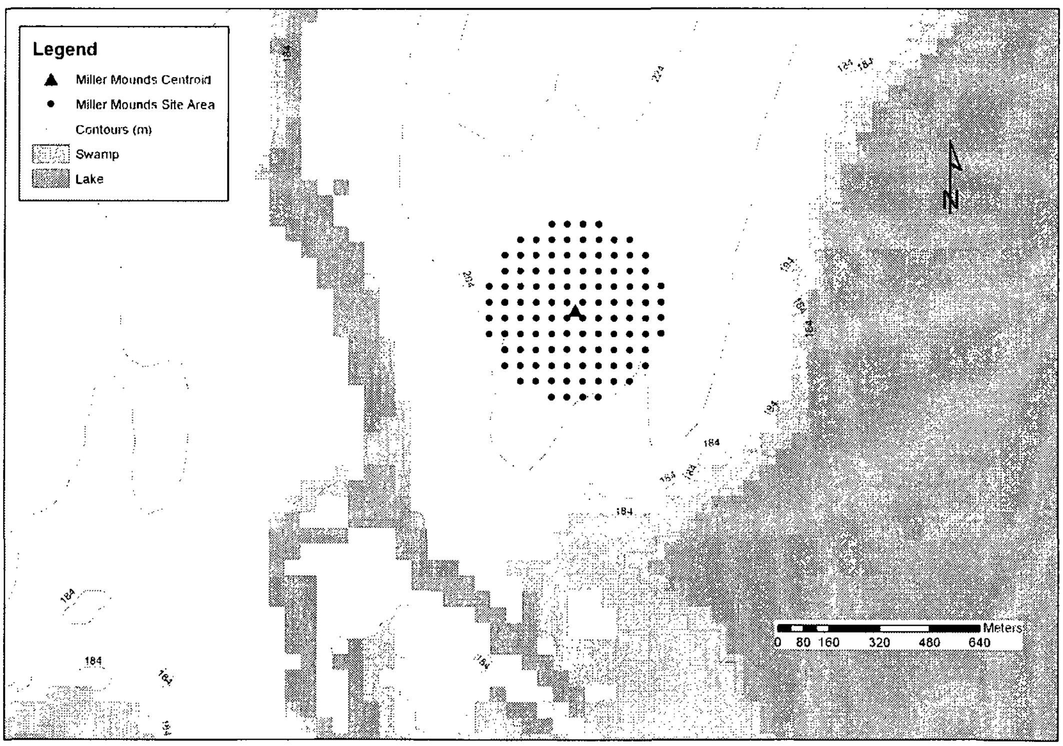

Figure 4.6. Site area points generated for the Miller Mounds site (BaGn-2)

viewsheds from multiple points are referred to as multiple viewsheds (Conolly and Lake 2006:227).

Another concern when analyzing visibility from a given site is the impact the previously discussed vegetation model has on the viewsheds. To prevent the vegetation mask from covering the sites in this study it is necessary to create a buffer around the sites. If this is not done the sites take their observer height point from the vegetation mask, which would inflate the range of visibility significantly. For all non-mound sites a radius of 300 m is left clear around the site corresponding with the site areas discussed above. A 600-m radius is left clear around the mound sites. The 600-m figure is selected to accommodate the recorded extent of these sites. With the exception of the Harris Island mound, the mound sites with all of their components including middens and other areas seem to occupy considerably larger areas than the non-mound sites. The reason 600 m is used for the vegetation clearance around the mounds and not for the actual area of the sites being used to generate viewsheds is to ensure that the visibility analysis would not be inflated statistically in favour of the mound sites.

4.3 Sample Used for Study

In total, five datasets are used for the purpose of this analysis. Of these, three are based on site data for the Rice Lake region, while the other two are randomly generated datasets. The site-based datasets include a set with the five confirmed Rice Lake mound sites, a set with 11 non-mound Middle Woodland Rice Lake sites, and a set with 11 Late Archaic and Early Woodland sites. The latter of the three sets was combined because the Early Woodland sites on Rice Lake are under-represented. Due to the under-representation of Early Woodland Sites, the Archaic/Early Woodland dataset will henceforth be referred to as the pre Middle Woodland datatset. Tables 4.1 through 4.3 summarize those datasets discussed above. Two randomly generated datasets are also utilized in this study. The first of these is a set of 50 random sites generated along the northern shore and islands of Rice Lake so as to have a neutral sample with which the viewsheds of the actual sites could be statistically compared. These sites are generated by constructing a 700-m buffer around the exterior of the swamp layer and then erasing the buffer that fell within the swamp layer itself as well as the southern shore of Rice Lake. This buffer is then used as a mask, in which the 50 sites are randomly generated. The 700-m figure is selected to correspond to the furthest distance an existing site is located from the swamp area, which is the Miller Mounds. The 300-m buffers that had been generated around all of the existing sites are then also removed from the north shore buffer so that sites are not generated in the locations of existing sites. The random sites are generated in ArcGIS and are then converted to areas for the purpose of generating multiple viewsheds as discussed above. The second set of random points consists of 15000 points generated over the surface of the modified lake layer. These points are used to generate the visibility map of the lakeshore discussed below.

4.4 Visibility Analysis of the Burial Mounds and Other Sites Across Rice Lake

To assess the visibility characteristics of the Rice Lake mounds and that of Middle Woodland settlements on the lake in general, a number of different visibility analyses are selected. All of these analyses are intended to determine whether visibility in any form was a causal factor in site selection for the burial mounds on Rice Lake. All the analyses discussed below are conducted using the GRASS GIS platform.

Table 4.1. Rice Lake mound sites included in analysis

Borden #	Site Name
BbGm-11	East Sugar Island
BaGn-2	Miller Mounds
BbGm-2	Serpent Mounds
BbGm-27	Harris Island Mound
BbGm-1	Cameron's Point

Table 4.2. Rice Lake non-mound Middle Woodland sites included in analysis

Borden #	Site Name
BaGn-3	Jubilee Point
BbGn-2	McIntyre Site
BbGm-6	Loucks Site
BbGm-13	Spillsbury Bay
BbGm-12	Godfrey Point
BbGm-10	Birdsall Beach and Point
BbGm-14	Foley Point
BbGm-3	Harris Island
BbGm-8	Hickory Island
BaGn-7	West Grape Island
BaGn-10	Cow Point
BbGm-4	Rainy Point
BbGm-9	East Grape Island
BbGm-15	Exit River

Table 4.3 Rice Lake Archaic and Early Woodland sites included in analysis

Borden	Site Name
BbGn-2	McIntyre
BbGm-22	Poison ivy
BaGn-5	West Sugar Island
BaGn-14	Seidl
BaGn-63	Pengelly
BbGm-7	White's Island
BbGm-12	Godfrey Point
BbGm-21	John
BbGm-3	Harris Island
BaGn-16	Dawson Creek Site
BbGm-14	Foley Point

4.4.1 Visibility from Rice Lake

To ascertain the visibility of the surrounding shoreline from Rice Lake it is necessary to generate a kind of visibility map. This is done by generating 15000 random points over the pre-1830s surface of the lake and running viewsheds from all of them and then combining them into a single surface. The individual viewsheds are given a maximum distance of 10 km and observer height of one meter. One meter was selected to simulate a person sitting or kneeling in a vessel like a canoe that rides low to the water, because this would likely have been the way the inhabitants of the Rice Lake area would experience a water to shore view. The result of combining the viewsheds is a multi-valued layer, which expresses the number of lake points from which an individual shoreline cell is visible. To simplify the output, the shoreline visibility is reclassified into categories of visibility running from 0 to 9, with 0 being the cells not visible from the lake, and 9 being visible from the most points on the lake. Figure 4.7 shows the outcome of the visibility map.

To establish the visibility of sites from the lake, analysis is conducted through both quantitative and descriptive frameworks. Quantitatively, the area points generated for each site have their values recorded from the visibility map of shoreline recorded. Figure 4.8 shows the visibility map of the shoreline with the points generated at the Serpent Mounds site to represent area. All the points for all the sites included in each of the mound, Middle Woodland, Pre Middle Woodland, and random site datasets are grouped together and then the four datasets are compared statistically using a Wilcoxon test. The Wilcoxon test, also known as a Mann-Whitney, test is a straightforward non-parametric test (Conolly and Lake 2006:127). While both the Wilcoxon test and the

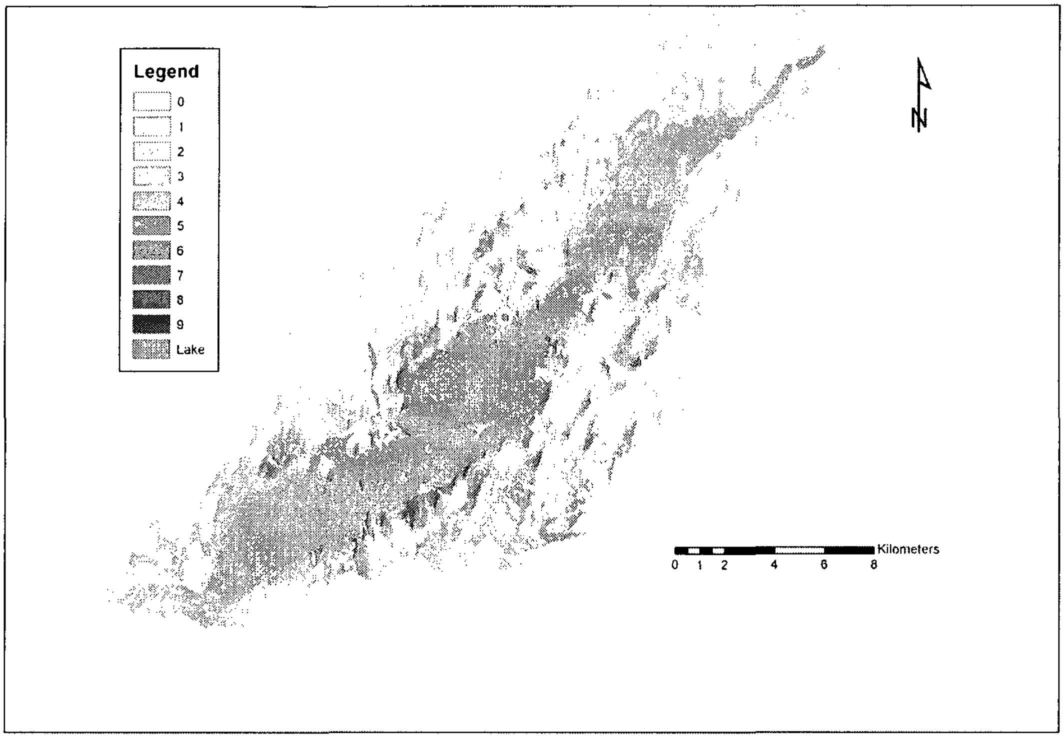

Figure 4.7. Visibility map of visibility from Rice Lake (0 values are not shown)

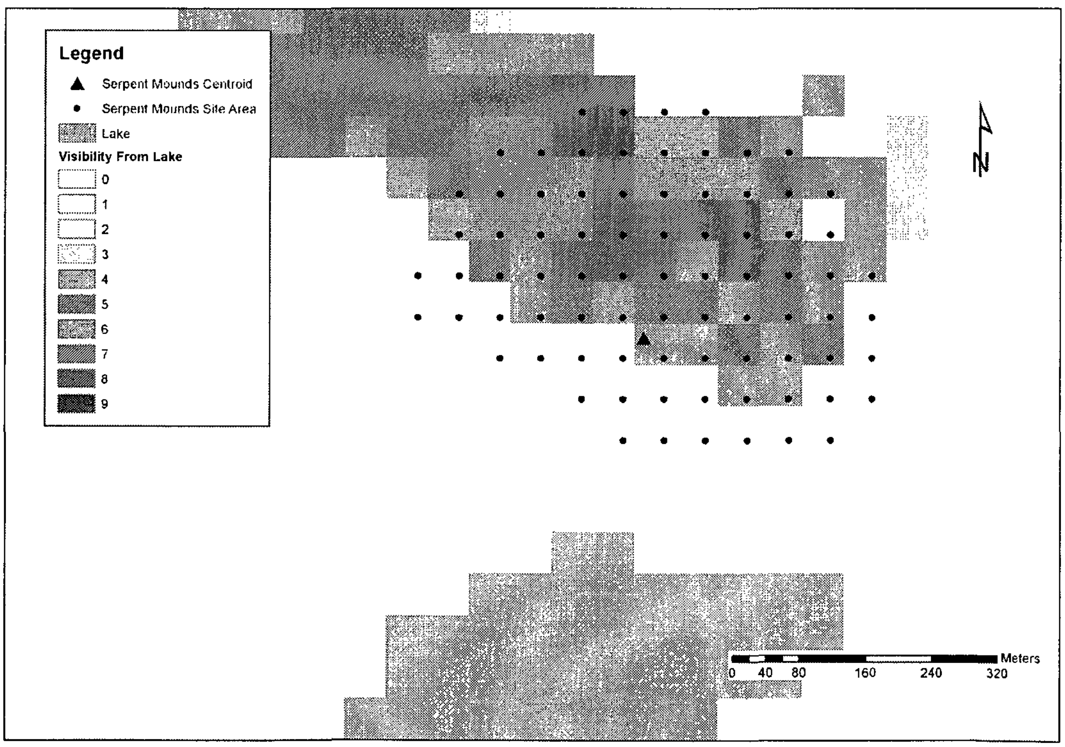

Figure 4.8 Visibility map of visibility from Rice Lake with area points for the Serpent Mounds site

Kolmogorov-Smirnov test (KS-test) discussed below are well suited to the analysis of non-parametric data, the Wilcoxon test is better at handling the ranked data that are being analyzed here (Shennan 1997:67). Non-parametric tests, such as the two applied in this study, are best applied to relatively small samples, as they tend to downplay significance in larger sample sizes (Conolly and Lake 2006:122). The result is compared to a table of critical values and significance is generally measured by whether the p value is equal or less than 0.05, or a 95% certainty (Conolly and Lake 2006:132). The results of the statistical analysis between the datasets will indicate whether sites from one dataset tend to be placed in more highly visible locations compared to another. For the descriptive analysis, the individual sites are examined to attempt to distinguish any patterns both within and between the various datasets. The focus of the descriptive analysis is to ascertain what, if any, relationship the visibility of the sites from the lake played in the selection of their location. While the statistical analysis identifies relational variation between the datasets, the descriptive analysis focuses on each set of sites in its own right and not in comparison to other site types or temporal periods. Ultimately, the purpose of this analysis is to determine whether sites were being selected for their visibility, either enhanced or restricted, from the lake, and to identify what if any variation there was in such selection criteria based on type of site or time period.

4.4.2 Viewsheds from the Mound Sites

This in many ways is the most fundamental form of visibility analysis and it is certainly the most common form used by archaeologists. Multiple viewsheds are generated for each site from the site areas discussed previously. The viewsheds generated from all of the points are added together and then reclassified so that the output cells are coded as '0' for cells not visible from any of the site points and '1' for cells visible from any of the site points. This binary coding is what differentiates the multiple viewshed from the cumulative viewshed discussed above. The assessment of the viewsheds is then carried out in a number of different ways both quantitative and qualitative. The criterion that is used to generate the viewsheds for all of the sites is identical to ensure equality in both the quantitative and qualitative forms of assessment. Observer height, a value added to the DEM representing the height of a person at the viewing point, is set to 1.75 m, which is a standard average height used for viewshed analysis. The maximum distance for visibility is set at 5 km. This distance was selected based on field observations which showed that this was approximately the maximum distance that could be seen when out on Rice Lake. It is important to note that this distance represents the maximum distance and not the limit of clear visibility. Clear visibility would likely be capped at a distance of one kilometer or perhaps up to 2 km under ideal circumstances. Variation in visibility such as this will be accounted for through the qualitative examination of site viewsheds. Through the use of these standards an even-handed model is created for assessing visibility on Rice Lake.

4.4.2.1 Quantitative Analyses

The purpose of quantitative analysis of viewsheds is to determine whether there is a significant difference between two sets of viewsheds based on how much is visible. In the previous visibility study conducted on the Rice Lake mounds the total visible area was considered, as was the total visible area of the lake, the lake and the swamplands, and just the swamplands (Dillane 2007:37). While the principal analysis remains the same a number of significant changes have been introduced for this study. First and foremost the initial study used the modern lake and swamp levels. This study employs the palaeoenvironmental model with lake levels compensating for the historic water level rise. In addition to the lake, lake and swamp, and swamp tests performed during the previous study, visibility to both the ideal and not ideal wild rice stands are also tested. In order to isolate the cells within the various areas of interest masks are applied to such areas. Masks are generated to block all cells that do not fall within the area of the designated layer, thereby excluding them from analytical processes such as the generation of statistics for the viewsheds.

In total six sets are used. The first is a total viewshed in which no mask is applied so all visible cells are included in each site total. The other sets are the lake, swamp, combined lake and swamp areas, ideal wild rice areas, and non-ideal wild rice areas. For these areas masks are placed over their respective layers so that the statistics generated for the site viewsheds include only those positive cells within each area. In addition to these six categories, each of the four datasets, mounds, Middle Woodland, Pre Middle Woodland and random sites are also compared using both the 'empty model' and 'vegetation model'. Table 4.4 summarizes the samples used in the quantitative analysis of views from the site datasets.

Samples are compared using the Kolmogorov-Smirnov Test (KS-test), a non-parametric method for testing the differences between two datasets (Conolly and Lake 2006:130). Two sets of data are converted into cumulative distributions, and the KS-test analyzes what the maximum level of difference is compared to the difference that would occur if both datasets came from the same distribution (Conolly and Lake 2006:131). Like the Wilcoxon test discussed above the result is expressed as a p-value and is considered significant if it is less than 0.05 or a 95% certainty. In the case of this analysis the KS-test will be used to demonstrate whether a significant difference is present in the total viewsheds of the various datasets. In the case of the mounds dataset compared to the Middle Woodland dataset, for example, the null hypothesis is that the two sets of viewsheds are of the same population and that no significant variation exists between their respective total viewsheds. The number of cells visible in each dataset are converted into cumulative distributions and compared. The resulting p-value determines the likelihood of whether the null hypothesis can be rejected and thus that one of the datasets' viewsheds is significantly different than the other.

4.4.2.2 Descriptive Assessment

While the quantitative analysis determines whether there is statistical variation in visibility between the various datasets, it is also central to the understanding of the visibility relationships of sites to examine what was visible. It is therefore necessary to consider the viewsheds from both the datasets as a whole as well as the individual sites to properly interpret the visibility characteristics of the sites from around the lake. An argument could be made that if qualitative observations are to be made regarding what is visible from a site, then it is better to make such observations in person at the physical site and not in the abstract world of the computer. However, because of the environmental changes, and the rise in water level in particular, making these observations using the digital model provides a clear advantage. All three of the datasets are visually assessed to determine if any specific features are visible from one set of sites and not the others. Also the individual sites within the datasets are evaluated to determine if any particular type of internal variation occurs.

Table 4.4 Samples used for quantitative analysis of views from sites

Dataset	Model	Area	Abbreviation
Mounds	empty	total	Mds-NV-T
Mounds	empty	lake	Mds-NV-L
Mounds	empty	swamp	Mds-NV-S
Mounds	empty	lake and swamp	Mds-NV-LS
Mounds	empty	ideal wild rice	Mds-NV-IR
Mounds	empty	not ideal wild rice	Mds-NV-NR
Mounds	vegetation	total	Mds-V-T
Mounds	vegetation	lake	Mds-V-L
Mounds	vegetation	swamp	Mds-V-S
Mounds	vegetation	lake and swamp	Mds-V-LS
Mounds	vegetation	ideal wild rice	Mds-V-IR
Mounds	vegetation	not ideal wild rice	Mds-V-NR
Middle Woodland	empty	total	MW-NV-T
Middle Woodland	empty	lake	MW-NV-L
Middle Woodland	empty	swamp	MW-NV-S
Middle Woodland	empty	lake and swamp	MW-NV-LS
Middle Woodland	empty	ideal wild rice	MW-NV-IR
Middle Woodland	empty	not ideal wild rice	MW-NV-NR
Middle Woodland	vegetation	total	MW-V-T
Middle Woodland	vegetation	lake	MW-V-L
Middle Woodland	vegetation	swamp	MW-V-S
Middle Woodland	vegetation	lake and swamp	MW-V-LS
Middle Woodland	vegetation	ideal wild rice	MW-V-IR
Middle Woodland	vegetation	not ideal wild rice	MW-V-NR
Pre Middle Woodland	empty	total	PMW-NV-T
Pre Middle Woodland	empty	lake	PMW -NV-L
Pre Middle Woodland	empty	swamp	PMW -NV-S
Pre Middle Woodland	empty	lake and swamp	PMW -NV-LS
Pre Middle Woodland	empty	ideal wild rice	PMW -NV-IR
Pre Middle Woodland	empty	not ideal wild rice	PMW -NV-NR
Pre Middle Woodland	vegetation	total	PMW -V-T
Pre Middle Woodland	vegetation	lake	PMW -V-L
Pre Middle Woodland	vegetation	swamp	PMW -V-S
Pre Middle Woodland	vegetation	lake and swamp	PMW -V-LS
Pre Middle Woodland	vegetation	ideal wild rice	PMW -V-IR
Pre Middle Woodland	vegetation	not ideal wild rice	PMW -V-NR
Random	empty	total	Rd-NV-T
Random	empty	lake	Rd-NV-L
Random	empty	swamp	Rd-NV-S
Random	empty	lake and swamp	Rd-NV-LS
Random	empty	ideal wild rice	Rd-NV-IR
Random	empty	not ideal wild rice	Rd-NV-NR
Random	vegetation	total	Rd-V-T
Random	vegetation	lake	Rd-V-L
Random	vegetation	swamp	Rd-V-S
Random	vegetation	lake and swamp	Rd-V-LS
Random	vegetation	ideal wild rice	Rd-V-IR
Random	vegetation	not ideal wild rice	Rd-V-NR

The results of the qualitative assessment are framed to answer a number of key research questions. Does the view from the mound sites reflect the control of select areas? Are resource areas particularly prevalent within the viewsheds of the mounds compared to contemporaneous non-mound sites? What variations exist between the viewsheds of the mounds and those of other types of sites from around the lake? Additionally, other patterns that emerge during the course of examination will be addressed. The importance of the qualitative investigation is to identify subtler patterns than those revealed during quantitative analysis, which are generally limited to how much of certain layers are visible and are not capable of detecting what is visible in any meaningful way.

4.4.2.3 Intervisibility Between Sites

Another form of descriptive assessment considered is the visual inter-relationship between sites on Rice Lake. For this analysis only sites that fall within the same temporal periods are considered. Like the previously discussed qualitative examination, the viewsheds for the sites are examined and those sites that fall into the viewsheds of other sites are identified. Any patterning beyond the individual site is examined and discussed. In addition to the actual intervisibility of sites, consideration also is given to areas of the lake and surrounding landscape that fall within the viewsheds of multiple sites, with particular emphasis placed on the Indian River locale. Areas visible from all three of East Sugar Island, Harris Island and Serpent Mounds may represent areas of particular importance in relation to the selection of the sites for the mounds.

4.5 Experiential Observations of Visibility of the Mound Sites

To provide an experiential aspect to the analysis of visibility on Rice Lake, as opposed to virtually simulated models discussed above, it was decided that field-based observations of the region should be conducted. Originally, the plan was to visit all five mound sites and canoe the lake around them. However, difficulties arose in identifying a few of the sites' former locations, as did problems acquiring permission to visit sites from landowners. These reasons on top of a particularly rainy period during the intended field season meant ambitions had to be scaled back for the field component. In the end, only two sites were visited, the Harris Island Mound and Serpent Mounds. Additionally, due to the weather restrictions of the summer, only the lake around the Serpent Mounds cluster was visited by boat. The Miller Mounds area was visited by boat, but failure to identify the former location of the mounds made that particular trip rather fruitless.

For the two mound sites that were visited, field observations were made using a standardized terrestrial observations form which can be found in Appendix A. Observations were taken along pathways walked from the four cardinal directions to the sites as well as from areas around the mounds, and with great respect, on top of the mounds themselves. Observations were made as to which other features of the sites were visible or likely visible if vegetation was less prevalent. Photographs were taken and GPS coordinates were recorded at each point observations were made. The GPS coordinates, especially at the Harris Island site, may not be completely accurate due to the heavy vegetation that covers that site. The GPS coordinates are digitized as point data and viewsheds are generated from them for the sake of comparison for both the terrestrial and aquatic observations.

Aquatic observations were made from Rice Lake in the area around the Serpent Mounds cluster, using standardized forms, which are presented in Appendix B. From a canoe, observations were made as to the visibility of sites and prominent landscape features. Due to heavy modern vegetation, estimations of mound site visibility were often based on the hypothetical clearance of vegetation. This automatically raises concerns about the accuracy of such observations. However, in combination with the digital model these observations do provide a vital understanding of certain aspects of local visibility. Like the ground observations, the aquatic observations were taken on vectors of approach, and GPS coordinates and photos accompany each observation point taken. The interpretation of these observations is used in tandem with the qualitative and quantitative analysis in order help draw a picture of what the Rice Lake mound builders visually experienced in the area and helps elicit what impact, if any, visibility had on the selection of sites where mounds were erected for interment of the deceased.

Chapter 5
Results

5.1 Quantified Analyses

5.1.1 Visibility of the Mounds from the Lake

The analysis of visibility of the Rice Lake burial mounds is carried out in two forms, one quantitative, the other descriptive. Quantitative evaluation is conducted using the site area points generated in a 300-m radius around the site centroids. The visibility data for the points were derived from the visibility map ranked from 0, for no visibility, to 9, for highest visibility from the lake. The values of all the points representing site areas for all the sites within each of the four datasets are combined into lists of cumulative distributions for statistical analysis. Figure 5.1 illustrates the variation in distribution between the four datasets. The datasets are then statistically compared

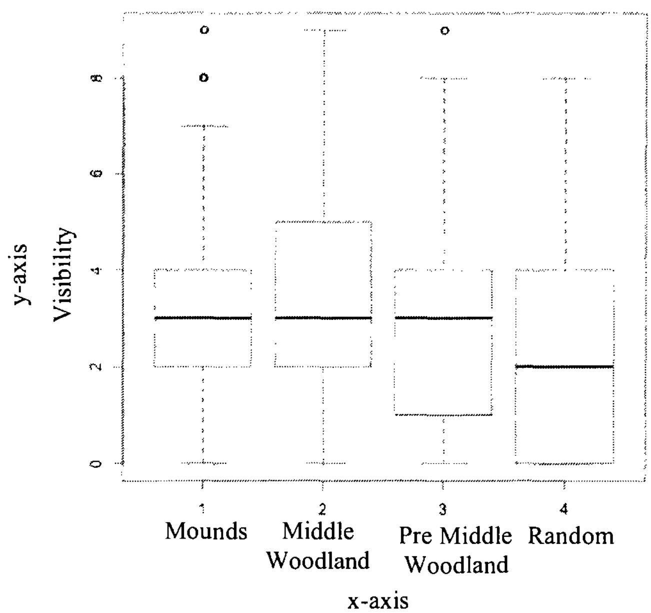

Figure 5.1. Box plot showing distribution of values of the views from Rice Lake (y-axis) to the four datasets (x-axis) The thick line represents the median, the upper and lower ends of the box represent the upper and lower quartiles of the distribution, and the upper and lower ends of the dotted line represent the total extent of the distribution

against one another using a Wilcoxon test to determine whether a significant difference in distribution exists among them.

The results of the Wilcoxon tests are presented in Table 5.1. The most significant results come from the comparisons between the real datasets and the random dataset. This is not surprising, given the overall lower distribution of the random sites compared to the other datasets as shown in Figure 5.1. Significance is also identified when the Pre Middle Woodland sites are compared to the Middle Woodland sites. As illustrated by Figure 5.1, the significance identified in this comparison refers to the tendency towards more highly visible locations for the distribution of Middle Woodland sites compared to the Pre Middle Woodland sites. The mound sites compared to the non-mound Middle Woodland sites show an almost significant relationship. While this would be significant if 0.1 is accepted as a critical value, there is a higher chance of error. The difference between the two distributions appears to be a higher upper quartile in the Middle Woodland site dataset (Figure 5.1). This means that on the whole the non-mound Middle Woodland sites are more highly visible, though the overall median for both the mound and non-mound sites is basically equivalent. No significance was found in the comparison of the mound sites with the Pre Middle Woodland sites.

5.1.2 Viewsheds from the Mounds

The quantitative analysis of visibility from the mound sites compared to visibility of sites from the other datasets was carried out using the KS-test discussed in the previous chapter. A total of 72 KS-tests were performed between the eight core datasets and their six subset variations. The eight datasets included the vegetation and empty model viewsheds of the mound sites, Middle Woodland sites, Pre Middle Woodland

Table 5.1. Resulting p-values from the Wilcoxon tests for visibility from Rice Lake

Dataset 1	Dataset 2	p-value
mounds	Middle Woodland	0.08314
mounds	Pre Middle Woodland	0.6275
mounds	random	< 2.2e-16
Middle Woodland	Pre Middle Woodland	0.003776
Middle Woodland	random	< 2.2e-16
Pre Middle Woodland	random	< 2.2e-16

Note: < 2.2e-16= < 0.00000000000000022

sites, and randomly generated sites discussed previously. Each of these datasets included area subsets for total viewshed, view to the lake, view to the swamp, view to both lake and swamp, view to ideal areas for wild rice growth, and view to non-ideal but plausible areas of wild rice growth. The p-value results of the KS-tests are given in Appendix C. The only significant results came from the three real site datasets in comparison to the random datasets. Table 5.2 lists the significant results of the tests between the three real site datasets and the random sites.

The results of the KS-test indicate significance only between the real sites datasets compared to the random datasets. Significant results imply that there is a 95% certainty that the two datasets being compared are of different distributions. This means that one of the site datasets has a significantly larger area of view compared to the other when each dataset is examined as a cumulative range. Examination of the datasets suggests that the actual site sets have a greater visible area than do the random sets. As no significance was established between any of the existing site datasets, it would appear that all of the existing sites fit into similar cumulative distributions. Additionally, because no datasets showed significance when views to the reconstructed wild rice fields were tested, it can be surmised that if the fields were where the simulations indicate, settlements were not situated specifically to have a view to them.

Table 5.2. Significant p-values from KS-tests for viewshed datasets

Dataset 1	Dataset 2	p-value
MW-NV-T	Rd-NV-T	0.004
PMW-NV-L	Rd-NV-L	0.02
PMW-NV-S	Rd-NV-S	0.04
MW-NV-LS	Rd-NV-LS	0.05
PMW-NV-LS	Rd-NV-LS	0.03
Mds-V-T	Rd-V-T	0.05
MW-V-T	Rd-V-T	0.004
PMW-V-L	Rd-V-L	0.01
MW-V-S	Rd-V-S	0.05
Mds-V-LS	Rd-V-LS	0.03
MW-V-LS	Rd-V-LS	0.02

Note: Mds=mounds MW=Middle Woodland PMW=Pre Middle Woodland Rd=Random NV=No Vegetation V=Vegetation T=Total Viewshed L=Viewshed to Lake S=Viewshed to Swamp LS=Viewshed to both Lake and Swamp

The p-value results of significance varied considerably. Six of them occurred within the vegetation model whereas five were from the empty model. All three of the real datasets had some significant results, as did the tests of total viewshed, view of lake, view of swamp, and view of lake and swamp. The amount of variability in the significant results suggests no clear variation between the mound, Middle Woodland, and Pre Middle Woodland sites. The results do suggest, however, that there is certainly a relationship between site locations of all periods and types included in this study and view to the lake and swamps compared to the random sites. From this it appears that visibility to the lake was an important factor of site selection for Pre Middle Woodland and Middle Woodland sites in the Rice Lake region. While proximity to water has always been incorporated into predictive models for identifying past settlement locations, these results suggest that an actual visual relation is also a factor, for despite the fact the random dataset was generated within the same proximity of the lake as the existing sites, the views to the lake and swamps are significantly less pronounced.

5.1.3 Potential Sources of Error

The analysis of visibility from site locations has several potential sources of error. Amongst these is the omission of sites from the Pre Middle Woodland and Middle Woodland non-mound datasets. Due to difficulty digitizing some of the smaller islands and the southern shoreline, four Middle Woodland sites were excluded from the sample dataset, an error not noticed until late in the process. These sites included the Middle Woodland Hickory Island site, East Grape Island site, West Grape Island site and Exit River site. As a result the dataset used in the quantitative portion of analysis was not complete. While it was not possible to include these sites so late in the analysis process, they are incorporated into the descriptive analysis discussed below.

5.2 Descriptive Analysis

Descriptive analysis was carried out to provide a more nuanced range of observations than what is available through quantitative analysis. While the quantitative analysis tests how much was visible, the descriptive analysis below examines what was visible. In particular, emphasis is placed on the intervisible relationship between sites in the same temporal periods, as well as between sites and key points of the surrounding rivers and the lake. The descriptive analysis is largely qualitative; however, it is still constrained within the confines of the digitally generated viewshed and the comparisons between datasets. Such constraints limit the interpretations of the results to a relatively small range of properties for the sites in question. Comparisons between datasets are also limited to a comparison of mounds to other Middle Woodland sites, and comparisons of all Middle Woodland sites with the Pre Middle Woodland sites.

5.2.1 Views From the Mounds and Non-Mound Middle Woodland Sites

Due to the apparent clustering of Middle Woodland sites around the rivers draining into Rice Lake, and the distance between the site clusters, site intervisibility is considered mainly within the individual clusters. The three clusters considered here are the Otonabee River locale, the Indian River locale, and the Ouse River locale as defined by Spence et al. (1984) (Figure 5.2). While there is some overlap in viewshed between these groups, most viewsheds are confined to their own locale due to the distance restriction applied to the viewshed analysis. Intervisibility between sites is summarized in Tables 5.3 through 5.9.

The Otonabee River locale consists of the Miller Mounds site, the Jubilee Point site, the Cow Island site and the West Grape Island Site (Figure 5.3). The Miller Mounds site viewshed in the empty model (Figure 5.4) shows an extensive view to the lake south of the site including the islands to the south and the southern shoreline. There is also excellent visibility to a portion of area west of the Otonabee River. The view to the river itself is extremely limited and only the river's mouth is highly visible from the site. The view to the ideal wild rice areas is excellent from the site. There is visibility from the site to both the Cow Island and Jubilee Point sites, but not to West Grape Island. The Miller Mound site is partially visible from both the Cow Island and Jubilee Point sites but West Grape Island is not visible from either of those sites (Figure 5.5 to 5.6). The south shore of the lake and southern islands are also highly visible from both sites as are the ideal wild rice areas. The view to the river and its delta is good from both sites. There is also intervisibility between the two sites. The vegetation model for the Otonabee locale is generally similar to the empty model. The only difference in the visibility from Jubilee

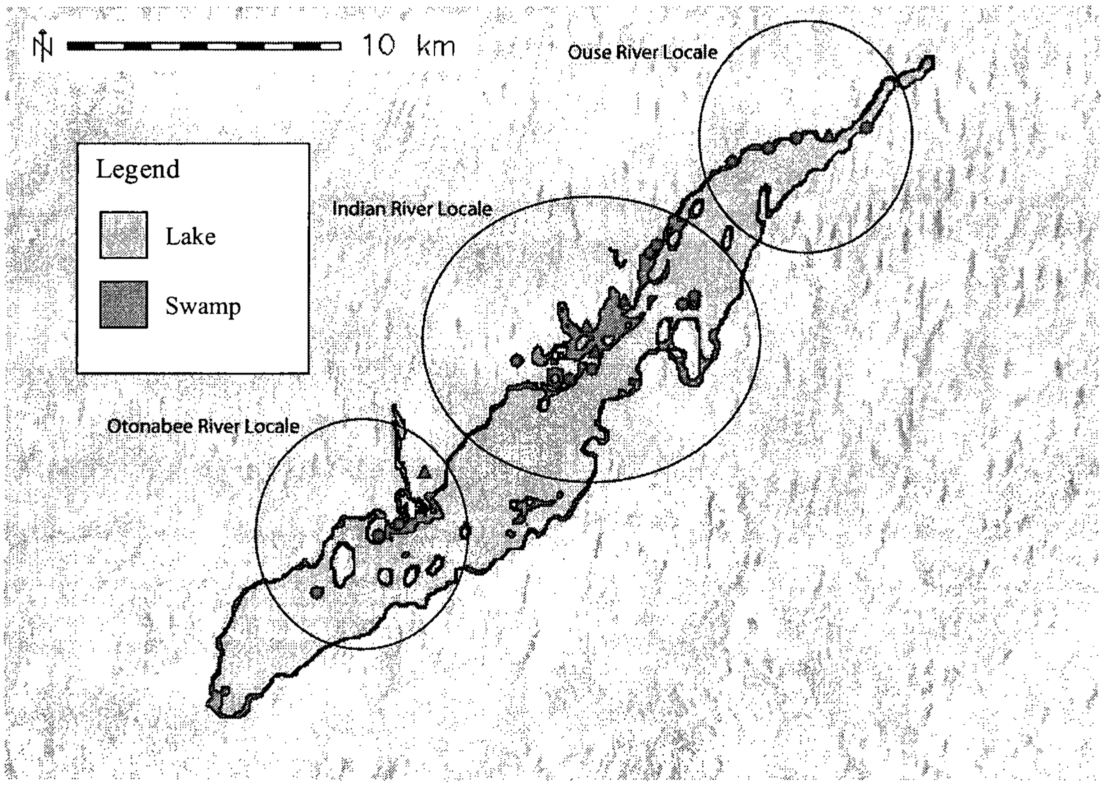

Figure 5.2. Middle Woodland site cluster locales (reconstructed from Spence et al. 1986)

Table 5.3. Intervisibility of sites in the Otonabee River locale (empty model)

Visibility From/To	Miller Mounds	Jubilee Point	Cow Island	West Grape Island
Miller Mounds		good	good	none
Jubilee Point	partial		good	none
Cow Island	partial	good		none
West Grape Island	--	--	--	

Table 5.4. Intervisibility of sites in the Otonabee River locale (vegetation), emphasis on differences between vegetation and empty models

Visibility From/To	Miller Mounds	Jubilee Point	Cow Island	West Grape Island
Miller Mounds		**partial**	**partial**	none
Jubilee Point	partial		good	none
Cow Island	partial	good		none
West Grape Island	--	--	--	

Table 5.5. Intervisibility of sites in the Indian River locale (empty)

Visibility From/To	McIntyre Site	Harris Island	Rainy Point	Serpent Mounds	Harris Mounds	East Sugar Island	Foley Point	Loucks	Hickory Island	East Grape Island
McIntyre Site		partial	partial	partial	poor	partial	none	none	--	--
Harris Island	good		partial	partial	poor	poor	none	none	--	--
Rainy Point	good	good		partial	poor	poor	none	none	--	--
Serpent Mounds	good	good	good		good	good	partial	partial	--	--
Harris Mounds	good	partial	good	good		good	none	none	--	--
East Sugar Island	good	good	good	good	good		none	none	--	--
Foley Point	none	none	none	partial	none	good		good	--	--
Loucks	none	none	none	partial	none	poor	good		--	--
Hickory Island	good	none	good	good	good	good	good	good		--
East Grape Island	good	none	good	good	good	good	good	good	--	

Table 5.6. Intervisibility of sites in the Indian River locale (vegetation), emphasis on differences between vegetation and empty models

Visibility From/To	McIntyre Site	Harris Island	Rainy Point	Serpent Mounds	Harris Mounds	East Sugar Island	Foley Point	Loucks	Hickory Island	East Grape Island
McIntyre Site		partial	partial	partial	poor	partial	none	none	--	--
Harris Island	good		partial	**poor**	poor	poor	none	none	--	--
Rainy Point	good	good		**poor**	poor	poor	none	none	--	--
Serpent Mounds	**partial**	**partial**	good		good	good	**none**	**none**	--	--
Harris Mounds	good	**none**	good	good		good	none	none	--	--
East Sugar Island	good	**partial**	good	good	good		none	none	--	--
Foley Point	none	none	none	**none**	none	**partial**		good	--	--
Loucks	none	none	none	**none**	none	poor	good		--	--
Hickory Island	**partial**	none	good	good	good	good	good	good		--
East Grape Island	**partial**	none	good	good	good	good	good	good	--	

Table 5.7. Intervisibility of sites in the Ouse River locale (empty model)

Visibility From/To	Godfrey Point	Spillsbury Bay	Bridsall Bay	Cameron's Point	Exit River
Godfrey Point		good	good	partial	poor
Spillsbury Bay	partial		partial	partial	none
Bridsall Bay	good	good		partial	poor
Cameron's Point	partial	partial	partial		good
Exit River	--	--	--	--	

Table 5.8. Intervisibility of sites in the Ouse River locale (vegetation model), emphasis on differences between vegetation and empty models

Visibility From/To	Godfrey Point	Spillsbury Bay	Bridsall Bay	Cameron's Point	Exit River
Godfrey Point		good	good	partial	poor
Spillsbury Bay	partial		partial	partial	none
Bridsall Bay	**partial**	good		partial	**none**
Cameron's Point	partial	partial	partial		good
Exit River	--	--	--	--	

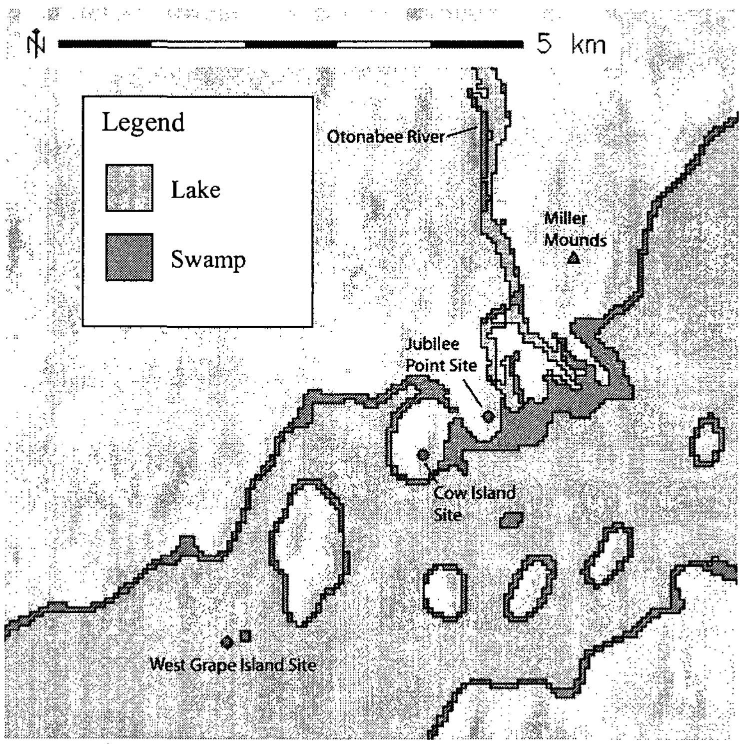

Figure 5.3. Sites included in the Otonabee River locale

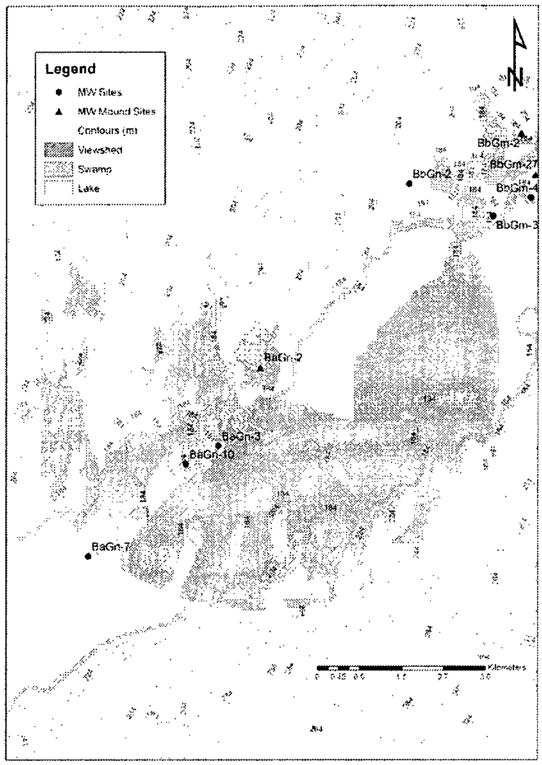

Figure 5.4. Viewshed from the Miller Mound Site (BaGn-2) in the empty model

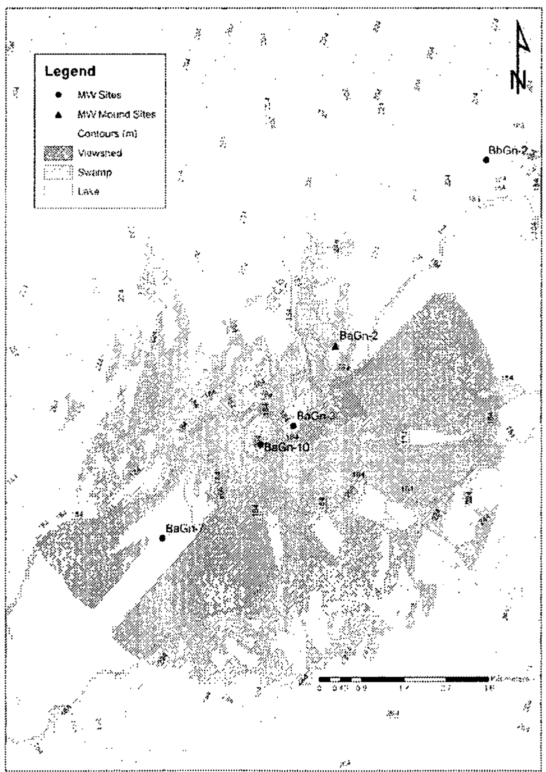

Figure 5.5. Viewshed from the Cow Island site (BaGn-10) in the empty model

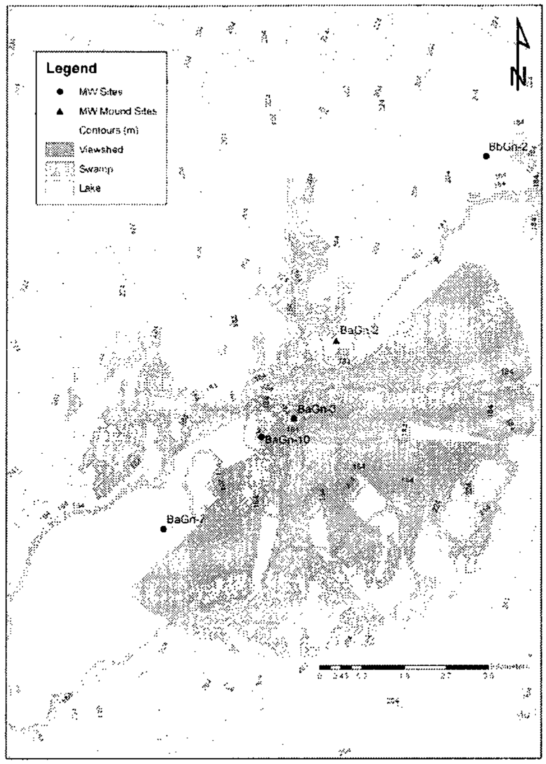

Figure 5.6. Viewshed from the Jubilee Point site (BaGn-3) in the empty model (BaGn-2) in the vegetation model

Point and Cow Island sites is that visibility from the Cow Island site to the Otonabee River is not as good as in the empty model. The only difference for the Miller Mounds site between the two models is visibility to the Jubilee Point, and Cow Island sites is not as clear in the vegetation model (Figure 5.7).

The Indian River locale consists of three known mound sites, Serpent Mounds, East Sugar Island Mounds, and the Harris Mound sites, and seven non-mound Middle Woodland sites including the Foley, Loucks, Rainy Point, Harris Island, McIntyre, Hickory Island, and East Grape Island sites (Figure 5.8). The three mound sites are all intervisible with each other (Figure 5.9). The swampy areas around Serpent Mounds and the main channel in the middle of Rice Lake are also visible from all three sites, as is the

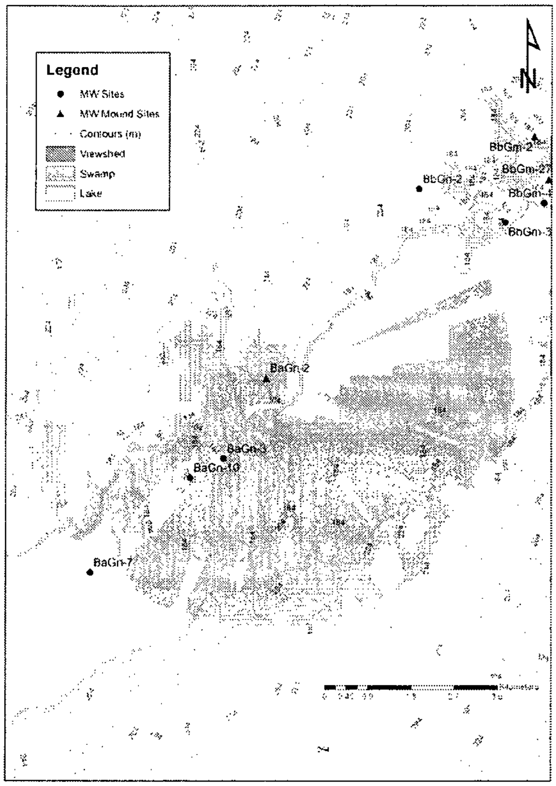

Figure 5.7. Viewshed from the Miller Mounds Site (BaGn-2) in the vegetation model

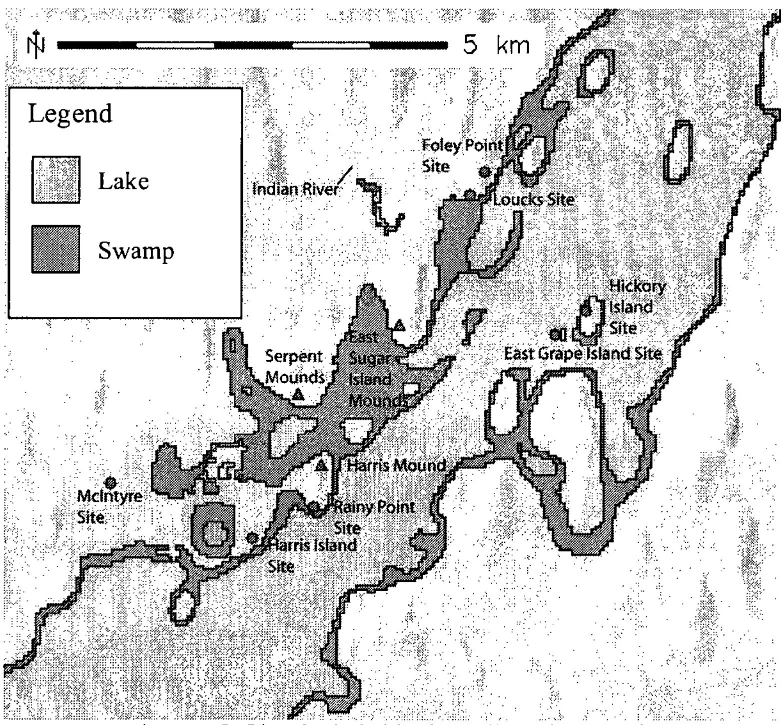

Figure 5.8. Sites included in the Indian River locale

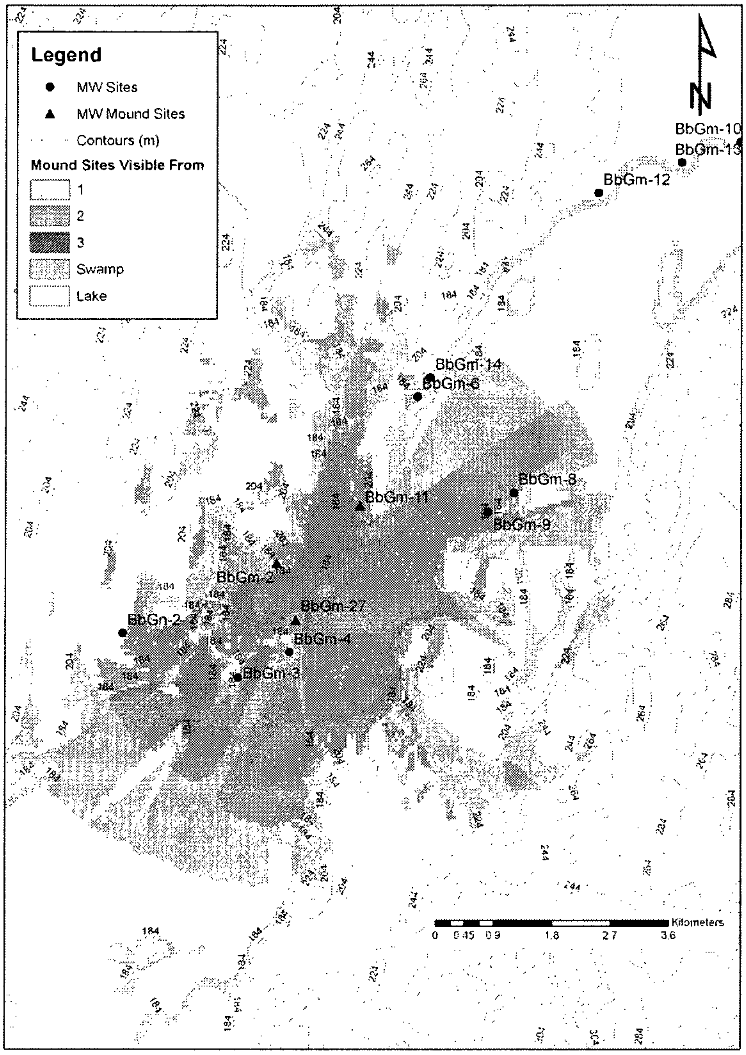

Figure 5.9. Viewshed from the three mound sites at the Indian River locale in the empty model

visibility to ideal wild rice growth areas near the Foley Point site. In the vegetation model the visibility from the mound sites is essentially the same (Figure 5.10). The only differences are that the Loucks and Foley Point sites are not visible at all from Serpent Mounds, and visibility to sites only partially visible in the empty model are even poorer.

The views from the non-mound sites of the Indian River locale overlap the Ouse River locale. Under the empty model the Loucks and Foley Point sites, located on the same peninsula, are intervisible. East Sugar Island Mounds and Harris Island Mound are

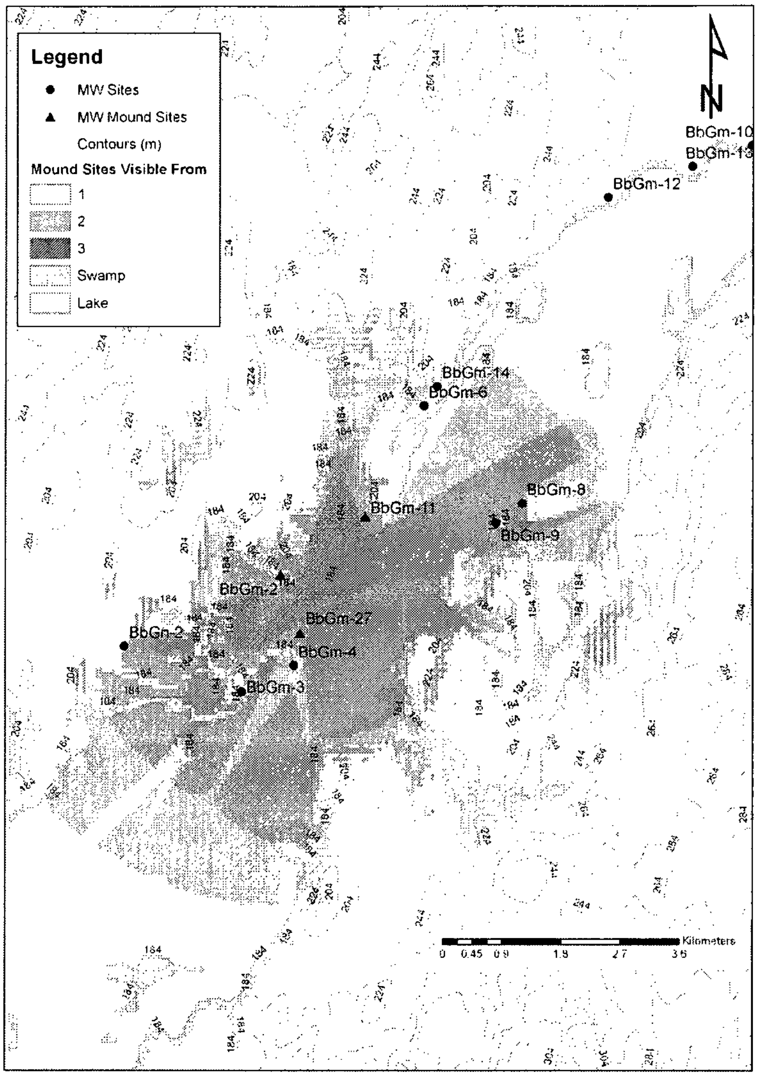

Figure 5.10. Viewsheds from the three mound sites at the Indian River locale in the vegetation model

not visible from either site, but the very eastern extent of Serpent Mounds is visible. Under the vegetation model none of the mound sites are visible from either site, though no other differences are present for the Loucks and Foley Point sites. Under the empty model the three mound sites are all visible from the Rainy Point, Harris Island, and McIntyre sites, though the Harris Island Mound is only partially visible from the Rainy Point site. Both the Rainy Point and Harris Island sites are visible from the McIntyre site, though it is only partially visible from the two sites. Foley Point and Loucks sites are not visible from the aforementioned sites, while the Hickory Island and East Grape Island sites are both visible as is the main channel of the lake. Under the vegetation model there is no change except that the Harris Island Mound is not visible from the Rainy Point site and Serpent Mounds is barely visible from the McIntyre site.

Site views to the Indian River are difficult to gauge because according to the digital reconstruction of the lake levels the location of the river's mouth would have been farther south than its current location. This means it could be on either side of East Sugar Island, which, prior to the AD 1838 damming would have likely have been attached to the mainland. The reconstruction used in this study seems to indicate the mouth of the river was to the west of East Sugar Island, given slightly lower elevation values compared to the eastern side of the island. However, Sonnenburg's reconstruction of the pre-1830s shoreline (Figure 5.11) places the mouth of the river just to the east of East Sugar Island. Based on the high accuracy of her bathymetric mapping her reconstruction is likely correct. Where the river drains into the lake has a fundamental effect on the interpretations of the viewsheds for the Indian River locale. If the river drained to the west of East Sugar Island, it would be visible from Serpent Mounds, East Sugar Island Mounds and Harris Island Mound. It would also be visible from all five sites for which viewsheds were generated in the Indian River locale, though only partially visible from the Loucks and Foley Point sites. However, if it drained east of the island the river's mouth would only be partially visible from the East Sugar Island Mounds and not visible from Serpent Mounds and the Harris Island Mound. Likewise, the mouth of the river would not be visible from the Harris Island, McIntyre, or Rainy Point sites, though it would be clearly visible from the Loucks and Foley Point sites.

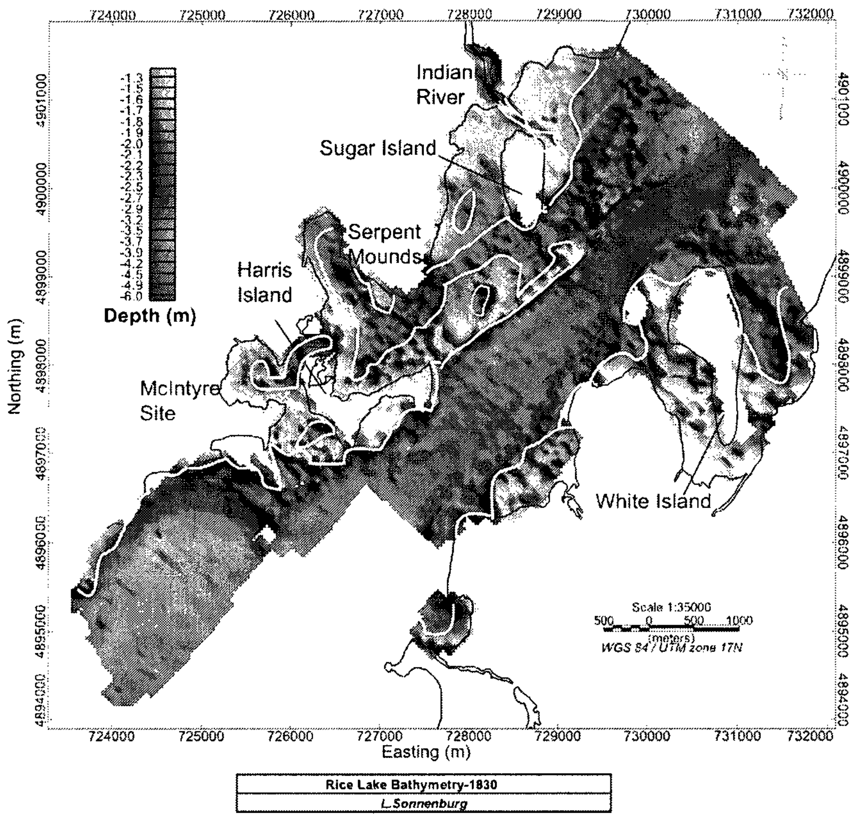

Figure 5.11. Reconstruction of pre-1830s shoreline based on bathymetric analysis (used with permission of Elizabeth Sonnenburg, McMaster University)

The Ouse River locale (Figure 5.12) consists of the Cameron's Point Mounds site, the Godfrey Point, Spillsbury Bay, Birdsall Point, and Exit River sites, the latter of which did not have viewsheds generated due to the digitizing problems discussed above. From Cameron's Point (Figure 5.13) there is excellent visibility to the Exit River site, and partial visibility to the Godfrey Point, Spillsbury Bay, and Birdsall Point sites. There is also good visibility to the eastern portion of the lake and to the Trent River. Cameron's Point is partially visible from the Godfrey Point and Birdsall Point sites, and is clearly visible from the Spillsbury Bay site. The Exit River site is not visible from the Spillsbury Bay or Birdsall Point sites, and is partially visible from the Godfrey Point site. The Birdsall Point, Spillsbury Bay, and Godfrey Point sites are all intervisible with one

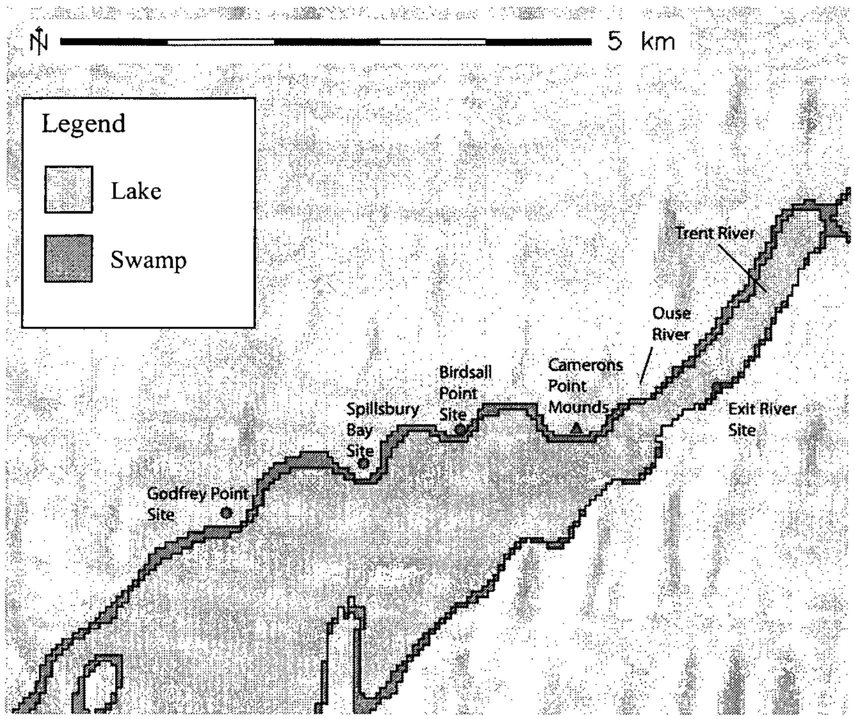

Figure 5.12. Sites included in the Ouse River locale

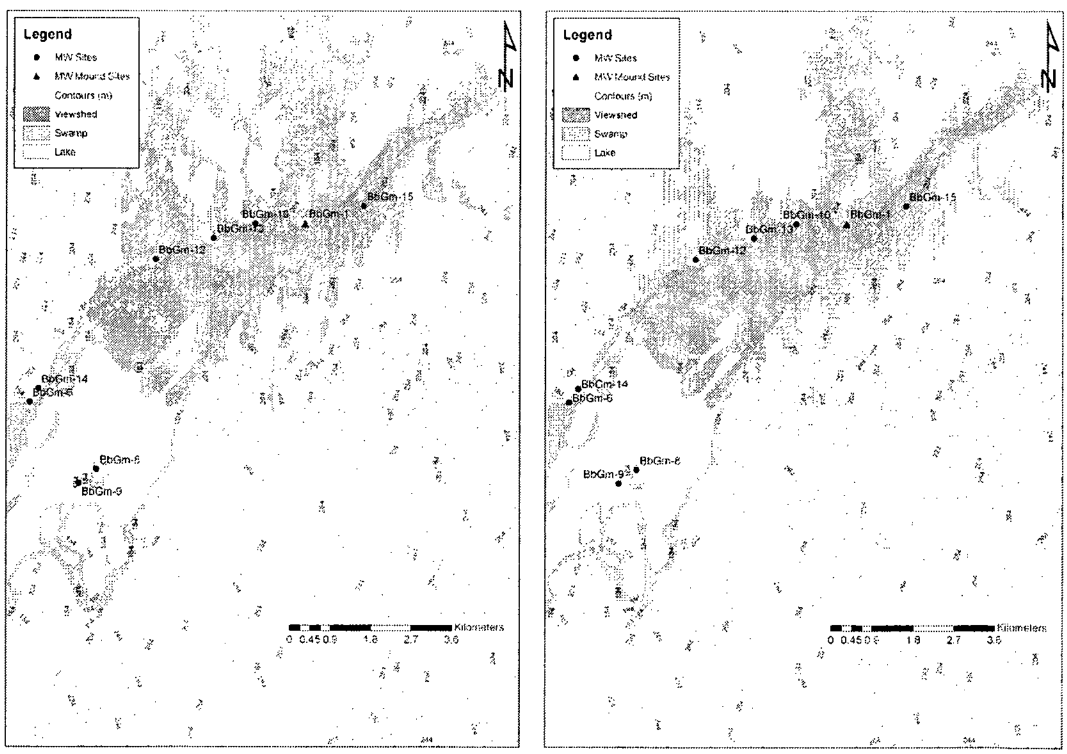

Figure 5.13. Viewshed from Cameron's Point mounds site in both the empty (left) and vegetation (right) models

another. The eastern portion of Rice Lake is also clearly visible from all three of the aforementioned sites, though none of them have a view to the Trent River or the Ouse River. The Hickory Island and Foley Point sites are visible from the Godfrey Point site, and Foley Point is somewhat visible from the Spillsbury Bay site. The only difference in the vegetation model is that Foley Point is not visible from the Spillsbury Bay site.

Ultimately, no clear trends are distinguishable for the mound sites in general. Certainly East Sugar Island Mounds, Harris Island Mound, and Serpent Mounds were constructed in locations with intentional intervisibility to one another. This, however, could not have been a primary motivator for all three sites, since one was likely used as a burial site before the other two. Cameron's Point Mounds and the Miller Mounds were both built in locations with views to drainages of major rivers, though Miller Mounds' view to the Otonabee is generally poor north of the river mouth. However, if Sonnenburg is correct in her reconstruction of the Indian River drainage east of East Sugar Island, this is not the case for the Indian River mound sites, with the possible exception of the East Sugar Island Mounds, which may have had a view to the river mouth if it was far enough south along the island. The Indian River mound sites do, however, share a view of the main channel of Rice Lake, which connects two wider sections of the lake like a very wide river.

No general pattern is present for the non-mound Middle Woodland sites on the lake in relation to the mound sites either. Both the Miller Mounds and Cameron's Point Mounds appear visible or partially visible from the non-mound sites around them. However, many of those sites are several kilometers away from the mound sites and therefore the mounds themselves would not be discernable. In the Indian River locale, the mound sites are generally visible from the non-mound sites to the west of them, but not from the Loucks and Foley Point sites to the east. Many of the non-mound site locations also have views to nearby river drainages while others do not. Many sites on the lake, both mound and non-mound, have views to ideal wild rice areas though the Ouse River locale seems to be generally lacking in such areas.

5.2.2 Views From all Middle Woodland Sites Compared to Pre Middle Woodland Sites

When the Middle Woodland sites are compared to the Pre Middle Woodland sites on the lake there does appear to be a greater trend towards intervisibility among the former. While there was no clear pattern amongst the Middle Woodland sites, intervisibility occurred much more frequently than it did among Pre Middle Woodland sites (Tables 5.9 and 5.10). This difference is likely the result of the increased site clustering that occurred during the Middle Woodland period. Like the Middle Woodland period sites, there is no clear patterning of Pre Middle Woodland sites being located with a visual relationship with particular landscape features or the ideal wild rice areas. Viewsheds for all Pre Middle Woodland and Middle Woodland mound and non-mound sites not shown above are presented in Appendix D.

5.2.3 Views To Sites on Rice Lake

As discussed with regards to the quantitative analysis of the view to sites from Rice Lake, a visibility map of the shoreline is used to rank how visible landscape areas were on a scale of 0 to 9 (Figure 5.14). The descriptive analyses of the visibility of the mound and non-mound Middle Woodland sites vary somewhat from one another.

Table 5.9. Intervisibility of Pre Middle Woodland sites (empty)

Visibility From/To	Godfrey Point	John	Foley Point	Poison Ivy	Whites Island	Harris Island	McIntyre	West Sugar Island	Pengelly	Seidl	Dawson Creek
Godfrey Point		good	good	none	none	none	none	none	none	none	none
John	good		good	partial	none	none	none	none	none	none	none
Foley Point	good	good		good	none	none	none	none	none	none	none
Poison Ivy	none	none	partial		none	good	none	none	none	none	none
Whites Island	none	none	none	partial		partial	partial	none	none	none	none
Harris Island	none	none	none	partial	partial		good	none	none	none	none
McIntyre	none	none	none	poor	none	partial		none	none	none	none
West Sugar Island	none	none	none	none	none	none	none		none	none	none
Pengelly	none	none	none	none	none	none	none	poor		good	none
Seidl	none	none	none	none	none	none	none	none	good		none
Dawson Creek	none	none	none	none	none	none	none	none	none	none	

Table 5.10. Intervisibility of Pre Middle Woodland sites (vegetation), emphasis on differences between vegetation and empty models

Visibility From/To	Godfrey Point	John	Foley Point	Poison Ivy	Whites Island	Harris Island	McIntyre	West Sugar Island	Pengelly	Seidl	Dawson Creek
Godfrey Point		**poor**	good	none	none	none	none	none	none	none	none
John	good		good	partial	none	none	none	none	none	none	none
Foley Point	**partial**	good		**partial**	none	none	none	none	none	none	none
Poison Ivy	none	none	partial		none	good	none	none	none	none	none
Whites Island	none	none	none	**none**		**none**	poor	none	none	none	none
Harris Island	none	none	none	partial	**none**		good	none	none	none	none
McIntyre	none	none	none	**none**	none	partial		none	none	none	none
West Sugar Island	none	none	none	none	none	none	none		none	none	none
Pengelly	none	none	none	none	none	none	none	**none**		**partial**	none
Seidl	none	none	none	none	none	none	none	none	good		none
Dawson Creek	none	none	none	none	none	none	none	none	none	none	

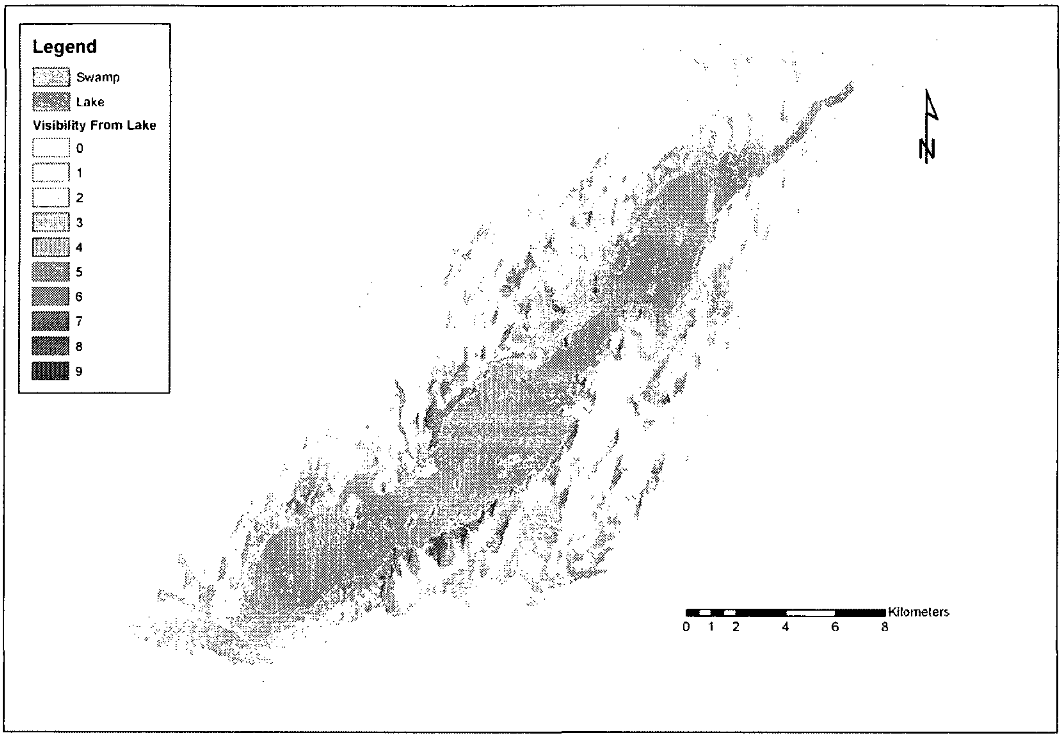

Figure 5.14. Visibility map of Rice Lake

While the non-mound sites all tend to be on or very close to the most visible points in their areas, the only exceptions being the Exit River site and the Foley Point site, the mound sites do not appear to be generally placed on the most visible points. Harris Island Mound and Miller Mounds are both located on lower lying and less visible areas, though low lying areas do not necessarily mean there will be low visibility or vice versa. The location of Harris Island Mound has been confirmed to be correct. The location of the Miller Mounds on the other hand is somewhat suspect, as Boyle's (1897) account of their location is somewhat vague and the location provided by the Ministry of Culture may only be estimated. If the location is close, however, the mounds are located predominantly in a low visibility area. The other three mound sites, Serpent Mounds, East Sugar Island Mounds, and Cameron's Point Mounds are located on or adjacent to high visibility areas.

When the Middle Woodland sites are compared to the Pre Middle Woodland sites a difference is evident. While almost all the Middle Woodland sites are located on areas highly visible from the water, the Pre Middle Woodland sites are more often not (Figure 5.15). The only sites that are on the most visible prominences are the McIntyre, Harris Island, Foley Point, Godfrey Point and West Sugar Island sites. All of these, with the exception of West Sugar Island, are multicomponent sites with Middle Woodland occupations. Of the random sites fifteen of fifty, or 30%, occurred on the most prominent point in their section of the landscape (Figure 5.16). This suggests that the variation between almost 100% of the non-mound Middle Woodland sites being located on highly visible areas and just under 50% of the Pre Middle Woodland sites being built in such locations is patterned and not random. There are a number of possible explanations for this patterning that are explored in the discussion chapter.

5.2.4 Potential Sources of Errors

A major problem of the analysis of intervisibility between sites is chronology. While some studies have sought to refine the chronology of Middle Woodland sites in the Rice Lake area based on radiocarbon dates and ceramic seriation (Curtis 2003), the chronology of the sites is still unclear at best. The result is the very difficult determination of which sites are contemporary with one another. Added to this problem is the lack of radiocarbon dates and the lack of ceramic data for some sites that were not thoroughly investigated, like the Harris Island Mound. While Serpent Mounds and East Sugar Island Mounds appear to be relatively contemporary with one another, based on radio-carbon dates, it is impossible to determine when the Harris Island Mound was constructed in relation to those sites because no excavation has taken place at that site.

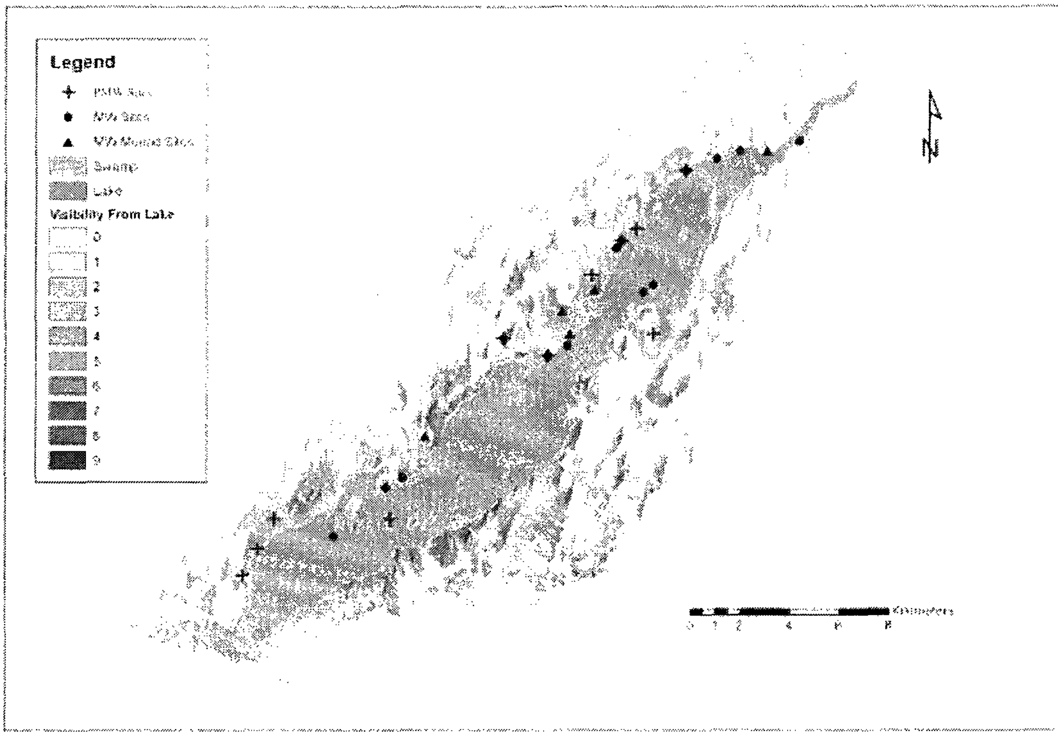

Figure 5.15. Visibility map of Rice Lake showing Pre Middle Woodland and Middle Woodland sites

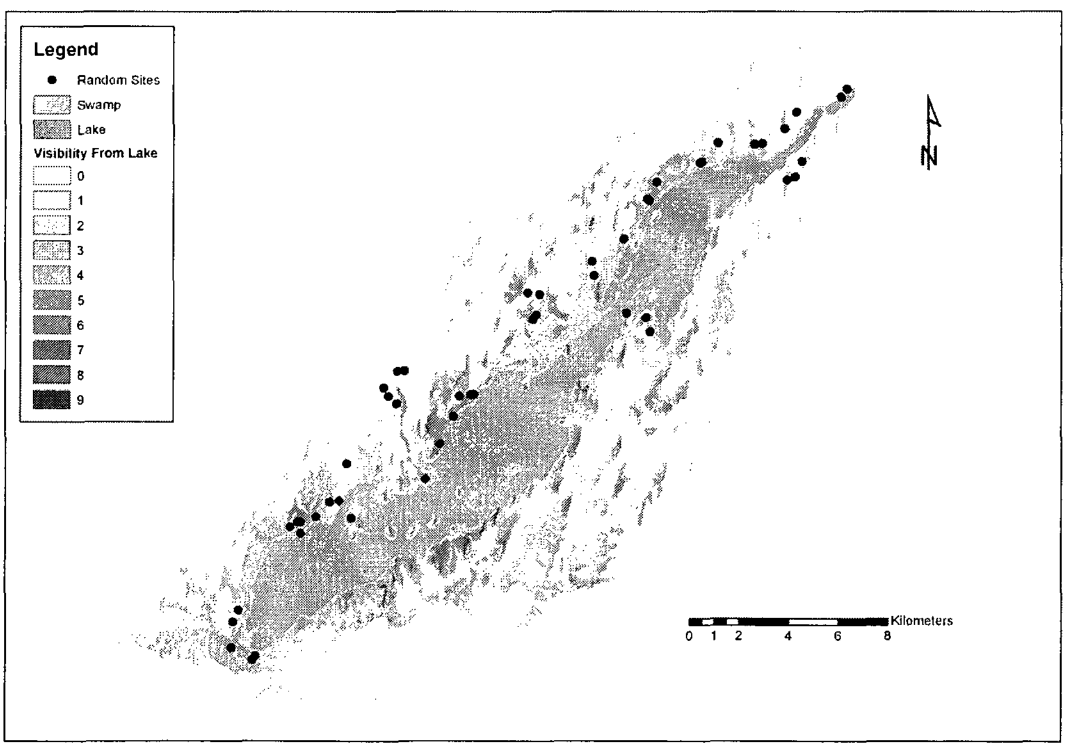

Figure 5.16. Visibility map of Rice Lake showing random site locations

Therefore, while the three sites appear intervisible it could be that the Harris Island Mound was constructed much later than the other two and was not a factor in their site selections. The same goes for many non-mound sites around the lake. It is therefore important to recognize that the intervisible relationships identified in this analysis are not absolute and may in fact be the product of one of the two site's selection or they may just be coincidence. The most important visible relationship for the mound sites may have been with aspects of the surrounding landscape including the lake and swamps. This does not necessarily invalidate the findings identified above. Many of the sites, including Serpent Mounds and the Loucks Site (Johnson 1968b:18), have evidence of repeated use over a long-term period. Furthermore, even though intervisibility between two sites may not have been the product of the selection strategy for both, it does not preclude the possibility that it was for one of them. The only limitation here is determining which site was established first.

Another potential problem that has already been touched on i this chapter is the accuracy of the site locations provided by the Ontario Ministry of Culture. Sites such as the Miller Mound site that were destroyed or are no longer visible on the surface are difficult to relocate. Most of these sites were identified in the mid-twentieth century or earlier, before the development of spatial location technologies such as global positioning systems. Added to this is the lack of accurate maps for many of the sites included in this study that could allow for the relocation of the sites now. The result of this is that many of the site locations included in the Ministry of Culture's database of archaeological sites are likely estimated based on memories and often unclear locational descriptions. This means that the locations used for the generation of viewsheds and for the descriptive analysis may not be 100% accurate. This unreliability was part of the impetus for the use of site areas in the generation of viewsheds. It is also the reason that sites that fall close to or partially into viewsheds or high visibility patches were included into such ranges during the descriptive analysis. While the overall accuracy of the descriptive analysis may have been affected by this problem, the patterns that were identified remain general enough that their validity remains cogent.

5.3 Field Based Observations

The integration of field-based observations is intended to validate the outcomes of some of the GIS viewsheds as well as to provide a separate perspective into the visibility of the Rice Lake area. As was discussed in the previous chapter, there were a number of limitations that constrained how much field based observations could be recorded for the purpose of this research. An additional problem is that the observations were made at the modern lake level, 1.8 m higher then the water levels would have been. Such an increase will make a difference in the view. The results of the observations are summarized in Appendices A and B.

The observations made from the sites (Appendix A) provided minimal insights into their locations. This is in part due to the heavy vegetation that surrounds the sites now, with the Harris Island Mound particularly heavily forested. Serpent Mounds would be very clearly visible from the Harris Island Mound if the vegetation was cleared, while the East Sugar Island Mounds site would be visible, although its individual mounds would likely not be clearly distinguishable. The view from Serpent Mounds varies over the area of the site. Again, specific views are described in Appendix A. Of note the only places both East Sugar Island Mounds and the Harris Island Mound are visible is along the southeastern area of the Serpent Mounds. When standing in the centre of the mound group, very little of the surrounding landscape is visible, with the exception of the eastern and western gaps between the mounds.

Figures 5.17 and 5.18 show the locations of the observations taken by the Miller Mounds site and Serpent Mounds group on Rice Lake. The viewsheds generated for those points generally match the observations of site visibility. The viewsheds do tend to show slightly greater visibility than the recorded observations. This can be explained by the lack of vegetation in the digital model combined with its low resolution, which results in the generalization of much of the terrain. Despite this, the overall similarity between the viewsheds and observations gives a good indication of the accuracy of the viewsheds generated for this study. The only significant observation of note from the water points was that all three of the mound sites of the Indian River locale are visible from the channel between the three sites. This appears to be the only area from which all three of the mound sites would be clearly visible. However, if one moves too close to any of the three sites' shores, than one or more of the other site's mounds would become indiscernible.

5.4 Overview of Results

A number of conclusions arise from the results discussed above. First and foremost, there is no statistical difference between the total viewsheds of the mounds compared to the other Middle Woodland or Pre Middle Woodland sites on Rice Lake. However, there does appear to be a strong positive relationship between the site locations and high landscape visibility for all Middle Woodland and Pre Middle Woodland sites, particularly towards the lake. The implication of this is that visibility to the lake was

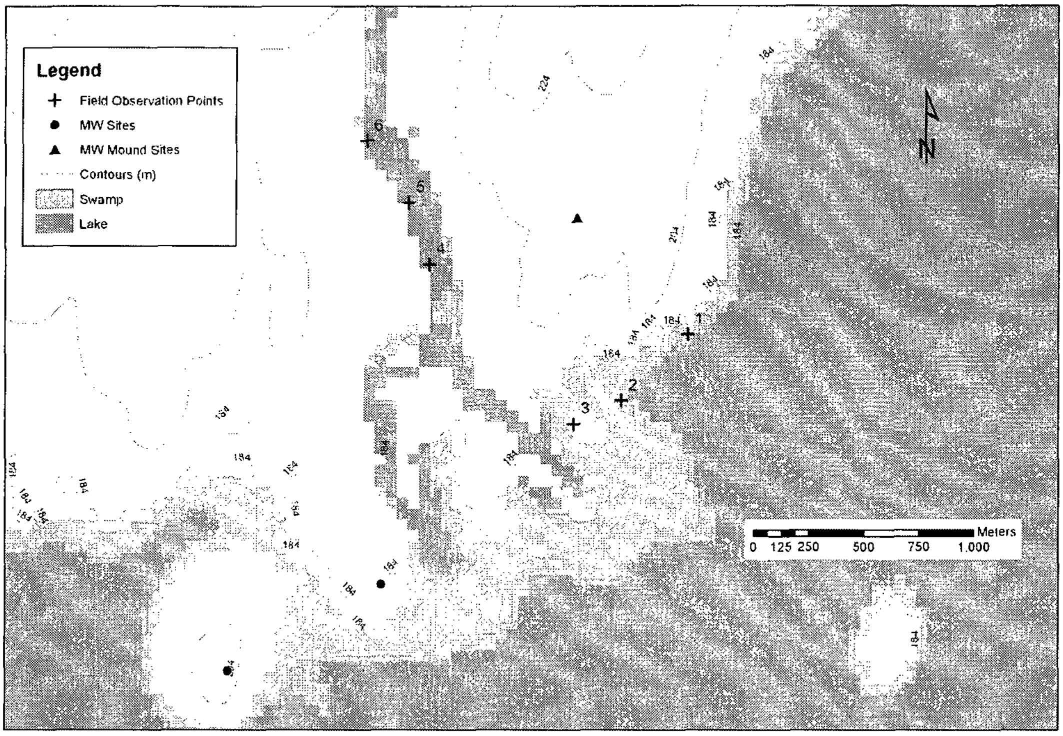

Figure 5.17. Field observation points around the Miller Mound site

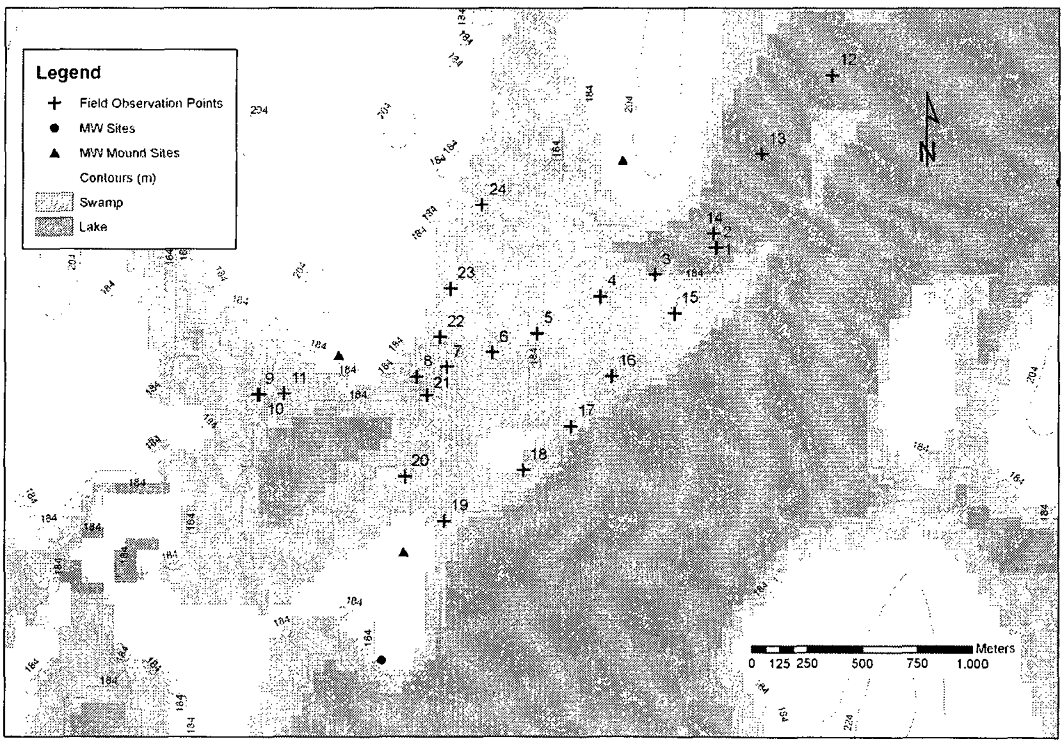

Figure 5.18. Field observation points around the Serpent Mounds site

certainly a factor for site selection during those periods. There is, however, a change in site selection strategy between the Pre Middle Woodland and Middle Woodland periods with regards to visibility from Rice Lake. While less then half of Pre Middle Woodland sites are built on the most prominently visible spot in their area from the lake, almost all of the Middle Woodland sites are found in such locations. This implies that while the view to the lake remained constant between the two temporal periods, the visibility of sites from the lake became more important leading up to and during the Middle Woodland period.

Regarding site intervisibility, few conclusive findings can be interpreted from the results of this analysis. Intervisibility between sites is certainly much more common amongst Middle Woodland sites than amongst Pre Middle Woodland sites, but this can be attributed to the increasingly clustered placement of Middle Woodland sites around major river drainages and does not necessarily suggest an emphasis on intervisibility between local sites. Taçon (1990:28), for example notes that burials in the Great Lakes region often occur at prominent points in the landscape. Such prominent locations include areas of interface between earth and water (i.e. swamps), and the burial of the ancestors at such powerful locations served to not only bind them to those places, but to increase the power of the location itself (Taçon 1990:30). Between the mound sites, intervisibility is a difficult thing to conclusively demonstrate. Certainly, the three mound sites in the Indian River locale were constructed in intervisible locations. It may be that intervisibility with other mound sites was a priority in site selection, especially for the Harris Island Mound if it was constructed later than the other two. Both Serpent Mounds and the East Sugar Island Mounds were constructed on high, very visible ridges. The

Harris Island Mound on the other hand was constructed behind such a ridge at a site with a clear view (barring the presence of vegetation) to both Serpent Mounds and the East Sugar Island Mounds. Without firm chronological markers for the Harris Island Mound it is impossible to say for certain when in the sequence the mound was constructed, but its unusual location may indicate it is of later construction than its neighbouring mounds.

The Indian River mound sites are intervisible only with sites on islands to the west, and even then, much of the intervisibility is only partial. The same is true of the viewshed back to the mound sites. The Miller Mounds site and Cameron's Point Mounds sites are obviously not intervisible with other mound sites due to their distance from such sites. Intervisibility, however, does exist between these sites and the non-Middle Woodland sites in close proximity to them. However, that intervisibility is generally only partial. Likewise, the views from the sites in the Otonabee and Ouse River locales to their respective mound sites are generally only partial, though almost all of those sites do have some view. The lack of very clear views of the mound sites from the majority of sites around them seems to indicate that if intervisibility with such sites was a factor in site selection, it was only a minor one, and that other factors were more of a priority to the builders.

Chapter 6
Discussion and Interpretations

6.1 The Rice Lake Burial Mounds as Territorial Markers

In order to assess whether and in what context the Rice Lake burial mounds may have functioned as territorial markers in their respective landscapes several questions must first be addressed. First, do the Middle Woodland occupants of Rice Lake fit the economic schema of a culture that would have need for resource control as put forward by the Saxe/Goldstein hypothesis? Second, do the mounds represent an ancestor cult, through which lineal descent from the dead is used to demark control of restricted resources (Morris 1991:152), a display of mortuary ritual through which group cohesion is reaffirmed and social roles are negotiated (Jamieson 2008:16) or both? Finally, as the idea of restricted resources and control of such resources is key to the Saxe/Goldstein hypothesis (Morris 1991:148), the question of which restricted resources lineages could claim control of from the mound sites is also examined.

Morris (1991:151), in his discussion of the prerequisites for the existence of lineal claims of territory put forth by the Saxe/Goldstein hypothesis, draws on an important distinction made by Woodburn (1982:432-433) regarding the economic structure of societies. Woodburn puts forth a distinction between immediate return systems, in which resources are gathered or hunted and consumed immediately or over a short duration, and delayed return systems where by necessity some level of rights or control are in place over resources that require long term procurement, processing, and/or storage. While farmers and pastoralists all fall into the latter, hunter-gatherers can fall into either category (Woodburn 1982:433). The Middle Woodland occupants of Rice Lake may represent delayed return hunter-gatherers. The storage of goods over the long term is in a sense necessitated by the harsh winters of the region, during which food resources would be extremely sparse. This combined with the introduction of ceramic vessels, and the apparent growth of the regional population (Spence et al. 1984:133) indicates the presence of a well-defined delayed return system. Economically, this suggests the presence of the social dependencies by Woodburn's (1982:433) definition, and likely the presence of some kind complex social structure.

The definition of a formal bounded cemetery is also critical to the Saxe/Goldstein hypothesis. This means that the cemetery area must be used exclusively for the interment of the dead (Goldstein 1981:61). Such a definition is somewhat precarious for the mounds if one accepts the identification of the midden areas at most of the mound sites as base camps (Spence et al. 1984:123, Curtis 2003:28). More recent work (Jamieson 2008:16) suggests that the midden areas were the site mortuary feasts and related activity and not used for general settlement. Such an explanation is far more likely. If these areas represent aspects of the funerary practices, including mortuary feast locations, carried out during the construction of the mounds and in years following burial for the veneration of dead, then the argument can be made that the mound sites would fit the criteria of formal bounded cemeteries exclusively used for the interment of the dead as the activities performed at the adjacent components of the mound site directly relate to the burials and veneration of the dead.

The next pertinent question regarding the position of the mounds as territorial markers is whether they were used as oblique symbols of resource control through lineal descent from the dead, i.e., an ancestor cult, or whether they represent status competition within a lineage through mortuary ritual, or whether both types of behaviour are present.

Previous interpretation of the Rice Lake burial mounds has focused extensively on the latter. Spence et al. (1984:124) interpreted the arrangement of primary and secondary burials in Cameron's Point Mound C and the amount of grave goods associated with the primary burials as indicators of status differentiation and social hierarchy. They argued that the individuals interred as primary burials in sub-mound pits tended to be accompanied by the most elaborate burial goods, and therefore both grave goods and burial type represented indicators of social status. Such interpretations are consistent with the mortuary ritual element of burials discussed by Morris (1991:153). However, as pointed out by Wilson (1993:23) and Dougherty (2003:128-130) there may be alternative explanations for the burial type differentiation found within the mounds. Jamieson (2008:14) also suggests that different forms of social hierarchy may be represented. She suggests at this time that some of the social groups occupying Rice Lake could be viewed as fitting a horizontal egalitarian model, while others potentially fit a ranked model (Jamieson 2008:15)

The mound sites, which likely were the exclusive domain of the dead except during veneration ritual or the subsequent interment of the dead, tend to be placed atop drumlins overlooking the lake (the Harris Island Mound and possibly some of the Miller Mounds are exceptions to this as previously discussed). While the views from the mounds have no statistical significance when compared to non-mound Middle Woodland sites, they are situated at sites with very extensive visibility both to and from their locations. The mounds, given their monumental structures, could be clearly viewed from the surrounding areas, making them distinct reminders of the presence of the ancestors and of a right of ownership for their descendants.

A key element of the Saxe/Goldstein hypothesis is the control of restricted resources through the presence of formal cemeteries. If the ancestor cult model is applicable to the burial mounds of Rice Lake it is likely that a restricted resource would be in close proximity to the mound sites. As has been discussed in Chapter Three, the subsistence patterns of the Middle Woodland hunter-gatherers on Rice Lake was contingent on the seasonal exploitation of resources around the lake (Spence et al. 1984:120). It is unlikely that hunting grounds could be demarked by static symbols, nor is it likely that terrestrial wild plants would grow in any concentration great enough to warrant such claims. Given the apparent relationship between sites in the region and the lake, it seems likely that the most important restricted resources would be aquatic. The two resources that seem most likely are wild rice and mussels. Both resources would be found in restricted areas of the lake and likely represent important seasonal resources to the inhabitants.

The problems with identifying wild rice as a subsistence resource for the Middle Woodland occupation of Rice Lake have already been discussed in Chapter Three, so this discussion is hypothetical. However, the visibility models generated for this research indicate good visibility from the mound sites to areas of high probability for wild rice growth (Figure 6.1 to 6.3). Harvesting wild rice would require a great deal of processing and a sizeable labour pool would be greatly advantageous. Wild rice patches on the lake would also be very restricted, even more so than the model employed here suggests. Control of such a resource would therefore be extremely important and the solidifying of control through an ancestor cult seems to fit this particular case. Again this notion still requires evidence for wild rice harvesting for the Middle Woodland period. This

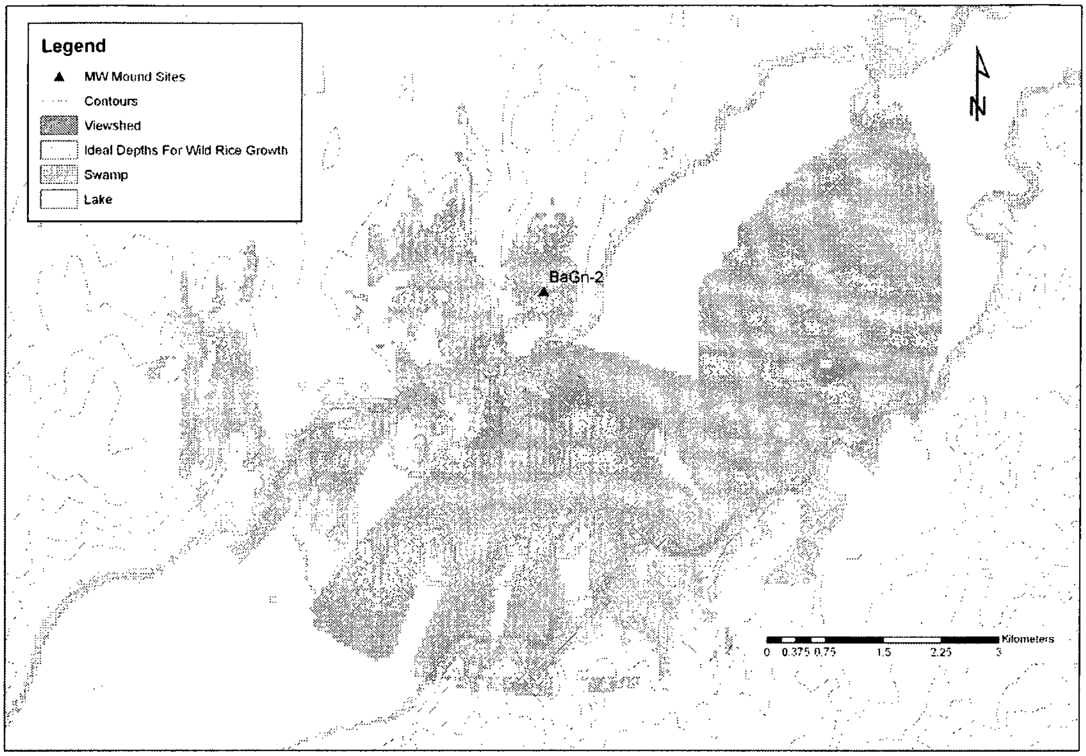

Figure 6.1. View of wild rice fields from the Miller Mounds site (BaGn-2)

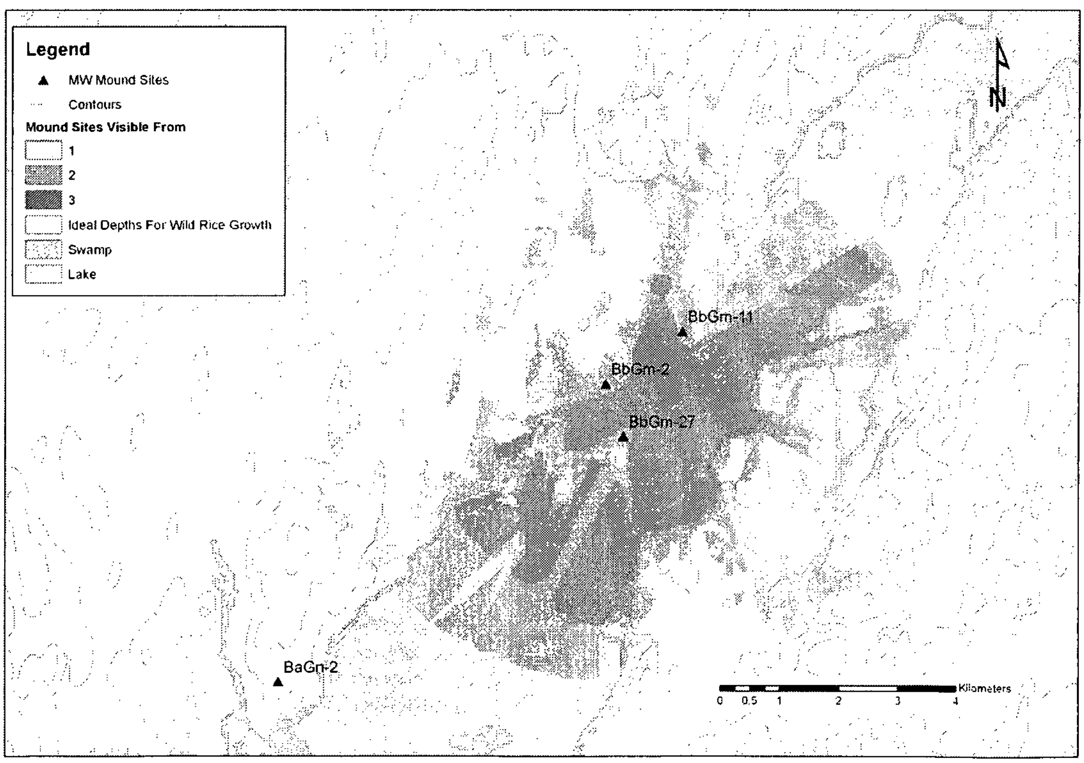

Figure 6.2. View of wild rice fields from the mound sites in the Indian River locale

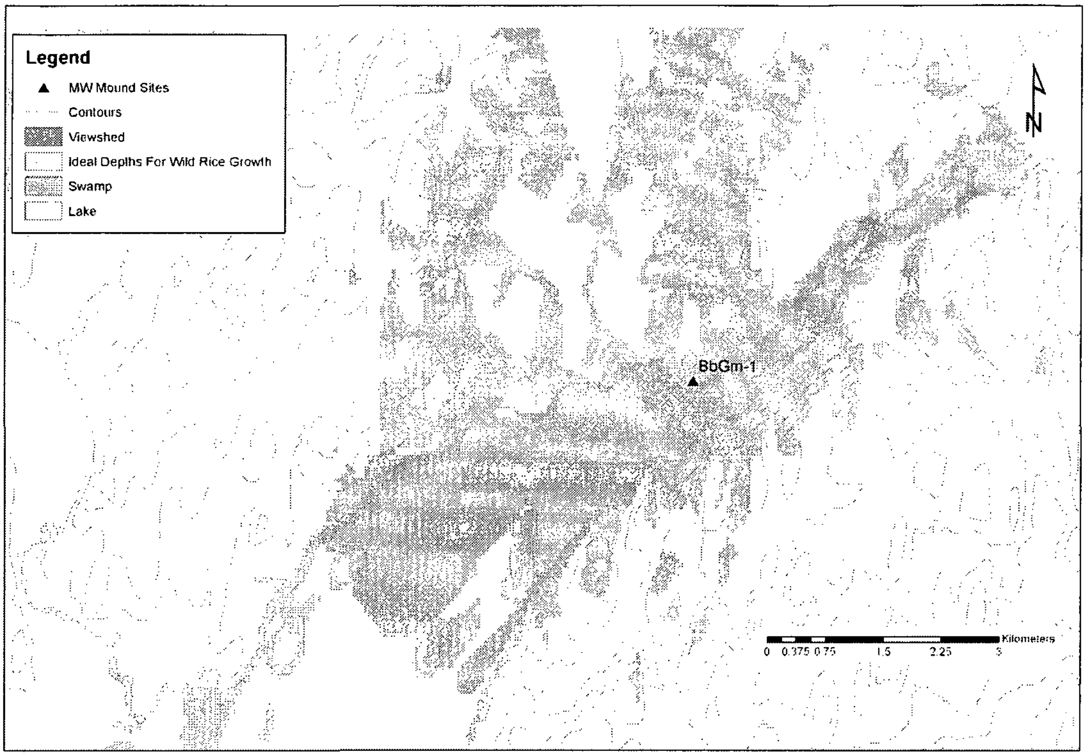

Figure 6.3. View of wild rice fields from the Cameron's Point Mounds site (BbGm-1)

model also does not seem to fit the Ouse River locale as well as it does the other two locales, because the former lacks any extensive areas suitable for wild rice growth, with the possible exceptions of the Ouse and Trent Rivers (Figure 6.3). The view to the wild rice patches from the Indian River locale mounds is also less than ideal (Figure 6.2), with the major wild rice patch by Foley Point only visible from two of the three mound sites. Though due to a build up of sediments resulting from the modern drainage of the Indian River in the lake immediately east of Serpent Mounds (Figure 6.4), the water level may have been deeper than the reconstruction provided here, and therefore may have been better suited to wild rice growth.

There is better evidence that freshwater mussels played a role in Middle Woodland subsistence patterns. The large shell middens found at the Serpent Mounds, East Sugar Island Mounds, and Cameron's Point sites point to some association between

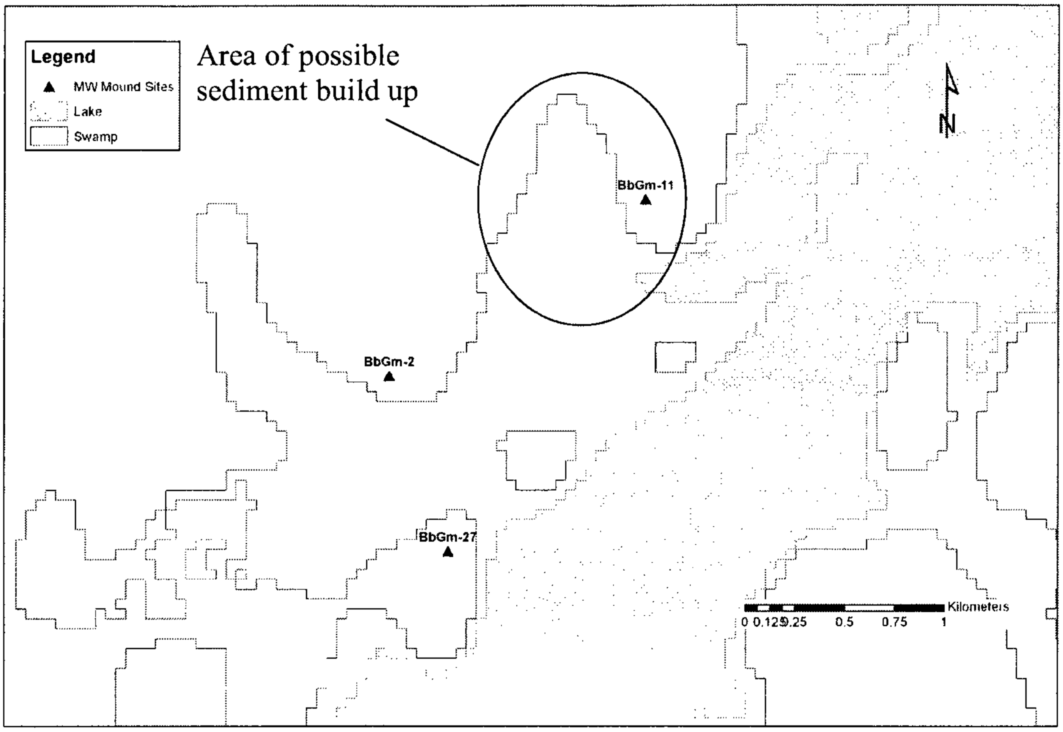

Figure 6.4. Area of possible sediment build up east of Serpent Mounds (BaGn-2)

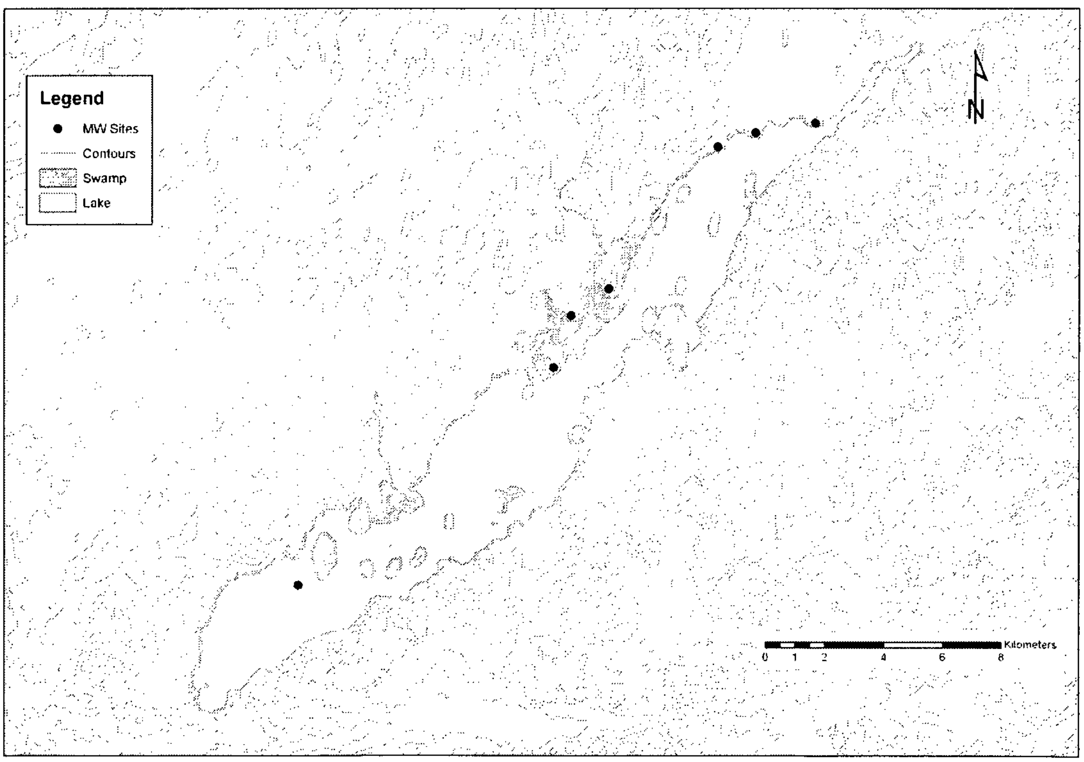

Figure 6.5. Middle Woodland sites on Rice Lake with confirmed shell middens

the mounds and shellfish. While other shell middens have been found at non-mound Middle Woodland sites (Figure 6.5), the middens found at the mounds sites are extensive and were utilized over hundreds of years (Johnston 1968a:44). Furthermore, the presence of local mussel shells in direct association with the mounds (Whates 1965:6), seem to indicate an interrelationship between the shell and the funerary beliefs of the mound builders. The strength of this interrelationship is further supported by the location of the mound sites. The two species of shellfish identified in the Serpent Mounds shell midden, *L. radiata* siliquoidea and *E. complanata,* favour shallow lakes and riverbeds (Clarke 1981:266, 344). Such locations are within very close proximity and are visible from all of the mound sites. For the Serpent Mound cluster, the shallow swampy area between the three mound sites would likely be the ideal location for shellfish harvesting and would be very good habitat for the species represented from the midden. Given that the shell middens of Serpent Mounds and the East Sugar Island Mounds lie on either side of this area, there is a strong likelihood that this was a key harvesting area. For the Cameron's Point Mounds, the large shell midden identified at the site ran along the bank of the Trent River. Such a riverbank would be ideal for the species identified in the Serpent Mounds midden, assuming the same species were collected at Cameron's Point. Cameron's Point also has an excellent view of the Trent River (Figure 6.3). It is unclear whether a shell midden was present at the Miller Mounds site. Boyle does mention the presence of an extensive midden running along the Otonabee River, though his description does not mention shell in the fill (Boyle 1897:30). However, it is possible that like the other middens found in association with mound sites on Rice Lake, an ash layer covered the surface of the midden and the shell layers lay beneath it (Ritchie 1949:7). If this was the case, the Miller Mounds also were in close association with the Otonabee River, which would have provided suitable habitat for the shell species represented at Serpent Mounds. While the Miller Mounds' viewshed to the Otonabee is not a clear as the other sites, it would still afford visual prominence over the suggested restricted resource.

6.2 Ideational Context of Burial Mound Locations

The above discussion presents a largely economic interpretation of the relationship between the locations of the mound sites and their visual relationship with their surrounding landscape. But funerary customs are not simply the functional disposal of the dead by the living. They are experiences wrapped in deep emotion and occur within cultural frameworks with historic and ideological significance specific to the societies that experience them. Cross-cultural generalizations such as the Saxe/Goldstein hypothesis, while grounded in scientific positivism, are inadequate for reaching the experiences of grief and commemoration of the individual (Cannon 2002:191). Even ideas of territoriality as discussed above, must be considered within a cultural system that is constantly changing. While one or more of the above interpretations may accurately define one motivation for situating the burial sites at a particular time there is no reason to assume that reason remained constant throughout the entire Middle Woodland period. It is therefore important not only to view such generalized perspectives as possible components of the individual or group reasoning that led to the placement of the mounds, but to understand that such decisions were made in an ideological framework with its own historic antecedents and subject to the actions and beliefs of individuals.

Ideology, like the concept of territoriality, is difficult to infer directly from the archaeological record because it requires archaeologists to get into the heads of past people to some degree. For the purposes of this research, the aspects of ideology considered for interpretation are limited to beliefs surrounding the placement of the dead in relation to the surrounding landscape. In the case of the Rice Lake burial mounds, visibility analysis provides little insight into the possible ideological significance of the mound locations. There is no clear patterning amongst the mound sites that suggests that sites were oriented to have clear visibility either to or from a specific direction, and the intervisible relationships between the mound sites and non-mound sites around them vary indicating no definite inclusive or exclusionary relationship between the living and the dead in daily life. However, site orientation and inter-site relationships are certainly not the only way ideology can be manifested in a landscape context.

The positioning of the mound sites within their landscape may be more significant than the view to or from the sites. The majority of the Rice Lake burial mounds are situated on the edges of large drumlins overlooking the lake. As noted by Taçon (1990:28) the locating of burials at prominent locations relates directly to the ideological importance of such areas. As noted above, this position places them in a highly visible location that could function as territorial markers in the landscape. However, in their interpretation of Middle Archaic bluff top mounds in the lower Illinois Valley, Buikstra and Charles (1999:212) note that such locations are also liminal zones between the earth and sky, a significant context within the three-tiered universe prevalent in cosmologies throughout North America (Brown 1997:476). The drumlins the mounds are situated on also emerge out of the lake suggesting liminality between earth and water, and the swampy areas surrounding the mound sites could also symbolize a connection between earth and water. Thus the locations of the majority of mound site serve as axes between all three realms. The close association of death, fertility/subsistence, and water suggests that the visibility from at least some of the mound sites may hold cosmological significance not detectable through comparison with other site types.

The relationship between earth and water realms seems particularly significant for the Rice Lake mounds, especially given the large amounts of shell associated with mounds and mound sites both in the form of manufactured artifacts and subsistence debris. The visual inter-relationship between the mounds and the lake and swamps, and the possible inclusion of mud and sand from the lake in the internal structures of the mound further support the significance of this relationship. Furthermore, a number of the animal species included as grave goods including a marine shell worked into a turtle effigy, loon beaks, and remains of animals like turtles and mink as well as numerous other examples (Johnston 1968a; Kenyon 1986), represent animals that transcend the earth and water worlds. The connection with earth-water liminal animals and underwater marl inclusions may relate to the Earth-diver creation story common in cosmologies across North America (Hall 1997:18). This could also explain the significant relationship between the mounds and the swamps surrounding them. As Hall (1979:260) notes, the dramatization of the earth diver myth of world creation would explain the presence of underwater sediments in many Middle Woodland burial mounds throughout the Northeast and Midwest of North America. This connection suggests that the mound burials may have included renewal rituals, in which the world is destroyed and recreated. Such ceremonies have links to fertility and subsistence among many North American cultures and often involve feasting and other ritual acts. This would explain the presence of the extensive shell middens at the mound sites, because they could have been the sites of annual mortuary feasts to venerate the dead, and reestablish social bonds and relationships between kin groups (Jamieson 2008:13).

6.3 Synthesis of Results Within the Wider Context of Rice Lake's Middle Woodland

A number of conclusions have been drawn from the quantitative and descriptive comparisons of the visual character of the mound sites with other existing and random sites on Rice Lake. Sites were generally selected to have a visual relationship with the lake and with swamps. Middle Woodland sites tend to be more visible from the lake compared to Pre Middle Woodland period sites. Middle Woodland sites are more commonly intervisible than Pre Middle Woodland sites, though this is likely related to the clustering of Middle Woodland sites around the major river drainages on the lake. Statistically, it would appear that the non-mound Middle Woodland sites were actually more visible from the lake than the mound sites. These results suggest little variation in visibility relationships between the mound and non-mound Middle Woodland sites around Rice Lake. However, as discussed in the above interpretations, the important relationships between the mound sites and the visible landscapes may not be clear through comparisons with other sites.

When considered on their own, a number of patterns can be drawn for the visibility relationships of the Rice Lake burial mounds. First, the majority of the mounds were constructed on highly visible drumlins overlooking the lake and the surrounding swamps, and in particular ideal areas for the collection of shellfish. Second, while a number of mound sites have good views of projected wild rice patches, this does not appear to be a primary motivator for site selection. While the Miller Mounds and Cameron's Point Mounds sites have at least partial views of major rivers nearby, the mound sites in the Indian River locale lack such a relationship with the Indian River, if the river's mouth has been projected correctly east of East Sugar Island. The latter mound sites do, however, afford an excellent view of the narrow portion in the middle of Rice Lake. Finally, all Middle Woodland sites are generally situated in areas both highly visible to, and afford good visibility from, the selected site location.

Based on these conclusions and the preexisting data regarding the Middle Woodland occupation of Rice Lake, it is possible to suggest an interpretive framework for the settlement selection process for the lake. The following is largely hypothetical given the existing gaps in the archaeological record for the region. During the Archaic period, the region was occupied by small groups of highly mobile hunter-gatherers who selected sites seasonally on the lakeshore to take advantage of mainly terrestrial resources. Sites were not only selected with an intentional view to the lake and swamps, but were also selected for their visibility from the lake. During this period the dead were interred where they died, and were buried individually with red ochre and occasionally with grave goods of copper or other material (Johnston 1968b:25). Around 3000 BP, the water levels of Rice Lake began to rise (Yu and McAndrews 1994:142). This led to the proliferation of a greater abundance of aquatic resources including wild rice, which first appears in pollen cores around this time (McAndrews 1984:185). This resulted in a more stable seasonal system around Rice Lakes and sites, such as the McIntyre and Dawson Creek sites, began to be occupied repeatedly from season to season. With the increased emphasis on aquatic resources sites also began to be selected based on their visibility from the lake, as well as their visibility to the lake. This change in the selection process may have been the result of greater concern over the control of restricted aquatic resources, or it may have been the result of increasing travel on the lake leading to picking visible areas for settlement. Either way, this shift would explain why many of the multi-component sites like the McIntyre and Harris Island sites are located in areas highly visible from the lake, while other Archaic sites tend not to be.

Around the same time (3000-2500 BP) ceramics were introduced into the area marking the beginning of the Early Woodland Period. As no confirmed Early Woodland burials have been identified on the lake, commenting on burial patterns for this time period would be entirely speculative. However, if Johnston (1968a:40) was correct and the habitation area of Serpent Mounds represents either a very early Middle Woodland or Early Woodland occupation, than the cremation found to the north of the structure might represent an Early Woodland burial. With the increasing utilization of stable aquatic resources and the introduction of ceramic vessels, possibly for storage, populations likely expanded leading to increasing resource competition. As groups continued to move seasonally, burial mounds, the idea for which likely diffused from the Midwestern United States through groups residing in Western New York State, were adopted into the local ideology, and used to denote lineage territory. While wild rice might have been an important resource, shellfish fields may have been the key resource the mounds were built to control. Modern wild rice crops tend to fail one out of every four years (Steeves 1952:124), so if groups depended on this resource, they would require some food source as a substitution. Mussels (Parmalee and Klippel 1974:431), like wild rice (Aiken et al. 1988:92), are rich in protein, making them an ideal substitute. They can also be preserved and stored for extended periods of time. It is therefore possible that the shellfish harvests, which led to the accumulation of the midden sites near the mounds, occurred only when the wild rice harvest failed. This would explain the long-term utilization of the middens, as annual use by any sizeable group would likely lead to the exhaustion of the shell beds. This is not meant to imply that either wild rice or shellfish served as a staple of the Middle Woodland diet; rather it is meant to suggest that these foods played an important part of a wide ranging hunter-gatherer subsistence pattern. The visual association of the mounds with the large shellfish beds on Rice Lake may therefore have held two important cultural functions: first, as territorial markers indicating ownership of the beds by particular lineal bands, and second, as a ritual renewal of the resources on Rice Lake. Given the association between the dead, the underworld and renewal, it is possible that the interment and veneration of the dead was an attempt to renew depleted resources, such as the failed wild rice crops. But the burial of the dead, the construction of mounds, and the mortuary feasts that would accompany such activities and be performed in the years following would also hold significance. Not only would such events further bond the mound builders to such economically and spiritually significant places in the landscape, they would serve to reaffirm cohesiveness within groups and between groups. Such feasts would allow attendees to build social relationships and alliances, create social identity, and to amass "...prestige and authority through acts of generosity and sharing" (Jamieson 2008:16). Such events would also facilitate the exchange of exotic and local goods.

This does not imply that the dead were interred every four years, because this does not fit with the population estimates for the region for the single episode interments within the mounds. Rather veneration of the dead occurred during such events and mussels, which represent a liminal food because they are found in underwater mud, were collected and stored and perhaps used in feasts for the dead. The construction of new mounds and the interment of the dead may have occurred during some of these events. Over time the mounds themselves and not their location near resources became more important. With the introduction and eventual dependence on maize as a staple by approximately AD 1000 (Harrison and Katzenberg 2003:239), burials like the Serpent Pits continued to be interred in the same locations even though the original important resources were no longer of any consequence. The utility of the mound as a marker of territorial control over aquatic resources would also have declined with the decline in importance of the particular resource. Therefore, by the beginning of the Late Woodland period between AD 900 to 1000, mounds were no longer constructed over the burials.

Though much of the above is hypothetical, it does provide a way of interpreting how site visibility and site selection could have played out during the period in question. The visibility of sites and burial sites in particular seems to fit the known pattern of settlement in the Rice Lake region from the Archaic to Middle Woodland periods. From terrestrial based economy of the Pre Middle Woodland period, to an increasingly sedentary aquatic based economy during the Middle Woodland period, the changes in economy are also reflected in the burial patterns which include the development of formal and highly visible burial mounds with ideological relationships reflecting both lineage continuity and important elements of social cohesion, as well as subsistence. During the transition to the Late Woodland period, the connection to the ancestors remained significant with burials continuing to be interred in the same locations; however, the importance of territorial control declined as the resource base of the economy shifted away from the aquatic resources back to terrestrial resources, and maize horticulture in particular.

6.4 Suitability and Contribution of Visibility Analysis for the Rice Lake Burial Mounds

Ultimately, the question must be asked as to whether or not visibility analysis is a suitable avenue with which to examine the landscape context of the Rice Lake burial mounds. While no clear patterns emerged regarding the visual relationship of the mound sites and their surrounding environments, a number of temporal trends have been picked up through the comparison of the mound and non-mound sites compared to Pre Middle Woodland period sites. These trends appear to indicate that there was a shift during the Late Archaic to the Middle Woodland period for sites to be placed in locations highly visible from the water. This is quite significant and may indicate a greater emphasis on the lake both in terms as a subsistence resource as well as a transportation route.

One of the important contributions of this research is the evidence that patterning exists regarding placement of sites at highly visible locations. The application of visibility analysis to predictive modeling may represent temporally specific criteria that could help identify additional sites in this region. Visibility, both to and from a location, represents a fundamentally important aspect of human experience and such a relationship can provide significant insight into settlement site selection. This research has demonstrated that the inhabitants of Rice Lake had, during both the Pre Middle Woodland and Middle Woodland periods, selected site locations with a visible relationship to the lake. While predictive models tend to incorporate proximity to water, these findings suggest that the more experiential element of visibility to the lake was also an important aspect of site selection.

Despite the speculative nature of many of the interpretations presented above, this research does present a much-needed examination of the landscape aspects of the Rice Lake region, particularly during the Middle Woodland period. As much of the research into this period predates the introduction of landscape analysis in archaeology, this represents the first such formal study. While this study fails to provide concrete support of a number of the key aspects of the above interpretations, it has provided a thorough examination of one important aspect of the past landscape, and has indicated what gaps must be filled by future research. It is hoped that this study will act as a starting point for such research.

6.5 Future Research Directions

The most important next step for research into the Middle Woodland occupation of Rice Lake is a thorough examination of the settlement and subsistence patterns for sites in the area. The suggested seasonal model for the Rice Lake Middle Woodland occupation remains speculative (Spence et al. 1984:120). While there are well defined spring through autumn occupations across the lake, the only suggestions for inland winter campsites is the absence of such sites on the lake. No other evidence exists to indicate such sites are present. The first step is the identification of seasonal patterning amongst sites and an attempt to determine if and where winter campsites may be located. This is crucial to increasing our understanding of the way local landscapes were utilized by the Middle Woodland inhabitants, and could enhance our current perceptions of the placement of mound sites both on the lake and in the Trent Valley region in general. If winter camps can be identified inland from the lakes or rivers, their location in relation to the warmer season occupations could explain much of the spatial and visual patterning we see on Rice Lake.

Another important research direction for the Middle Woodland occupation of Rice Lake is the determination of the role wild rice might have played in local subsistence patterns. As previously stated, no direct evidence for wild rice has been identified at any Middle Woodland sites on Rice Lake. However, given that the majority of sites on the lake were excavated prior to modern recovery techniques like flotation, it is possible that such evidence may yet be found. A number of techniques could be used to ascertain the presence of wild rice. The most effective approach would be residue analysis from ceramic sherds already recovered from Rice Lake sites. If the sherds have not been scrubbed completely clean it is possible that small amounts macrobotanical remains can be identified. Flotation could also be used on feature soil from Middle Woodland sites from the lake, though this would require excavation of such sites. Furthermore, wild rice is so fragile that it is unlikely to survive the flotation process. Another method that could assist in indicating whether or not wild rice was utilized and to what degree would be a more refined palaeobotanical reconstruction of where it would most likely have grown. The model utilized in this study only took water depth into account for determining the ideal and less than ideal areas on the lake wild rice would have grown. However, wild rice stands are affected by a number of factors which contribute strongly to where it can flourish, including fluctuation in water levels, speed of the current, and competition with other aquatic plants (Aiken et al. 1988:39-47). If such data can be generated for the reconstructed pre-1830s Rice Lake model then a more refined wild rice model could be constructed and the location of sites in relation to wild rice stands could be more accurately assessed.

Regarding the future research applications of visibility analysis, the utility of such methods for predictive modeling have already been touched on. However, the variation between the Middle Woodland and Pre Middle Woodland occupations site selection criteria where visibility is concerned suggests the importance of considering temporal and regional variation when constructing predictive models. Predictive modeling as applied to the identification of archaeological sites tends to be extremely general, lumping many geographic regions and temporal periods together. There are a number of reasons such generalizations are problematic. The presumption that site selection for settlement can be generalized over thousands of years dismisses changes that occur in the environment. As this research has shown there have been significant changes in the Rice Lake region over the past 200 years, most notably to the lake level due to damming. Such an impact means that any predictive model applied to the Rice Lake area that uses water level as a criteria for identifying prehistoric sites will be in error. For predictive models to accurately build probability models for identifying archaeological sites, analysts must construct temporally and regionally specific models that take into account both environmental and cultural factors that change the criteria of site selection over time. Factors like visibility from a water body can also be incorporated in situations like that presented in this research, where the existing sites frequent such highly visible locations.

Chapter 7
Conclusion

7.1 Summary of Research

This research has examined the way in which landscape visibility factored into the site selection decision processes for the Rice Lake burial mounds. Through both descriptive and statistical analysis, mound viewsheds were examined and compared to other datasets and a number of hypotheses were considered. This thesis began with an examination of the theoretical and methodological background of landscape and visibility analysis as well as that of the cultural background for the Rice Lake region. The methodology being applied here was then explained, including the steps involved in environmental reconstruction for the area, the types of analysis being conducted, and the way in which field observations were incorporated into the study. Through both descriptive and statistical analysis mound viewsheds were examined and compared to other datasets and a number of hypotheses were considered. The results of the analysis were then discussed. Finally interpretations of the results were presented as were a number of suggestions for future research directions based on this analysis.

The results of the analysis reveal a number of significant findings. Statistically no significance was found suggesting that the mound sites were situated in locations that had a greater visibility to the surrounding landscape than contemporaneous Middle Woodland sites. Likewise, no significant results were identified when Middle Woodland sites were compared to Pre Middle Woodland sites. However, all three datasets based on real sites had significant results when compared to the randomly generated sites. As those sites were constrained to have the same proximity to the lake as the existing sites, it can be concluded that sites from the Pre Middle Woodland and Middle Woodland periods were selected to have a view to the lake and the surrounding swamps, regardless of the site's function.

The results of the analysis of visibility from Rice Lake show a number of statistically significant results as well. A nearly significant result was identified between the mound sites and the non-mound Middle Woodland sites. They would have been significant if a lower standard of 90% as opposed to 95% was accepted as significant. However, examination of the distributions revealed that this difference between the two distributions reflects a generally higher visibility of non-mound sites compared to the mound sites. The comparison between Middle Woodland and Pre Middle Woodland sites proved significant and suggests that Middle Woodland sites were generally placed in areas of higher visibility from the lake compared to Pre Middle Woodland sites. Again all datasets proved significant when compared against the random dataset, suggesting that site selection was not random in terms of the visible relationship with the lake.

Descriptive analysis largely corroborated the statistical findings. An examination of the sites on the visibility map seems to suggest that the majority of Middle Woodland sites on the lake were placed in the most highly visible point when viewed from the lake in their general area. Less than half of the Pre Middle Woodland period sites are located on the most prominently visible point when viewed from the lake. This has been interpreted as the result of one of two factors; first that during the Pre Middle Woodland period, terrestrial travel was more common and therefore site selection took place on land and not from the lake, or alternatively, that visibility from the lake became more important during the Middle Woodland period, possibly as a result of the population increase that took place in the region.

Intervisibility is much harder to assess definitively through comparative analysis, due to significant changes in settlement patterns on Rice Lake that occurred during the Middle Woodland period. Sites began clustering around the river drainages during that period, and as a result it is difficult to determine whether the increase in site intervisibility that occurred during the Middle Woodland period, compared to the Pre Middle Woodland, was intentional, or merely a side effect of the clustering. Intervisibility does appear to be intentional among the three mound sites in the Indian River locale. However, other intervisibility relationships between mound sites and non-mound sites remain ambiguous. While some non-mound Middle Woodland sites appear to be clearly intervisible with local mound sites, the intervisibility relationship with others appear partial or non-existent. This means that it is impossible to say with any certainty that mound and non-mound sites were built to have or not have a visible relationship.

Field observations recorded from Rice Lake and from the Harris Island Mound and Serpent Mounds sites added very little to the overall interpretation of visibility. However, they did serve to validate the viewshed analysis. The observations made in the field largely matched the assessment of the viewsheds generated from sites and the lake. Furthermore, viewsheds generated from those observation points were generally corroborated by the field observations, thus indicating that the viewsheds and digital model provide an accurate representation of the real world in which to conduct analysis. Finally the incorporation of field observations served to demonstrate the level of clarity sites would have in relation to each other. In particular, the mounds at the Indian River locale, while generally intervisible, would not necessarily be clearly visible from one another. Serpent Mounds is clearly visible from the Harris Island Mound. However, East Sugar Island is farther away and observations from both the lake and from the other two mound sites suggests that while the location of the mounds is visible, they would not be clearly visible without some strong colour contrast. For example if the mounds were cleared of vegetation, the brown earth would contrast the green surroundings making the structure more highly visible.

Having shown few significant results for the mounds compared to non-mound sites on Rice Lake, interpretations of mound site locations focused largely on the mounds and their surrounding environment, and less on their relationships with other sites around them. It is concluded that mounds may have functioned as territorial markers over significant restricted resources, as suggested by the Saxe/Goldstein hypothesis (Goldstein 1981). While wild rice may have been a significant resource, it is suggested here that the mussel shell beds were the focus of mound site locations, as shell appears both within the structure of some mounds, and in large deposits associated with the mound sites. Cosmological importance of visibility and site locations tie into these interpretations, with the significance of the lake and swamps as both the source of subsistence and a symbol of the underworld. The visible relationships of the mound sites to the lake and swamps, as well as to shellfish and other aquatic resources, suggests a liminal bond with the underworld.

7.2 Consistent Problems

A number of shortcomings remain in the evaluation of visibility as factor in site selection for the Rice Lake burial mounds. Many of the technical and philosophical complications of viewshed analysis and visibility analysis in general have been addressed throughout this thesis. These have included understanding the biases inherent in studying visibility to the exclusion of the other senses, problems of accuracy and abstraction involved in using a digital model through to more common problems like possible errors in site location data and poorly defined chronology for the period and region being considered. Such problems are admittedly serious, and do represent possible sources of error. However, a number of solutions to these problems have been implemented throughout the analysis process in order to minimize any adverse effects. Technical problems like the digital abstraction of the study region and the difficulties in modeling palaeovegetation can never be entirely corrected for, however, methods such as checking results against field observations and applying probability models allow for flexibility in the overall interpretation of the results. For the more philosophical issues, such as the bias towards visibility over the other human senses the solutions are less than clear-cut. Such problems are not unique to this study and in many ways permeate much of our study of the past. It cannot be stated here that sites were selected for visibility characteristics to the exclusion of auditory or olfactory characteristics. All that can be stated are the aforementioned results regarding the visibility characteristics of site locations.

The most significant shortcoming for this research has been the lack of adequate settlement and subsistence data for the Middle Woodland period at Rice Lake. While a number of studies have attempted to define chronological sequences of sites on Rice Lake (Curtis 2003; Johnston 1968a), the multi-component nature of many of the sites, and the use of antiquated excavation techniques on others has meant that such chronologies remain limited. This is particularly problematic in the assessment of site intervisibility carried out in this study, because it means the identification of particular site sequences is highly ambiguous. Furthermore, the relationship between sites at Rice Lake and those in the surrounding areas are also lacking in the literature. In particular, the areas along the Otonabee, Indian, and Ouse River drainages are severely understudied. While it has been proposed that these areas represent parts of the seasonal sequence of the Rice Lake mound builders, there has been little to no evidence identified to support this (Spence and Fox 1986:36). Unfortunately, this scarcity of data means that much more work is required in the Rice Lake area to support the interpretations put forth in this analysis. However, the visibility analysis presented here has provided much insight into settlement process at Rice Lake, and has suggested a number of new avenues, both locally and methodologically, for future research.

7.3 Contribution of Research

This research has provided a new perspective on visibility and landscape relationships for sites in the Rice Lake region of Southern Ontario. While the methodology applied may not be flawless, such new approaches to archaeological research provide unique perspectives with which to develop our understanding of the way past peoples lived. Although Rice Lake has been the focus of considerable research over the past 120 years, much of that work has focused exclusively on the mounds or the analysis of ceramics throughout the region in order to develop chronologies. Little focus has been placed on attempts to understand the interrelationships between sites and their surrounding landscapes. Such understanding is crucial to explaining site selection and formation processes since individuals and their social groups do not experience their worlds exclusively where they leave the traces of themselves. Rather the areas in between archaeological sites are just as important for our interpretation of past cultures.

Through the study of the visibility relationships of the Middle Woodland period on Rice Lake, this study has provided new insights into the past life-ways of the inhabitants of Rice Lake. Understanding relationships between the placement of the dead and the settlement systems of the living is an often-overlooked aspect of mortuary analysis.

This study also presents new methodological approaches to the study of landscape for southern Ontario, and for archaeology as a whole. While viewshed analysis itself has been applied in archaeological research for almost twenty years, it remains an underutilized, and often misused, technology. This study provides a thorough application of visibility analysis, which can be applied with relative ease to other regions both within and outside of southern Ontario. Furthermore, the application of visibility models, like that applied here, suggests ways in which visibility analysis can be tied into predictive modeling. As patterns of variation between temporal periods were indicated here, such a model could be applied elsewhere to determine whether high visibility was a factor in site selection, and then could be incorporated into local predictive models.

The understanding of how people experienced their landscape, even through their sense of vision alone, provides a unique avenue into the cognitive processes of past people. Such insights should not be under-rated or dismissed. This study has provided an analytical framework with which to approach such experience. By utilizing thorough and carefully applied methodologies, archaeologists can reach into areas traditionally dismissed as subjective. While a degree of subjectivity will always remain in the interpretation of analytically derived results, the results themselves remain valid. It is only through the careful interpretation and subsequent critique of those interpretations that future research can be directed and our understanding of the past enhanced.

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Appendix A

Table A.1. Form template for land-based observations

Site name:	Borden Number:	Date:

Weather Conditions:

Visibility Conditions:

Start Time: End Time:

Local Vegetation Density:

Local Vegetation Type:

Local Topography:

Observations From Mound Site:

Overall Visibility:

Notable Landscape Features Visible From Site:

Extent of Water Visible From Site:

Observations:

Table A.2. Land-based observations at the Serpent Mounds site

Site: Serpent Mounds	Borden Number: BbGm-2	Date: 11/07/08

Weather Conditions: Sunny, clear and warm

Visibility Conditions: Immediate vicinity is good, lake is misty limiting long distance visibility

Local Vegetation Density: West half of site is cleared and well manicured, east half is sparsely vegetated on the site heavily forested going down to the shell midden area to the east

Local Vegetation Type: oak, pine, cedar, beach, birch, and low lying shrubs

Local Topography: site situated on Drumlin emerging from lake

Observations From Mound Site:

Overall Visibility: very good

Notable Landscape Features Visible From Site: Harris Island Mound site would be clearly visible if cleared of vegetation. East Sugar Island mounds would be visible if east side of Serpent Mounds was cleared of vegeation.

Extent of Water Visible From Site: Main channel is visible as is the shallow waters surrounding the site

Observations: Point #1 727371 4898823

The western gap

North:

Max Visible Distance (m): 4+ km

Full extent of main channel highly visible

East:

Max Visible Distance (m): 5+ km

If vegetation was cleared, an extensive area of the lake would be visible. Currently only mounds F, G, and the end of E are visible

South:

Max Visible Distance (m): 4 km

Harris Island is clearly visible as is a large area of the lake looking over mound E

West:

Max Visible Distance (m): 500m

Currently skewed by a row of cedar bushes, the view to the north would likely not have extended more than 500 m

Observations: Point #1 situated in the gap between mounds E and H on some prominent rocks, affords excellent view to the western portion of the lake.

Observations: Point #2 727412 4898838
The eastern gap
East:
Max Visible Distance (m): 5+ km
If vegetation was cleared, E.S.I would be clearly visible as would a large portion of the lake
South:
Harris Island is clearly visible
Observations: Point #2 was selected due to its position in the gap between mound E and mound G

Observations: Point #3 727489 4898838
Shell midden
Excellent view to the eastern end of the lake, including East Sugar Island, View up to Serpent Mounds would be good if vegetation was cleared. Currently mounds can only be partially distinguished through the brush.

Observations: Point #4 727455 4898771
Shell Midden 2
Another area where shell midden remains are visible extending into the lake. Harris Island is visible to the south, and East Sugar Island is visible to the northeast. The main lake corridor is obscured by dense vegetation to the west.

Observations: Point #5 727 353 4898845
Mound H
Visibility is difficult to judge due to modern vegetation. Mound F is due east and Harris Island is just visible to the south

Observations: Point #6 727390 4898801
Mound D
To the south is Harris Island, to the west is the bay, to the north the view is obscured by mound E and to the East vegetation obscures the view to the lake and possibly the shell midden.

Table A.3. Land-based observations at the Harris Island Mound site

Site name: Harris Is. Mound	Borden Number: BbGm-27	Date:09/19/08

Weather Conditions: Sunny, some wind from the Southwest

Visibility Conditions: Clear but heavy vegetation at site

Start Time: End Time:
Local Vegetation Density: heavy

Local Vegetation Type: oak, beach, birch

Local Topography: Undulating slightly, site located north of a drumlin peak in a relatively flat area

Observations From Mound Site:
Overall Visibility: Poor due to vegetation, if clear likely good in all directions but south

Notable Landscape Features Visible From Site: Serpent Mounds likely clearly visible if vegetation was clear, East Sugar Island would likely be visible as well, though the mounds would likely be to far away to discern

Extent of Water Visible From Site: Good view from the northwest to the southeast, south to west not visible

Observations:
Serpent Mounds is about 20 degrees off of not north from the mound

East Sugar Island visible to the northeast

To the south, drumlin cuts off view

View to the west likely obscured by terrain before reaching lake, though for the most part the area is relatively flat

If cleared of vegetation the mound would be visible at some distance from all directions, particularly to the east of it from the lake.

Appendix B

Table B.1. Form template for aquatic observations

Locale:			Date:	

Weather Conditions:

Visibility Conditions:

Lake Conditions:

Current Strength:

Wind Direction and Strength:

Starting Point UTM/Location :

Point	Course/ Orientation	UTM	Notable visible land or water features/Photo log	Visibility or suggested visibility of mounds

Table B.2. Observations made at the Otonabee River locale

Locale: Otonabee River Date: 11/09/08

Weather Conditions: Sunny some clouds

Visibility Conditions: clear

Lake Conditions: slightly rough

Current Strength: strong from the west

Wind Direction and Strength: wind coming in from northeast

Starting Point UTM/Location : 61/East of Otonabee River Mouth

Point	Course/ Orientation	UTM	Notable visible land or water features/Photo log	Visibility or suggested visibility of mounds
1	Towards Otonabee from east	61 722124 4893180	Limited visibility, large number of cottages and heavy vegetation along shoreline. Photos 1-3	Uncertain mound location, poor visibility along shoreline due to vegetation
2		62 721817 4892875	Visibility to crest of Drumlin fairly good 4-5	Drumlin crest clearly visible
3	100 m from mouth	63 721599 4892766	6-9 10 clear area possible former mound location	Drumlin clearly visible
4	Eastern Side of Otonabee River	64 720933 4893504	Low sloping area down from Drumlin, heavy vegetation and cottages photos 14-16	Heavy vegetation and cottages obscure view
5	Just north of previous area	65 720840 4893790	Large clear area running up drumlin photos 17-19	Large Drumlin clearly visible northeast
6	Mouth of Otonabee Facing East	66 720651 4894075	Beginning of crest of drumlin photos 20-22	uncertain

Table B.3. Observations made at Indian River locale Part 1

Locale: Indian River Date: 08/19/08

Weather Conditions: Sunny with some cloud cover, slight breeze

Visibility Conditions: clear

Lake Conditions: calm

Current Strength: weak

Wind Direction and Strength: slight breeze from northeast

Starting Point UTM/Location: Mouth of Indian River coming from Keene

Point	Course/ Orientation	UTM	Notable Visible Land or Water Features/photo log	Visibility or Suggested Visibility of Mounds
0	South along western side of ESI	--	HI, ESI and SM land areas	Poor to no visibility for all three sites
1	Southern end of ESI heading west	48 0728949 4899315	Three mounds Shell middens visible	All three sites visible ESI and HI somewhat visible. SM partly visible though difficult to discern
2		49 0728944 4899315	114	Serpent Mounds more clearly discernable ESI mounds very visible HI possibly visible
3	Due south of ESI heading west	50/51 0728814 4899271 0728662 4899191	Indian River Mouth, southern shoreline running visible for approximately 3-4 km	ESI, SM Visible HI likely
4		52 0728413 4899089	121-124	ESI, SM, HI all clearly discernable

5		53 0728123 4898920	125-128	ESI still likely visible, if clear of vegetation mounds would be visible. SM and HI clearly visible
6		54 0727918 4898833	129-131	SM, HI clearly visible, ESI only visible under ideal circumstances
7	Heading towards SM shell midden	55 0727707 4898766	132-134	SM clearly visible, HI maybe, ESI likely not
8		56 0727571 4898720	135	SM clearly discernable but any closer slope would obscure view of the mounds. HI possibly visible ESI visible only under ideal conditions.
9	Starting Due west of SM and heading east towards SM	58 0726844 4898640	141 -142	HI possibly visible. ESI not visible at all. SM clearly visible if veg absent
10		59 0726852 4898639	143	SM clearly visible HI possibly ESI not.
11		60 0726963 4898643	144	SM clearly visible, much of the mounds would be easily delineated. HI clearly visible

Table B.4. Observations made at Indian River locale Part 2

Locale: Indian River   Date: 09/18/08

Weather Conditions: clear some clouds

Visibility Conditions: excellent

Lake Conditions: calm

Current Strength: gentle

Wind Direction and Strength: slight wind from northeast

Starting Point UTM/Location : due south of Loucks site

Point	Course/ Orientation	UTM	Notable visible land or water features/Photo log	Visibility or suggested visibility of mounds
12	Facing west towards ESI	67 729468 4900112	Loucks site photo 24 ESI photo 25 Harris Island photo 26	SM, ESI not visible, HI poor visibility
13	Towards Harris Island	68 729150 4899750	ESI 200m south Loucks photo 27 ESI photo 28 Channel and Harris Island 29	Loucks site clearly visible ESI mounds not visible Some visiblilty to SM though poor HI far away but visible
14	Still heading west	69 728933 4899380	Loucks site photo 30 ESI 31 Harris Island 32 SM 33	Loucks still visible though far away HI definable vegetation so likely visible SM likely visible without vegetation ESI obscured by drumlin crest, though possibly visible
15	continued	70 728752 4899013	Loucks site photo 35 ESI photo 36 Serpent Mounds 37 Harris Island 38	Loucks very far away but visible ESI, SM (east side), HI visible

16	Center of the channel, heading west	71 728466 4898724	Loucks 39 ESI 40 SM 41 HI 42	ESI, SM, HI all clearly visible
17	Closer to HI and SM than ESI	72 728280 4898494	ESI 43 SM 44 HI 45	Loucks site out of view ESI clearly visible SM and HI clearly visible if vegetation was clear
18	Near shore of Harris Island still heading west	73 728060 4898293	Sparse wild rice plants present 47 ESI 48 SM 49 HI 50	ESI good visibility SM, HI good visibility
19	100m off of the northern point HI	74 727697 4898062	ESI 51 SM 52 HI 53	Far enough from ESI that individual mounds would not be discernable SM and HI clearly visible
20	Towards channel btw SM and ESI	75 727517 4898264	ESI 56 SM 57-59 HI 60-61	SM and HI clearly visible ESI visible though mounds are likely undescernable
21	Adjacent to SM	76 727616 4898637	ESI 62 SM 63 HI 64	ESI, SM good visibility HI some visibility
22	Channel between SM and ESI	77 727679 4898904	ESI 65 SM 66 HI 67	Possible visibility to ESI and SM HI if visible just barely
23	Heading towards Indian River	78 727724 4899127	ESI 68 SM 69 HI 70	Good visibility to ESI Visible but mound would likely not be discernable SM not visible
24	Final Point	79 727868 4899513	ESI 71, SM 72, HI 73	ESI may be visible SM and HI not visible

Appendix C

Table C.1. P-values resulting for K-S test for total viewsheds between datasets in the empty model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.17	.66	.27
M. Woodland	.17		.73	.004
Pre Middle Woodland	.66	.73		.12
Random	.27	.004	.12	

Table C.2. P-values resulting for K-S test for lake viewsheds between datasets in the empty model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.92	.77	.44
M. Woodland	.92		.63	.12
Pre Middle Woodland	.77	.63		.02
Random	.44	.12	.02	

Table C.3. P-values resulting for K-S test for swamp viewsheds between datasets in the empty model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.65	.48	.08
M. Woodland	.65		.98	.08
Pre Middle Woodland	.48	.98		.04
Random	.08	.08	.04	

Table C.4. P-values resulting for K-S test for lake and swamp viewsheds between datasets in the empty model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.92	.48	.08
M. Woodland	.92		.66	.05
Pre Middle Woodland	.48	.66		.03
Random	.08	.05	.03	

Table C.5. P-values resulting for K-S test for less than ideal wild rice areas viewsheds between datasets in the empty model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.92	.66	.59
M. Woodland	.92		.86	.44
Pre Middle Woodland	.66	.86		.13
Random	.59	.44	.13	

Table C.6. P-values resulting for K-S test for ideal wild rice areas viewsheds between datasets in the empty model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.92	.98	.59
M. Woodland	.92		.91	.23
Pre Middle Woodland	.98	.91		.15
Random	.59	.23	.15	

Table C.7. P-values resulting for K-S test for total viewsheds between datasets in the vegetation model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.92	.69	.05
M. Woodland	.92		.47	.004
Pre Middle Woodland	.69	.47		.27
Random	.05	.004	.27	

Table C.8. P-values resulting for K-S test for lake viewsheds between datasets in the vegetation model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.92	.69	.23
M. Woodland	.92		.29	.06
Pre Middle Woodland	.69	.29		.01
Random	.23	.06	.01	

Table C.9. P-values resulting for K-S test for swamp viewsheds between datasets in the vegetation model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.35	.12	.07
M. Woodland	.35		.95	.05
Pre Middle Woodland	.12	.95		.07
Random	.07	.05	.07	

Table C.1. P-values resulting for K-S test for lake and swamp viewsheds between datasets in the vegetation model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.99	.45	.03
M. Woodland	.99		.48	.02
Pre Middle Woodland	.45	.48		.07
Random	.03	.02	.07	

Table C.11. P-values resulting for K-S test for less than ideal wild rice areas viewsheds between datasets in the vegetation model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.99	.66	.53
M. Woodland	.99		.37	.23
Pre Middle Woodland	.66	.37		.22
Random	.53	.23	.22	

Table C.12. P-values resulting for K-S test for less ideal wild rice areas viewsheds between datasets in the vegetation model

	Mounds	Middle Woodland	Pre Middle Woodland	Random
Mounds		.65	.48	.53
M. Woodland	.65		.09	.1
Pre Middle Woodland	.48	.09		.15
Random	.53	.1	.15	

Appendix D

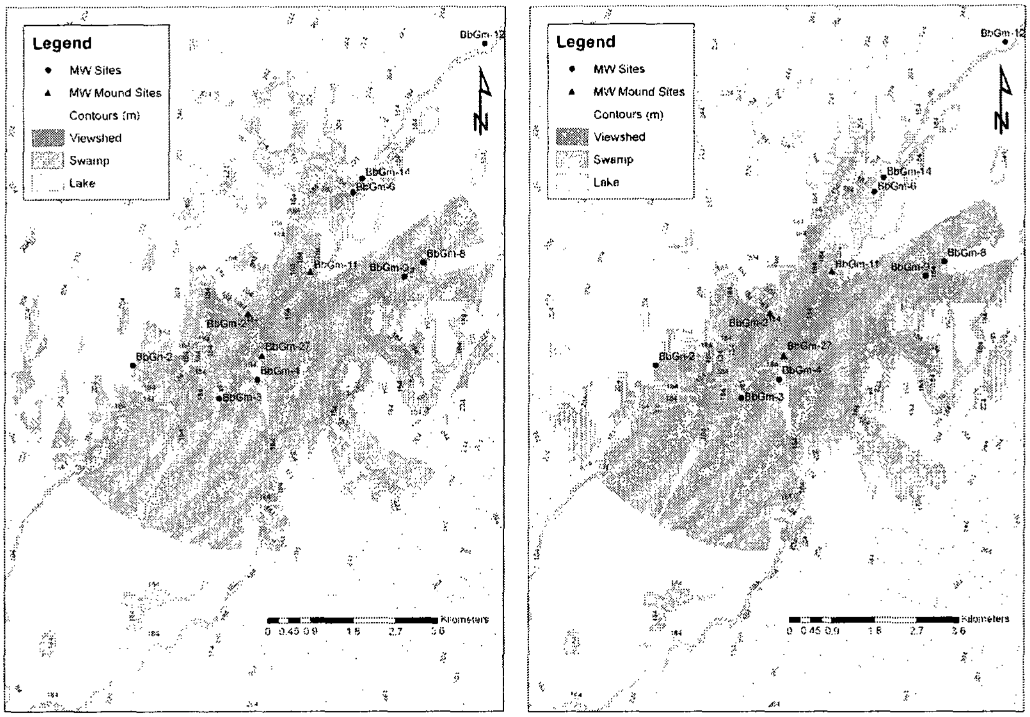


Figure D.1. Viewsheds from Serpent Mounds (BbGm-2) in the empty model (left) and vegetation model (right)

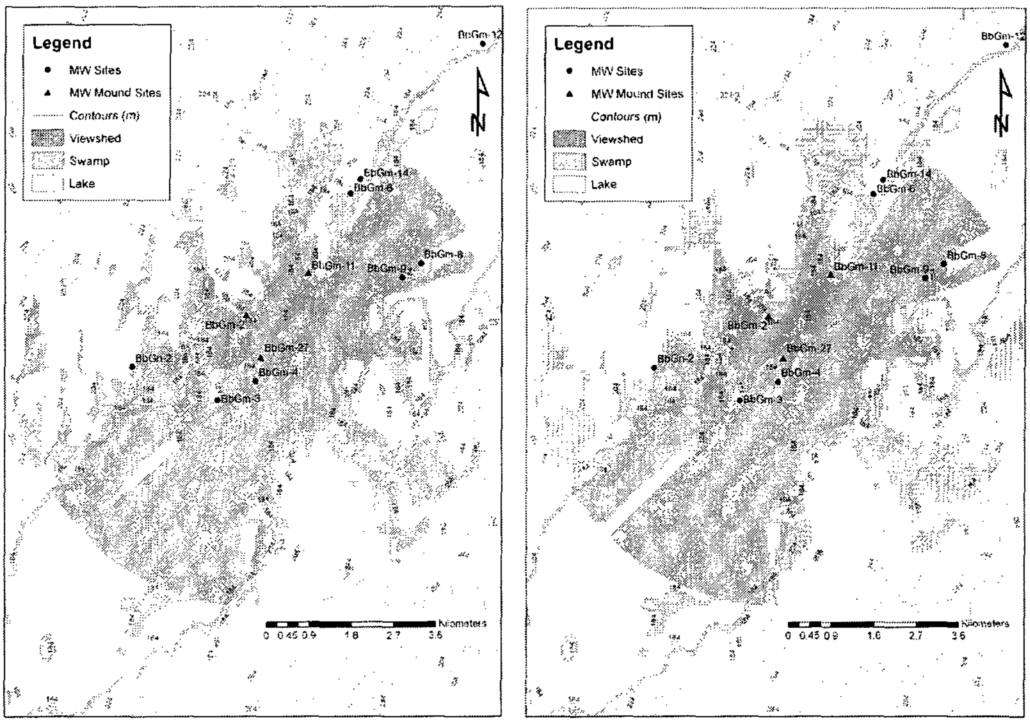


Figure D.2. Viewsheds from the Harris Island Mound (BbGm-27) in the empty model (left) and vegetation model (right)

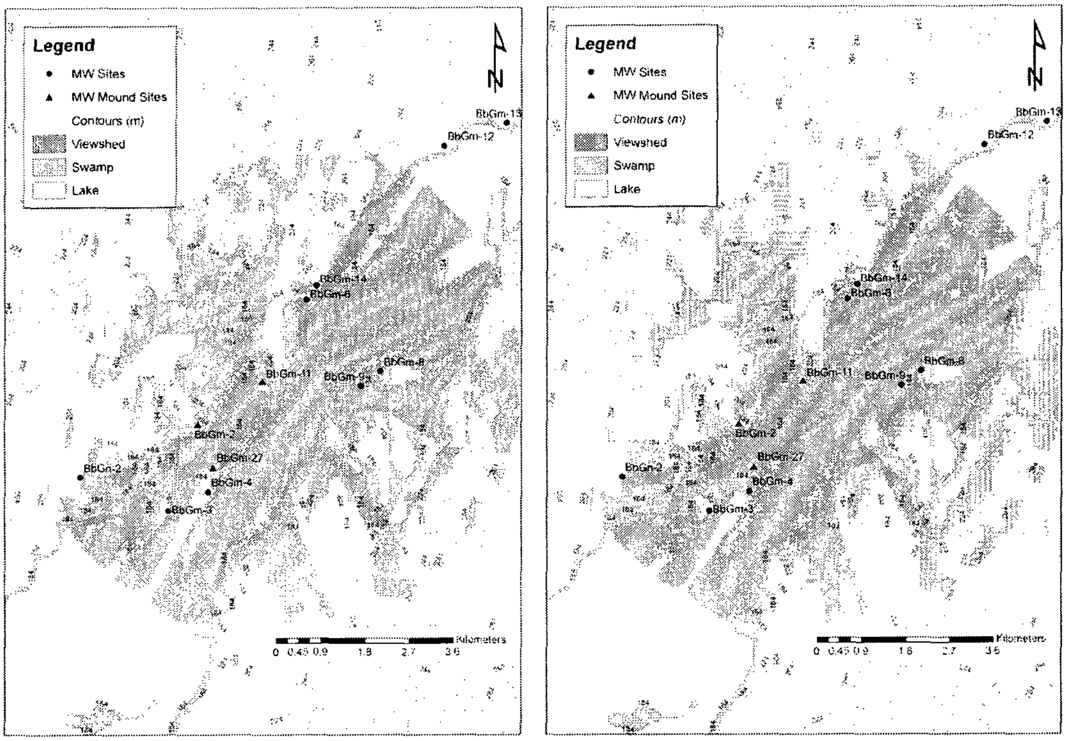


Figure D.3. Viewsheds from the East Sugar Island Mounds (BbGm-11) in the empty model (left) and vegetation model (right)

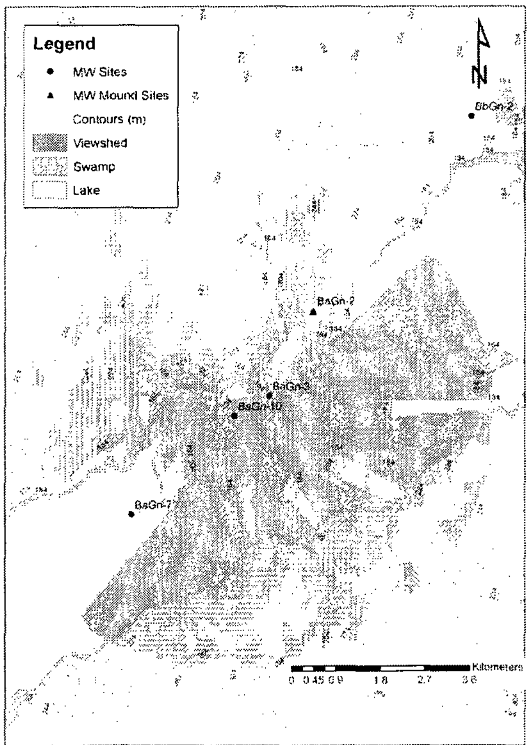


Figure D.4. Viewshed from the Cow Island Site (BaGn-10) in the vegetation model

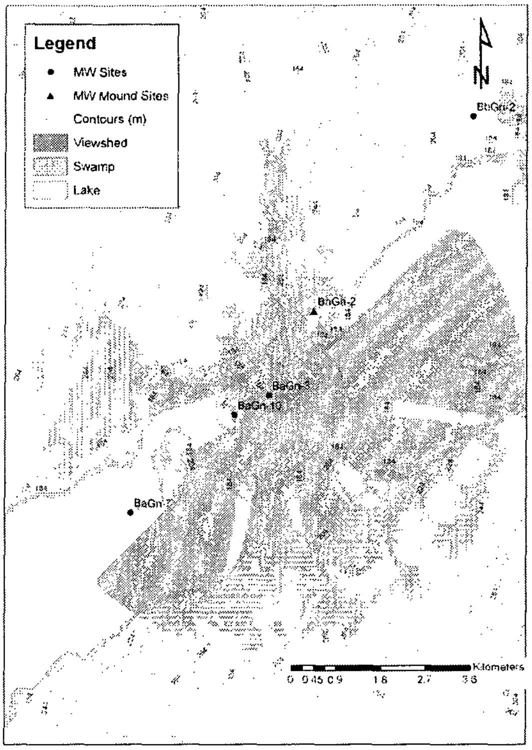
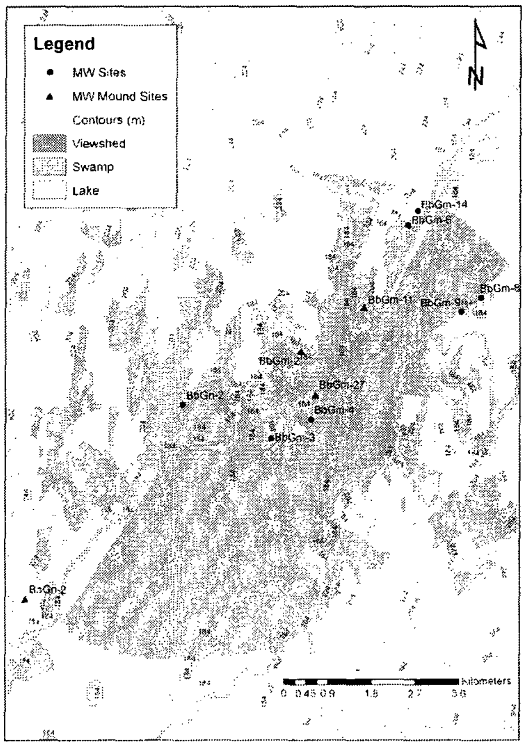


Figure D.5. Viewshed from the Jubilee Point Site (BaGn-3) in the vegetation model



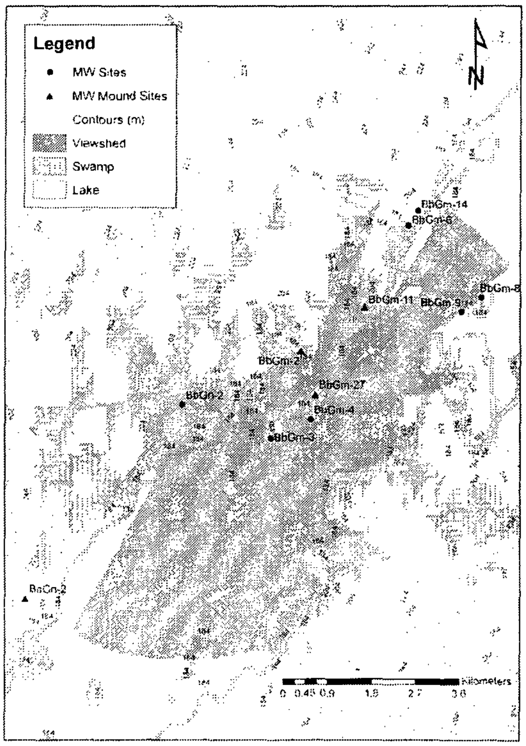


Figure D.6. Viewsheds from the McIntyre Site (BbGn-2) in the empty model (left) and vegetation model (right)

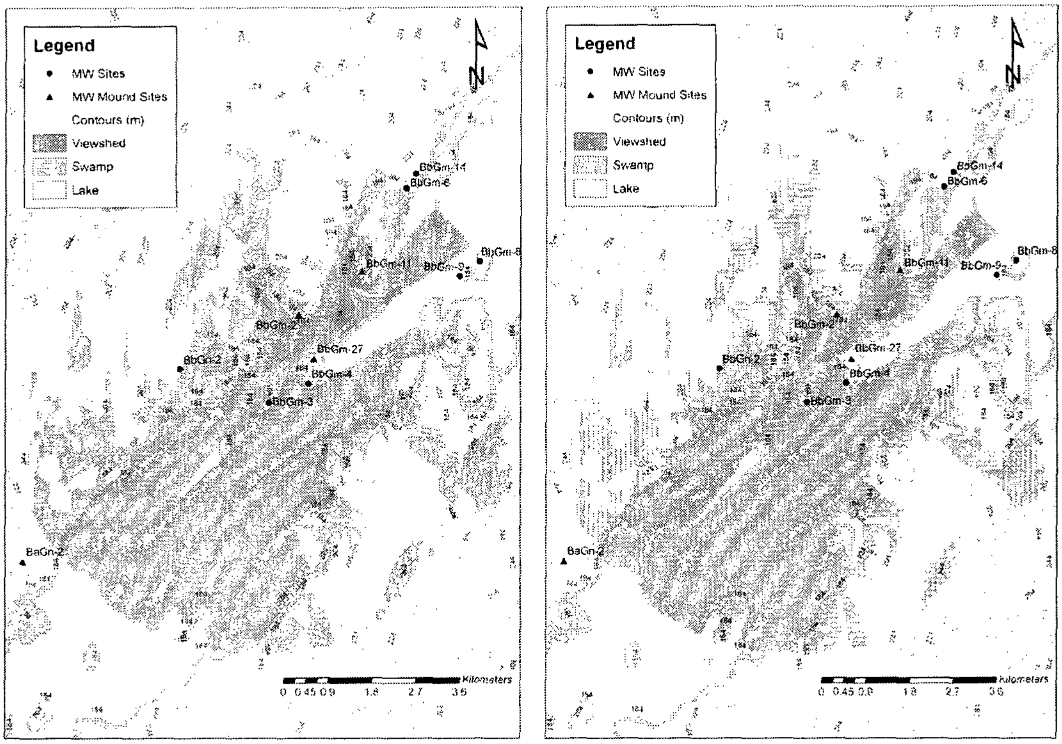


Figure D.7. Viewsheds from the Harris Island site (BbGm-3) in the empty model (left) and vegetation model (right)

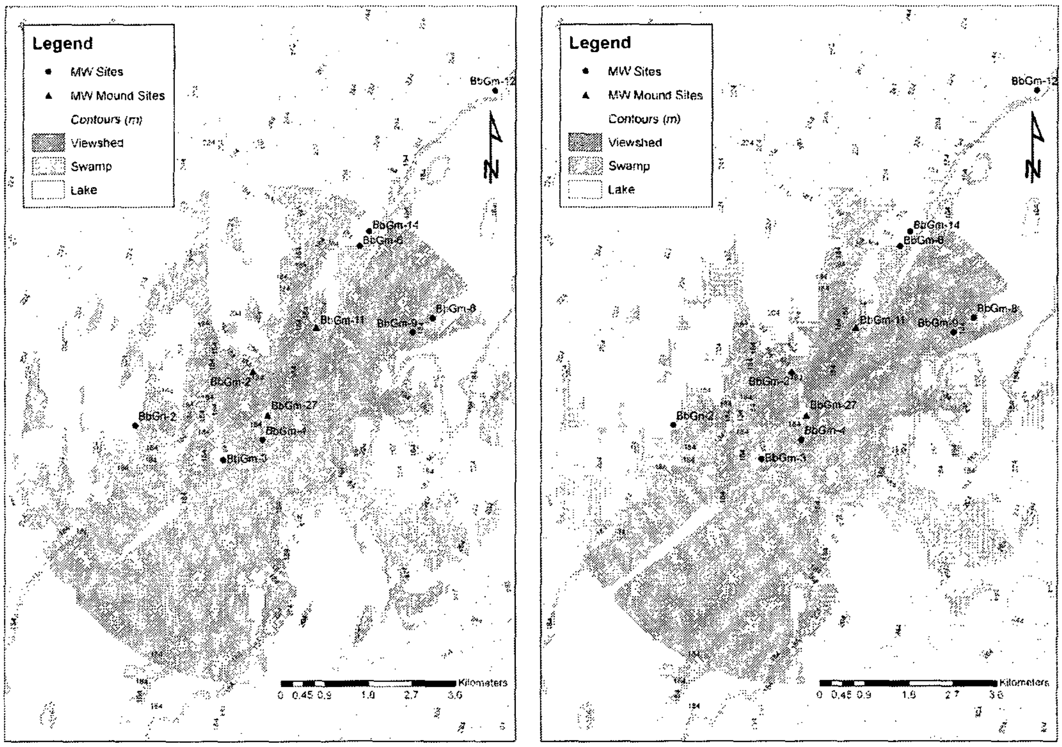


Figure D.8. Viewsheds from the Rainy Point site (BbGm-4) in the empty model (left) and vegetation model (right)

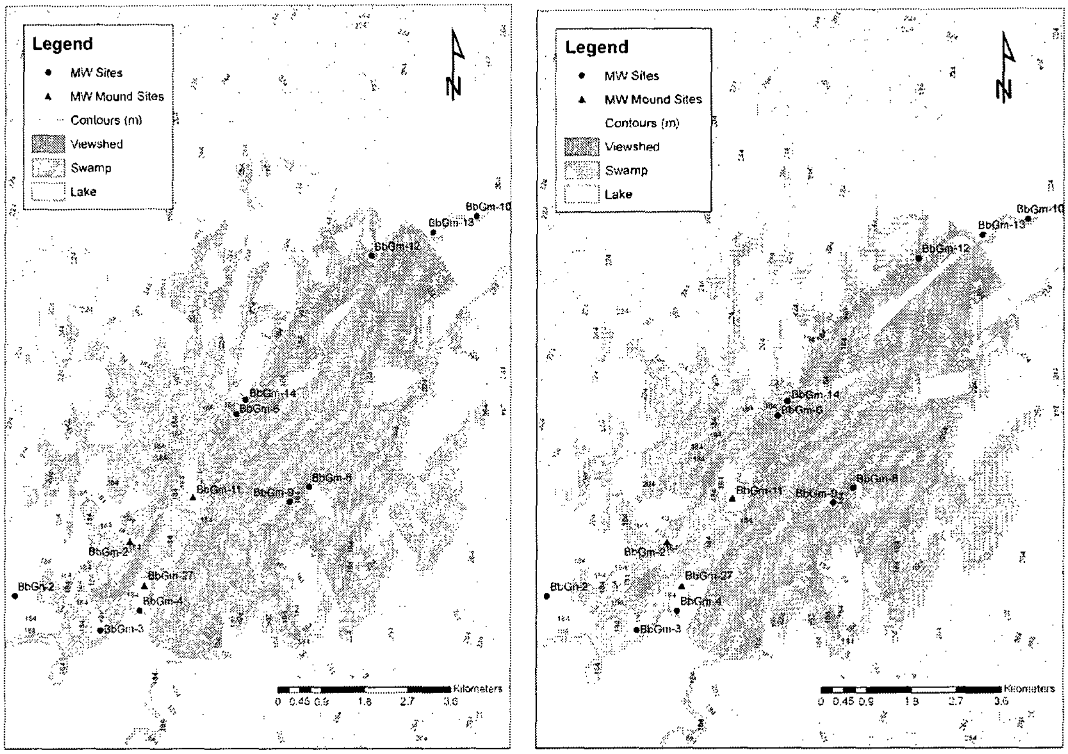


Figure D.9. Viewsheds from the Loucks site (BbGm-6) in the empty model (left) and vegetation model (right)

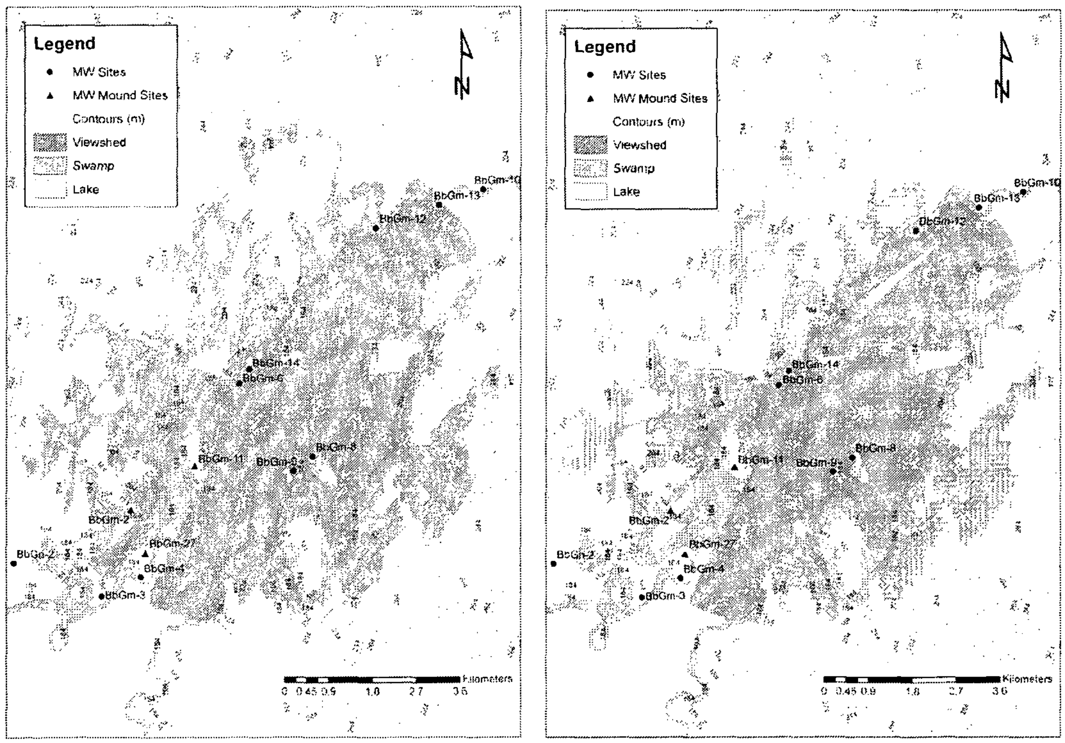


Figure D.10. Viewsheds from the Foley site (BbGm-14) in the empty model (left) and vegetation model (right)

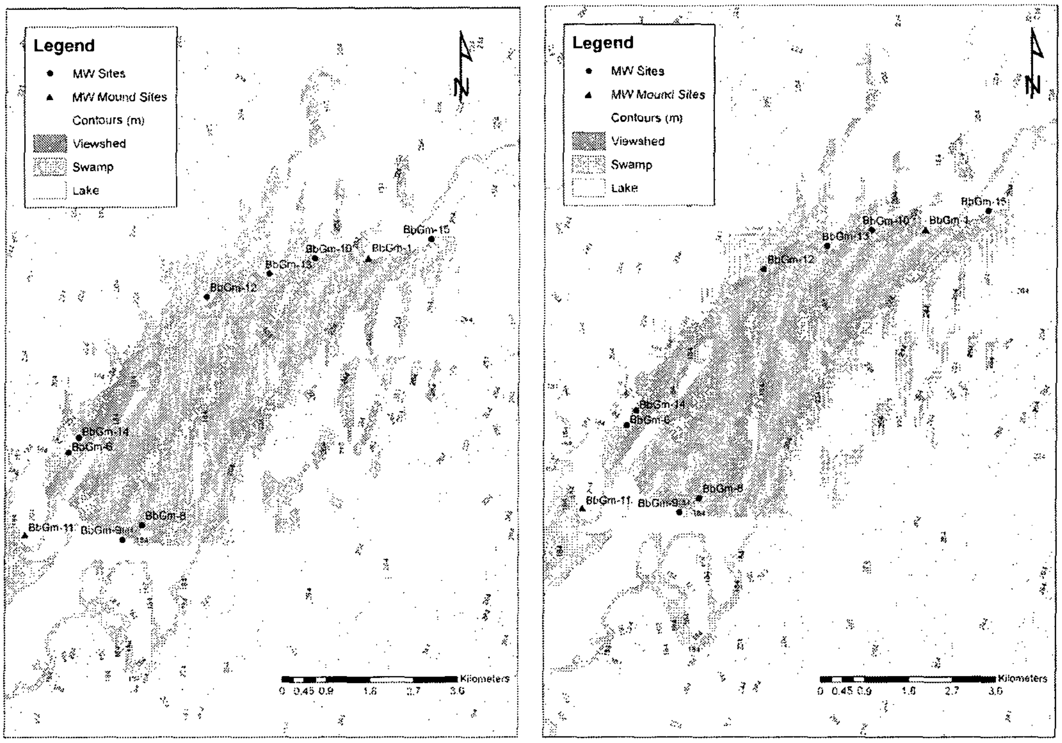


Figure D.11. Viewsheds from the Godfrey Point site (BbGm-12) in the empty model (left) and vegetation model (right)

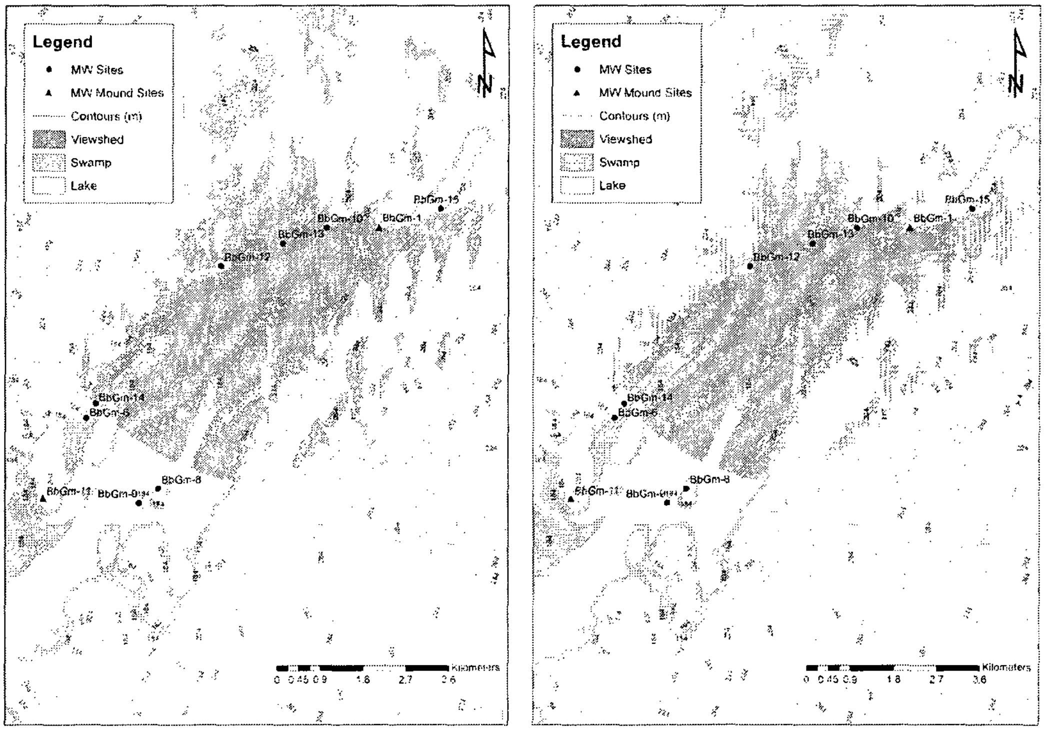


Figure D.12. Viewsheds from the Spillsbury Bay site (BbGm-13) in the empty model (left) and vegetation model (right)

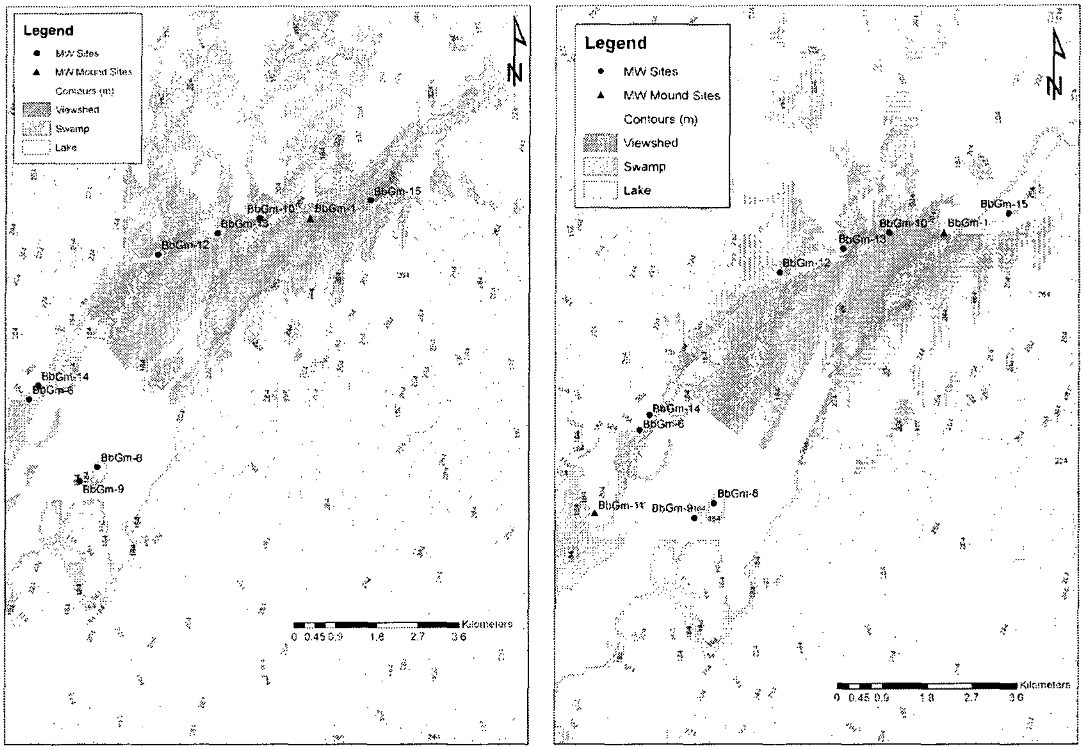


Figure D.13. Viewsheds from the Birdsall Bay site (BbGm-10) in the empty model (left) and vegetation model (right)

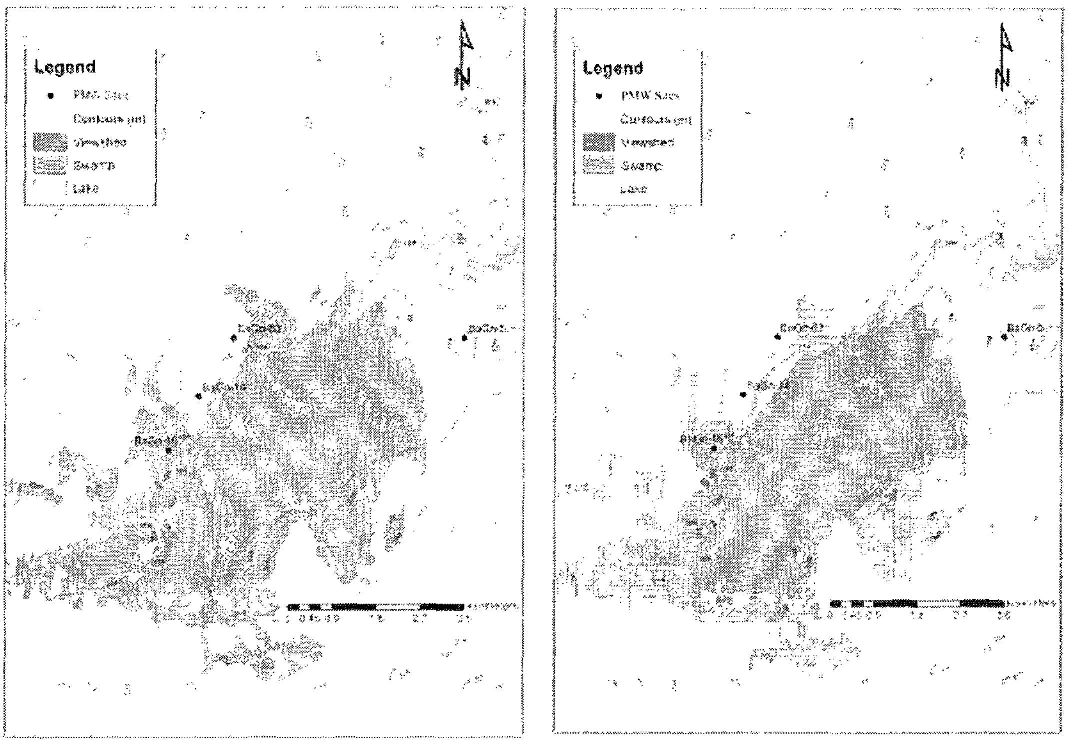


Figure D.14. Viewsheds from the Dawson Creek site (BaGn-16) in the empty model (left) and vegetation model (right)

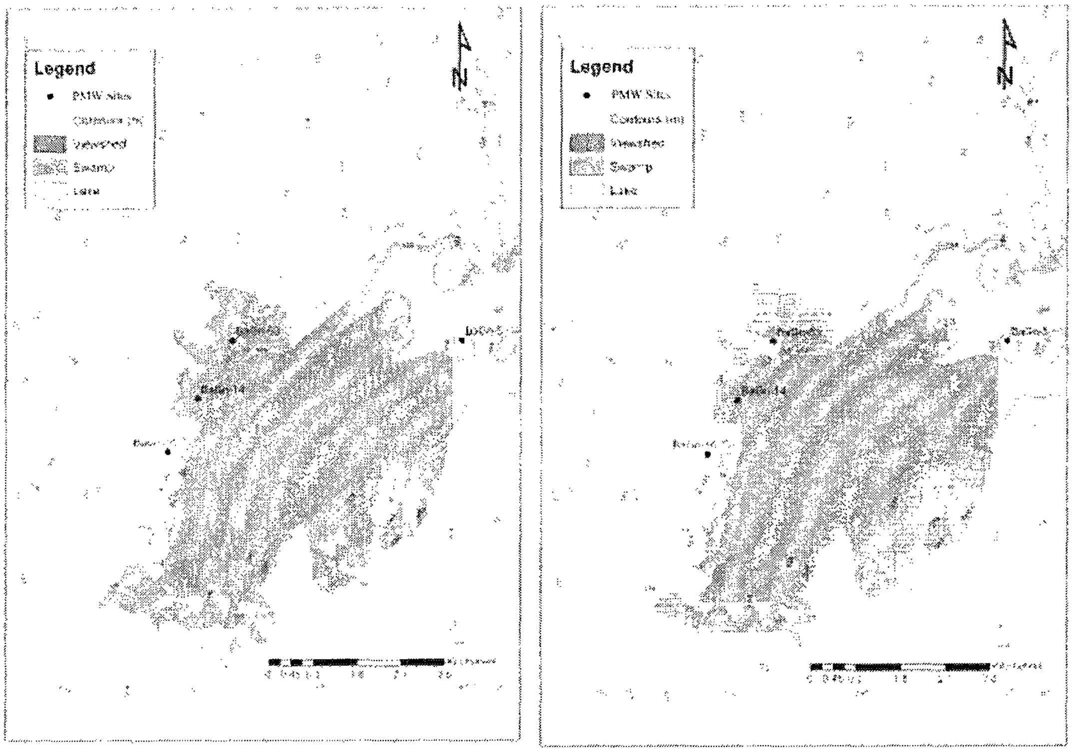


Figure D.15. Viewsheds from the Seidl site (BaGn-14) in the empty model (left) and vegetation model (right)

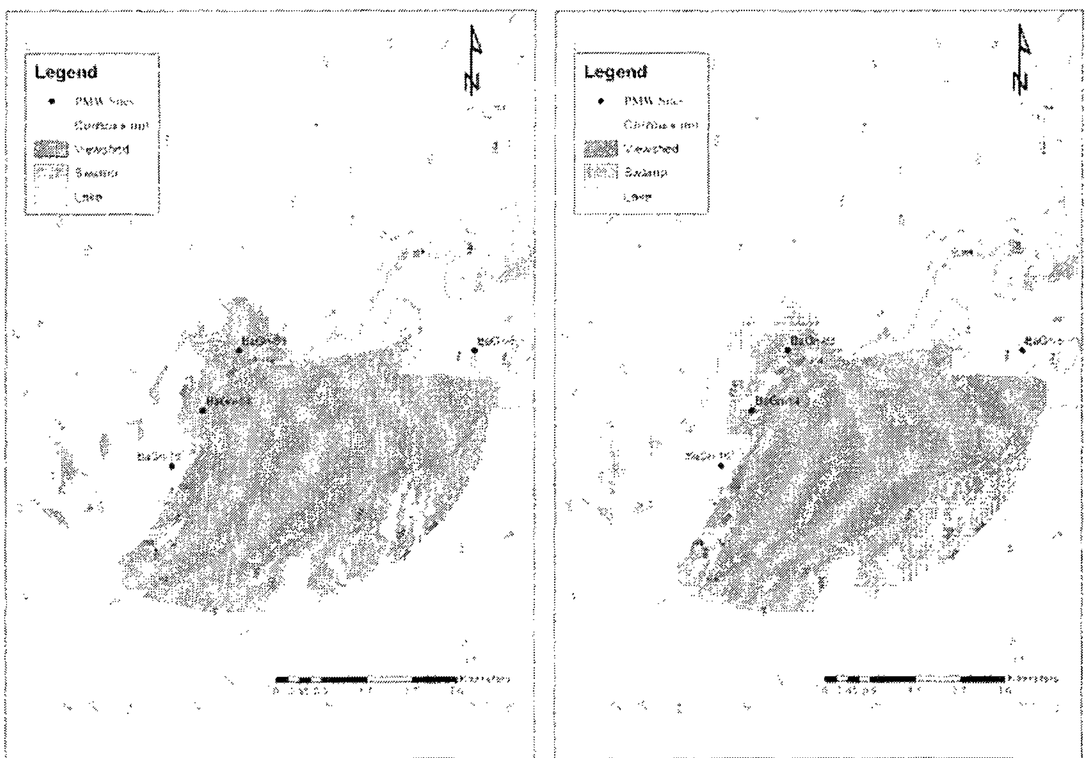


Figure D.16. Viewsheds from the Pengelly site (BaGn-36) in the empty model (left) and vegetation model (right)

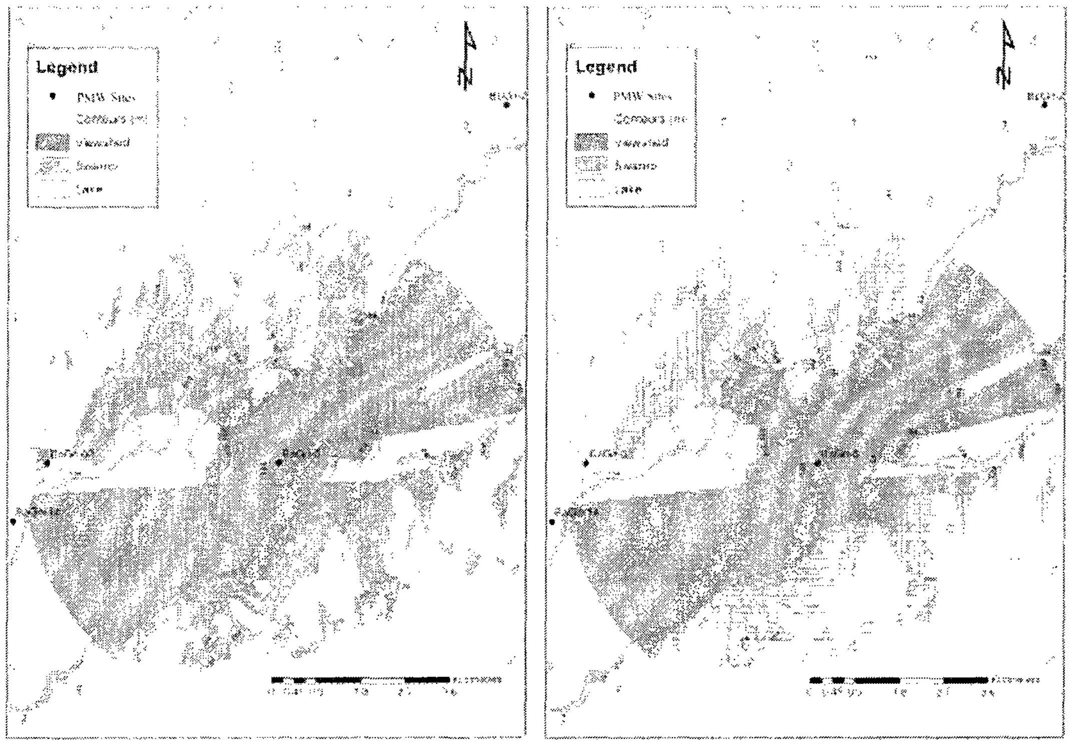


Figure D.17. Viewsheds from the West Sugar Island site (BaGn-5) in the empty model (left) and vegetation model (right)

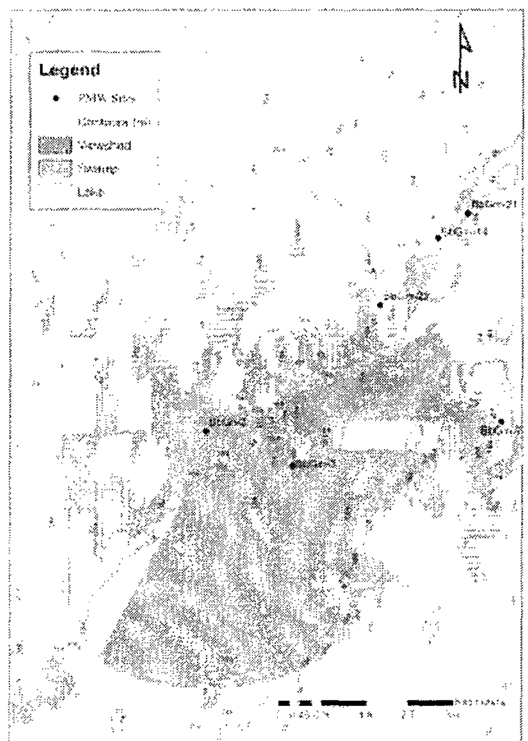


Figure D.18. Pre Middle Woodland viewshed from the McIntyre site (BbGn-2) in the vegetation model (The empty model is the same as the Middle Woodland McIntyre empty model viewshed in Figure D.6)

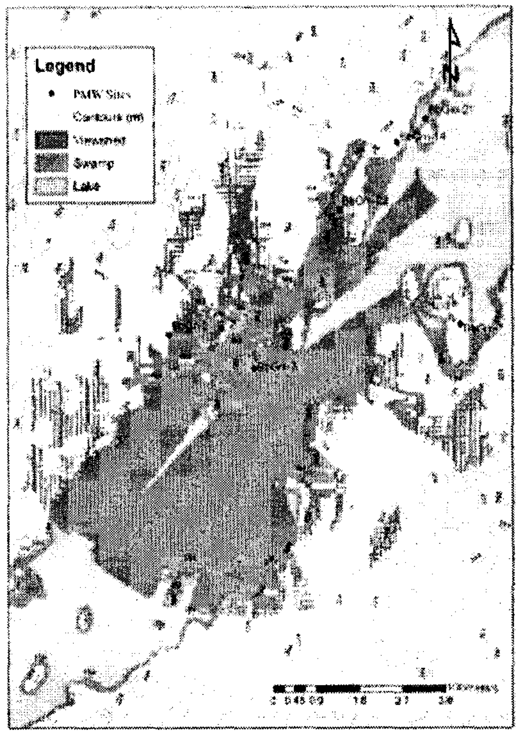


Figure D.19. Pre Middle Woodland viewshed from the Harris Island site (BbGm-3) in the vegetation model (The empty model is the same as the Middle Woodland Harris Island empty model viewshed in Figure D.7)

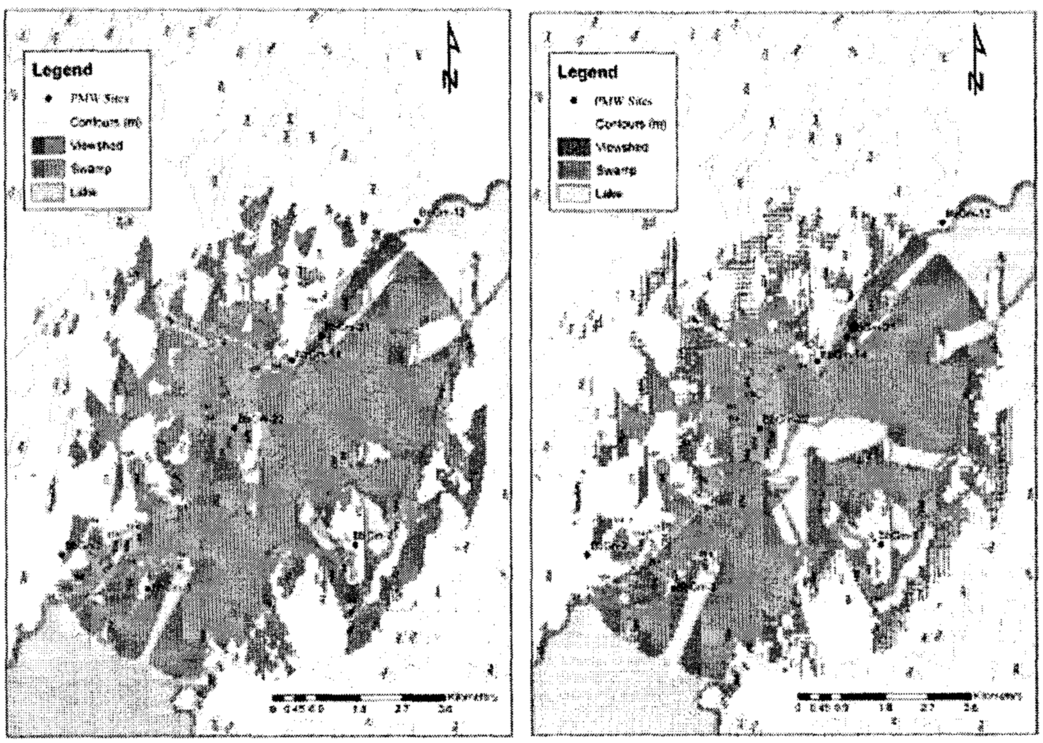


Figure D.20. Viewsheds from the Poison Ivy site (BbGm-22) in the empty model (left) and vegetation model (right)

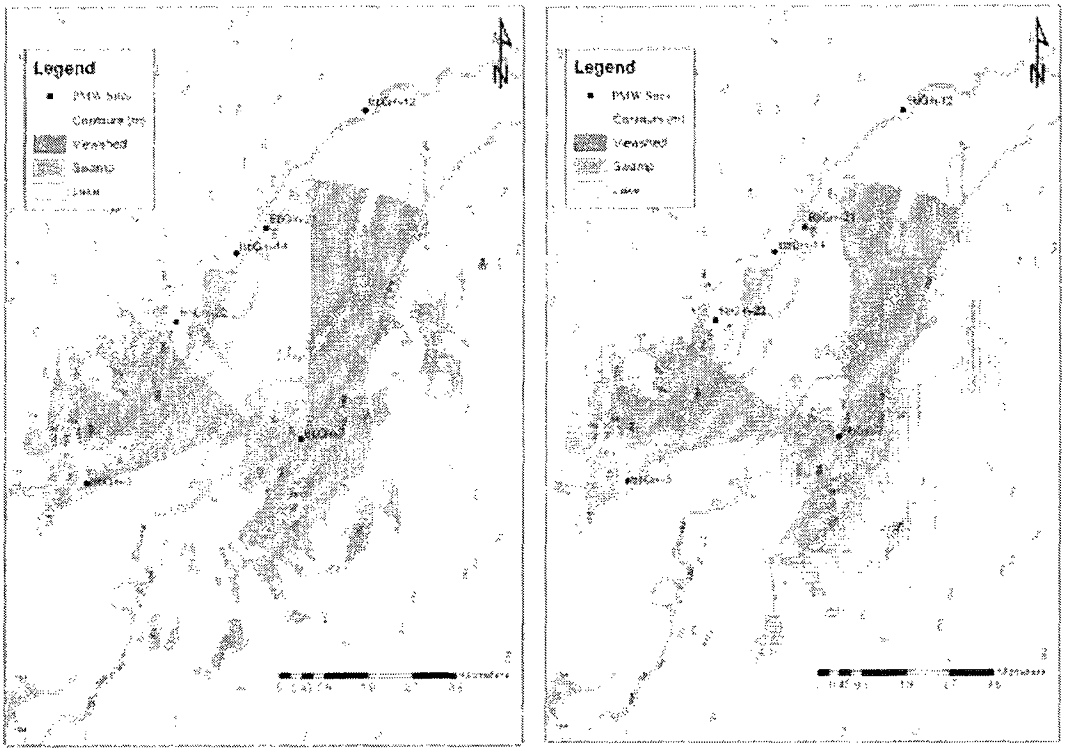


Figure D.21. Viewsheds from the Whites Island site (BbGm-7) in the empty model (left) and vegetation model (right)

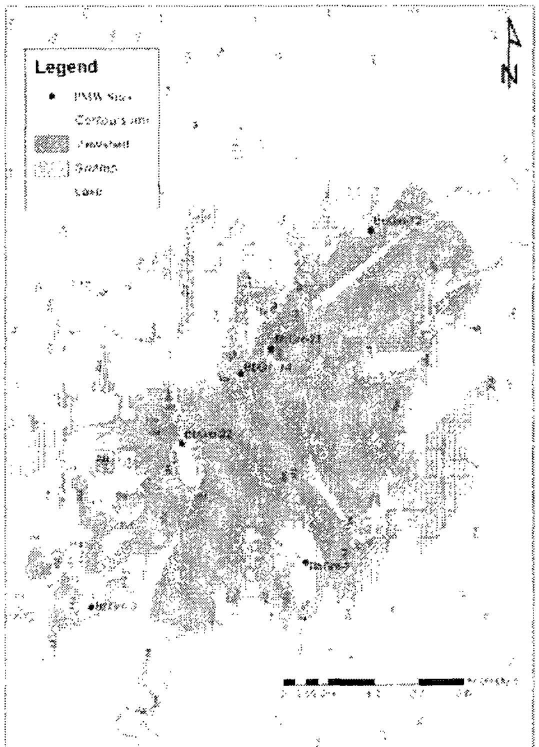


Figure D.22. Pre Middle Woodland viewshed from the Foley Point site (BbGm-14) in the vegetation model (The empty model is the same as the Middle Woodland Foley Point empty model viewshed in figure D.10)

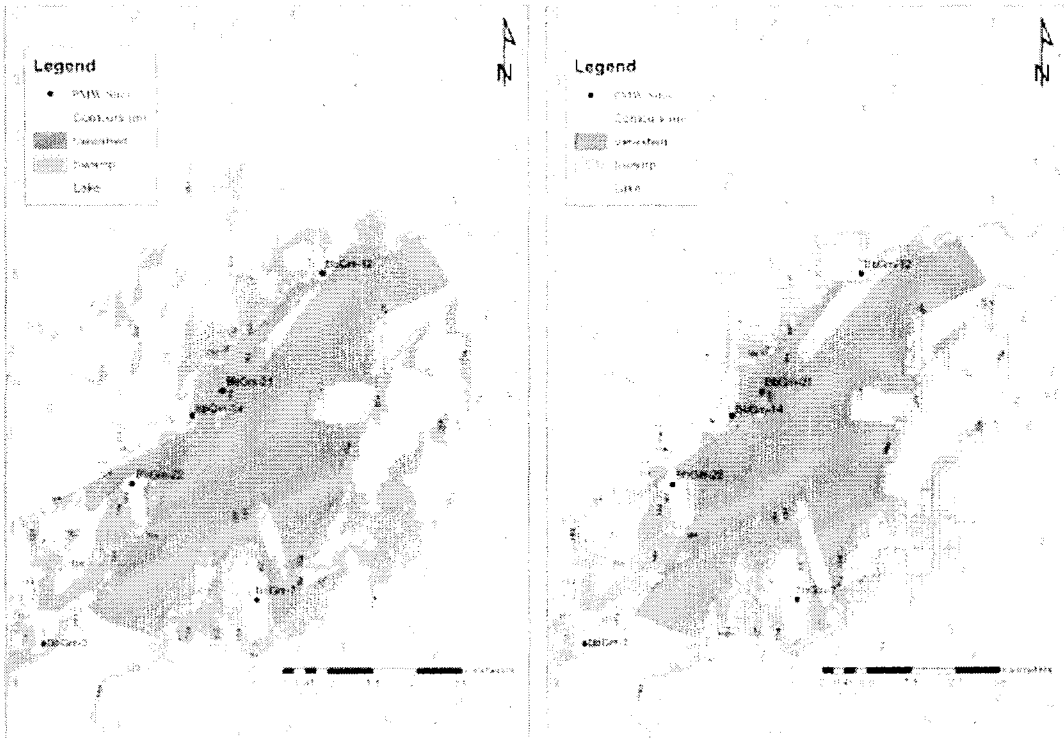


Figure D.23. Viewsheds from the John site (BbGm-21) in the empty model (left) and vegetation model (right)

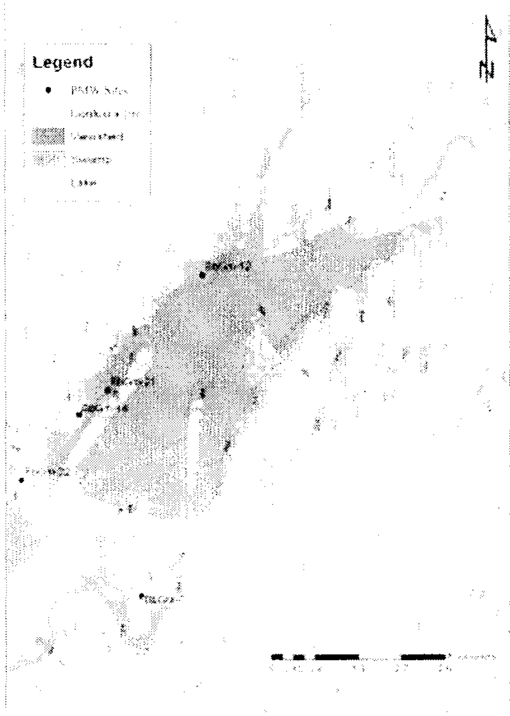


Figure D.24. Pre Middle Woodland viewshed from the Godfrey Point site (BbGm-12) in the vegetation model (The empty model is the same as the Middle Woodland Godfrey Point empty model viewshed in figure D.11)